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LOAD BALANCING OF FINANCIAL DATA USING MACHINE LEARNING AND CLOUD ANALYTICS

A Thesis
Presented to
The Faculty of the School of Engineering and Applied Sciences
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Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

By
Dimple Jaiswal

May 2020

LOAD BALANCING OF FINANCIAL DATA USING MACHINE LEARNING AND
CLOUD ANALYTICS

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Associate Professor for research and graduate Education

To my grandparents, mother, father, brother and friends.

&

To the faculty of the Computer Science Department at Western Kentucky University.

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The rising use of technology for web applications, android applications, digital marketing, and e-application systems for financial investments benefits a large sector of stakeholders and common people. It allows investors to make an appropriate choice for investment and to increase their capital growth. This requires proper research of investment companies, their trends in price and analysis of historical and current information. In addition, prediction of prices makes the process of investment more comfortable and reliable for investors as shares are the most volatile type of investment. To offer this service to multiple users spread across the globe, there are certain vulnerable challenges for developers: specially to handle peak conditions and to channelize requests to servers in an optimal way. This demands high performance, cost-effective and sustainable approach to manage the concurrent user request on servers. It also needs to manage increasing utilization of computing resources to satisfy the increasing requirement.

The process of balancing simultaneous requests is highly complicated, non-trivial and critical at times, which forces to add a subsystem or an external service to handle requests and balance the resource utilization as per requirements. Load balancing is a method used to channelize requests across the servers in back-end. It helps in improving the performance of the system by optimizing the use of resources, maximizing the throughput and reducing the latency. The traditional method to load balancing is inadequate and inflexible

to satisfy the growing demand. Increasing only hardware resources to balance the system is not an effective approach all the time. This needs an in-depth study of jobs to be performed and analysis of various approaches to organize sub-tasks to fulfill the objective.

In this project, four different type of techniques were used for balancing the user requests; they are: round robin, least connected, IP hash and weighted round robin methods. By analyzing the performance of all the computing nodes and by analyzing the logs generated using different load balancing approaches, it was found that weighted round robin resulted in better performance in all the factors: success request rate, failure request rate and average response time. The weight parameter for node 2 and node 3 was 2 and for node 1, it was 1, as computing node 2 and node 3 have better performance than node 1.

Chapter 1

INTRODUCTION

1.1 History and Analysis of Existing Problems

Resource utilization and management has become a major concern with advent use of technology for development to improve functionality, flexibility, reliability and efficiency of existing systems. Cloud computing plays a major role in maximizing resource utilization without affecting services and features provided by the system. It provides essential services like high availability, high throughput, scalability and optimized approach in model design. As Wang [Wang, 2011] suggests that stock market data analysis is an important research domain of natural sciences, economics, and financial trading, and poor market economy will affect stock investments.

In [Hargreaves and Hao, 2012], Hargreaves and Hao discusses how stock data is dually concerned among financial companies and people. Many financial companies are discovering different ways to find productive information from large data sets of stock market and on the other hand, how private investors have keen interest in prediction of stock prices so that they result in profitable investments with minimum risk. Fonseka and Liyanage [Fonseka and Liyanage, 2008] focuses on how efficient market hypothesis is associated with the idea of "random walk", and discusses different ways in which an investor can reduce short term risks while investing in stock market using data mining. Since trading being a secondary source of income for massive number of people, it gives an exponential

increase in the number of users accessing financial website during market hours. This generates heavy traffic on web applications, which affects the performance of the system and sometimes, results in adverse conditions like malfunctioning of server, computing node failure and at worst system failure. This needs strategic and optimized allocation of requests and hardware resources. Every user searches for various information- with different time frame and different types of view according to their requirement. The processing time of these requests varies based on their type, view and complexity. The requests are diversified on various attributes. Moreover, the stock market generates lots of data in short span. Capturing and processing stock data is the most difficult task as the data is generated very frequently, which results in lots of ambiguity and missing data. The most demanded request is for prediction of stock prices, which basically deals with data preprocessing and model design.

1.2 Brief Discussion on Financial Data and Various Job Requests

1.2.1 Data Preprocessing

Data preprocessing is done using Extract, Transform and Load(ETL) process. Data is extracted using 'yfinance' library. Data is available from the year 2015 and is updated everyday. Data preprocessing involves data extraction, data cleaning and loading the processed data in the storage node.

1.2.2 Commonly Known User Requests on Financial Web Application

There are many types of user requests are made to analyze the trends in the market. The most commonly found user requests are-

1.2.2.1 Prediction of Stock Prices

Prediction of stock prices for a particular stock for a provided date is most highly demanded user request. Prediction of stock price is usually done using data mining or using machine learning algorithm, which involves mathematical computation and thereby, utilizes large amount of resources and results in high execution time. Here, Prophet is used for prediction purposes. It is an open-source software released by Facebook's Core Data Science team. It is a procedure used for forecasting time series data based on an additive model, where non-linear trends are fit with yearly, weekly, and daily seasonality, plus holiday effects. It is an accurate and fast, fully automatic, tunable forecast and available in R/Python language [Taylor and Letham, 2017]. It is based on concepts of joint probability approach as probabilistic approach has better predictive results as compared to other techniques. Thus, it can be treated as complexed request and should be processed to a node, which has ample amount of resources.

1.2.2.2 Display Historical Data

Stock data visualization with different properties and representation is used to analyze stock data to obtain common trends in market. It can be visualized in various different types of representation methods. In the designed application, a line graph, a candlestick chart and a simple table is used to analyze the stock data. This type of request can be classified as moderate type of requests as they do not involve any computation operation.

1.2.2.3 Display Market Movers

To display market movers, i.e., top gainers and losers, can be treated as minor request as this request can be processed as a batch process and will result same for every user

requesting in the same time frame. Users can analyze market movers for last day or for a week or for a month.

Figure 1.1: Types of User Requests

1.2.2.4 Measure Trends: Simple Moving Average(SMA) and Exponential Moving Average(EMA)

SMA and EMA are technical indicators to make decisions to buy or sell an asset based on crossovers and divergences from the historical average. Computation of SMA

and EMA with different timeframes and different representation methods can be classified as moderate or complicated requests based on the timeframe and type of representation selected by the user.

1.2.2.5 Comparison of Two Stocks

Sometimes, when situations are tough to make a decision for an investor and investor is not sure of choosing a specific stock for investment, comparing two different stock data helps investor to make a more valuable and logical choice for an investment. These requests can be categorized as moderate because it doesn't require any computation and data of selected stocks is just fetched and represented.

1.2.3 Analysis of Execution Time of Different Job Requests

The web application design commonly consist of 5 different types of job. On the basis of their complexity and time consumption, they are primarily classified as- low, moderate and highly complexed jobs. The given bar graph below provides the execution time taken for both the type of request- GET and POST request for every type of job without any additional parameter. More about analysis of execution time of each type of job request is discussed briefly in Chapter 4. This testing is performed using ab - Apache HTTP server benchmarking tool.

Figure 1.2: Total Time Taken for Execution of Individual Job

1.3 Proposed Solution

This work intends to focus on analysis of various strategic approaches to solve the complexity faced at the time of decision making to schedule jobs and to learn load balancing concepts so that deployment of application on any additional node, could be easily achieved in faster and in more secured way. Moreover, it aims on applying knowledge of Machine Learning for analyzing the training data and preparing a comparative study of deploying an application on public and private cloud. So, that the resultant study can be used as pre-requisites for future application deployment process with consideration of different performance parameters. The next chapter describes brief study of topics involved in research and development. The chapter 3 provides the detailed view of hardware and software architecture. In chapter 4, the design and work flow of project is discussed briefly. In last chapter, performance analysis is computed by comparing performance of web application deployed on local cloud with web application hosted on public cloud. It also talks about the results obtained in research and topics that can be implemented in future.

Chapter 2

BACKGROUND

2.1 Cloud Computing

Due to arising information revolution, the need for hardware resources and its optimized utilization has exponentially increased. This demands excessive computation for analysis of data generated by machines to improve the quality, response time, reduce maintenance cost and mitigate problems in existing system. Cloud computing provides the most preeminent solution to these existing problems. It aims to reduce computing cost, increasing reliability and adding flexibility to scale up, down and across according to use. Essential part of this is cloud rely on virtualization and virtualization is a process for mapping of Information Technology resources to business needs[Foster, Zhao, Raicu, and Lu, 2008]. Thus, reducing the cost of hardware, improving computing power and storage capacity.

2.1.1 Several Characteristics of Cloud Computing

The common key factors which makes cloud computing most popular and sustainable field as described by [NOVKOVIC, 2017] are as follows:

1. Virtualization: cloud computing utilizes server and storage virtualization extensively to allocate/reallocate resources rapidly
2. Multi-tenancy and resource pooling: Resources can be pooled and shared among multiple users working on either same application or same physical infrastructure.

3. Broad network access: Resources are available on network and can be accessed via web-browser or thin client by diverse customer platforms.
4. On-demand self-service: Resources are self-provisioned and available online. Thereby, do not require any human interaction from service provider.
5. Rapid elasticity and scalability: Resources can scale up or down, automatically.

2.1.2 Services Provided by Cloud Computing

On the basis of various features of Cloud Computing given above, services provided by Cloud Computing are broadly classified as -

2.1.2.1 *Infrastructure As a Service(IaaS)*

Compute, storage, networking, and other elements (security, tools) are provided by the IaaS provider via public Internet, VPN, or dedicated network connection. Users own and manage operating systems, applications, and information running on the infrastructure and pay by usage.

2.1.2.2 *Software As a Service(SaaS)*

Software runs on computers owned and managed by the SaaS provider, versus installed and managed on user computers. The software is accessed over the public internet and generally offered on a monthly or yearly subscription.

2.1.2.3 *Platform As a Service(PaaS)*

All software and hardware required to build and operate cloud-based applications are provided by the PaaS provider via public Internet, VPN, or dedicated network connection. Users pay by use of the platform and control how applications are utilized throughout their lifecycle.

Figure 2.1: Cloud Reference Architecture [Kumar and Goudar, 2012]

Cloud computing also provides various other services, such as Cloud-Based Analytics-as-a-Service (CLAAaaS), Database-as-a-Service (DBaaS/DaaS), Machine Learning-as-a-service (MLaaS), Disaster recovery-as-a-service (DRAas) etc, which are dependent on the three basic services provided by cloud [Sharma, Chang, Tim, Wong, and Gadia, 2016]. Thus, it has numerous benefits like high availability, faster implementation and rapid scalability with low infrastructure and facility costs.

2.2 Load Balancing

2.2.1 Introduction

The traditional load balance technique uses master-slave architecture to balance the load, in which, slave-servers sends a heartbeat to master-node (load balancer) to indicate that it is up and alive every time and the master-node accordingly redistributes the load. The most common approach used by master node to distribute traffic is round robin method .

Round robin scheduling approach is based on time sharing among jobs in equal slice / quantum and in FIFO(First In First Out) queue basis. The scheduling is done completely on the basis of job fairness, and jobs are independent from each other for their execution. However, it results in starvation or indefinite blocking for a job, which extremely varies in size and requirements due to unsatisfactory [Raj, Singh, and Bansal, 2013].

Figure 2.2: Round Robin Approach used to Balance Various Requests Acting as Load on Given Two Servers [Villanueva, 2015]

When heterogeneous servers are used based on different configurations in a system, using round robin approach for load balancing leads to over-loaded condition on less hardware configured servers and under-loaded condition for a highly configured server. This results in a highly imbalance system. Thus, a modified form of round robin approach is used, termed as Weighted Round Robin load balancing method. It distributes load on basis of the capacity of servers.

Figure 2.3: Weighted Round Robin Approach used to Balance Various Requests Acting as Load on Given Two servers [Villanueva, 2015]

In the master-slave architecture used in round robin and weighted round robin methods, if any slave-server node dies, then master node(load balancer) redistributes the load of that node to other working nodes. Thus, making interaction between master and slave nodes tightly coupled, time and energy are consumed. The most risky drawback of this method is that if master node dies, it lead to single point failure and all slave-servers becomes orphans; which is very critical and unpredictable. This usually happens in static load balancing. Thus, this needs a technique which is dynamic and fault-tolerant. To avoid such conditions, a queue is added between load balancer and slave-servers, which channelizes the communication. Thus, working are not completely dependant on master node and makes system loosely coupled and uses less energy and resources.

In Honey bee behavior based approach for dynamic load balancing, the capacity and load of all virtual machines are calculated and if load is greater than maximum capacity, then, the honey bee foraging behaviour is used for load balancing. This approach clusters virtual machines into low loaded(LVM), balanced loaded (BLM) and over loaded(OLM) VM groups. Then, Algorithm calculates supply and demand of all LVMs and OLMs, and

sorts OVMs with descending order and LVMs with ascending order. Thus, it goes on optimizing the request iteratively in loop until all request are fulfilled and also the change machine state from OVM to BVM/LVM or LVM to OVM/BVM based on conditions dynamically[L.D. and Krishna, 2013]. Thereby, optimizing use of resources and improvising the system efficiency.

Figure 2.4: Flow Diagram of the Behavioral Control Structure for Honey Bee Behavior Inspired Load Balancing of Tasks in Cloud Computing Inspired by Foraging Behavior of Real Honey Bees Adapted from Johnson and Nieh with Minor Changes. [Johnson and Nieh, 2010]

In autonomous agent based shortest path load balancing method, the channel agent creates local agents and keeps information of each local agent in its table. On the basis of this information, channel agent distributes its neighbour information to its all local agent. All the local agents maintain information about its neighbour and whenever local agent does not have enough space to execute process, it broadcasts its id, process id and required

space to all its neighbour. If neighbour has enough space, then, they send true message. Otherwise, the neighbour forwards the request to its neighbour. If local agent gets same packets from different neighbour, then, it chooses shortest path neighbour to execute its process and if local agent receives multiple true messages, then, it makes decision based on shortest distance and more memory of neighbour. This dynamic approach reduces overall request time and simulation time for different cloudlet. [Vig et al., 2016]

Figure 2.5: Channel Agent Searching for Virtual Machines [Vig et al., 2016]

2.3 Machine Learning

Machine learning is scientific study of algorithms and mathematical model to solve real-time problems. An algorithm can be made trained in three broadly classified ways - supervised, unsupervised and reinforcement learning [Wikipedia contributors, 2019b]. It is kind of Artificial Intelligence technique, which mainly focuses to make system learn automatically without human intervention [Saravanan and Sujatha, 2018]. In supervised learning, the algorithm is trained and using training set and results are supervised on the

basis of predicted outcomes. This approach can be used to develop load balancer for a specific applications, which has ample information about resource utilization by a specific job and wide range of data-set to train the algorithm. Supervised technique used with Dijkstra algorithm can be used to find and predict an optimized path for balancing load.

The most widely used technique to train algorithm is classification. In order to select the most suitable and optimized approach to solve the problem, three parameters can be used - representation, evaluation and optimization. These components makes the process of selection of algorithm much easier and simple [Domingos, 2012].

Representation	Evaluation	Optimization
Instances	Accuracy/Error rate	Combinatorial optimization
K-nearest neighbor	Precision and recall	Greedy search
Support vector machines	Squared error	Beam search
Hyperplanes	Likelihood	Branch-and-bound
Naive Bayes	Posterior probability	Continuous optimization
Logistic regression	Information gain	Unconstrained
Decision trees	K-L divergence	Gradient descent
Sets of rules	Cost/Utility	Conjugate gradient
Propositional rules	Margin	Quasi-Newton methods
Logic programs		Constrained
Neural networks		Linear programming
Graphical models		Quadratic programming
Bayesian networks		
Conditional random fields		

Figure 2.6: Learning = Representation + Evaluation + Optimization [Domingos, 2012]

In unsupervised learning approach, training data is unclassified and unlabelled, as used by [Tang, Liu, Wang, and Liu, 2010] for static load balancing algorithm in homogeneous multiprocessor system since it has no relation with current state of load and do not store load information. So, it has great blindness and low efficiency. The dynamic algorithm has load information of each node of current state. Hence, it has high performance and real-time applications.

Reinforcement technique interacts with the environment by responding with errors

or rewards [Saravanan and Sujatha, 2018]. This can be used to improvise service provided by the developed load balancer to test efficiency and judge the results. However, this technique cannot be used as a direct method for load balancing.

2.3.1 Classification Technique

Classification is a supervised learning approach, in which data is categorized into classes. It can be either classified as binary classification or multi-class classification, depending on the training dataset used for training the algorithm. The type of classification technique to be used for training a model can be decided by visualizing the dataset and observing how the data points are outspreaded over the graph. As [Domingos, 2012] mentioned that classification is the most popular technique used for training algorithm, given below are the different types of classification methods commonly used-

2.3.1.1 *Logistic Regression*

Logistic Regression(LR) is a statistical model uses a logistic function to model a binary dependent variable [Wikipedia contributors, 2020c]. Basically, it is an approach used to find the best fitted relation between dependent and independent attributes for a given dataset. For example, in [Zhou and Yan, 2016] the author uses LR for software test management, to find the best fitting relationship between the test quality of software project and the test management data collected during test process. LR is most effective and highly recommended technique only when the data is to be classified or predicted as binary. Otherwise, accuracy is not guaranteed.

2.3.1.2 *Decision tree*

Decision tree approach is a predictive model that uses decision tree that undergoes from observations about an item (represented in the branches) to conclusions about the

item's target value (represented in the leaves). On the basis of the predicted outcome, decision tree can be classified as Regression tree or Classification tree. When the prediction outcome is a real number, then, it is called as regression tree and when the prediction outcome is class (discrete), it is known as Classification tree [Wikipedia contributors, 2020a]. Decision trees are very informative as compare to any other supervised approach. Generating rules is the most part in decision tree and in [Shamim et al., 2010], the author proposed a framework to transform the knowledge presented in decision trees and decision tables into knowledge base, their aim is to automate the construction of rules from decision tree and decision table.

Figure 2.7: Proposed Framework to Transform Decision Table or Decision Tree to Directly Generate Set of Rules [Shamim et al., 2010]

2.3.1.3 *Naive Bayes Classifier*

Naive Bayes classifiers are known as simple "probabilistic classifiers" and are based on applying Bayes' theorem with strong (naïve) independence assumptions between the features. It is typically based on conditional probability model and is one of the oldest method used for spam filtering. It is highly scalable [Wikipedia contributors, 2020d]. In [Solanki, Verma, and Kumar, 2015], a hybrid approach is used for spam filtering, the technique is based on local and global classifier, which results in improved classification accuracy. As it is based on Bayes' theorem and probabilistic approach has better predictive outcome, Naive Bayes classifier is effective in terms of accuracy.

2.3.1.4 *K-nearest neighbor Classifier*

K-nearest neighbor Classifier (k-NN) is a type of instance-based learning, or lazy learning, in which the function is only approximated locally and all computation is deferred until the function evaluation. As classification is majorly depended upon the distance metrics, normalizing the training set brings a lot of improvement in accuracy [Wikipedia contributors, 2020b]. It is most popular non-parametric classification method and therefore, requires a huge amount of classification time to search k nearest neighbors of an unlabelled object point. Thus, in [Yu and yu, 2006], the author proposed an adaptive k-nearest neighbors classifier (AKNNAC) technique to improve the performance and efficiency. The algorithm involves two steps, first step is to find the k nearest neighbor of the object point and the second step is to label that object point. The algorithm results indicate that when k is settled, AKNNAC is the most better approach than any other algorithms, in terms of performance.

2.3.1.5 Support Vector Machine

Support vector Machine (SVM) constructs a hyperplane or set of hyperplanes in a high or infinite-dimensional space, which can be used for classification, regression, or other tasks like outliers detection [Wikipedia contributors, 2020e]. SVMs are originally designed for binary classifications and for multi-classifications, the values are converted into binary. Thus, multi-classification results in large amount of unclassified regions and thus, in [Bo Liu, Zhi-Feng Hao, and Xiao-Wei Yang, 2005], the author suggests a novel method for multi-classification called as Nesting Support Vector Machine (NSVMS). NSVMS is basically designed to deal with unclassifiable regions in the One-against-One algorithm. The algorithm first constructs hyperplanes based on One-against-One approach. Secondly, it selects the data points in the middle unclassifiable region and lastly, it uses the data points in the unclassifiable region alone to construct hyperplanes with the same hyperparameters. The last two steps are called repetitively until there are no data points in middle of region or the region disappears. Thus, results shows that the training accuracy of NSVM is higher than those of One-Against-One and Fuzzy Least Square Support Vector Machine (FLS-SVM), and its generalization performance is also comparable with them.

2.4 Cloud Analytics

Cloud computing is mostly widely used for hosting applications and increasing demand to adopt cloud-based architecture urges for more agility and cost-effectiveness in system. The use of cloud delivery models as Analytics as a service simplifies obtaining useful information from an operational enterprise data center helping to cost and performance optimizations. This uses Big data analytics to extract actionable information from system

management metrics data, which brings more agility, elasticity and scalability in system [Routray, 2015]. Thus, benefits process of load balancing either by making an appropriate decision for scaling the application or by using it for developing another independent similar system with different configurations.

In [Wu and Marotta, 2013], Wu and Marotta talks about developing a Framework for Assessing Cloud Trustworthiness (FACT) that treats cloud as a black box and assesses its trustworthiness from the trusted cloud client. This is implemented by designing set of diagnostic tests, the diagnostic tests for data objects stored in the cloud are based on a separate cryptographic hash-based check that verifies their data integrity. The diagnostic tests are based on the acceptance tests that are already generated during the application development and testing lifecycle to make sure that they test the functionality of the application in the cloud accurately. They are integrated with the local application client, to ensure that they run within a single process. The results of the diagnostic tests are evaluated at the client side and if a test fails, the framework attempts to redeploy the cloud application on alternative cloud resources and rerun the instrumented client. This process is conducted repetitively until all diagnostic test pass or until time constraints are exceeded. This provides high data security for large scale applications and helps developer to evaluate the cloud performance.

The proposed method of designing web robots for collecting data to analyze stock data automatically suggested in [Ching-Te Wang and Yung-Yu Lin, 2015], which can be used to gather data and necessary information to analyze cloud data to improve the performance.

[Bhole et al., 2015] describes use of logs generated for analysis and prediction. The

individual events that occur in a sequence of logs are extracted and grouped together based on domain knowledge into patterns. These patterns are considered for detailed analysis, which can be also served as an input to generate the statistics of the overall behavior. The stages involved in analyzing the log files are - data extraction, data cleaning , pattern recognition and visualization. The results of analysis can be used evaluate performance issues and furthermore, helps in improving the overall performance of the applications.

Figure 2.8: Log Analytics on Cloud [Bhole et al., 2015]

2.5 Job Scheduling

Job scheduling is a NP Complete problem, there is no specific methods to get solve these problems. It depends and varies according to different properties of a job or request. Usually, a single conventional queue is used for scheduling and it has several drawbacks like more waiting time for execution, enlarging size of queue due to delay and FIFO approach. Thus, a different technique to handle requests is needed such as multilevel queuing or divide and conquer approach.

2.5.1 Genetic Algorithm

The Genetic Algorithm (GA) is an optimization algorithm which uses the method of computerized search based on natural selection and genetics. Each solution to a problem is represented by chromosome, which consist set of elements called genes. The algorithm

in beginning starts with random population of chromosomes, and quality of population is evaluated using an objective function, called as 'Fitness Function'. After initialization of population, with randomly generated solutions, new offspring chromosomes are generated by cross over or mutation. Again, the newly generated solutions are evaluated using fitness function to test with the previous one. If solution produced is optimal, then, that population is adopted. This process of generating offspring is repeated to obtain an optimal solution until best offspring are created. In Improved Load Balanced Min-Min (ILBMM) algorithm, the execution time of task on the virtual machine is calculated. This provides the minimum or maximum time of task on virtual machine (VM), which can be used in combination with Genetic Algorithm [Rajput and Kushwah, 2016].

Figure 2.9: Flowchart for Genetic Algorithm [Rajput and Kushwah, 2016]

2.5.2 Imperialist Competitive Algorithm

In Imperialist Competitive Algorithm, machine can simulate natural selection. The algorithm initializes population of countries and each country represents solution to a problem. The best countries are termed as Imperialists, based on a fitness function and rest of population become colonies to imperialists. The imperialists assimilate colony's characteristics based on optimization criteria to improve them. This builds a healthy competition among imperialist to become a powerful one and thus, weaker imperialists gets eliminated. The powerful country is considered as most optimized solution. This also helps in optimizing energy consumption with comparatively more reliable solution [Dutta and Aggarwal, 2017].

2.6 Comparison of AWS and IBM Clouds

In [Kaur et al., 2018], the author compares AWS and IBM cloud on the basis of performance and security measures, the testing of performance is done on AWS Elastic Compute Cloud[EC2] and Virtual server of IBM cloud using Phoronix Test Suite. The results in given below figures indicates that AWS services are easy to use on linux platform and offers more highlights in the linux Virtual machines. AWS has more adoption rate than any other cloud services available. It has better disk performance and RAM Speed than IBM. Also, AWS has an additional security feature of RSA security technique while IBM lacks behind in this aspect.

Figure 2.10: Apache benchmarking results [Kaur et al., 2018]

Figure 2.11: Dbenchmark benchmarking results [Kaur et al., 2018]

Figure 2.12: RAMSpeed benchmarking results [Kaur et al., 2018]

Figure 2.13: AWS vs. IBM Enterprise Scorecard [Kaur et al., 2018]

Similarly, here the financial web application was hosted on both the clouds. On IBM cloud, the application was hosted on Cloud Foundry app and on AWS, the application was hosted on AWS Elastic Beanstalk. The performance was analysed by conducting load testing with the help of ab - Apache HTTP server benchmarking tool and following results were obtained-

Figure 2.14: Performance of Web Application hosted on AWS vs. IBM Cloud

The above figure shows that the time taken for execution for all the types of requests for IBM cloud is comparatively more than AWS cloud and AWS cloud performance is better than IBM cloud. Moreover, AWS provides a lot of features to monitor the performance of the application as compare to IBM cloud. It is also observed that the application on IBM cloud automatically stops working within a range of 8 to 10 days and service needs to be restarted again. Thus, AWS cloud is considered for further performance analysis work.

2.7 Amazon Web Services

Amazon Web Services(AWS) is the first and most popular "pay-as-you-go" service that provides on-demand cloud computing platforms and APIs to wide variety of clients by Amazon.com. The services provided that are broadly classified on the basis of- computing, storage, networking, database, analytics, application services, deployment, management, mobile, developer tools, and tools for the Internet of Things [Sharma et al., 2016; Wikipedia

contributors, 2019a]. AWS attracts the attention of scholars in the field of high performance computing because of its high bandwidth, low latency, high computing power and price characteristics [Li, Wang, and Hu, 2015].

Figure 2.15: Cloud Service Provider Competitive Positioning [Reno and Group, Reno and Group]

Amazon Simple Storage Service (S3) is the storage service provided by Amazon, where customer data is organized by means of objects stored in buckets. A bucket is a logical unit of storage uniquely identified and belonging to one of the locations in which the provider has deployed its storage infrastructures [Persico, Montieri, and Pescapè, 2016]. Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable computing capacity provided by Amazon [Li et al., 2015]. Similarly, there around 165 services and tools provided by Amazon [Amazon, Amazon] .

2.7.1 AWS Tools used for Implementation

2.7.1.1 *Amazon Simple Storage Service (Amazon S3)*

Amazon Simple Storage Service (Amazon S3) is an object storage service that provides scalability, data availability, security, and performance. Different features provide various applications like -S3 Storage Class Analysis to analyze access patterns; S3 Lifecycle policies to transfer objects to lower-cost storage classes; S3 Cross-Region Replication to replicate data into other regions and many more. This provides a highly safe and secured environment to store data [Amazon, Amazon].

2.7.1.2 *Amazon Elastic Compute Cloud (Amazon EC2)*

Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides secure, resizable compute capacity required in the cloud. It is designed to make web-scale cloud computing easier for developers. Amazon EC2's web service interface is very developer friendly and simple, helps developers to obtain and configure capacity with minimal friction. It also provides developers to have a complete control of all the computing resources used by them to the run application on Amazon's proven computing environment [Amazon, Amazon].

2.7.1.3 *AWS Elastic Beanstalk*

AWS Elastic Beanstalk is an easy-to-use service for deploying and scaling web applications and services developed using various language and frameworks. In this project, the web application is developed with Python, using Django framework. The AWS Elastic Beanstalk is known as "Easy to begin, impossible to outgrow" service as just by uploading the code, it not only automatically handles the deployment, capacity provisioning, load

balancing, auto-scaling and health monitoring of an application, but also, gives its users access to its underlying resources and full control over the AWS resources used in their application. Moreover, there is no additional charges for using Elastic Beanstalk; users only pay for AWS resources need to store and run the application. Amazon S3 bucket is used for storing the application and Amazon EC2 instance for running the web application. Thus, the costs of running a web application varies based on several factors such as the number of Amazon EC2 instances needed to handle the web application traffic, the bandwidth consumed by web application, and the database or storage used for application. The primary cost is typically based on Amazon EC2 instance(s) used and for the elastic load balancing that distributes traffic between the instances running the application [Amazon, Amazon].

Chapter 3

HARDWARE AND SOFTWARE ARCHITECTURE

A load balancer acts as the “traffic cop” sitting in front of all the servers and routes client requests across all the servers in different ways. The process of directing request is done in such a way that it maximizes the speed and capacity utilization without overloading a particular server. Thus, it ensures high availability and reliability by sending requests only to servers that are online and provides flexibility to add or remove servers according to the demand [NGINX, 2020]. Here, nginx is used as a HTTP load balancer to distribute traffic to various computing nodes. The complete load balancing system acts as a single system. The given diagram below shows how a load balancer handles the client requests. A similar approach is used for development of the project.

Figure 3.1: Load Balancing Diagram [NGINX, 2020]

3.1 Hardware Architecture

There are two main components used for the development of the project: master node and computing nodes. Thus, the architecture used for directing requests is master/slave architecture. The cluster has one master node and three computing nodes. The user requests are directed to master node and these request are then internally executed on one of the three worker/computing nodes. The selection of computing node for execution of job is decided by the type of load balancing approach is used.

Nginx is used as a web server for balancing the load and is sitting on master node. Thus, the major task of load balancing is performed on master node. Master node also acts as a storage node. It stores the entire stock data and all log files generated by nginx. Therefore, it plays a crucial part in the project, and all the configuration settings to add or remove a computing node in cluster can be performed at master node. The job execution takes place at all the computing nodes. The given table below provides the information for master node and all the computing nodes.

ID	CPU Cores	RAM Size	Disk Size	IP Address
WS (Master Node)	4	16	240GB	161.6.5.209 192.168.1.167 (Local)
NODE 1	4	8	131GB	192.168.1.240
NODE 2	4	8	233GB	192.168.1.158
NODE 3	4	32	163GB	192.168.1.243

Table 3.1: Hardware Architecture of Master Node and Computing Nodes

3.2 Software Architecture

The software architecture comprises of two parts: front-end and back-end architecture. The front-end deals with web application design. All the users make request through web interface; these requests are executed on back-end servers and the response is directed back to client. The complete process involves interaction between the client and the server. Thus, communication between master and computing nodes needs to be very efficient so that the overall performance of the system is not affected. The architecture supports adding of more computing nodes to handle heavy traffic on application without making changes in the present system. Thus, the system is horizontally scalable. The below given diagram displays the interaction of end user with the load balancing system.

Figure 3.2: Cluster Architecture

3.2.1 Front-end Architecture

The front-end architecture handles the client side of the application. It basically involves web application design. Here, django is used for web application development. Django is the most popular web server framework that follows the model-template-view (MVC) architectural pattern. It is developed in python and has several benefits. First, it provides functionality for user authentication, content administration, site maps and many more tasks. Second, it handles security attacks like SQL injection, cross-site scripting, cross-site request forgery and clickjacking. Third, it has an ability to scale quickly to handle heavy traffic on applications [Django, Django]. Bootstrap4 is used for front-end design.

3.2.2 Back-end Architecture

The back-end is completely implemented using shell script and python language. The implementation of data preprocessing is done using python. Django is used for building and designing the web application. The application uses SQLite database for storing user information. It is the default database provided by django. The application is successfully deployed on each computing node and is ready to handle user request.

The user makes a request on IP address of master node(192.168.1.167) and at 8082 port, nginx HTTP server is listening for incoming connections. When a request is encountered by the nginx, nginx interacts with uWSGI server and then, schedules the request to one of the computing node for execution. The uWSGI server is used to deploy WSGI applications and is responsible for loading django application using the WSGI interface. It also helps in faster communication between users and application.

Each node is listening at its port number and IP address. Here, node 1 is listening on address: 192.168.1.240 and on 4001 port number. Similarly, node 2 is listening on 192.168.1.158 IP address and 4002 port number, and node 3 is listening on 192.168.1.243 IP address and 4003 port number. The uWSGI at each node handles the execution of a job. All the computing nodes make an internal request to access stock data using 'paramiko' library. The response is directed back to the user after successful execution of job. The complete process takes place in back-end and logs are updated whenever a request is addressed.

Chapter 4

DESIGN AND IMPLEMENTATION

The load balancing component acts as a single system but involves various functions to distribute the requests to application servers. These functions are pipelined in such a way that the designed system is more effective and efficient, in terms of performance. The design and workflow for the project is divided into several steps as shown in the below given diagram and each step is discussed in detail in this chapter.

Figure 4.1: Design and Workflow of the Project

4.1 Stock Data Preprocessing

The data preprocessing is implemented using Extract, Transfer and Load process; it is the traditional and most widely used technique for data preprocessing and data management. There are several financial data providers like Google Finance, Yahoo Finance, Alphavantage, Quandl and many more. The data is provided through APIs and this data can be used for generating technical indicators, which helps in designing trading strategies and monitoring the market price [Huang, 2020]. The data source used here is Yahoo Finance and data is extracted with the help of 'yfinance' python module.

The first step is data extraction. In this step, the stock price for the day is extracted. Each entry of data consist of 7 attributes- date, open, high, low, close, adj. close and volume. The next step is data cleaning and transformation, which mainly involves handling missing data and adding stock name to extracted data entry. In this step, missing data is replaced by computing the mean value of the missing attribute. After completion of this step, the data is set to load in stock data marts. This process is automated and scheduled job executes at 8pm, everyday. The complete process is performed only on master node and all other computing nodes request master node for the required data. The data preprocessing is implemented using pandas, numpy and scikit-learn libraries of python.

Figure 4.2: ETL- Extract, Transform and Load Process

Date	Open	High	Low	Close	Adj. Close	Stock Name	Volume
02-01-2015	15.95	16.25	15.25	16.200001	16.200001	Astronics Corporation	225500
05-01-2015	16	16.15	15.35	15.5	15.5	Astronics Corporation	224100
06-01-2015	15.5	15.7	15	15.05	15.05	Astronics Corporation	252700
07-01-2015	15.2	15.55	14.85	15.5	15.5	Astronics Corporation	279500
08-01-2015	15.65	15.65	15.25	15.35	15.35	Astronics Corporation	250700

Figure 4.3: Example of Stock Data after Completion of Data Preprocessing

4.2 Web Application Development

The web application is developed by creating an isolated python virtual environment, which helps to keep dependencies required by the project separately and makes it easy to replicate on another node. The web application provides 5 types of function to users: prediction of stock price, historical analysis of stock data, top stock gainers and losers, comparison of two stocks and trend analysis. Analysis of each type of job request is discussed in below given section.

4.2.1 Implementation of Different Types of Job Requests

Each job is implemented and represented in a different way. All the jobs use: 'paramiko' library- to access stock data from master node, and 'pandas' and 'numpy'

library- for performing operations. The following points provides the implementation of job requests:

1. Prediction of stock price is implemented using 'fbprophet' library and price can predicted either for next day, next week, next month or next year.
2. Historical analysis and comparison of stock data are implemented using 'mask' method of pandas, and are represented using 'plotly' library in three different forms: table, line graph and candlestick graph.
3. Market movers (top gainers and losers) are computed at master node and the result is read using paramiko. This reduces execution time as reading every stock data using paramiko consumes a lot of time.
4. Measure trends include computation of SMA and EMA for the provided range by user. The calculation of SMA and EMA to get trends in market is implemented using 'rolling' and 'ewm' function of pandas; the calculated values are represented in table and line graph.

To examine the performance of different jobs for all the computing nodes, one of locust test output is considered here. The total number of users are 32 with 8 concurrent users accessing at the same time. Following are the observations made:

1. For prediction requests, node 2 consumes large amount of time than node 3 and node 3 consumes more time than node 1.
2. For historical analysis requests, for table and candlestick representation, node 2 takes lot of time than node 3 and node 1. For line representation, node 1 takes time than node 3 and node 2.

3. For comparing two stocks, for all the type of representation, node 2 consumes more time than node 1 and node 3.
4. For market movers, node 1 and node 3 consumes more time than node 2.
5. For measure trends, node 2 takes large amount of time than node 3 and node 1.

Thus, it was found that for this test, the execution time for node 2 is comparatively higher than node 1 and the execution time for node 1 is more than node 3 for almost all types of jobs.

Figure 4.4: Response Time Analysis for Different Types of Job Requests

4.3 Training Set Creation using Locust

4.3.1 Load Testing Performed at Every Node

To test the application for performance analysis at each node, stress testing is performed using locust. Locust is a load testing tool and helps in finding how many concurrent users can be handled by the system. It is event-based and thereby supports large number of concurrent users on a single machine. For every node, it generates 3 files: stats.csv, stats_history.csv and failures.csv files. The stats.csv provides the complete statistics about request with all the parameters. The stats_history.csv records request information with timestamp and failures.csv contains all the errors occurred by a request. To compare the performance of nodes, stats.csv file is used for analysis.

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	Type	Name	# requests	# failures	Median response time	Average response time
1	GET	/	32	0	3	10
2	POST	/	32	0	230	246
3	GET	/analysis.html	10	0	22	38
4	POST	/analysisResult.html?stock=Apple&type=Candle&date_from=2015-11-03&date_to=2020-02-20	4	0	144000	109657
5	POST	/analysisResult.html?stock=Apple&type=Line&date_from=2015-11-03&date_to=2020-02-20	4	0	146000	110679
6	POST	/analysisResult.html?stock=Apple&type=Table&date_from=2015-11-03&date_to=2020-02-20	2	0	2500	2920
7	GET	/compare.html	10	0	20	27
8	POST	/compareResult.html?stock1=American&stock2=Adobe&type=Candle&date_from=2015-02-02&date_to=2020-02-20	6	0	153000	105517
9	POST	/compareResult.html?stock1=American&stock2=Adobe&type=Line&date_from=2015-02-02&date_to=2020-02-20	3	0	151000	103443
10	POST	/compareResult.html?stock1=American&stock2=Adobe&type=Table&date_from=2015-02-02&date_to=2020-02-20	1	0	127465	127465
11	GET	/measure.html	17	0	29	93
12	POST	/measureResults.html	17	0	67000	67753
13	GET	/movers.html	10	0	47	49
14	POST	/moversResult.html	10	0	134000	110497
15	GET	/prediction.html	5	0	52	38
16	POST	/predictionResult.html	5	0	12000	69542
17	None	Aggregated	168	0	190	27224

Figure 4.5: Example of stats.csv file generated

4.3.2 Analysis of Data Generated at Nodes by Locust Testing

The important attributes in 'stats.csv' file generated by the locust are: Type, Name, requests, failures, Median response time, Average response time, Min response time, Max

response time, Average Content Size, Requests/s and Requests Failed/s. Out of all the mentioned attributes; requests, failures and Average response time are considered for performance analysis at node level. These 3 attributes are extracted for every type of load and following are the observations made:

1. The success rate for node 2 and node 3 is better than node 1. It was obtained that all the three nodes were available till 256 total users. The success rate of node 2 was around 50% for total 256 users with 4 concurrent users; after that it was unavailable. The success rate for node 3 was around 30% for total 256 users with 4 concurrent users, it also became unavailable after this test. The success rate for node 1 was 50% for total 256 users with only 1 user accessing a time and it stopped working after that. Thus, node2 performance was better in general.
2. The failure rate for node 1 was comparatively more than node 2 and node 3. Node 1 started failing with total 128 users with 128 concurrent users at failure rate around 38%. Node 2 and node 3 started failing with total 256 users with 4 concurrent users with failure rate around 38% and 65%, respectively. Node 2 has less failure requests comparatively.
3. The average response time for node 2 was relatively higher than node 1 and node 3. The response time for node 2 was maximum for total 128 users with 8 concurrent users and was 1721 seconds. The response time for node 1 was maximum for total 64 users with 1 concurrent user and was 1397 seconds. The response time for node 3 was maximum for total 64 users with 4 concurrent users and was 1113 seconds. Thus, response time for node 3 is much better than node 1 and node 2.

Figure 4.6: Success Request Rate for All the Nodes

Figure 4.7: Failure Request Rate for All the Nodes

Figure 4.8: Average Response Time(in seconds) for All the Nodes

4.4 Load Balancing

To design load balancing system, a web server is required to handle the requests and in this project, nginx is used as a web server for HTTP load balancing purpose. The nginx uses uWSGI for loading django application. The 'ngx_http_uwsgi_module' module allows nginx to pass the request to a uwsgi server. Nginx provides four types of load

balancing methods: round robin, least connection, iphash and weighted round robin. The below given section provides details for each type of technique.

4.4.1 Types of Load Balancing

4.4.1.1 Round Robin Load Balancing Method

In round robin approach, the requests are distributed across all the computing nodes sequentially. It is the default approach used for load balancing, if none of the load balancing method is specified. As we have seen in chapter 2 the round robin method is a static approach and doesn't utilize resources efficiently.

By performing testing using round robin approach in the developed system, it was found that the approach results in average performance and is not recommended for applying in the present developed system.

4.4.1.2 Least Connection Load Balancing Method

In situations, when some requests take a long time to respond, using least connection approach to balance the load will bring more stability and fairness in the system. In least connection approach, the new requests are distributed to servers, which are less burdened and will not overburden a busy application server. Thus, it builds a balanced environment and reduces the chances of performance and system issues. This approach can be used in nginx by adding 'least_conn' directive in server group configuration part of nginx configuration file.

4.4.1.3 IP Hash Load Balancing Method

In applications, when there is a need to direct some client to a specific server, nginx provides ip hash technique to attain the requirement. In other words, it makes client's session "sticky" or "persistent" to a particular application server. To attain this session per-

sistence mechanism, ip hash method uses client's IP as a hashing key to choose application server from a group of application servers. It also ensures that the same client's request are directed to the same application server unless that application server is down or unavailable. This approach can be used in nginx by adding 'ip_hash' directive to server group configuration part of nginx configuration file.

4.4.1.4 Weighted Round Robin Load Balancing Method

Nginx provides an approach to assign weights to servers as per requirement of the application. This can be accomplished by using weighted round robin approach in nginx. The assigned weight in the weight parameter is considered for load balancing decision. By analyzing the performance of each node in the designed system, it was observed that the performance of node 2 and node 3 is similar and better than node 1 performance. Thus, weight parameter for node 2 and node 3 are same in the designed system. The assigned weight for node 2 and node 3 is 2 and for node 1, the weight is 1. Therefore, for every 5 new requests, the application will direct 2 requests to node 2 and node 3, and one request to node 1. The system was tested with the assigned weights and the performance of system was evaluated. It was observed that overall performance of the system was decent and recommendable for application, in consideration to all the factors like success rate, failure rate and average response time.

4.4.1.5 Performance Analysis of Different Load Balancing Approaches

1. It was observed that all the load balancing techniques worked fine for total 512 users with 512 concurrency rate but performance was varied from algorithm to algorithm. The success rate for IP hash technique was around 95% , for weighted round robin, it was around 89% , for least connected, it was around 62% and for round robin, it was

60%. The IP hash and weighted round robin techniques have much better performance than least connected and round robin approach.

2. The failure rate for least connected method was comparatively high among all the other techniques for total 512 users with different concurrent users. The failure rate for least connected was maximum for total 512 users with 32 concurrent users and was 80%. The failure rate for round robin was maximum for total 512 users with 128 concurrent users and was around 58%. The failure rate for weighted round robin was maximum for total 512 users with 4 concurrent users and was around 63%. The failure rate for IP hash was maximum for total 512 users with 32 concurrent users and was around 78%. The overall failure rate for IP hash and weighted round robin, was very less often and less. However, the overall failure rate for least connected and round robin, was very often.
3. The average response time for IP hash technique was comparatively more than all other approaches. The average response time for IP hash was maximum for total 512 users with 128 concurrent users and was 1200 seconds. The average response time for least connected and round robin, was maximum for total 512 users with 128 concurrent users and was around 1100 seconds. The average response time for weighted round robin was maximum for total 512 users with 32 concurrent users and was around 1100 seconds.

Thus, it was observed that overall performance of least connected and round robin approach was similar and is not recommended for this application with the present architecture. The IP hash technique has lower failure rate and high success rate, but it directs re-

quest to a particular server for a specific client, which overloads some servers. This creates imbalance in system and does not distribute requests evenly and moreover, it experiences high response time. Thus, it is not recommended for this application. The weighted round robin approach has better success rate, comparatively less error rate and average response time. Therefore, weighted round robin approach is suggested approach for load balancing this application.

Figure 4.9: Success Request Rate for Different Types of Load Balancers

Figure 4.10: Failure Request Rate for Different Types of Load Balancers

Figure 4.11: Average Response Time(in seconds) for Different Types of Load Balancers

4.4.2 Log Analysis

Nginx records its events in two types of logs: access log and error log. Access log provides all the information about the users accessing the web application. For example, it provides information like IP address of client, what type of request made, request time, response time and much more. Below given is the access log format:

```
'$upstream_addr - "$http_x_forwarded_for" - $remote_addr - $remote_user [$time_local]
"$request" , '$status $body_bytes_sent , "$http_referer" "$http_user_agent" , $request_time
, $upstream_response_time'
```

The error log records all the issued encountered by nginx. It is used to debug issues in the system and can be used to monitor the performance of the system. Error logs do not have a specific format and the below given figure shows an example of error log generated.

```
2020/06/30 06:27:58 [warn] 13043#13043: *69748 an upstream response is buffered to a temporary file /var/cache/nginx/uwsgi_temp/2/56/00000000562 while reading upstream, client:
192.168.1.167, server: 192.168.1.167, request: "POST /measureResults.html HTTP/1.1", upstream: "uwsgi://192.168.1.243:4003", host: "192.168.1.167:8082", referer:
"http://192.168.1.167:8082/measureResults.html"
2020/06/30 06:46:05 [warn] 13043#13043: *70067 an upstream response is buffered to a temporary file /var/cache/nginx/uwsgi_temp/3/56/00000000563 while reading upstream, client:
192.168.1.167, server: 192.168.1.167, request: "POST /compareResult.html?stock1=American&stock2=Adobe&type=Candle&date_from=2015-02-02&date_to=2020-02-20 HTTP/1.1", upstream:
"uwsgi://192.168.1.158:4002", host: "192.168.1.167:8082", referer: "http://192.168.1.167:8082/compareResult.html?stock1=American&stock2=Adobe&type=Candle&date_from=2015-02-
02&date_to=2020-02-20"
2020/06/30 06:59:31 [warn] 13043#13043: *70594 an upstream response is buffered to a temporary file /var/cache/nginx/uwsgi_temp/4/56/00000000564 while reading upstream, client:
192.168.1.167, server: 192.168.1.167, request: "POST /compareResult.html?stock1=American&stock2=Adobe&type=Candle&date_from=2015-02-02&date_to=2020-02-20 HTTP/1.1", upstream:
"uwsgi://192.168.1.243:4003", host: "192.168.1.167:8082", referer: "http://192.168.1.167:8082/compareResult.html?stock1=American&stock2=Adobe&type=Candle&date_from=2015-02-
02&date_to=2020-02-20"
2020/06/30 07:08:07 [warn] 13043#13043: *71270 an upstream response is buffered to a temporary file /var/cache/nginx/uwsgi_temp/5/56/00000000565 while reading upstream, client:
192.168.1.167, server: 192.168.1.167, request: "POST /compareResult.html?stock1=American&stock2=Adobe&type=Candle&date_from=2015-02-02&date_to=2020-02-20 HTTP/1.1", upstream:
"uwsgi://192.168.1.158:4002", host: "192.168.1.167:8082", referer: "http://192.168.1.167:8082/compareResult.html?stock1=American&stock2=Adobe&type=Candle&date_from=2015-02-
02&date_to=2020-02-20"
```

Figure 4.12: Example of Error Log Generated by Nginx

Figure 4.13: Total Number of Requests made by Different Types of Load Balancing techniques

Figure 4.14: Total Number of Successful Requests for Every Node using Different Types of Load Balancing Techniques

Figure 4.15: Total Number of Requests Failed by Different Types of Load Balancing techniques

Figure 4.16: Total Number of Failure Requests for Every Node using Different Types of Load Balancing Techniques

Following are the observations made by analyzing both the logs:

1. It was observed that IP hash technique handles large number of requests as compared to other approaches. All other load balancing handles the same number of requests.
2. The number of successful requests and failure requests made by IP hash technique is comparatively higher than any other techniques.
3. The number of failed requests for least connected is comparatively less than all the other approaches. The number of failure requests made by round robin and weighted round robin is same.
4. For round robin, least connected and weighted round robin methods, node 2 and node 3 handles larger number of requests than node 1.

5. For IP hash technique, larger number of requests are handled by node 2, than node 3 and then, node 1.

Thus, it was observed by analyzing the logs that- node 2 and node 3 handles comparatively larger number of requests than node 1. Therefore, descending order of performance of nodes can be represented as:

Node2 > Node 3 > Node 1

Chapter 5

COMPARATIVE STUDY AND CONCLUSION

5.1 Comparative Study

In chapter 2, it was found that the application performance on AWS cloud was much better than the IBM cloud. In order, to conduct comparative study and analysis, the application on local cloud was compared with the application hosted on AWS cloud. To compare the load balancing module, designed system with round robin approach was selected to analyze the performance with AWS load balancer. After conducting stress testing of application on AWS cloud, it was observed that the performance of application on AWS cloud was not good enough to compare with other load balancing techniques than round robin. On AWS cloud, the application was deployed with the help of AWS Elastic Beanstalk service.

AWS free-tier account provides 750 hours of t2.micro instances for each month for a year and as studied in chapter 2 that the Elastic Beanstalk uses Amazon EC2 instance for running the web application. Since, t2.micro instances are low-cost and designed for serving general-purpose applications, it is not recommended to use for applications with heavy traffic. When undergoing heavy traffic, the load balancing and auto-scaling feature of Elastic Beanstalk gets highly affected. As a result, EC2 instances are unavailable to serve the upcoming new requests. Thus, the application hosted on AWS cloud results in

inefficient performance and upgrading instance type is the only solution to improve the performance of the application.

By performing stress testing using Locust on application on AWS cloud and application on local cluster using round robin approach, it was found that:

1. The request success rate for for AWS cloud was inconsistent and the application was unavailable for the most of the time. For round robin approach on local system, the success rate was 60% for total 512 users with 512 concurrent users. The application on AWS cloud was available for only few tests.
2. The request failure rate for application on AWS cloud was 100% for most of the tests and only for total 8 users with 1 concurrent user, it is 0%. For local system, failure rate was around 58% for total 512 users with 128 concurrent users.
3. The average response time for application on AWS cloud was at maximum for a total of eight users with 1 concurrent user and was around 4900 seconds. For a local system, the average response time was maximum for total 512 users with 128 concurrent users and was around 1100 seconds.

Thus, application on AWS cloud is unavailable most of the time and response time is also very high. Thereby, results in poor performance.

Figure 5.1: Success Request Rate for Round Robin Load Balancing Method with AWS Load Balancer

Figure 5.2: Failure Request Rate for Round Robin Load Balancing Method with AWS Load Balancer

Figure 5.3: Average Response Time(in seconds) for Round Robin Load Balancing Method with AWS Load Balancer

5.2 Future work

In present designed system, the test duration for conducting stress testing was around 10 hours for performing testing on computing nodes at node level and for testing all the types of balancers, the test duration was around 5 hours, due to time constraints. Thus, by increasing testing time would be the next step, it will help for much better anal-

ysis and will bring more accuracy in decision making of the system. Next step will be implementation of automated log analysis system for better and easy analysis purpose.

The designed application do not have any external security feature to handle security attacks like Distributed Denial of Service Attack (DDoS) attack, Cross-Site Scripting (XSS) attack etc. Thus, another step would be adding security mechanism to the existing system. Also, the present system can be scaled horizontally, without affecting the performance of existing system. However, the system is not vertically scalable and adding this feature will be next step for further implementation.

Chapter 6

CONCLUSION

The main purpose of this project is to improve resource utilization and manage loads over system in an efficient way. The designed system helps user to analyze the stock data in different ways with less amount of time. The data is updated and processed daily, so user can analyze the stock price with updated data at the end of the day. The existing system has three computing nodes for processing the user requests, out of which, node 2 and node 3 have better performance in handling large number of requests than node 1. The average response time for node 2 is comparatively higher than node 1 and the average response time for node 1 is more than node 3. Moreover, by performing log analysis, it was found that node 2 and node 3 are better than node 1. Thus, overall performance of node 2 and node 3 is better than node 1 and more load can be distributed to these nodes. Also, by conducting the stress testing on the present system, it was observed that only hardware architecture cannot be used for making decision to balance the load, it also needs a complete analysis of jobs executed at each node. In addition, the designed system is horizontally scalable. Therefore, adding computing nodes will not affect the performance of the existing system.

The developed application was tested with four types of load balancing approaches: Round Robin, Least Connected, IP Hash and Weighted Round Robin. Out of all, it was observed that the overall performance of weighted round robin was better in terms of: success request rate, failure request rate and average response time. For the present system,

the weight parameter used for node 2 and node 3 is 2, and for node 1, it is 1. The weight parameter was decided by looking at the performance of all the computing nodes used in the system. Also, here only one client was used to perform testing on the system. The type of client is also a contributing factor for selection of load balancing approach.

As client-base changes, it cannot be claimed that the same load balancing approach will be effective for all the situations. So, selection of type of load balancer depends on various factors like types of jobs, types of users, hardware architecture of the system and the performance of computing nodes used. The performance of designed system was also compared with application hosted on AWS cloud to analyze the performance of application on public cloud. It was observed that the application on AWS cloud has poor performance and was unavailable due to heavy traffic generated while stress testing. The performance of application on AWS cloud can be improved by upgrading the type of EC2 instance used. Also, AWS cloud provides services at cheap rates and the web interface provides a wide variety of factors for users to monitor the performance of the application . Thus, it is most widely used service.

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Appendices

Appendix A

APPENDIX A: SETTING UP THE ARCHITECTURE

1. Install Ubuntu 18.04.3 LTS
2. Set up hardware
3. Check CPU Cores, RAM and memory using `-grep -c ^processor /proc/cpu`
4. Install Anaconda3
5. Install Visual studio code

A.1 Stock Data Pre-processing script

The stock data entry is extracted, processed and stored every day using the following script-

```
1 from datetime import datetime, timedelta
2 import numpy as np
3 from sklearn.impute import SimpleImputer
4 import csv
5 import pandas as pd
6 from yahoo_historical import Fetcher
7 import time
8 import math
9 import os
10 from fbprophet import Prophet
11 import schedule
12 import yfinance as yf
13 from pandas_datareader import data as pdr
14 yf.pdr_override()
15
16 # extract data
17 def dataExtract(start, end):
18     undoneStock=[]
19     stocknames=[]
20     stockData=[]
21     readTickers=open("/home/dimple/Project/Stockdetails.csv",encoding='
latin1')
22     reader = csv.reader(readTickers, delimiter=',')
23     for row in reader:
24         stockData.append(row[0])
25         stocknames.append(row[1])
26     readTickers.close()
27
28     stocknames = [sub.replace(',', ' ') for sub in stocknames]
29     startDate=[]
30     startDate.append(start.year)
31     startDate.append(start.month)
32     startDate.append(start.day)
33
34     endDate=[]
35     endDate.append(end.year)
36     endDate.append(end.month)
```

```

37     endDate.append(end.day)
38
39     stockFetchedData=[]
40     #stockFetchedActualData=[]
41     count=0
42     print(len(stockData))
43
44     div1 =math.ceil(len(stockData)*0.25)
45     div2 =math.ceil(len(stockData)*0.5)
46     div3 =math.ceil(len(stockData)*0.75)
47
48     for i in range(0,div1):
49         time.sleep(0.3)
50         while True:
51             try :
52                 data=pdr.get_data_yahoo(stockData[i], start, end)
53                 data.reset_index(level=0, inplace=True)
54                 count+=1
55                 time.sleep(0.5)
56                 stockFetchedData.append(data)
57                 break
58             except KeyError:
59                 time.sleep(0.8)
60                 undoneStock.append(stockData[i])
61
62
63     time.sleep(0.5)
64
65     for i in range(div1,div2):
66         time.sleep(0.3)
67         while True:
68             try :
69                 data=pdr.get_data_yahoo(stockData[i], start, end)
70                 data.reset_index(level=0, inplace=True)
71                 count+=1
72                 time.sleep(0.5)
73                 stockFetchedData.append(data)
74                 break
75             except KeyError:
76                 time.sleep(0.8)
77                 undoneStock.append(stockData[i])
78
79     time.sleep(0.5)
80
81     for i in range(div2,div3):
82         time.sleep(0.3)
83         while True:
84             try :
85                 data=pdr.get_data_yahoo(stockData[i], start, end)
86                 data.reset_index(level=0, inplace=True)
87                 count+=1
88                 time.sleep(0.5)
89                 stockFetchedData.append(data)
90                 break

```

```

91         except KeyError:
92             time.sleep(0.8)
93             undoneStock.append(stockData[i])
94
95     time.sleep(0.5)
96
97     for i in range(div3, len(stockData)):
98         time.sleep(0.3)
99         while True:
100             try :
101                 data=pdr.get_data_yahoo(stockData[i], start, end)
102                 data.reset_index(level=0, inplace=True)
103                 count+=1
104                 time.sleep(0.5)
105                 stockFetchedData.append(data)
106                 break
107             except KeyError:
108                 time.sleep(0.8)
109                 undoneStock.append(stockData[i])
110
111
112     print(len(stockFetchedData))
113     print("Successfullt extracted stock data")
114     time.sleep(0.5)
115
116
117
118
119     for i in range(0, len(stockFetchedData)):
120         stockd=stockFetchedData[i]
121         stockd.drop_duplicates(subset ="Date", keep = False, inplace =
True)
122         if(not (stockd.empty)):
123             improved=ModifyData(stockd)
124             gets=pd.DataFrame(improved)
125             gets.insert(6, 'Stock Name', stocknames[i])
126             gets= np.asarray(gets)
127             appendToStockMart (gets, stockData[i])
128
129     print("Successfully inserted data in stock mart")
130     print("Stocks which are not extracted are:")
131     for i in undoneStock:
132         print(i)
133
134
135
136 # data preprocessing step
137 def ModifyData(extractData):
138
139     imputer = SimpleImputer(missing_values=np.nan, strategy='mean') #
replacing all missing values with mean of values
140     MStock=extractData.iloc[:,1:].values #getting values of stock
141     imputer=imputer.fit(MStock[:, :]) #fitting missing values

```

```

142     MStock[:, :]=imputer.transform(MStock[:, :]) #transforming stock
dataset
143     mstock=MStock[:, :]
144     mstock=mstock.astype(np.unicode)
145     mstock=pd.DataFrame(mstock)
146     mstock= pd.concat([extractData.iloc[:, :1], mstock], axis=1)
147     return(mstock)
148
149 #add data to stock mart
150 def appendToStockMart(mstock, stockFile):
151     fileStock=open("/home/dimple/Project/Stock Data/"+stockFile+".csv", "
a+")
152     np.savetxt(fileStock, mstock, fmt='%s', delimiter=",")
153     fileStock.close()
154
155 # create file for every ticker
156 def createStockFiles():
157     readTickers=open("/home/dimple/Project/Stockdetails.csv", encoding='
latin1')
158     reader = csv.reader(readTickers, delimiter=',')
159     for row in reader:
160         #print(row[0])
161         fileStock=open("/home/dimple/Project/Stock Data/"+row[0]+".csv",
"a+")
162         fileStock.close()
163         readTickers.close()
164
165 #To remove duplicate entries of files due to bug while scheduling the
job
166 def recheckFiles():
167     stockMart = '/home/dimple/Project/Stock Data'
168     columnNames=['Date', 'Open', 'High', 'Low', 'Close', 'Adj Close', 'Stock
Name', 'Volume']
169     for stockFiles in os.listdir(stockMart):
170         #print(stockFiles)
171         data= pd.read_csv("/home/dimple/Project/Stock Data/"+stockFiles,
names=columnNames, header=None)
172         data.drop_duplicates(subset='Date', keep='last', inplace=True)
173         fileStock=open("/home/dimple/Project/Stock Data/"+stockFiles, "a+
")
174         fileStock.seek(0)
175         fileStock.truncate()
176         np.savetxt(fileStock, data, fmt='%s', delimiter=",")
177         fileStock.close()
178
179 # perform data extraction daily
180 def extractAndLoadJob():
181     start = datetime.today()
182     end = datetime.today()+timedelta(days=1)
183     print("Code execution started")
184     print(str(start.date())+ " is start date and end date is "+str(end.
date()))
185     dataExtract(start, end) #Extract data everyday
186     recheckFiles() #check Files to confirm

```

```
187
188 schedule.every().day.at("17:00").do(extractAndLoadJob) #Cron job to
    update files daily at 5:00 pm
189 print("Job started")
190
191 #run job daily
192 while True:
193     schedule.run_pending()
194     time.sleep(1)
```

Code A.1.0.1: Data preprocessing script

Figure A.1: Work flow of methods called in Data preprocessing script

A.2 Web Application Design

1. Create virtual environment using- `python -m virtualenv --python=/usr/bin/python3.6 env`
2. Install Django 3.0.2 using `pip install Django==3.0.3`

3. Create project Finance using- `django-admin startproject Finance`
4. Create an app finWeb in project using- `python manage.py startapp finWeb`
5. Create a file `urls.py` in finWeb app
6. Add app finWeb in settings.py of Finance project by adding line '`finWeb.apps.FinwebConfig`' in `INSTALLED_APPS`
7. Make migrations in database by given below commands-
`Python manage.py makemigrations finWeb`
`python manage.py sqlmigrate finWeb 0001`
8. Install all libraries required for development by executing- `pip3 install -r requirements.txt`

```

1 absl-py==0.9.0
2 altgraph==0.17
3 asgiref==3.2.3
4 astor==0.8.1
5 attrs==19.3.0
6 awsebcli==3.17.1
7 bcrypt==3.1.7
8 bleach==3.1.0
9 blessed==1.17.2
10 botocore==1.14.17
11 cached-property==1.5.1
12 cachetools==4.0.0
13 cement==2.8.2
14 certifi==2019.11.28
15 cffi==1.14.0
16 chardet==3.0.4
17 Click==7.0
18 colorama==0.3.9
19 ConfigArgParse==1.0
20 convertdate==2.2.0
21 cryptography==2.8
22 cycller==0.10.0
23 Cython==0.29.15
24 decorator==4.4.1
25 defusedxml==0.6.0
26 Django==3.0.3
27 docker==4.2.0
28 docker-compose==1.25.4
29 dockerpty==0.4.1
30 docopt==0.6.2
31 docutils==0.15.2
32 entrypoints==0.3
33 fbprophet==0.5
34 Flask==1.1.1
35 future==0.16.0
36 gast==0.2.2
37 gevent==1.5a2
38 geventhttpclient-wheels==1.3.1.dev2
39 google-auth==1.11.2
40 google-auth-oauthlib==0.4.1
41 google-colab==1.0.0

```

```
42 google-pasta==0.1.8
43 greenlet==0.4.15
44 grpcio==1.27.2
45 h5py==2.10.0
46 holidays==0.9.8
47 idna==2.7
48 importlib-metadata==1.5.0
49 ipykernel==4.6.1
50 ipython==5.5.0
51 ipython-genutils==0.2.0
52 itsdangerous==1.1.0
53 Jinja2==2.11.1
54 jmespath==0.9.4
55 joblib==0.14.1
56 jsonschema==3.2.0
57 jupyter-client==5.3.4
58 jupyter-core==4.6.3
59 Keras-Applications==1.0.8
60 Keras-Preprocessing==1.1.0
61 kiwisolver==1.1.0
62 locustio==0.14.4
63 lunardate==0.2.0
64 lxml==4.5.0
65 Markdown==3.2.1
66 MarkupSafe==1.1.1
67 matplotlib==3.1.3
68 mistune==0.8.4
69 msgpack-python==0.5.6
70 multitasking==0.0.9
71 nbconvert==5.6.1
72 nbformat==5.0.4
73 notebook==5.2.2
74 numpy==1.18.1
75 oauthlib==3.1.0
76 opt-einsum==3.1.0
77 pandas==0.24.2
78 pandas-datareader==0.8.1
79 pandocfilters==1.4.2
80 paramiko==2.7.1
81 pathspec==0.5.9
82 pexpect==4.8.0
83 pickleshare==0.7.5
84 Pillow==7.0.0
85 plotly==4.5.0
86 portpicker==1.2.0
87 prompt-toolkit==1.0.18
88 protobuf==3.11.3
89 psutil==5.6.7
90 ptyprocess==0.6.0
91 pyasn1==0.4.8
92 pyasn1-modules==0.2.8
93 pycparser==2.19
94 Pygments==2.5.2
95 PyInstaller==3.6
```

```
96 PyMeeus==0.3.6
97 PyNaCl==1.3.0
98 pyparsing==2.4.6
99 pyrsistent==0.15.7
100 pystan==2.19.1.1
101 python-dateutil==2.8.0
102 pytz==2019.3
103 PyYAML==5.2
104 pyzmq==18.1.1
105 requests==2.21.0
106 requests-oauthlib==1.3.0
107 retrying==1.3.3
108 rsa==4.0
109 schedule==0.6.0
110 scikit-learn==0.22.1
111 scipy==1.4.1
112 semantic-version==2.5.0
113 setuptools-git==1.2
114 simplegeneric==0.8.1
115 six==1.12.0
116 sqlparse==0.3.0
117 tensorboard==1.15.0
118 tensorflow-estimator==1.15.1
119 termcolor==1.1.0
120 terminado==0.8.3
121 testpath==0.4.4
122 texttable==1.6.2
123 TFANN==1.0.1
124 tornado==4.5.3
125 traitlets==4.3.3
126 urllib3==1.24.3
127 wcwidth==0.1.8
128 webencodings==0.5.1
129 websocket-client==0.57.0
130 Werkzeug==1.0.0
131 wrapt==1.12.0
132 yfinance==0.1.54
133 zipp==3.0.0
```

Code A.2.0.1: requirements.txt

A.2.1 Directory Tree Structure for Web Application

```
dimple@node1:~/Project$ tree -I '*env*|*loc*|*automate*|__py*|logs|Loc*|*.html|*.jpg' -L 4
.
├── Finance
│   ├── db.sqlite3
│   └── Finance
│       ├── asgi.py
│       ├── __init__.py
│       ├── settings.py
│       ├── urls.py
│       └── wsgi.py
│   ├── finWeb
│   │   ├── admin.py
│   │   ├── apps.py
│   │   ├── forms.py
│   │   ├── __init__.py
│   │   ├── migrations
│   │   │   └── 0001_initial.py
│   │   │       └── __init__.py
│   │   ├── models.py
│   │   ├── Stockdetails.csv
│   │   ├── templates
│   │   ├── tests.py
│   │   ├── TimeConsumed.csv
│   │   ├── urls.py
│   │   └── views.py
│   ├── manage.py
│   ├── requirements.txt
│   ├── static
│   │   └── admin
│   │       ├── css
│   │       ├── fonts
│   │       ├── img
│   │       └── js
│   └── uwsgi_params
└── .
```

Figure A.2: Directory Tree Structure for Web Application

A.2.2 Files in project Finance

There are 5 files in Finance folder of project- asgi.py, settings.py, urls.py, wsgi.py and init.py, which is empty file.

```
1 """
2 ASGI config for Finance project.
3
4 It exposes the ASGI callable as a module-level variable named ``
5     application``.
6
7 For more information on this file, see
8 https://docs.djangoproject.com/en/3.0/howto/deployment/asgi/
9 """
10 import os
11
12 from django.core.asgi import get_asgi_application
13
14 os.environ.setdefault('DJANGO_SETTINGS_MODULE', 'Finance.settings')
15
16 application = get_asgi_application()
```

Code A.2.2.1: asgi.py

```
1 """
```

```

2 Django settings for Finance project.
3
4 Generated by 'django-admin startproject' using Django 3.0.3.
5
6 For more information on this file, see
7 https://docs.djangoproject.com/en/3.0/topics/settings/
8
9 For the full list of settings and their values, see
10 https://docs.djangoproject.com/en/3.0/ref/settings/
11 """
12
13 import os
14
15 # Build paths inside the project like this: os.path.join(BASE_DIR, ...)
16 BASE_DIR = os.path.dirname(os.path.dirname(os.path.abspath(__file__)))
17
18
19 # Quick-start development settings - unsuitable for production
20 # See https://docs.djangoproject.com/en/3.0/howto/deployment/checklist/
21
22 # SECURITY WARNING: keep the secret key used in production secret!
23 SECRET_KEY = '*1zm6eldpu7$ki3lpt!5eylt%8qn)@41llrg4oa5+ge9q4#s$k) '
24
25 # SECURITY WARNING: don't run with debug turned on in production!
26 DEBUG = True
27
28 ALLOWED_HOSTS = ['*']
29
30
31 # Application definition
32
33 INSTALLED_APPS = [
34     'finWeb.apps.FinwebConfig',
35     'django.contrib.admin',
36     'django.contrib.auth',
37     'django.contrib.contenttypes',
38     'django.contrib.sessions',
39     'django.contrib.messages',
40     'django.contrib.staticfiles',
41 ]
42
43 MIDDLEWARE = [
44     'django.middleware.security.SecurityMiddleware',
45     'django.contrib.sessions.middleware.SessionMiddleware',
46     'django.middleware.common.CommonMiddleware',
47     'django.middleware.csrf.CsrfViewMiddleware',
48     'django.contrib.auth.middleware.AuthenticationMiddleware',
49     'django.contrib.messages.middleware.MessageMiddleware',
50     'django.middleware.clickjacking.XFrameOptionsMiddleware',
51 ]
52
53 ROOT_URLCONF = 'Finance.urls'
54
55 TEMPLATES = [

```

```

56     {
57         'BACKEND': 'django.template.backends.django.DjangoTemplates',
58         'DIRS': [],
59         'APP_DIRS': True,
60         'OPTIONS': {
61             'context_processors': [
62                 'django.template.context_processors.debug',
63                 'django.template.context_processors.request',
64                 'django.contrib.auth.context_processors.auth',
65                 'django.contrib.messages.context_processors.messages',
66             ],
67         },
68     },
69 ]
70
71 WSGI_APPLICATION = 'Finance.wsgi.application'
72
73
74 # Database
75 # https://docs.djangoproject.com/en/3.0/ref/settings/#databases
76
77 DATABASES = {
78     'default': {
79         'ENGINE': 'django.db.backends.sqlite3',
80         'NAME': os.path.join(BASE_DIR, 'db.sqlite3'),
81     }
82 }
83
84
85 # Password validation
86 # https://docs.djangoproject.com/en/3.0/ref/settings/#auth-password-
87     validators
88 AUTH_PASSWORD_VALIDATORS = [
89     {
90         'NAME': 'django.contrib.auth.password_validation.
91         UserAttributeSimilarityValidator',
92     },
93     {
94         'NAME': 'django.contrib.auth.password_validation.
95         MinimumLengthValidator',
96     },
97     {
98         'NAME': 'django.contrib.auth.password_validation.
99         CommonPasswordValidator',
100    },
101    {
102        'NAME': 'django.contrib.auth.password_validation.
103        NumericPasswordValidator',
104    },
105 ]
106
107 # Internationalization

```

```

105 # https://docs.djangoproject.com/en/3.0/topics/i18n/
106
107 LANGUAGE_CODE = 'en-us'
108
109 TIME_ZONE = 'UTC'
110
111 USE_I18N = True
112
113 USE_L10N = True
114
115 USE_TZ = True
116
117
118 # Static files (CSS, JavaScript, Images)
119 # https://docs.djangoproject.com/en/3.0/howto/static-files/
120
121
122 STATIC_URL = '/static/'
123 STATICFILES_DIRS = (
124     os.path.join(BASE_DIR, "finWeb", "static"),
125 )
126
127 STATIC_ROOT = os.path.join(BASE_DIR, "staticfiles")

```

Code A.2.2.2: settings.py

```

1 """Finance URL Configuration
2
3 The `urlpatterns` list routes URLs to views. For more information please
4     see:
5     https://docs.djangoproject.com/en/3.0/topics/http/urls/
6 Examples:
7 Function views
8     1. Add an import:  from my_app import views
9     2. Add a URL to urlpatterns:  path('', views.home, name='home')
10 Class-based views
11     1. Add an import:  from other_app.views import Home
12     2. Add a URL to urlpatterns:  path('', Home.as_view(), name='home')
13 Including another URLconf
14     1. Import the include() function: from django.urls import include,
15     path
16     2. Add a URL to urlpatterns:  path('blog/', include('blog.urls'))
17 """
18 from django.contrib import admin
19 from django.urls import path, include
20
21 urlpatterns = [
22     path('admin/', admin.site.urls),
23     path('', include('finWeb.urls')),
24 ]

```

Code A.2.2.3: urls.py

```

1 """

```

```

2 WSGI config for Finance project.
3
4 It exposes the WSGI callable as a module-level variable named ``
    application``.
5
6 For more information on this file, see
7 https://docs.djangoproject.com/en/3.0/howto/deployment/wsgi/
8 """
9
10 import os
11
12 from django.core.wsgi import get_wsgi_application
13
14 os.environ.setdefault('DJANGO_SETTINGS_MODULE', 'Finance.settings')
15
16 application = get_wsgi_application()

```

Code A.2.2.4: wsgi.py

```

1 uwsgi_param  QUERY_STRING      $query_string;
2 uwsgi_param  REQUEST_METHOD    $request_method;
3 uwsgi_param  CONTENT_TYPE      $content_type;
4 uwsgi_param  CONTENT_LENGTH    $content_length;
5
6 uwsgi_param  REQUEST_URI       $request_uri;
7 uwsgi_param  PATH_INFO         $document_uri;
8 uwsgi_param  DOCUMENT_ROOT     $document_root;
9 uwsgi_param  SERVER_PROTOCOL   $server_protocol;
10 uwsgi_param  REQUEST_SCHEME    $scheme;
11 uwsgi_param  HTTPS             $https if_not_empty;
12
13 uwsgi_param  REMOTE_ADDR       $remote_addr;
14 uwsgi_param  REMOTE_PORT       $remote_port;
15 uwsgi_param  SERVER_PORT       $server_port;
16 uwsgi_param  SERVER_NAME       $server_name;

```

Code A.2.2.5: uwsgi_params

A.2.3 Files in finWeb app

The application consist of mainly six files - admin.py, apps.py, forms.py, models.py, urls.py, views.py and init.py, which is an empty file used to initialize attribute of class. All HTML pages are created in a separate folder called templates in Django.

```

1 from django.contrib import admin
2
3 # Register your models here.

```

Code A.2.3.1: admin.py

```

1 from django.apps import AppConfig
2
3
4 class FinwebConfig(AppConfig):
5     name = 'finWeb'

```


Code A.2.3.2: apps.py

```
1 from django import forms
2 from django.contrib.auth.models import User
3 from finWeb.models import UserProfileInfo
4
5 class LoginPage(forms.Form):
6     username = forms.CharField()
7     password = forms.CharField(max_length=25, widget=forms.PasswordInput)
8
9
10 class UserForm(forms.ModelForm):
11     password = forms.CharField(widget=forms.PasswordInput())
12     class Meta():
13         model = User
14         fields = ('username', 'password')
15
16
17 class UserProfileInfoForm(forms.ModelForm):
18     class Meta():
19         model = UserProfileInfo
20         fields = ('portfolio_site', 'profile_pic')
```

Code A.2.3.3: forms.py

```
1 from django.db import models
2 from django.contrib.auth.models import User
3
4 # Create your models here.
5
6 class Users(models.Model):
7
8     user_Name = models.CharField(max_length=100, primary_key=True)
9     user_password = models.CharField(max_length=25)
10
11
12 class GuestLogin(models.Model):
13
14     userName = models.CharField(max_length=100, primary_key=True)
15     userpassword = models.CharField(max_length=25)
16
17
18 class UserProfileInfo(models.Model):
19     user = models.OneToOneField(User, on_delete=models.CASCADE)
20     portfolio_site = models.URLField(blank=True)
21     profile_pic = models.ImageField(upload_to='profile_pics', blank=True)
22     def __str__(self):
23         return self.user.username
```

Code A.2.3.4: models.py

```

1 from django.urls import path
2 from . import views
3 from django.contrib.auth import views as auth_views
4
5 urlpatterns = [
6     path('', views.guestLogin, name='guestLogin'),
7     #path('Loginpage.html', views.guestLogin, name='guestLogin'),
8     path('signup.html', views.signup, name='signup'),
9     path('home.html', views.home, name='home'),
10    path('prediction.html', views.predict, name='predict'),
11    path('analysis.html', views.analysis, name='analysis'),
12    path('movers.html', views.movers, name='movers'),
13    path('compare.html', views.compare, name='compare'),
14    path('measure.html', views.trends, name='trends'),
15    path('predictionResult.html', views.prediction, name='prediction'),
16    path('analysisResult.html', views.analysisSelection, name='
analysisSelection'),
17    path('compareResult.html', views.compareStocks , name = '
compareStocks'),
18    path('measureResults.html', views.measureTrends, name = '
measureTrends'),
19    path('moversResult.html', views.marketMovers, name = 'marketMovers')
20
21    #path('predictionResultNoData.html', views.prediction, name='
prediction'),
22
23
24 ]

```

Code A.2.3.5: urls.py

```

1 from django.shortcuts import render, HttpResponseRedirect
2 from django.http import HttpResponse
3 from finWeb.models import Users
4 from .models import GuestLogin
5 from django.views.generic import TemplateView
6 from django.contrib.auth import authenticate, login , logout
7 from finWeb.forms import UserProfileInfoForm, UserForm
8 import csv
9 from fbprophet import Prophet
10 from datetime import datetime, timedelta
11 import numpy as np
12 from sklearn.impute import SimpleImputer
13 #from itertools import islice
14 import pandas as pd
15 import time
16 import math
17 import schedule
18 #import stocker
19 import os
20 from fbprophet.plot import plot_plotly
21 import plotly.offline as py
22 from plotly.offline import plot, init_notebook_mode

```

```

23 import plotly.graph_objs as go
24 import plotly.express as px
25 from pandas_datareader import data as pdr
26 import yfinance as yf
27 import timeit
28 import paramiko as param
29
30 #py.init_notebook_mode()
31 # Create your views here.
32
33 def guestLogin(request):
34     if request.method == 'POST':
35         username = request.POST.get('username')
36         password = request.POST.get('password')
37
38         user = authenticate(username=username, password=password)
39         if user:
40             login(request, user)
41             return render(request, 'home.html', {})
42         else:
43
44             return HttpResponseRedirect("Invalid login details given")
45
46     else:
47
48         return render(request, 'Loginpage.html', {})
49
50 def signup(request):
51     registered = False
52     if request.method == 'POST':
53         user_form = UserForm(data=request.POST)
54         profile_form = UserProfileInfoForm(data=request.POST)
55         if user_form.is_valid() and profile_form.is_valid():
56             user = user_form.save()
57             user.set_password(user.password)
58             user.save()
59             profile = profile_form.save(commit=False)
60             profile.user = user
61             if 'profile_pic' in request.FILES:
62                 print('found it')
63                 profile.profile_pic = request.FILES['profile_pic']
64             profile.save()
65             registered = True
66         else:
67             print(user_form.errors, profile_form.errors)
68
69
70     return render(request, 'signup.html',
71                  {'user_form': user_form,
72                   'profile_form': profile_form,
73                   'registered': registered})
74
75
76

```

```

77     else:
78         user_form = UserForm()
79         profile_form = UserProfileInfoForm()
80     return render(request, 'signup.html',
81                   {'user_form':user_form,
82                   'profile_form':profile_form,
83                   'registered':registered})
84
85 def index(request):
86
87
88     return render (request, 'Loginpage.html', {},)
89
90 #HOME
91 def home(request):
92     #return HttpResponse("This is finance web application")
93     count=0
94     directoryPath = os.getcwd()+"/finWeb/StockData/"
95     for file in os.listdir(directoryPath):
96         if file.endswith(".csv"):
97             #dataDf= pd.read_csv(directoryPath+file ,encoding='utf-8',
names=columnNames,header=None)
98             count+=1
99     print(count)
100
101     return render (request, 'home.html', {},)
102
103
104
105 #history homepage
106 def analysis(request):
107
108     count=0
109     stocknames=[]
110     stockData=[]
111     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
112     reader = csv.reader(readTickers, delimiter=',')
113     for row in reader:
114         stockData.append(row[0])
115         stocknames.append(row[1])
116         count+=1
117     readTickers.close()
118
119     #print(count)
120
121     return render (request, 'analysis.html', {'stocknames':stocknames},)
122
123
124
125 #movers homepage
126 def movers(request):
127
128     return render (request, 'movers.html', {},)

```

```

129
130
131
132
133 #compare stock homepage
134 def compare(request):
135     stocknames=[]
136     stockData=[]
137     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
138     reader = csv.reader(readTickers, delimiter=',')
139     for row in reader:
140         stockData.append(row[0])
141         stocknames.append(row[1])
142
143     readTickers.close()
144
145     return render (request, 'compare.html', {'stocknames':stocknames},)
146
147
148
149 # trends homepage -sma and ema
150 def trends(request):
151     stocknames=[]
152     stockData=[]
153     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
154     reader = csv.reader(readTickers, delimiter=',')
155     for row in reader:
156         stockData.append(row[0])
157         stocknames.append(row[1])
158
159     readTickers.close()
160
161     return render (request, 'measure.html', {'stocknames':stocknames},)
162
163
164
165 #get market movers
166 def marketMovers(request):
167     selectedType = request.POST.get('Duration',None)
168     selectedRange = request.POST.get('Input Range',None)
169     fromDate=datetime.today()
170     print(selectedType)
171     print(selectedRange)
172
173
174     getRange = selectedRange.split(" ")
175     getSecond = int(getRange[1])
176     columnNames=['Stock Name', 'Close' , 'High', 'Low']
177     try:
178         sshWk = param.SSHClient()
179         sshWk.load_system_host_keys()
180         sshWk.set_missing_host_key_policy(param.AutoAddPolicy())

```

```

181     sshWk.connect("192.168.1.167",username="dimple",password="#####
    ")
182     sshWk.get_transport().window_size = 3 * 1024 * 1024
183
184     stdin, stdout, stderr= sshWk.exec_command("(cd /home/dimple/
    Desktop; source /home/dimple/dummy/testFinWeb/env2/bin/activate; ./
    marketMovers.py)")
185     print("stderr: ", stderr.readlines())
186     print("pwd: ", stdout.readlines())
187     fileStock = sshWk.open_sftp()
188
189     if(selectedType=="Last day"):
190
191         actualFile = fileStock.open("/home/dimple/Project/
    MarketMoversdata/Top30Lastday.csv")
192         actualFile.prefetch()
193         getData=[]
194         for i in actualFile:
195             getData.append(i)
196
197         actualFile.close()
198         dataDfHighValues = pd.DataFrame(columns=columnNames)
199
200         for i in getData:
201             getRow = i.split(",")
202             makeSeries = pd.Series(getRow, index = dataDfHighValues.
    columns)
203             dataDfHighValues = dataDfHighValues.append(makeSeries,
    ignore_index=True)
204
205             dataDfHighValues = dataDfHighValues.head(getSecond)
206
207
208         actualFile = fileStock.open("/home/dimple/Project/
    MarketMoversdata/Last30Lastday.csv")
209         actualFile.prefetch()
210         getData=[]
211         for i in actualFile:
212             getData.append(i)
213
214         actualFile.close()
215         dataDfLowValues = pd.DataFrame(columns=columnNames)
216
217         for i in getData:
218             getRow = i.split(",")
219             makeSeries = pd.Series(getRow, index = dataDfLowValues.
    columns)
220             dataDfLowValues = dataDfLowValues.append(makeSeries,
    ignore_index=True)
221
222             dataDfLowValues = dataDfLowValues.head(getSecond)
223
224             dataDfHighValues['Low'] = dataDfHighValues['Low'].map(lambda
    x: x.rstrip('\n'))

```

```

225         dataDfLowValues['Low'] = dataDfLowValues['Low'].map(lambda x
: x.rstrip('\n'))
226
227
228         dataDfLowValues = dataDfLowValues.to_html(justify="center")
229         dataDfHighValues = dataDfHighValues.to_html(justify="center")
230
231
232
233
234
235         return render (request, 'moversResult.html', {'selectedType':
selectedType, 'selectedRange': selectedRange,
236                 'dataDfHighValues': dataDfHighValues, 'dataDfLowValues':
dataDfLowValues, }
237                 )
238
239         elif(selectedType=="Weekly"):
240
241             actualFile = fileStock.open("/home/dimple/Project/
MarketMoversdata/Top30Weekly.csv")
242             actualFile.prefetch()
243             getData=[]
244             for i in actualFile:
245                 getData.append(i)
246
247             actualFile.close()
248             dataDfHighValues = pd.DataFrame(columns=columnNames)
249
250             for i in getData:
251                 getRow = i.split(",")
252                 makeSeries = pd.Series(getRow, index = dataDfHighValues.
columns)
253                 dataDfHighValues = dataDfHighValues.append(makeSeries,
ignore_index=True)
254
255             dataDfHighValues = dataDfHighValues.head(getSecond)
256
257
258             actualFile = fileStock.open("/home/dimple/Project/
MarketMoversdata/Last30Weekly.csv")
259             actualFile.prefetch()
260             getData=[]
261             for i in actualFile:
262                 getData.append(i)
263
264             actualFile.close()
265             dataDfLowValues = pd.DataFrame(columns=columnNames)
266
267             for i in getData:
268                 getRow = i.split(",")
269                 makeSeries = pd.Series(getRow, index = dataDfLowValues.
columns)

```

```

270         dataDfLowValues = dataDfLowValues.append(makeSeries,
271 ignore_index=True)
272
273         dataDfLowValues = dataDfLowValues.head(getSecond)
274
275         dataDfHighValues['Low'] = dataDfHighValues['Low'].map(lambda
276 x: x.rstrip('\n'))
277         dataDfLowValues['Low'] = dataDfLowValues['Low'].map(lambda x
278 : x.rstrip('\n'))
279
280         dataDfLowValues = dataDfLowValues.to_html(justify="center")
281         dataDfHighValues = dataDfHighValues.to_html(justify="center")
282
283
284         return render (request, 'moversResult.html', {'selectedType':
285 selectedType, 'selectedRange': selectedRange,
286 'dataDfHighValues': dataDfHighValues, 'dataDfLowValues':
287 dataDfLowValues, }
288 )
289
290     elif(selectedType=="Monthly"):
291
292         actualFile = fileStock.open("/home/dimple/Project/
293 MarketMoversdata/Top30Monthly.csv")
294         actualFile.prefetch()
295         getData=[]
296         for i in actualFile:
297             getData.append(i)
298
299         actualFile.close()
300         dataDfHighValues = pd.DataFrame(columns=columnNames)
301
302         for i in getData:
303             getRow = i.split(",")
304             makeSeries = pd.Series(getRow, index = dataDfHighValues.
305 columns)
306             dataDfHighValues = dataDfHighValues.append(makeSeries,
307 ignore_index=True)
308
309         dataDfHighValues = dataDfHighValues.head(getSecond)
310
311
312         actualFile = fileStock.open("/home/dimple/Project/
313 MarketMoversdata/Last30Monthly.csv")
314         actualFile.prefetch()
315         getData=[]
316         for i in actualFile:
317             getData.append(i)
318
319         actualFile.close()
320         dataDfLowValues = pd.DataFrame(columns=columnNames)

```



```

315         for i in getData:
316             getRow = i.split(",")
317             makeSeries = pd.Series(getRow, index = dataDfLowValues.
318 columns)
319             dataDfLowValues = dataDfLowValues.append(makeSeries,
ignore_index=True)
320
321             dataDfLowValues = dataDfLowValues.head(getSecond)
322
323             dataDfHighValues['Low'] = dataDfHighValues['Low'].map(lambda
x: x.rstrip('\n'))
324             dataDfLowValues['Low'] = dataDfLowValues['Low'].map(lambda x
: x.rstrip('\n'))
325
326
327             dataDfLowValues = dataDfLowValues.to_html(justify="center")
328             dataDfHighValues = dataDfHighValues.to_html(justify="center")
329
330
331
332         return render (request, 'moversResult.html', {'selectedType':
selectedType, 'selectedRange': selectedRange,
333 'dataDfHighValues': dataDfHighValues, 'dataDfLowValues':
dataDfLowValues, }
334             )
335
336     elif(selectedType=="Yearly"):
337
338         actualFile = fileStock.open("/home/dimple/Project/
MarketMoversdata/Top30Yearly.csv")
339         actualFile.prefetch()
340         getData=[]
341         for i in actualFile:
342             getData.append(i)
343
344         actualFile.close()
345         dataDfHighValues = pd.DataFrame(columns=columnNames)
346
347         for i in getData:
348             getRow = i.split(",")
349             makeSeries = pd.Series(getRow, index = dataDfHighValues.
columns)
350             dataDfHighValues = dataDfHighValues.append(makeSeries,
ignore_index=True)
351
352             dataDfHighValues = dataDfHighValues.head(getSecond)
353
354
355         actualFile = fileStock.open("/home/dimple/Project/
MarketMoversdata/Last30Yearly.csv")
356         actualFile.prefetch()
357         getData=[]
358         for i in actualFile:

```

```

359         getData.append(i)
360
361         actualFile.close()
362         dataDfLowValues = pd.DataFrame(columns=columnNames)
363
364         for i in getData:
365             getRow = i.split(",")
366             makeSeries = pd.Series(getRow, index = dataDfLowValues.
columns)
367             dataDfLowValues = dataDfLowValues.append(makeSeries,
ignore_index=True)
368
369             dataDfLowValues = dataDfLowValues.head(getSecond)
370
371             dataDfHighValues['Low'] = dataDfHighValues['Low'].map(lambda
x: x.rstrip('\n'))
372             dataDfLowValues['Low'] = dataDfLowValues['Low'].map(lambda x
: x.rstrip('\n'))
373
374
375             dataDfLowValues = dataDfLowValues.to_html(justify="center")
376             dataDfHighValues =dataDfHighValues.to_html(justify="center")
377
378             return render (request, 'moversResult.html', {'selectedType':
selectedType, 'selectedRange': selectedRange,
379                 'dataDfHighValues':dataDfHighValues, 'dataDfLowValues':
dataDfLowValues,}
380                 )
381
382
383
384
385         else:
386
387             return render (request, 'moversResult.html', {'selectedType':
selectedType, 'selectedRange': selectedRange,
388                 'dataDfHighValues':dataDfHighValues,}
389                 )
390
391         finally:
392             fileStock.close()
393             sshWk.close()
394
395
396 def measureTrends(request):
397
398     stocknames=[]
399     stockData=[]
400     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
401     reader = csv.reader(readTickers, delimiter=',')
402     for row in reader:
403         stockData.append(row[0])
404         stocknames.append(row[1])

```

```

405
406 readTickers.close()
407 #stocknames = stocknames.sort(reverse=True)
408 #print(stocknames)
409 selectedStock= request.POST.get('Stock Name',None)
410 selectedType = request.POST.get('selected Type',None)
411 selectedRange = request.POST.get('selected Range',None)
412 selectedAverage = request.POST.get('selected Average',None)
413 print(selectedStock)
414 print(selectedType)
415 print(selectedAverage)
416
417
418 readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
419 reader = csv.reader(readTickers, delimiter=',')
420 getTicker=""
421 getStockName=""
422 for row in reader:
423     if(row[1].startswith(selectedStock)):
424         getTicker=row[0]
425         getStockName=row[1]
426 readTickers.close()
427 print(getTicker)
428
429 columnNames=['Date', 'Open','High','Low','Close', 'Adj Close', '
Stock Name','Volume']
430 dataDf= retrieveData(getTicker)
431
432 if(selectedAverage=="Simple Moving Average(SMA)"):
433
434     simpleMoving = dataDf['Close'].rolling(window=int(selectedRange)
).mean()
435     simpleMoving = simpleMoving.to_frame()
436
437
438 if(selectedType=="Table"):
439     simpleMoving = simpleMoving.fillna(0)
440     simpleMoving = simpleMoving.reset_index(drop=True)
441     simpleMoving = simpleMoving.to_html(justify="center")
442
443     return render (request,'measureResultTable.html',{ '
stocknames':stocknames, 'selectedStock':getStockName,
444         'selectedType':selectedType, 'selectedRange':
selectedRange, 'selectedAverage':selectedAverage, 'dataDf1':
simpleMoving ,
445
446         },)
447
448 else:
449     x = dataDf['Date']
450     y1 = simpleMoving['Close']
451
452     data =[]

```

```

453         tracel = go.Scatter(x=x, y=y1, marker={'color': 'blue', '
symbol': 104, },
454                             mode="lines", name='Close ')
455
456
457         data.append(tracel)
458
459         layout=go.Layout(title=" Simple Moving Average ", xaxis={ '
title': 'Selected Dates'}, yaxis={'title': 'Stock Price'})
460         figure=go.Figure(data=data, layout=layout)
461         figure.update_layout(
462             xaxis=go.layout.XAxis(
463                 rangeselector=dict(
464                     buttons=list([
465                         dict(count=1,
466                             label="1m",
467                             step="month",
468                             stepmode="backward"),
469                         dict(count=6,
470                             label="6m",
471                             step="month",
472                             stepmode="backward"),
473                         dict(count=1,
474                             label="YTD",
475                             step="year",
476                             stepmode="todate"),
477                         dict(count=1,
478                             label="1y",
479                             step="year",
480                             stepmode="backward"),
481                         dict(step="all")
482                     ])
483                 ),
484                 rangeslider=dict(
485                     visible=True
486                 ),
487                 type="date"
488             )
489         )
490         plot_div = py.plot(figure, auto_open=False, output_type='div
')
491
492
493
494         return render (request, 'measureResultLine.html', {'stocknames
': stocknames, 'selectedStock': getStockName,
495                     'selectedType': selectedType, 'selectedRange':
selectedRange, 'selectedAverage': selectedAverage, 'dataDf1':
plot_div,
496
497                     },)
498
499
500     elif(selectedAverage=="Exponential Moving Average (EMA)"):

```

```

501     exponentialAverage = dataDf['Close'].ewm(span=int(selectedRange)
502 ,adjust=False).mean()
503     exponentialAverage = exponentialAverage.to_frame()
504
505
506     if(selectedType=="Table"):
507         exponentialAverage = exponentialAverage.fillna(0)
508         exponentialAverage = exponentialAverage.to_html()
509
510         return render (request,'measureResultTable.html',{
511 stocknames':stocknames, 'selectedStock':getStockName,
512         'selectedType':selectedType, 'selectedRange':
513 selectedRange, 'selectedAverage':selectedAverage, 'dataDf1':
514 exponentialAverage ,
515
516         },)
517
518     else:
519         x = dataDf['Date']
520         y1 = exponentialAverage['Close']
521
522         data =[]
523         tracel = go.Scatter(x=x, y=y1, marker={'color': 'blue', '
524 symbol': 104, },
525                             mode="lines", name='Close ')
526
527         data.append(tracel)
528
529         layout=go.Layout(title=" Exponential Moving Average ", xaxis
530 ={'title':'Selected Dates'}, yaxis={'title':'Stock Price'})
531         figure=go.Figure(data=data,layout=layout)
532         figure.update_layout(
533             xaxis=go.layout.XAxis(
534                 rangeselector=dict(
535                     buttons=list([
536                         dict(count=1,
537                             label="1m",
538                             step="month",
539                             stepmode="backward"),
540                         dict(count=6,
541                             label="6m",
542                             step="month",
543                             stepmode="backward"),
544                         dict(count=1,
545                             label="YTD",
546                             step="year",
547                             stepmode="todate"),
548                         dict(count=1,
549                             label="1y",
550                             step="year",
551                             stepmode="backward"),

```

```

549         dict(step="all")
550     ])
551     ),
552     rangeslider=dict(
553         visible=True
554     ),
555     type="date"
556 )
557 )
558 plot_div = py.plot(figure, auto_open=False, output_type='div
')
559
560
561
562     return render (request, 'measureResultLine.html', {'stocknames
':stocknames, 'selectedStock':getStockName,
563         'selectedType':selectedType, 'selectedRange':
selectedRange, 'selectedAverage':selectedAverage, 'dataDf1':plot_div
,
564
565         },)
566
567
568
569
570     else:
571
572         return render (request, 'measureResults.html', {'stocknames':
stocknames, 'selectedStock':getStockName,
573         'selectedType':selectedType, 'selectedRange':
selectedRange, 'selectedAverage':selectedAverage, 'dataDf1':
exponentialAverage ,
574
575         },)
576
577
578
579
580 def compareStocks(request):
581     selectedStock1= request.GET.get('stock1',None)
582     selectedStock2= request.GET.get('stock2',None)
583     selectedType = request.GET.get('type',None)
584     selectedTo= request.GET.get('date_from',None)
585     selectedFrom = request.GET.get('date_to',None)
586
587     print(selectedStock1)
588     print(selectedStock2)
589     print(selectedType)
590     print(selectedTo)
591     print(selectedFrom)
592
593     count=0
594     stocknames=[]
595     stockData=[]

```

```

596     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
597     reader = csv.reader(readTickers, delimiter=',')
598     for row in reader:
599         stockData.append(row[0])
600         stocknames.append(row[1])
601         count+=1
602     readTickers.close()
603
604     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
605     reader = csv.reader(readTickers, delimiter=',')
606     getTicker1=""
607     getStockName1=""
608     getTicker2=""
609     getStockName2=""
610     for row in reader:
611         if(row[1].startswith(selectedStock1)):
612             getTicker1=row[0]
613             getStockName1=row[1]
614         if(row[1].startswith(selectedStock2)):
615             getTicker2=row[0]
616             getStockName2=row[1]
617     readTickers.close()
618     print(getTicker1)
619     print(getTicker2)
620
621     if( selectedStock1== selectedStock2):
622
623         return render (request,'compareSameStock.html',{ 'stocknames':
stocknames,'selectedStock2':getStockName2,
624         'selectedStock1':getStockName1,'selectedType':selectedType, '
selectedTo': selectedTo , 'selectedFrom': selectedFrom },)
625
626     else:
627
628
629
630
631         if(selectedType=="Table"):
632             columnNames=[ 'Date', 'Open', 'High', 'Low', 'Close', 'Adj Close
', 'Stock Name', 'Volume']
633             dataDf1= retrieveData(getTicker1)
634             mask1 = (dataDf1['Date'] > selectedTo) & (dataDf1['Date'] <=
selectedFrom)
635             dataDf1 = dataDf1.loc[mask1]
636             dataDf1 = dataDf1.reset_index(drop=True)
637             dataDf1 = dataDf1.to_html(justify="center")
638
639             dataDf2= retrieveData(getTicker2)
640             mask2 = (dataDf2['Date'] > selectedTo) & (dataDf2['Date'] <=
selectedFrom)
641             dataDf2 = dataDf2.loc[mask2]
642             dataDf2 = dataDf2.reset_index(drop= True)

```

```

643         dataDf2 = dataDf2.to_html(justify="center")
644
645
646
647         return render (request, 'compareResultTable.html', { '
stocknames':stocknames, 'selectedStock1':getStockName1,
648             'selectedStock2':getStockName2, 'selectedType':
selectedType, 'selectedTo': selectedTo, 'selectedFrom':selectedFrom,
        'dataDf1':dataDf1 ,
649            'dataDf2':dataDf2,
650            },)
651
652
653     elif(selectedType=="Line") :
654         #py.init_notebook_mode()
655         columnNames=['Date', 'Open', 'High', 'Low', 'Close', 'Adj Close
', 'Stock Name', 'Volume']
656         dataDf1= retrieveData(getTicker1)
657         mask1 = (dataDf1['Date'] > selectedTo) & (dataDf1['Date'] <=
selectedFrom)
658         dataDf1 = dataDf1.loc[mask1]
659
660         dataDf2= retrieveData(getTicker2)
661         mask2 = (dataDf2['Date'] > selectedTo) & (dataDf2['Date'] <=
selectedFrom)
662         dataDf2 = dataDf2.loc[mask2]
663
664
665         x1 = dataDf1['Date']
666         y11 = dataDf1['Close']
667         y12 = dataDf1['High']
668         y13 = dataDf1['Low']
669         data1 = []
670         trace11 = go.Scatter(x=x1, y=y11, marker={'color': 'blue', '
symbol': 104, },
671                               mode="lines", name='Close ')
672         trace12 = go.Scatter(x=x1, y=y12, marker={'color': 'green',
'symbol': 104, },
673                               mode="markers", name='High')
674         trace13 = go.Scatter(x=x1, y=y13, marker={'color': 'red', '
symbol': 104, },
675                               mode="markers", name='Low')
676
677         data1.append(trace11)
678         data1.append(trace12)
679         data1.append(trace13)
680
681         x2 = dataDf2['Date']
682         y21 = dataDf2['Close']
683         y22 = dataDf2['High']
684         y23 = dataDf2['Low']
685         data2 = []
686         trace21 = go.Scatter(x=x2, y=y21, marker={'color': 'blue', '
symbol': 104, },

```



```

687         mode="lines", name='Close ')
688     trace22 = go.Scatter(x=x2, y=y22, marker={'color': 'green',
689 'symbol': 104, },
689         mode="markers", name='High')
690     trace23 = go.Scatter(x=x2, y=y23, marker={'color': 'red', '
691 'symbol': 104, },
692         mode="markers", name='Low')
693
694     data2.append(trace21)
695     data2.append(trace22)
696     data2.append(trace23)
697
698     layout1=go.Layout(title="First Stock : "+getStockName1,
699 xaxis={'title': 'Selected Dates'}, yaxis={'title': 'Stock Price'})
700     figure1=go.Figure(data=data1, layout=layout1)
701     figure1.update_layout(
702         autosize=False,
703         width=520,
704         height=550,
705         margin=go.layout.Margin(
706             l=5,
707             r=5,
708             b=20,
709             t=100,
710             pad=4
711         ),
712         paper_bgcolor="#d2f7f2",
713         xaxis=go.layout.XAxis(
714             rangeselector=dict(
715                 buttons=list([
716                     dict(count=1,
717                         label="1m",
718                         step="month",
719                         stepmode="backward"),
720                     dict(count=6,
721                         label="6m",
722                         step="month",
723                         stepmode="backward"),
724                     dict(count=1,
725                         label="YTD",
726                         step="year",
727                         stepmode="todate"),
728                     dict(count=1,
729                         label="1y",
730                         step="year",
731                         stepmode="backward"),
732                     dict(step="all")
733                 ])
734             ),
735             rangeslider=dict(
736                 visible=True
737             ),
738             type="date"
739         )

```

```

738
739         )
740         plot_div1 = py.plot(figure1, auto_open=False, output_type='
div')
741
742         layout2=go.Layout(title="Second Stock : "+getStockName2,
743         xaxis={'title':'Selected Dates'}, yaxis={'title':'Stock Price'})
744         figure2=go.Figure(data=data2,layout=layout2)
745         figure2.update_layout(
746             autosize=False,
747             width=520,
748             height=550,
749             margin=go.layout.Margin(
750                 l=5,
751                 r=5,
752                 b=20,
753                 t=100,
754                 pad=4
755             ),
756             paper_bgcolor="#d2f7f2",
757             xaxis=go.layout.XAxis(
758                 rangeselector=dict(
759                     buttons=list([
760                         dict(count=1,
761                             label="1m",
762                             step="month",
763                             stepmode="backward"),
764                         dict(count=6,
765                             label="6m",
766                             step="month",
767                             stepmode="backward"),
768                         dict(count=1,
769                             label="YTD",
770                             step="year",
771                             stepmode="todate"),
772                         dict(count=1,
773                             label="1y",
774                             step="year",
775                             stepmode="backward"),
776                         dict(step="all")
777                     ])
778                 ),
779                 rangeslider=dict(
780                     visible=True
781                 ),
782                 type="date"
783             )
784         )
785         plot_div2 = py.plot(figure2, auto_open=False, output_type='
div')
786
787
788

```

```

789         return render (request, 'compareResultLine.html', {'stocknames
':stocknames, 'selectedStock1':getStockName1,
790                     'selectedStock2':getStockName2, 'selectedType':
selectedType, 'selectedTo': selectedTo, 'selectedFrom':selectedFrom,
791                     'plot_div1': plot_div1, 'plot_div2' : plot_div2,
792                     },)
793
794     elif(selectedType=="Candle"):
795         #py.init_notebook_mode()
796         columnNames=['Date', 'Open', 'High', 'Low', 'Close', 'Adj Close
', 'Stock Name', 'Volume']
797         dataDf1= retrieveData(getTicker1)
798         mask1 = (dataDf1['Date'] > selectedTo) & (dataDf1['Date'] <=
selectedFrom)
799         dataDf1 = dataDf1.loc[mask1]
800
801         dataDf2= retrieveData(getTicker2)
802         mask2 = (dataDf2['Date'] > selectedTo) & (dataDf2['Date'] <=
selectedFrom)
803         dataDf2 = dataDf2.loc[mask2]
804
805
806         x1 = dataDf1['Date']
807         close_data1 = dataDf1['Close']
808         open_data1 = dataDf1['Open']
809         high_data1 = dataDf1['High']
810         low_data1 = dataDf1['Low']
811
812         x2 = dataDf2['Date']
813         close_data2 = dataDf2['Close']
814         open_data2 = dataDf2['Open']
815         high_data2 = dataDf2['High']
816         low_data2 = dataDf2['Low']
817
818
819         candle_data1 = go.Candlestick(x=x1,open=open_data1,high=
high_data1,low=low_data1,close=close_data1)
820         data1 = [candle_data1]
821
822         candle_data2 = go.Candlestick(x=x2,open=open_data2,high=
high_data2,low=low_data2,close=close_data2)
823         data2 = [candle_data2]
824
825
826
827         layout1=go.Layout(title="First Stock : "+getStockName1,
xaxis={'title':'Selected Dates'}, yaxis={'title':'Stock Price'})
828
829         figure1=go.Figure(data=data1,layout=layout1)
830         figure1.update_layout(
831             autosize=False,
832             width=550,
833             height=550,
834             margin=go.layout.Margin(

```

```

835         l=5,
836         r=5,
837         b=20,
838         t=100,
839         pad=4
840     ),
841     paper_bgcolor="#d2f7f2",
842     xaxis=go.layout.XAxis(
843         rangeselector=dict(
844             buttons=list([
845                 dict(count=1,
846                     label="1m",
847                     step="month",
848                     stepmode="backward"),
849                 dict(count=6,
850                     label="6m",
851                     step="month",
852                     stepmode="backward"),
853                 dict(count=1,
854                     label="YTD",
855                     step="year",
856                     stepmode="todate"),
857                 dict(count=1,
858                     label="1y",
859                     step="year",
860                     stepmode="backward"),
861                 dict(step="all")
862             ])
863         ),
864         rangeslider=dict(
865             visible=True
866         ),
867         type="date"
868     )
869 )
870 pdiv1 = py.plot.figure1, auto_open=False, output_type='div')
871
872 layout2=go.Layout(title="Second Stock : "+getStockName2,
873 xaxis={'title':'Selected Dates'}, yaxis={'title':'Stock Price'})
874 figure2=go.Figure(data=data2,layout=layout2)
875 figure2.update_layout(
876     autosize=False,
877     width=550,
878     height=550,
879     margin=go.layout.Margin(
880         l=5,
881         r=5,
882         b=20,
883         t=100,
884         pad=4
885     ),
886     paper_bgcolor="#d2f7f2",
887

```

```

888         xaxis=go.layout.XAxis(
889             rangeselector=dict(
890                 buttons=list([
891                     dict(count=1,
892                         label="1m",
893                         step="month",
894                         stepmode="backward"),
895                     dict(count=6,
896                         label="6m",
897                         step="month",
898                         stepmode="backward"),
899                     dict(count=1,
900                         label="YTD",
901                         step="year",
902                         stepmode="todate"),
903                     dict(count=1,
904                         label="1y",
905                         step="year",
906                         stepmode="backward"),
907                     dict(step="all")
908                 ])
909             ),
910             rangeslider=dict(
911                 visible=True
912             ),
913             type="date"
914         )
915     )
916     pdiv2 = py.plot.figure2, auto_open=False, output_type='div')
917
918
919
920
921     return render (request, 'compareCandleStick.html', { '
stocknames': stocknames, 'selectedStock2': getStockName2,
922         'selectedStock1': getStockName1, 'selectedType':
selectedType, 'selectedTo': selectedTo, 'selectedFrom': selectedFrom,
923         'plot_div1': pdiv1, 'plot_div2': pdiv2
924     },)
925
926     else:
927
928         return render (request, 'compareResult.html', { 'stocknames':
stocknames, 'selectedStock2': getStockName2,
929         'selectedStock1': getStockName1, 'selectedType': selectedType, '
selectedTo': selectedTo, 'selectedFrom': selectedFrom
930     },)
931
932     '''
933     except Exception:
934
935         return render (request, 'memoryError.html', { 'stocknames':
stocknames, 'selectedStock': getStockName1 },)
936

```

```

937
938     '''
939
940
941
942
943
944
945
946
947
948
949 def analysisSelection(request):
950     selectedStock= request.GET.get('stock',None)
951     selectedType = request.GET.get('type',None)
952     selectedTo= request.GET.get('date_from',None)
953     selectedFrom = request.GET.get('date_to',None)
954
955     selectedTo1 =selectedTo
956     selectedFrom1 = selectedFrom
957
958     print(type(selectedFrom))
959     print(selectedStock)
960     print(selectedType)
961     print(selectedTo)
962     print(selectedFrom)
963
964
965
966     count=0
967     stocknames=[]
968     stockData=[]
969     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
970     reader = csv.reader(readTickers, delimiter=',')
971     for row in reader:
972         stockData.append(row[0])
973         stocknames.append(row[1])
974         count+=1
975     readTickers.close()
976
977     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
978     reader = csv.reader(readTickers, delimiter=',')
979     getTicker=""
980     getStockName=""
981     for row in reader:
982         if(row[1].startswith(selectedStock)):
983             getTicker=row[0]
984             getStockName=row[1]
985     readTickers.close()
986     print(getTicker)
987
988     try :

```

```

989         if(selectedType=="Table") :
990             columnNames=['Date', 'Open','High','Low','Close', 'Adj Close
', 'Stock Name','Volume']
991             dataDf= retrieveData(getTicker)
992             dataDf['Date'] = pd.to_datetime(dataDf['Date'])
993             mask = (dataDf['Date'] > selectedTo) & (dataDf['Date'] <=
selectedFrom)
994             dataDf = dataDf.loc[mask]
995             print(dataDf.tail(1))
996             dataDf = dataDf.reset_index(drop= True)
997             print("good at 1033")
998             dataDf = dataDf.to_html(justify="center")
999             #print(dataDf.tail(1))
1000             print("good at 1035")
1001             return render (request,'analysisResultTable.html',{'
stocknames':stocknames,
1002                             'selectedStock':getStockName, 'selectedType':
selectedType, 'selectedTo': selectedTo1, 'selectedFrom':
selectedFrom1, 'dataDf':dataDf
1003                             },)
1004
1005         elif(selectedType=="Line") :
1006             #py.init_notebook_mode()
1007             columnNames=['Date', 'Open','High','Low','Close', 'Adj Close
', 'Stock Name','Volume']
1008             dataDf= retrieveData(getTicker)
1009
1010             mask = (dataDf['Date'] > selectedTo) & (dataDf['Date'] <=
selectedFrom)
1011             dataDf = dataDf.loc[mask]
1012
1013             x = dataDf['Date']
1014             y1 = dataDf['Close']
1015             y2 = dataDf['High']
1016             y3 = dataDf['Low']
1017             data =[]
1018             tracel = go.Scatter(x=x, y=y1, marker={'color': 'blue', '
symbol': 104, },
1019                                 mode="lines", name='Close ')
1020             trace2 = go.Scatter(x=x, y=y2, marker={'color': 'green', '
symbol': 104, },
1021                                 mode="markers", name='High')
1022             trace3 = go.Scatter(x=x, y=y3, marker={'color': 'red', '
symbol': 104, },
1023                                 mode="markers", name='Low')
1024
1025             data.append(tracel)
1026             data.append(trace2)
1027             data.append(trace3)
1028             layout=go.Layout(title="Line graph : Stock Prices/Selected
Dates ", xaxis={'title':'Selected Dates'}, yaxis={'title':'Stock
Price'})
1029             figure=go.Figure(data=data,layout=layout)
1030             figure.update_layout(

```

```

1031         xaxis=go.layout.XAxis(
1032             rangeselector=dict(
1033                 buttons=list([
1034                     dict(count=1,
1035                         label="1m",
1036                         step="month",
1037                         stepmode="backward"),
1038                     dict(count=6,
1039                         label="6m",
1040                         step="month",
1041                         stepmode="backward"),
1042                     dict(count=1,
1043                         label="YTD",
1044                         step="year",
1045                         stepmode="todate"),
1046                     dict(count=1,
1047                         label="1y",
1048                         step="year",
1049                         stepmode="backward"),
1050                     dict(step="all")
1051                 ])
1052             ),
1053             rangeslider=dict(
1054                 visible=True
1055             ),
1056             type="date"
1057         )
1058     )
1059     plot_div = py.plot(figure, auto_open=False, output_type='div
1060 ')
1061
1062     return render (request, 'analysisResultLine.html', { '
1063 stocknames':stocknames,
1064     'selectedStock':getStockName, 'selectedType':
1065 selectedType, 'selectedTo': selectedTo1, 'selectedFrom':
1066 selectedFrom1, 'plot_div':plot_div
1067 },)
1068
1069     elif(selectedType=="Candle"):
1070         #py.init_notebook_mode()
1071         columnNames= ['Date', 'Open', 'High', 'Low', 'Close', 'Adj Close
1072 ', 'Stock Name', 'Volume']
1073         dataDf= retrieveData(getTicker)
1074
1075         mask = (dataDf['Date'] > selectedTo) & (dataDf['Date'] <=
1076 selectedFrom)
1077         dataDf = dataDf.loc[mask]
1078
1079         x = dataDf['Date']
1080         close_data = dataDf['Close']
1081         open_data = dataDf['Open']
1082         high_data = dataDf['High']
1083         low_data = dataDf['Low']

```



```

1079         candle_data = go.Candlestick(x=x,open=open_data,high=
1080         high_data,low=low_data,close=close_data)
1081         data = [candle_data]
1082         layout=go.Layout(title="Candlestick Chart : Stock Prices/
1083         Selected Dates ", xaxis={'title':'Selected Dates'}, yaxis={'title':'
1084         Stock Price'})
1085         figure=go.Figure(data=data,layout=layout)
1086         figure.update_layout(
1087             xaxis=go.layout.XAxis(
1088                 rangeselector=dict(
1089                     buttons=list([
1090                         dict(count=1,
1091                             label="1m",
1092                             step="month",
1093                             stepmode="backward"),
1094                         dict(count=6,
1095                             label="6m",
1096                             step="month",
1097                             stepmode="backward"),
1098                         dict(count=1,
1099                             label="YTD",
1100                             step="year",
1101                             stepmode="todate"),
1102                         dict(count=1,
1103                             label="1y",
1104                             step="year",
1105                             stepmode="backward"),
1106                         dict(step="all")
1107                     ])
1108                 ),
1109                 rangeslider=dict(
1110                     visible=True
1111                 ),
1112                 type="date"
1113             )
1114         )
1115         pdiv = py.plot(figure, auto_open=False, output_type='div')
1116
1117         return render (request,'analysisResultCandlestick.html',{'
1118         stocknames':stocknames,
1119         'selectedStock':getStockName, 'selectedType':
1120         selectedType, 'selectedTo': selectedTo1, 'selectedFrom':
1121         selectedFrom1, 'plot_div': pdiv
1122         },)
1123
1124     else:
1125
1126         return render (request,'analysisResult.html',{'stocknames':
1127         stocknames,
1128         'selectedStock':getStockName, 'selectedType':selectedType, '
1129         selectedTo': selectedTo1, 'selectedFrom':selectedFrom1
1130         },)

```

```

1125
1126
1127     except Exception as e:
1128
1129         print(e)
1130
1131         return render (request, 'analysisResult.html', { 'stocknames':
stocknames, 'selectedStock':getStockName,
1132             'selectedType':selectedType, 'selectedTo': selectedTo1, '
selectedFrom':selectedFrom1,
1133                                     },)
1134
1135
1136
1137
1138 #predict homepage
1139 def predict(request):
1140     stocknames=[]
1141     stockData=[]
1142     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
1143     reader = csv.reader(readTickers, delimiter=',')
1144     for row in reader:
1145         stockData.append(row[0])
1146         stocknames.append(row[1])
1147
1148     readTickers.close()
1149
1150     return render (request, 'prediction.html', {'stocknames':stocknames},)
1151
1152
1153
1154
1155 #prediction output page
1156 def prediction(request):
1157     stocknames=[]
1158     stockData=[]
1159     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
1160     reader = csv.reader(readTickers, delimiter=',')
1161     for row in reader:
1162         stockData.append(row[0])
1163         stocknames.append(row[1])
1164
1165     readTickers.close()
1166     #stocknames = stocknames.sort(reverse=True)
1167     #print(stocknames)
1168     selectedStock= request.POST.get('Stock Name',None)
1169     selectedDay = request.POST.get('Input Day',None)
1170     print(selectedStock)
1171     print(selectedDay)
1172
1173

```

```

1174     readTickers=open(os.getcwd()+"/finWeb/Stockdetails.csv",encoding='
latin1')
1175     reader = csv.reader(readTickers, delimiter=',')
1176     getTicker=""
1177     getStockName=""
1178     for row in reader:
1179         if(row[1].startswith(selectedStock)):
1180             getTicker=row[0]
1181             getStockName=row[1]
1182     readTickers.close()
1183     print(getTicker)
1184
1185
1186     #try :
1187     if(os.path.getsize(os.getcwd()+"/finWeb/StockData/"+getTicker+ '.csv
')>0):
1188
1189         return render (request,'predictionResultNoData.html',{ '
stocknames':stocknames,'selectedStock':getStockName,'selectedDay':
selectedDay },)
1190
1191     else:
1192         #init_notebook_mode()
1193         dateCloseDf = retrieveData(getTicker)
1194         dateCloseDf=dateCloseDf.iloc[:,[0,4]]
1195         dateCloseDf.columns=['ds','y']
1196         prophetObject = Prophet()
1197         prophetObject.fit(dateCloseDf)
1198
1199         if( selectedDay=='Next Day prediction'):
1200             future = prophetObject.make_future_dataframe(periods=1)
1201             forecast = prophetObject.predict(future)
1202
1203
1204             fig = plot_plotly(prophetObject, forecast)
1205             plot_div = plot(fig, output_type='div', include_plotlyjs=
False, show_link=False, link_text="")
1206
1207             return render (request,'predictionResult.html',{
1208                 #'listForecast':listForecast,
1209
1210                 'stocknames':stocknames,'selectedStock':getStockName,'
selectedDay':selectedDay, 'plot_div': plot_div },)
1211
1212         elif(selectedDay=='weekly prediction'):
1213             future = prophetObject.make_future_dataframe(periods=7)
1214             forecast = prophetObject.predict(future)
1215
1216             fig = plot_plotly(prophetObject, forecast)
1217             plot_div = plot(fig, output_type='div', include_plotlyjs=
False, show_link=False, link_text="")
1218
1219             return render (request,'predictionResult.html',{
1220

```

```

1221         'stocknames':stocknames,'selectedStock':getStockName, '
selectedDay':selectedDay , 'plot_div': plot_div},)
1222
1223     elif(selectedDay=='monthly prediction'):
1224         future = prophetObject.make_future_dataframe(periods=30)
1225         forecast = prophetObject.predict(future)
1226
1227         fig = plot_plotly(prophetObject, forecast)
1228         plot_div = plot(fig, output_type='div', include_plotlyjs=
False, show_link=False, link_text="")
1229
1230
1231         return render (request,'predictionResult.html',{
1232
1233             'stocknames':stocknames,'selectedStock':getStockName, '
selectedDay':selectedDay, 'plot_div': plot_div},)
1234
1235
1236     elif(selectedDay=='yearly prediction'):
1237         future = prophetObject.make_future_dataframe(periods=365)
1238         forecast = prophetObject.predict(future)
1239
1240         fig = plot_plotly(prophetObject, forecast)
1241         plot_div = plot(fig, output_type='div', include_plotlyjs=
False, show_link=False, link_text="")
1242
1243
1244
1245         return render (request,'predictionResult.html',{
1246
1247             'stocknames':stocknames,'selectedStock':selectedStock, '
selectedDay':selectedDay , 'plot_div': plot_div},)
1248
1249     else:
1250         print("No input selected")
1251
1252         return render (request,'predictionResult.html',{},)
1253
1254 #connect to master node, retrive stock data
1255 def retrieveData(ticker):
1256     while True:
1257         try:
1258             sshWk = param.SSHClient()
1259             sshWk.load_system_host_keys()
1260             sshWk.set_missing_host_key_policy(param.AutoAddPolicy())
1261             sshWk.connect("192.168.1.167",username="dimple",password="
#####")
1262             fileStock = sshWk.open_sftp()
1263             actualFile = fileStock.open("/home/dimple/Project/Stock Data
/"+ticker+".csv")
1264             getData=[]
1265
1266             for i in actualFile:
1267                 getData.append(i)

```

```

1268         actualFile.close()
1269         columnNames=['Date', 'Open','High','Low','Close', 'Adj Close
', 'Stock Name','Volume']
1270         getdataDf = pd.DataFrame(columns=columnNames)
1271
1272         for i in getData:
1273             getRow = i.split(",")
1274             makeSeries = pd.Series(getRow, index = getdataDf.columns
)
1275             getdataDf = getdataDf.append(makeSeries,ignore_index=
True)
1276
1277             getdataDf['Volume'] = getdataDf['Volume'].map(lambda x: x.
rstrip('\n'))
1278             return(getdataDf)
1279
1280         finally:
1281             if sshWk:
1282                 sshWk.close()

```

Code A.2.3.6: views.py

The templates folder contains of following files -

Figure A.3: Directory Tree Structure for templates folder

1. For historical analysis

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Analysis </title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1
">
7   <style>
8   body {
9     background: #e6ffff;

```

```

10     background: linear-gradient(to right, #e6ffff , #33ffff);
11 }
12
13 </style>
14
15 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
16 <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
.2/themes/smoothness/jquery-ui.css">
17 <script src="https://code.jquery.com/jquery-2.2.4.min.js"
integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
crossorigin="anonymous"></script>
18 <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
crossorigin="anonymous"></script>
19 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
20
21
22
23 </head>
24 <body>
25
26 <!-- Nav pills -->
27
28 <ul class="nav nav-pills nav-justified">
29   <li class="nav-item">
30     <a class="nav-link " data-toggle="pill" href="#home" onclick="
window.location.href='home.html'">Home</a>
31   </li>
32   <li class="nav-item">
33     <a class="nav-link" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
34   </li>
35   <li class="nav-item">
36     <a class="nav-link active" data-toggle="pill" href="#analysis"
onclick="window.location.href='analysis.html'">Historical
Analysis</a>
37   </li>
38   <li class="nav-item">
39     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
40   </li>
41   <li class="nav-item">
42     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
window.location.href='compare.html'">Compare Stocks</a>
43   </li>
44   <li class="nav-item">
45     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
46   </li>
47   <li class="nav-item">

```

```

48     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'">Logout</a>
49     </li>
50 </ul>
51
52
53 <!-- Tab panes -->
54 <div class="tab-content">
55     <div class="tab-pane container fade" id="home"> </div>
56     <div class="tab-pane container fade" id="prediction"></div>
57     <div class="tab-pane container active" id="analysis">
58     <div class="container mx-auto">
59     <form id="send_data" method="post" action="/analysisResult.html"
autocomplete="off" >
60         {% csrf_token %}
61         <div class="form-row mt-5 mx-auto ">
62             <div class="form-group col mx-auto">
63                 <label for="inputStock"><b> Stock Name </b></label>
64             </div>
65             <div class="form-group col mx-auto">
66                 <select id="inputStock" class="form-control custom-select"
name="Stock Name" required autofocus>
67                     <!-- <option selected>Choose...</option> -->
68                     {% for entry in stocknames %}
69                     <option value={{entry}}
70                     {% if entry == selectedStock %}>selected="{{entry}}
endif %}>
71                     {{ entry}}</option>
72                     {% endfor %}
73                 </select>
74             </div>
75             <div class="form-group col mx-auto">
76                 <label for="inputType"><b>Select Type </b></label>
77             </div>
78             <div class="form-group col mx-auto">
79                 <select id="inputType" class="form-control custom-select"
name="Input Type" required>
80                     <!-- <option selected>Choose...</option> -->
81                     <option value="Table">
82                     Table</option>
83                     <option value="Line"> Line graph</option>
84                     <option value="Candle"> Candlestick chart</option>
85                 </select>
86
87             </div>
88
89         </div>
90
91     <div class="form-row mx-auto ">
92         <div class="form-group col mx-auto">
93
94             <label for="inputTo"><b>Select Dates </b></label>
95         </div>
96         <div class="form-group col mx-auto">

```

```

97         <input id="date_from" name="date_from" required>
98
99     </div>
100 <div class="form-group col mx-auto">
101     <input id="date_to" name="date_to" required>
102
103 </div>
104
105
106
107 <div class="form-group col mx-auto">
108
109     <button type="submit" class="btn btn-primary" id="
Visualize"> Visualize Stock</button>
110 </div>
111
112
113 </div>
114
115
116
117 </form>
118 </div>
119
120
121 </div>
122 <div class="tab-pane container fade" id="movers"></div>
123 <div class="tab-pane container fade" id="compare"></div>
124 <div class="tab-pane container fade" id="measure"></div>
125 </div>
126 <script>
127     // Init jquery ui datepickers
128     $(document).ready(() => {
129         $("#date_from").datepicker({
130             dateFormat: 'yy-mm-dd',
131             timepicker: false,
132             maxDate: "today",
133             minDate: new Date(2015, 1 - 1, 1),
134             onSelect: function(selected)
135             {   $("#date_to").datepicker("option", "minDate", selected);
136             }
137             });
138         $("#date_to").datepicker({
139             dateFormat: 'yy-mm-dd',
140             timepicker: false,
141             maxDate: "today",
142             minDate: new Date(2015, 1 - 1, 1),
143             onSelect: function(selected)
144             {   $("#date_from").datepicker("option", "maxDate", selected);
145             }
146             });
147         });
148
149     // Prevent default html submit

```



```

150         $(document).on("submit", "#send_data", function(e) {
151             e.preventDefault();
152             // Create your "data to pass" object
153             var data = {
154                 stock: $("#inputStock").val(),
155                 type: $("#inputType").val(),
156                 date_from: formatDate($("#date_from").datepicker(
157                     "getDate")),
158                 date_to: formatDate($("#date_to").datepicker("
159                     getDate"))
160             }
161             // Relocate and create a query string with $.param
162             window.location.href= $("#send_data").attr("action")
163             + "?" + $.param(data);
164             });
165
166             // Transform date from js.toDateString() to serverside
167             friendly date string
168             function formatDate(date) {
169                 var d = new Date(date),
170                     month = '' + (d.getMonth() + 1),
171                     day = '' + d.getDate(),
172                     year = d.getFullYear();
173
174                 if (month.length < 2)
175                     month = '0' + month;
176                 if (day.length < 2)
177                     day = '0' + day;
178
179                 return [year, month, day].join('-');
180             }
181
182             </script>
183 </body>
184 </html>

```

Code A.2.3.7: analysis.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Analysis </title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
7         ">
8     <style>
9     body {
10         background: #e6ffff;
11         background: linear-gradient(to right,#e6ffff , #33ffff);
12     }
13     div.fig {

```

```

14         border : 2px solid #ff3399;
15     }
16 }
17 </style>
18 <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
19 .2/themes/smoothness/jquery-ui.css">
20 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
21 bootstrap/4.4.1/css/bootstrap.min.css">
22 <script src="https://code.jquery.com/jquery-2.2.4.min.js"
23     integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
24     crossorigin="anonymous"></script>
25 <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
26     integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
27     crossorigin="anonymous"></script>
28 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
29 bootstrap.min.js"></script>
30
31 </head>
32 <body>
33
34     <!-- Nav pills -->
35
36     <ul class="nav nav-pills nav-justified">
37         <li class="nav-item">
38             <a class="nav-link " data-toggle="pill" href="#home" onclick="
39 window.location.href='home.html'">Home</a>
40         </li>
41         <li class="nav-item">
42             <a class="nav-link" data-toggle="pill" href="#prediction"
43 onclick="window.location.href='prediction.html'">Stock Price
44 Prediction</a>
45         </li>
46         <li class="nav-item">
47             <a class="nav-link active" data-toggle="pill" href="#analysis"
48 onclick="window.location.href='analysis.html'">Historical
49 Analysis</a>
50         </li>
51         <li class="nav-item">
52             <a class="nav-link" data-toggle="pill" href="#movers" onclick="
53 window.location.href='movers.html'"> Market Movers</a>
54         </li>
55         <li class="nav-item">
56             <a class="nav-link" data-toggle="pill" href="#compare" onclick="
57 window.location.href='compare.html'">Compare Stocks</a>
58         </li>
59         <li class="nav-item">
60             <a class="nav-link" data-toggle="pill" href="#measure" onclick="
61 window.location.href='measure.html'">Measure Trends</a>
62         </li>
63         <li class="nav-item">
64             <a class="nav-link" data-toggle="pill" href="#measure" onclick="
65 window.location.href='/'">Logout</a>
66         </li>
67     </ul>

```

```

52     </li>
53 </ul>
54
55
56 <!-- Tab panes -->
57 <div class="tab-content">
58     <div class="tab-pane container fade" id="home"> </div>
59     <div class="tab-pane container fade" id="prediction"></div>
60     <div class="tab-pane container active" id="analysis">
61     <div class="container mx-auto">
62     <form id="send_data" method="post" action="/analysisResult.html"
        autocomplete="off" >
63         {% csrf_token %}
64         <div class="form-row mt-5 mx-auto ">
65             <div class="form-group col mx-auto">
66                 <label for="inputStock"><b> Stock Name </b></label>
67             </div>
68             <div class="form-group col mx-auto">
69                 <select id="inputStock" class="form-control custom-select"
        name="Stock Name" required autofocus>
70                     <!-- <option selected>Choose...</option> -->
71                     {% for entry in stocknames %}
72                     <option value={{entry}}>
73                     {% if entry == selectedStock %}<selected="selected">{%
        endif %}>
74                     {{ entry}}</option>
75                     {% endfor %}
76                 </select>
77             </div>
78             <div class="form-group col mx-auto">
79                 <label for="inputType"><b>Select Type </b></label>
80             </div>
81             <div class="form-group col mx-auto">
82                 <select id="inputType" class="form-control
        custom-select" name="Input Type" required>
83                     <!-- <option selected>Choose...</option>
        -->
84                     <option value="Table" >
85                     Table</option>
86                     <option value="Line" >
87                     Line graph</option>
88                     <option value="Candle" >
89                     Candlestick chart</option>
90                 </select>
91             </div>
92         </div>
93     </div>
94
95     <div class="form-row mx-auto ">
96         <div class="form-group col mx-auto">
97
98             <label for="inputTo"><b>Select Dates </b></label>
99         </div>
100

```

```

101     <div class="form-group col mx-auto">
102         <input id="date_from" name="date_from" required>
103
104     </div>
105     <div class="form-group col mx-auto">
106         <input id="date_to" name="date_to" required>
107
108     </div>
109
110
111     <div class="form-group col mx-auto">
112
113         <button type="submit" class="btn btn-primary" id="
Visualize"> Visualize Stock</button>
114     </div>
115
116
117     </div>
118
119     <div class="overflow-auto mx-auto mt-5" style="height:
500px; width: 100%;">
120
121     </div>
122
123
124
125 </form>
126 </div>
127
128
129 </div>
130 <div class="tab-pane container fade" id="movers"></div>
131 <div class="tab-pane container fade" id="compare"></div>
132 <div class="tab-pane container fade" id="measure"></div>
133 </div>
134
135 <script>
136     // Init jquery ui datepickers
137     $(document).ready(() => {
138         $("#date_from").datepicker({
139             dateFormat: 'yy-mm-dd',
140             timepicker: false,
141             maxDate: "today",
142             minDate: new Date(2015, 1 - 1, 1),
143             onSelect: function(selected)
144             {   $("#date_to").datepicker("option", "minDate", selected)
145
146                 ;
147             }
148         });
149         $("#date_to").datepicker({
150             dateFormat: 'yy-mm-dd',
151             timepicker: false,
152             maxDate: "today",
153             minDate: new Date(2015, 1 - 1, 1),

```

```

152         onSelect: function(selected)
153         {   $("#date_from").datepicker("option", "maxDate",
selected);
154         }
155         });
156     });
157
158     // Get http query string and return an associative array
159     function getUrlVars() {
160         var vars = [], hash;
161         var hashes = window.location.href.slice(window.
location.href.indexOf('?') + 1).split('&');
162         for(var i = 0; i < hashes.length; i++)
163         {
164             hash = hashes[i].split('=');
165             vars.push(hash[0]);
166             vars[hash[0]] = hash[1];
167         }
168         return vars;
169     }
170
171     $(document).ready(function() {
172         var data = getUrlVars();
173         // For each key, set the right value to each input
174         $("#inputStock").val(data['stock']);
175         $("#inputType").val(data['type']);
176         console.log(data['type']);
177         console.log( data['date_from']);
178         console.log( data['date_to']);
179         $("#date_from").datepicker("setDate", data['
date_from']);
180         $("#date_to").datepicker("setDate", data['date_to'])
;
181     })
182
183
184 // Prevent default html submit
185 $(document).on("submit", "#send_data", function(e) {
186     e.preventDefault();
187     // Create your "data to pass" object
188     var data = {
189         stock: $("#inputStock").val(),
190         type: $("#inputType").val(),
191         date_from: formatDate($("#date_from").datepicker
("getDate")),
192         date_to: formatDate($("#date_to").datepicker("
getDate"))
193     }
194     // Relocate and create a query string with $.param
195     window.location.href= $("#send_data").attr("action")
+ "?" + $.param(data);
196     });
197

```

```

198         // Transform date from js.toDateString() to serverside
friendly date string
199         function formatDate(date) {
200             var d = new Date(date),
201                 month = '' + (d.getMonth() + 1),
202                 day = '' + d.getDate(),
203                 year = d.getFullYear();
204
205             if (month.length < 2)
206                 month = '0' + month;
207             if (day.length < 2)
208                 day = '0' + day;
209
210             return [year, month, day].join('-');
211         }
212     </script>
213
214
215
216 </body>
217 </html>

```

Code A.2.3.8: analysisResult.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Analysis </title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1
">
7   <style>
8   body {
9     background: #e6ffff;
10    background: linear-gradient(to right,#e6ffff , #33ffff);
11  }
12
13    div.fig {
14      border : 2px solid #ff3399;
15
16    }
17  </style>
18  <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
.2/themes/smoothness/jquery-ui.css">
19  <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
20  <script src="https://code.jquery.com/jquery-2.2.4.min.js"
integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
crossorigin="anonymous"></script>
21  <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
crossorigin="anonymous"></script>
22  <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>

```

```

23
24 </head>
25 <body>
26
27 <!-- Nav pills -->
28
29 <ul class="nav nav-pills nav-justified">
30   <li class="nav-item">
31     <a class="nav-link " data-toggle="pill" href="#home" onclick="
window.location.href='home.html'">Home</a>
32   </li>
33   <li class="nav-item">
34     <a class="nav-link" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
35   </li>
36   <li class="nav-item">
37     <a class="nav-link active" data-toggle="pill" href="#analysis"
onclick="window.location.href='analysis.html'">Historical
Analysis</a>
38   </li>
39   <li class="nav-item">
40     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
41   </li>
42   <li class="nav-item">
43     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
window.location.href='compare.html'">Compare Stocks</a>
44   </li>
45   <li class="nav-item">
46     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
47   </li>
48   <li class="nav-item">
49     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'>Logout</a>
50   </li>
51 </ul>
52
53 <!-- Tab panes -->
54 <div class="tab-content">
55   <div class="tab-pane container fade" id="home"> </div>
56   <div class="tab-pane container fade" id="prediction"></div>
57   <div class="tab-pane container active" id="analysis">
58     <div class="container mx-auto">
59       <form id="send_data" method="post" action="/analysisResult.html"
autocomplete="off" >
60         {% csrf_token %}
61         <div class="form-row mt-5 mx-auto ">
62           <div class="form-group col mx-auto">
63             <label for="inputStock"><b> Stock Name </b></label>
64             </div>
65             <div class="form-group col mx-auto">

```

```

67         <select id="inputStock" class="form-control custom-select"
        name="Stock Name" required autofocus>
68             <!-- <option selected>Choose...</option> -->
69             {% for entry in stocknames %}
70             <option value={{entry}}
71             {% if entry == selectedStock %}>selected="{{entry}}
endif %}>
72             {{ entry}}</option>
73             {% endfor %}
74         </select>
75     </div>
76     <div class="form-group col mx-auto">
77         <label for="inputType"><b>Select Type </b></label>
78     </div>
79     <div class="form-group col mx-auto">
80         <select id="inputType" class="form-control
custom-select" name="Input Type" required>
81             <!-- <option selected>Choose...</option>
-->
82             <option value="Table">
83             Table</option>
84             <option value="Line" >
85             Line graph</option>
86             <option value="Candle">
87             Candle-stick graph</option>
88         </select>
89
90     </div>
91
92 </div>
93
94 <div class="form-row mx-auto">
95     <div class="form-group col mx-auto">
96
97         <label for="inputTo"><b>Select Dates </b></label>
98     </div>
99     <div class="form-group col mx-auto">
100         <input id="date_from" name="date_from" required>
101
102     </div>
103     <div class="form-group col mx-auto">
104         <input id="date_to" name="date_to" required>
105
106     </div>
107
108     <div class="form-group col mx-auto">
109
110         <button type="submit" class="btn btn-primary" id="
Visualize"> Visualize Stock</button>
111     </div>
112
113
114     </div>
115

```



```

116         <div class="overflow-auto mx-auto mt-5" style="height:
117         500px; width: 90%;">
118             {% autoescape off %}
119             {{ plot_div }}
120             {% endautoescape off %}
121         </div>
122
123     </form>
124 </div>
125
126
127 </div>
128 <div class="tab-pane container fade" id="movers"></div>
129 <div class="tab-pane container fade" id="compare"></div>
130 <div class="tab-pane container fade" id="measure"></div>
131 </div>
132
133 <script>
134     // Init jquery ui datepickers
135     $(document).ready(() => {
136         $("#date_from").datepicker({
137             dateFormat: 'yy-mm-dd',
138             timepicker: false,
139             maxDate: "today",
140             minDate: new Date(2015, 1 - 1, 1),
141             onSelect: function(selected)
142             {   $("#date_to").datepicker("option", "minDate", selected)
143             ;
144             }
145             });
146         $("#date_to").datepicker({
147             dateFormat: 'yy-mm-dd',
148             timepicker: false,
149             maxDate: "today",
150             minDate: new Date(2015, 1 - 1, 1),
151             onSelect: function(selected)
152             {   $("#date_from").datepicker("option", "maxDate",
153             selected);
154             }
155             });
156         });
157
158         // Get http query string and return an associative array
159         function getUrlVars() {
160             var vars = [], hash;
161             var hashes = window.location.href.slice(window.
162             location.href.indexOf('?') + 1).split('&');
163             for(var i = 0; i < hashes.length; i++)
164             {
165                 hash = hashes[i].split('=');
166                 vars.push(hash[0]);
167                 vars[hash[0]] = hash[1];
168             }
169         }

```

```

166         return vars;
167     }
168
169     $(document).ready(function() {
170         var data = getUrlVars();
171         // For each key, set the right value to each input
172         $("#inputStock").val(data['stock']);
173         $("#inputType").val(data['type']);
174         console.log(data['type']);
175         console.log( data['date_from']);
176         console.log( data['date_to']);
177         $("#date_from").datepicker("setDate", data['
178         date_from']);
179         $("#date_to").datepicker("setDate", data['date_to'])
180     ;
181     })
182
183 // Prevent default html submit
184 $(document).on("submit", "#send_data", function(e) {
185     e.preventDefault();
186     // Create your "data to pass" object
187     var data = {
188         stock: $("#inputStock").val(),
189         type: $("#inputType").val(),
190         date_from: formatDate($("#date_from").datepicker
191         ("getDate")),
192         date_to: formatDate($("#date_to").datepicker("
193         getDate"))
194     }
195     // Relocate and create a query string with $.param
196     window.location.href= $("#send_data").attr("action")
197     + "?" + $.param(data);
198     });
199
200 // Transform date from js.toDateString() to serverside
201 friendly date string
202 function formatDate(date) {
203     var d = new Date(date),
204         month = '' + (d.getMonth() + 1),
205         day = '' + d.getDate(),
206         year = d.getFullYear();
207
208     if (month.length < 2)
209         month = '0' + month;
210     if (day.length < 2)
211         day = '0' + day;
212
213     return [year, month, day].join('-');
214 }
215
216 </script>

```

```
214 </body>
215 </html>
```

Code A.2.3.9: analysisResultLine.html

```
1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Analysis </title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1
7     ">
8   <style>
9     body {
10       background: #e6ffff;
11       background: linear-gradient(to right,#e6ffff , #33ffff);
12     }
13     div.fig {
14       border : 2px solid #ff3399;
15     }
16   </style>
17   <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
18     .2/themes/smoothness/jquery-ui.css">
19   <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
20     bootstrap/4.4.1/css/bootstrap.min.css">
21   <script src="https://code.jquery.com/jquery-2.2.4.min.js"
22     integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
23     crossorigin="anonymous"></script>
24   <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
25     integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
26     crossorigin="anonymous"></script>
27   <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
28     bootstrap.min.js"></script>
29
30 </head>
31 <body>
32   <!-- Nav pills -->
33   <ul class="nav nav-pills nav-justified">
34     <li class="nav-item">
35       <a class="nav-link " data-toggle="pill" href="#home" onclick="
36         window.location.href='home.html'">Home</a>
37     </li>
38     <li class="nav-item">
39       <a class="nav-link" data-toggle="pill" href="#prediction"
40         onclick="window.location.href='prediction.html'">Stock Price
41         Prediction</a>
42     </li>
43     <li class="nav-item">
```

```

39     <a class="nav-link active" data-toggle="pill" href="#analysis"
    onclick="window.location.href='analysis.html'">Historical
    Analysis</a>
40   </li>
41   <li class="nav-item">
42     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
    window.location.href='movers.html'"> Market Movers</a>
43   </li>
44   <li class="nav-item">
45     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
    window.location.href='compare.html'">Compare Stocks</a>
46   </li>
47   <li class="nav-item">
48     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
    window.location.href='measure.html'">Measure Trends</a>
49   </li>
50   <li class="nav-item">
51     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
    window.location.href='/'>Logout</a>
52   </li>
53 </ul>
54
55
56 <!-- Tab panes -->
57 <div class="tab-content">
58   <div class="tab-pane container fade" id="home"> </div>
59   <div class="tab-pane container fade" id="prediction"></div>
60   <div class="tab-pane container active" id="analysis">
61     <div class="container mx-auto">
62       <form id="send_data" method="post" action="/analysisResult.html"
        autocomplete="off" >
63         {% csrf_token %}
64         <div class="form-row mt-5 mx-auto ">
65           <div class="form-group col mx-auto">
66             <label for="inputStock"><b> Stock Name </b></label>
67           </div>
68           <div class="form-group col mx-auto">
69             <select id="inputStock" class="form-control custom-select"
            name="Stock Name" required autofocus>
70               <!-- <option selected>Choose...</option> -->
71               {% for entry in stocknames %}
72               <option value={{entry}}
73               {% if entry == selectedStock %}>selected="{{entry}}
74               {{ entry}}</option>
75               {% endfor %}
76             </select>
77           </div>
78           <div class="form-group col mx-auto">
79             <label for="inputType"><b>Select Type </b></label>
80           </div>
81           <div class="form-group col mx-auto">
82             <select id="inputType" class="form-control
            custom-select" name="Input Type" required>

```

```

83         <!-- <option selected>Choose...</option>
-->
84         <option value="Table">
85         Table</option>
86         <option value="Line">
87         Line graph</option>
88         <option value="Candle">
89         Candlestick chart</option>
90     </select>
91
92     </div>
93
94 </div>
95
96 <div class="form-row mx-auto ">
97     <div class="form-group col mx-auto">
98
99         <label for="inputTo"><b>Select Dates </b></label>
100     </div>
101     <div class="form-group col mx-auto">
102         <input id="date_from" name="date_from" required>
103
104     </div>
105     <div class="form-group col mx-auto">
106         <input id="date_to" name="date_to" required>
107
108     </div>
109
110     <div class="form-group col mx-auto">
111
112         <button type="submit" class="btn btn-primary" id="
Visualize"> Visualize Stock</button>
113     </div>
114
115
116     </div>
117
118     <div class="overflow-auto mx-auto mt-5" style="height: 500px;
width: 100%;">
119         {% autoescape off %}
120         {{ dataDf | safe }}
121         {% endautoescape %}
122     </div>
123
124
125
126 </form>
127 </div>
128
129
130 </div>
131 <div class="tab-pane container fade" id="movers"></div>
132 <div class="tab-pane container fade" id="compare"></div>
133 <div class="tab-pane container fade" id="measure"></div>

```

```

134 </div>
135
136 <script>
137     // Init jquery ui datepickers
138     $(document).ready(() => {
139         $("#date_from").datepicker({
140             dateFormat: 'yy-mm-dd',
141             timepicker: false,
142             maxDate: "today",
143             minDate: new Date(2015, 1 - 1, 1),
144             onSelect: function(selected)
145             {   $("#date_to").datepicker("option", "minDate", selected)
146                 ;
147             }
148             });
149         $("#date_to").datepicker({
150             dateFormat: 'yy-mm-dd',
151             timepicker: false,
152             maxDate: "today",
153             minDate: new Date(2015, 1 - 1, 1),
154             onSelect: function(selected)
155             {   $("#date_from").datepicker("option", "maxDate",
156                 selected);
157             }
158             });
159         // Get http query string and return an associative array
160         function getUrlVars() {
161             var vars = [], hash;
162             var hashes = window.location.href.slice(window.
163             location.href.indexOf('?') + 1).split('&');
164             for(var i = 0; i < hashes.length; i++)
165             {
166                 hash = hashes[i].split('=');
167                 vars.push(hash[0]);
168                 vars[hash[0]] = hash[1];
169             }
170             return vars;
171         }
172         $(document).ready(function() {
173             var data = getUrlVars();
174             // For each key, set the right value to each input
175             $("#inputStock").val(data['stock']);
176             $("#inputType").val(data['type']);
177             console.log( data['date_from']);
178             console.log( data['date_to']);
179             $("#date_from").datepicker("setDate", data['
180             date_from']);
181             $("#date_to").datepicker("setDate", data['date_to'])
182             ;
183         })

```

```

183
184 // Prevent default html submit
185 $(document).on("submit", "#send_data", function(e) {
186     e.preventDefault();
187     // Create your "data to pass" object
188     var data = {
189         stock: $("#inputStock").val(),
190         type: $("#inputType").val(),
191         date_from: formatDate($("#date_from").datepicker(
192             "getDate")),
193         date_to: formatDate($("#date_to").datepicker("
194             getDate"))
195     }
196     // Relocate and create a query string with $.param
197     window.location.href= $("#send_data").attr("action")
198     + "?" + $.param(data);
199     });
200
201     // Transform date from js.toDateString() to serverside
202     friendly date string
203     function formatDate(date) {
204         var d = new Date(date),
205             month = '' + (d.getMonth() + 1),
206             day = '' + d.getDate(),
207             year = d.getFullYear();
208
209             if (month.length < 2)
210                 month = '0' + month;
211             if (day.length < 2)
212                 day = '0' + day;
213
214             return [year, month, day].join('-');
215     }
216 }
217 </script>
218
219
220
221
222
223
224
225
226 </body>
227 </html>

```

Code A.2.3.10: analysisResultTable.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Analysis </title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
7     ">
8     <style>
9     body {
10         background: #e6ffff;
11         background: linear-gradient(to right, #e6ffff , #33ffff);

```

```

12
13     div.fig {
14         border : 2px solid #ff3399;
15
16     }
17 </style>
18 <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
19 .2/themes/smoothness/jquery-ui.css">
20 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
21 bootstrap/4.4.1/css/bootstrap.min.css">
22 <script src="https://code.jquery.com/jquery-2.2.4.min.js"
23     integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
24     crossorigin="anonymous"></script>
25 <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
26     integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
27     crossorigin="anonymous"></script>
28 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
29 bootstrap.min.js"></script>
30
31 </head>
32 <body>
33
34     <!-- Nav pills -->
35
36     <ul class="nav nav-pills nav-justified">
37         <li class="nav-item">
38             <a class="nav-link " data-toggle="pill" href="#home" onclick="
39 window.location.href='home.html'">Home</a>
40         </li>
41         <li class="nav-item">
42             <a class="nav-link" data-toggle="pill" href="#prediction"
43 onclick="window.location.href='prediction.html'">Stock Price
44 Prediction</a>
45         </li>
46         <li class="nav-item">
47             <a class="nav-link active" data-toggle="pill" href="#analysis"
48 onclick="window.location.href='analysis.html'">Historical
49 Analysis</a>
50         </li>
51         <li class="nav-item">
52             <a class="nav-link" data-toggle="pill" href="#movers" onclick="
53 window.location.href='movers.html'"> Market Movers</a>
54         </li>
55         <li class="nav-item">
56             <a class="nav-link" data-toggle="pill" href="#compare" onclick="
57 window.location.href='compare.html'">Compare Stocks</a>
58         </li>
59         <li class="nav-item">
60             <a class="nav-link" data-toggle="pill" href="#measure" onclick="
61 window.location.href='measure.html'">Measure Trends</a>
62         </li>
63         <li class="nav-item">
64             <a class="nav-link" data-toggle="pill" href="#measure" onclick="
65 window.location.href='/'">Logout</a>
66         </li>
67     </ul>

```



```

50     </li>
51 </ul>
52
53
54 <!-- Tab panes -->
55 <div class="tab-content">
56     <div class="tab-pane container fade" id="home"> </div>
57     <div class="tab-pane container fade" id="prediction"></div>
58     <div class="tab-pane container active" id="analysis">
59     <div class="container mx-auto">
60     <form id="send_data" method="post" action="/analysisResult.html"
        autocomplete="off" >
61         {% csrf_token %}
62         <div class="form-row mt-5 mx-auto ">
63             <div class="form-group col mx-auto">
64                 <label for="inputStock"><b> Stock Name </b></label>
65             </div>
66             <div class="form-group col mx-auto">
67                 <select id="inputStock" class="form-control custom-select"
        name="Stock Name" required autofocus>
68                     <!-- <option selected>Choose...</option> -->
69                     {% for entry in stocknames %}
70                     <option value={{entry}}
71                     {% if entry == selectedStock %}>selected="{%
endif %}>
72                     {{ entry}}</option>
73                     {% endfor %}
74                 </select>
75             </div>
76             <div class="form-group col mx-auto">
77                 <label for="inputType"><b>Select Type </b></label>
78             </div>
79             <div class="form-group col mx-auto">
80                 <select id="inputType" class="form-control
        custom-select" name="Input Type" required>
81                     <!-- <option selected>Choose...</option>
-->
82                     <option value="Table" >
83                     Table</option>
84                     <option value="Line" >
85                     Line graph</option>
86                     <option value="Candle" >
87                     Candlestick chart</option>
88                 </select>
89             </div>
90         </div>
91     </div>
92 </div>
93
94 <div class="form-row mx-auto ">
95     <div class="form-group col mx-auto">
96
97         <label for="inputTo"><b>Select Dates </b></label>
98     </div>

```

```

99     <div class="form-group col mx-auto">
100         <input id="date_from" name="date_from" required>
101
102     </div>
103     <div class="form-group col mx-auto">
104         <input id="date_to" name="date_to" required>
105
106     </div>
107     <!--
108     <div class="form-group col mx-0">
109
110         <label> <b> To</b></label>
111
112     </div> -->
113
114     <div class="form-group col mx-auto">
115
116         <button type="submit" class="btn btn-primary" id="
Visualize"> Visualize Stock</button>
117     </div>
118
119
120
121
122     <div class=" overflow-auto mx-auto mt-5" style="height:
500px; width: 100%;">
123         {% autoescape off %}
124         {{ plot_div }}
125         {% endautoescape off %}
126
127     </div>
128
129
130 </form>
131 </div>
132
133
134 </div>
135 <div class="tab-pane container fade" id="movers"></div>
136 <div class="tab-pane container fade" id="compare"></div>
137 <div class="tab-pane container fade" id="measure"></div>
138 </div>
139
140 <script>
141     // Init jquery ui datepickers
142     $(document).ready(() => {
143         $("#date_from").datepicker({
144             dateFormat: 'yy-mm-dd',
145             timepicker: false,
146             maxDate: "today",
147             minDate: new Date(2015, 1 - 1, 1),
148             onSelect: function(selected)
149             {
150                 $("#date_to").datepicker("option", "minDate", selected)
151             }
152         });
153     });
154 </script>

```

```

150     }
151     });
152     $("#date_to").datepicker({
153         dateFormat: 'yy-mm-dd',
154         timepicker: false,
155         maxDate: "today",
156         minDate: new Date(2015, 1 - 1, 1),
157         onSelect: function(selected)
158         {   $("#date_from").datepicker("option", "maxDate",
159             selected);
160         }
161     });
162
163     // Get http query string and return an associative array
164     function getUrlVars() {
165         var vars = [], hash;
166         var hashes = window.location.href.slice(window.
167             location.href.indexOf('?') + 1).split('&');
168         for(var i = 0; i < hashes.length; i++)
169         {
170             hash = hashes[i].split('=');
171             vars.push(hash[0]);
172             vars[hash[0]] = hash[1];
173         }
174         return vars;
175     }
176
177     $(document).ready(function() {
178         var data = getUrlVars();
179         // For each key, set the right value to each input
180         $("#inputStock").val(data['stock']);
181         $("#inputType").val(data['type']);
182         console.log(data['type']);
183         console.log( data['date_from']);
184         console.log( data['date_to']);
185         $("#date_from").datepicker("setDate", data['
186             date_from']);
187         $("#date_to").datepicker("setDate", data['date_to'])
188     ;
189     })
190
191 // Prevent default html submit
192 $(document).on("submit", "#send_data", function(e) {
193     e.preventDefault();
194     // Create your "data to pass" object
195     var data = {
196         stock: $("#inputStock").val(),
197         type: $("#inputType").val(),
198         date_from: formatDate($("#date_from").datepicker(
199             "getDate")),
200         date_to: formatDate($("#date_to").datepicker("
201             getDate"))

```

```

198         }
199         // Relocate and create a query string with $.param
200         window.location.href= $("#send_data").attr("action")
+ "?" + $.param(data);
201     });
202
203     // Transform date from js.toDateString() to serverside
friendly date string
204     function formatDate(date) {
205         var d = new Date(date),
206             month = '' + (d.getMonth() + 1),
207             day = '' + d.getDate(),
208             year = d.getFullYear();
209
210         if (month.length < 2)
211             month = '0' + month;
212         if (day.length < 2)
213             day = '0' + day;
214
215         return [year, month, day].join('-');
216     }
217     </script>
218
219
220
221 </body>
222 </html>
223
224
225 <!--
226     <div class=" overflow-auto mx-auto mt-5" style="height: 500px;
width: 100%;">
227         {% autoescape off %}
228         {{ plot_div }}
229         {% endautoescape off %}
230
231     </div>
232
233 -->

```

Code A.2.3.11: analysisResultCandlestick.html

2. For comparing two stocks

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Home Page</title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
">
7     <style>
8     body {
9         background: #e6ffff;
10        background: linear-gradient(to right,#e6ffff , #33ffff);

```

```

11 }
12
13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
15 <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-
rc.2/themes/smoothness/jquery-ui.css">
16
17
18 <script src="https://code.jquery.com/jquery-2.2.4.min.js"
integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
crossorigin="anonymous"></script>
19 <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
crossorigin="anonymous"></script>
20
21 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
22
23
24 </head>
25 <body>
26
27 <!-- Nav pills -->
28
29 <ul class="nav nav-pills nav-justified">
30 <li class="nav-item">
31 <a class="nav-link" data-toggle="pill" href="#home" onclick="
window.location.href='home.html'">Home</a>
32 </li>
33 <li class="nav-item">
34 <a class="nav-link" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
35 </li>
36 <li class="nav-item">
37 <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
"window.location.href='analysis.html'">Historical Analysis</a>
38 </li>
39 <li class="nav-item">
40 <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
41 </li>
42 <li class="nav-item">
43 <a class="nav-link active" data-toggle="pill" href="#compare"
onclick="window.location.href='compare.html'">Compare Stocks</a>
44 </li>
45 <li class="nav-item">
46 <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
47 </li>
48 <li class="nav-item">
49 <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'">Logout</a>

```

```

50     </li>
51 </ul>
52
53
54 <!-- Tab panes -->
55 <div class="tab-content">
56     <div class="tab-pane container fade" id="home"> </div>
57     <div class="tab-pane container fade" id="prediction"></div>
58     <div class="tab-pane container fade" id="analysis"></div>
59     <div class="tab-pane container fade" id="movers"></div>
60     <div class="tab-pane container active" id="compare">
61         <div class="container mx-auto">
62             <form id="send_data" method="post" action="/compareResult.
html" autocomplete="off" >
63                 {% csrf_token %}
64                 <div class="form-row mt-5 mx-auto ">
65                     <div class="form-group col mx-auto">
66                         <label for="inputStock"><b> First Stock </b></label>
67                     </div>
68                     <div class="form-group col mx-auto">
69                         <select id="inputStock" class="form-control custom-
select" name="Stock Name" required autofocus>
70                             <!-- <option selected>Choose...</option> -->
71                             {% for entry in stocknames %}
72                             <option value={{entry}}
73                             {% if entry == selectedStock1 %}selected="selected
"%>{{ entry}}</option>
74                             {% endfor %}
75                         </select>
76                     </div>
77                     <div class="form-group col mx-auto">
78                         <label for="inputStock"><b> Second Stock </b></label>
79                     </div>
80                     <div class="form-group col mx-auto">
81                         <select id="inputStock2" class="form-control
custom-select" name="Stock Name2" required autofocus>
82                             <!-- <option selected>Choose...</option> -->
83                             {% for entry in stocknames %}
84                             <option value={{entry}}
85                             {% if entry == selectedStock2 %}selected="
selected"%>{{ entry}}</option>
86                             {% endfor %}
87                         </select>
88                     </div>
89                     <div class="form-group col mx-auto">
90                         <label for="inputType"><b>Select Type </b></label>
91                     </div>
92                     <div class="form-group col mx-auto">
93                         <select id="inputType" class="form-control custom-
select" name="Input Type" required>
94                             <!-- <option selected>Choose...</option> -->
95

```

```

97         <option value="Table">
98         Table</option>
99         <option value="Line"> Line graph</option>
100        <option value="Candle"> Candle-stick graph</option>
101        </select>
102
103    </div>
104
105 </div>
106
107 <div class="form-row mx-auto ">
108     <div class="form-group col mx-auto">
109
110         <label for="inputTo"><b>Select Dates </b></label>
111     </div>
112     <div class="form-group col mx-auto">
113         <input id="date_from" name="date_from" required>
114
115     </div>
116     <div class="form-group col mx-auto">
117         <input id="date_to" name="date_to" required>
118
119     </div>
120
121     <div class="form-group col mx-auto">
122
123         <button type="submit" class="btn btn-primary">
Compare</button>
124     </div>
125
126
127 </div>
128
129
130
131 </form>
132 </div>
133
134
135 </div>
136 <div class="tab-pane container fade" id="measure"></div>
137 </div>
138 <script>
139     // Init jquery ui datepickers
140     $(document).ready(() => {
141         $("#date_from").datepicker({
142             dateFormat: 'yy-mm-dd',
143             timepicker: false,
144             maxDate: "today",
145             minDate: new Date(2015, 1 - 1, 1),
146             onSelect: function(selected)
147             {   $("#date_to").datepicker("option", "minDate", selected);
148                 }
149             });

```

```

150         $("#date_to").datepicker({
151             dateFormat: 'yy-mm-dd',
152             timepicker: false,
153             maxDate: "today",
154             minDate: new Date(2015, 1 - 1, 1),
155             onSelect: function(selected)
156             {   $("#date_from").datepicker("option", "maxDate", selected);
157             }
158         });
159     });
160
161     // Prevent default html submit
162     $(document).on("submit", "#send_data", function(e) {
163         e.preventDefault();
164         // Create your "data to pass" object
165         var data = {
166             stock1: $("#inputStock").val(),
167             stock2: $("#inputStock2").val(),
168             type: $("#inputType").val(),
169             date_from: formatDate($("#date_from").datepicker
170 ("getDate")),
171             date_to: formatDate($("#date_to").datepicker("
172 getDate"))
173         }
174         // Relocate and create a query string with $.param
175         window.location.href= $("#send_data").attr("action")
176 + "?" + $.param(data);
177     });
178
179     // Transform date from js.toDateString() to serverside
180 friendly date string
181     function formatDate(date) {
182         var d = new Date(date),
183             month = '' + (d.getMonth() + 1),
184             day = '' + d.getDate(),
185             year = d.getFullYear();
186
187         if (month.length < 2)
188             month = '0' + month;
189         if (day.length < 2)
190             day = '0' + day;
191
192         return [year, month, day].join('-');
193     }
194
195     </script>
196
197 </body>
198 </html>

```

Code A.2.3.12: compare.html


```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Home Page</title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1
7     ">
8   <style>
9     body {
10       background: #e6ffff;
11       background: linear-gradient(to right,#e6ffff , #33ffff);
12     }
13   </style>
14   <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
15     bootstrap/4.4.1/css/bootstrap.min.css">
16   <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
17     .2/themes/smoothness/jquery-ui.css">
18   <script src="https://code.jquery.com/jquery-2.2.4.min.js"
19     integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
20     crossorigin="anonymous"></script>
21   <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
22     integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
23     crossorigin="anonymous"></script>
24   <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
25     bootstrap.min.js"></script>
26 </head>
27 <body>
28   <!-- Nav pills -->
29   <ul class="nav nav-pills nav-justified">
30     <li class="nav-item">
31       <a class="nav-link" data-toggle="pill" href="#home" onclick="
32         window.location.href='home.html'">Home</a>
33     </li>
34     <li class="nav-item">
35       <a class="nav-link" data-toggle="pill" href="#prediction"
36         onclick="window.location.href='prediction.html'">Stock Price
37         Prediction</a>
38     </li>
39     <li class="nav-item">
40       <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
41         window.location.href='analysis.html'">Historical Analysis</a>
42     </li>
43     <li class="nav-item">
44       <a class="nav-link" data-toggle="pill" href="#movers" onclick="
45         window.location.href='movers.html'">Market Movers</a>

```

```

41     </li>
42     <li class="nav-item">
43       <a class="nav-link active" data-toggle="pill" href="#compare"
44       onclick="window.location.href='compare.html'">Compare Stocks</a>
45     </li>
46     <li class="nav-item">
47       <a class="nav-link" data-toggle="pill" href="#measure" onclick="
48       window.location.href='measure.html'">Measure Trends</a>
49     </li>
50     <li class="nav-item">
51       <a class="nav-link" data-toggle="pill" href="#measure" onclick="
52       window.location.href='/'>Logout</a>
53     </li>
54   </ul>
55
56   <!-- Tab panes -->
57   <div class="tab-content">
58     <div class="tab-pane container fade" id="home"> </div>
59     <div class="tab-pane container fade" id="prediction"></div>
60     <div class="tab-pane container fade" id="analysis"></div>
61     <div class="tab-pane container fade" id="movers"></div>
62     <div class="tab-pane container active" id="compare">
63       <div class="container mx-auto">
64         <form id="send_data" method="post" action="/compareResult.
65         html" autocomplete="off" >
66           {% csrf_token %}
67           <div class="form-row mt-5 mx-auto ">
68             <div class="form-group col mx-auto">
69               <label for="inputStock"><b> First Stock </b></label>
70             </div>
71             <div class="form-group col mx-auto">
72               <select id="inputStock" class="form-control custom-
73               select" name="Stock Name" required autofocus>
74                 <!-- <option selected>Choose...</option> -->
75                 {% for entry in stocknames %}
76                 <option value={{entry}}
77                 {% if entry == selectedStock1 %}selected="selected
78                 {% endif %}>
79                 {{ entry}}</option>
80                 {% endfor %}
81               </select>
82             </div>
83             <div class="form-group col mx-auto">
84               <label for="inputStock"><b> Second Stock </b></label>
85             </div>
86             <div class="form-group col mx-auto">
87               <select id="inputStock2" class="form-control
88               custom-select" name="Stock Name2" required autofocus>
89                 <!-- <option selected>Choose...</option> -->
90                 {% for entry in stocknames %}
91                 <option value={{entry}}

```

```

86         {% if entry == selectedStock2 %}selected="
selected"{% endif %}>
87         {{ entry}}</option>
88         {% endfor %}
89     </select>
90 </div>
91 <div class="form-group col mx-auto">
92     <label for="inputType"><b>Select Type </b></label>
93 </div>
94 <div class="form-group col mx-auto">
95     <select id="inputType" class="form-control custom-
select" name="Input Type" required>
96         <!-- <option selected>Choose...</option> -->
97         <option value="Table">
98         Table</option>
99         <option value="Line"> Line graph</option>
100        <option value="Candle"> Candle-stick graph</option>
101        </select>
102
103    </div>
104
105 </div>
106
107 <div class="form-row mx-auto ">
108     <div class="form-group col mx-auto">
109
110         <label for="inputTo"><b>Select Dates </b></label>
111     </div>
112     <div class="form-group col mx-auto">
113         <input id="date_from" name="date_from" required>
114
115     </div>
116     <div class="form-group col mx-auto">
117         <input id="date_to" name="date_to" required>
118
119     </div>
120
121     <div class="form-group col mx-auto">
122
123         <button type="submit" class="btn btn-primary">
Compare</button>
124     </div>
125
126
127 </div>
128
129
130
131 </form>
132 </div>
133
134
135 </div>
136 <div class="tab-pane container fade" id="measure"></div>

```

```

137 </div>
138 <script>
139     // Init jquery ui datepickers
140     $(document).ready(() => {
141         $("#date_from").datepicker({
142             dateFormat: 'yy-mm-dd',
143             timepicker: false,
144             maxDate: "today",
145             minDate: new Date(2015, 1 - 1, 1),
146             onSelect: function(selected)
147             {   $("#date_to").datepicker("option", "minDate", selected)
148                 ;
149             }
150             });
151         $("#date_to").datepicker({
152             dateFormat: 'yy-mm-dd',
153             timepicker: false,
154             maxDate: "today",
155             minDate: new Date(2015, 1 - 1, 1),
156             onSelect: function(selected)
157             {   $("#date_from").datepicker("option", "maxDate",
158                 selected);
159             }
160             });
161         // Get http query string and return an associative array
162         function getUrlVars() {
163             var vars = [], hash;
164             var hashes = window.location.href.slice(window.
165             location.href.indexOf('?') + 1).split('&');
166             for(var i = 0; i < hashes.length; i++)
167             {
168                 hash = hashes[i].split('=');
169                 vars.push(hash[0]);
170                 vars[hash[0]] = hash[1];
171             }
172             return vars;
173         }
174         $(document).ready(function() {
175             var data = getUrlVars();
176             // For each key, set the right value to each input
177             $("#inputStock").val(data['stock1']);
178             $("#inputStock2").val(data['stock2']);
179             $("#inputType").val(data['type']);
180             console.log( data['stock1']);
181             console.log( data['stock2']);
182             console.log( data['date_from']);
183             console.log( data['date_to']);
184             $("#date_from").datepicker("setDate", data['
185             date_from']);
186             $("#date_to").datepicker("setDate", data['date_to'])
187             ;

```

```

186         })
187
188
189     // Prevent default html submit
190     $(document).on("submit", "#send_data", function(e) {
191         e.preventDefault();
192         // Create your "data to pass" object
193         var data = {
194             stock1: $("#inputStock").val(),
195             stock2: $("#inputStock2").val(),
196             type: $("#inputType").val(),
197             date_from: formatDate($("#date_from").datepicker(
198                 "getDate")),
199             date_to: formatDate($("#date_to").datepicker("
200                 getDate"))
201         }
202         // Relocate and create a query string with $.param
203         window.location.href= $("#send_data").attr("action")
204         + "?" + $.param(data);
205     });
206
207     // Transform date from js.toDateString() to serverside
208     friendly date string
209     function formatDate(date) {
210         var d = new Date(date),
211             month = '' + (d.getMonth() + 1),
212             day = '' + d.getDate(),
213             year = d.getFullYear();
214
215             if (month.length < 2)
216                 month = '0' + month;
217             if (day.length < 2)
218                 day = '0' + day;
219
220             return [year, month, day].join('-');
221         }
222     }
223     </script>
224
225 </body>
226 </html>

```

Code A.2.3.13: compareResult.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Home Page</title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
7     ">
8     <style>
9     body {

```

```

9     background: #e6ffff;
10     background: linear-gradient(to right,#e6ffff , #33ffff);
11 }
12
13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
15 <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
.2/themes/smoothness/jquery-ui.css">
16
17
18 <script src="https://code.jquery.com/jquery-2.2.4.min.js"
integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
crossorigin="anonymous"></script>
19 <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
crossorigin="anonymous"></script>
20
21 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
22
23
24 </head>
25 <body>
26
27 <!-- Nav pills -->
28
29 <ul class="nav nav-pills nav-justified">
30   <li class="nav-item">
31     <a class="nav-link" data-toggle="pill" href="#home" onclick="
window.location.href='home.html'">Home</a>
32   </li>
33   <li class="nav-item">
34     <a class="nav-link" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
35   </li>
36   <li class="nav-item">
37     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
"window.location.href='analysis.html'">Historical Analysis</a>
38   </li>
39   <li class="nav-item">
40     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
41   </li>
42   <li class="nav-item">
43     <a class="nav-link active" data-toggle="pill" href="#compare"
onclick="window.location.href='compare.html'">Compare Stocks</a>
44   </li>
45   <li class="nav-item">
46     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
47   </li>
48   <li class="nav-item">

```

```

49     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'">Logout</a>
50     </li>
51 </ul>
52
53
54 <!-- Tab panes -->
55 <div class="tab-content">
56     <div class="tab-pane container fade" id="home"> </div>
57     <div class="tab-pane container fade" id="prediction"></div>
58     <div class="tab-pane container fade" id="analysis"></div>
59     <div class="tab-pane container fade" id="movers"></div>
60     <div class="tab-pane container active" id="compare">
61     <div class="container mx-auto">
62         <form id="send_data" method="post" action="/compareResult.
html" autocomplete="off" >
63             {% csrf_token %}
64             <div class="form-row mt-5 mx-auto ">
65                 <div class="form-group col mx-auto">
66                     <label for="inputStock"><b> First Stock </b></label>
67                 </div>
68                 <div class="form-group col mx-auto">
69                     <select id="inputStock" class="form-control custom-
select" name="Stock Name" required autofocus>
70                         <!-- <option selected>Choose...</option> -->
71                         {% for entry in stocknames %}
72                         <option value={{entry}}
73                         {% if entry == selectedStock1 %}selected="selected
74                         "{% endif %}>
75                             {{ entry}}</option>
76                         {% endfor %}
77                     </select>
78                 </div>
79                 <div class="form-group col mx-auto">
80                     <label for="inputStock"><b> Second Stock </b></label>
81                 </div>
82                 <div class="form-group col mx-auto">
83                     <select id="inputStock2" class="form-control
custom-select" name="Stock Name2" required autofocus>
84                         <!-- <option selected>Choose...</option> -->
85                         {% for entry in stocknames %}
86                         <option value={{entry}}
87                         {% if entry == selectedStock2 %}selected="
selected"{% endif %}>
88                             {{ entry}}</option>
89                         {% endfor %}
90                     </select>
91                 </div>
92                 <div class="form-group col mx-auto">
93                     <label for="inputType"><b>Select Type </b></label>
94                 </div>
95                 <div class="form-group col mx-auto">

```

```

95         <select id="inputType" class="form-control custom-
select" name="Input Type" required>
96             <!-- <option selected>Choose...</option> -->
97             <option value="Table">
98                 Table</option>
99             <option value="Line"> Line graph</option>
100             <option value="Candle"> Candle-stick graph</option>
101         </select>
102
103     </div>
104
105 </div>
106
107 <div class="form-row mx-auto ">
108     <div class="form-group col mx-auto">
109
110         <label for="inputTo"><b>Select Dates </b></label>
111     </div>
112     <div class="form-group col mx-auto">
113         <input id="date_from" name="date_from" required>
114
115     </div>
116     <div class="form-group col mx-auto">
117         <input id="date_to" name="date_to" required>
118
119     </div>
120
121
122     <!--
123     <div class="form-group col mx-0">
124
125         <label> <b> To</b></label>
126
127     </div> -->
128
129     <div class="form-group col mx-auto">
130
131         <button type="submit" class="btn btn-primary">
Compare</button>
132     </div>
133
134
135 </div>
136
137
138
139 </form>
140
141
142 <div class="container-fluid">
143
144     <div class="row">
145

```



```

146         <div class="text-center col-md-6 " style="height:
147         550px; width: 100%;">
148             <div class="mr-2 overflow-auto ">
149                 {% autoescape off %}
150                 {{ plot_div1 |safe}}
151                 {% endautoescape off %}
152             </div>
153         </div>
154
155         <div class=" text-center col-md-6 " style="height:
156         550px; width: 100%;">
157             <div class="ml-2 overflow-auto" >
158                 {% autoescape off %}
159                 {{ plot_div2 | safe }}
160                 {% endautoescape off %}
161             </div>
162         </div>
163     </div>
164
165 </div>
166 </div>
167
168
169 </div>
170 <div class="tab-pane container fade" id="measure"></div>
171 </div>
172 <script>
173     // Init jquery ui datepickers
174     $(document).ready(() => {
175         $("#date_from").datepicker({
176             dateFormat: 'yy-mm-dd',
177             timepicker: false,
178             maxDate: "today",
179             minDate: new Date(2015, 1 - 1, 1),
180             onSelect: function(selected)
181             {   $("#date_to").datepicker("option", "minDate", selected)
182             ;
183             }
184             });
185         $("#date_to").datepicker({
186             dateFormat: 'yy-mm-dd',
187             timepicker: false,
188             maxDate: "today",
189             minDate: new Date(2015, 1 - 1, 1),
190             onSelect: function(selected)
191             {   $("#date_from").datepicker("option", "maxDate",
192                 selected);
193             }
194             });
195         });
196
197         // Get http query string and return an associative array

```

```

196         function getUrlVars() {
197             var vars = [], hash;
198             var hashes = window.location.href.slice(window.
location.href.indexOf('?') + 1).split('&');
199             for(var i = 0; i < hashes.length; i++)
200             {
201                 hash = hashes[i].split('=');
202                 vars.push(hash[0]);
203                 vars[hash[0]] = hash[1];
204             }
205             return vars;
206         }
207
208         $(document).ready(function() {
209             var data = getUrlVars();
210             // For each key, set the right value to each input
211             $("#inputStock").val(data['stock1']);
212             $("#inputStock2").val(data['stock2']);
213             $("#inputType").val(data['type']);
214             console.log( data['stock1']);
215             console.log( data['stock2']);
216             console.log( data['date_from']);
217             console.log( data['date_to']);
218             $("#date_from").datepicker("setDate", data['
date_from']);
219             $("#date_to").datepicker("setDate", data['date_to'])
;
220         })
221
222
223         // Prevent default html submit
224         $(document).on("submit", "#send_data", function(e) {
225             e.preventDefault();
226             // Create your "data to pass" object
227             var data = {
228                 stock1: $("#inputStock").val(),
229                 stock2: $("#inputStock2").val(),
230                 type: $("#inputType").val(),
231                 date_from: formatDate($("#date_from").datepicker
("getDate")),
232                 date_to: formatDate($("#date_to").datepicker("
getDate"))
233             }
234             // Relocate and create a query string with $.param
235             window.location.href= $("#send_data").attr("action")
+ "?" + $.param(data);
236         });
237
238         // Transform date from js.toDateString() to serverside
friendly date string
239         function formatDate(date) {
240             var d = new Date(date),
241                 month = '' + (d.getMonth() + 1),
242                 day = '' + d.getDate(),

```

```

243         year = d.getFullYear();
244
245         if (month.length < 2)
246             month = '0' + month;
247         if (day.length < 2)
248             day = '0' + day;
249
250         return [year, month, day].join('-');
251     }
252     </script>
253
254
255
256 </body>
257 </html>

```

Code A.2.3.14: compareCandleStick.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Home Page</title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1">
7   <style>
8     body {
9       background: #e6ffff;
10      background: linear-gradient(to right,#e6ffff , #33ffff);
11    }
12
13  </style>
14  <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
15    bootstrap/4.4.1/css/bootstrap.min.css">
16  <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
17    .2/themes/smoothness/jquery-ui.css">
18
19  <script src="https://code.jquery.com/jquery-2.2.4.min.js"
20    integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
21    crossorigin="anonymous"></script>
22  <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
23    integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
24    crossorigin="anonymous"></script>
25  <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
26    bootstrap.min.js"></script>
27
28 </head>
29 <body>
30
31   <!-- Nav pills -->

```

```

29 <ul class="nav nav-pills nav-justified">
30   <li class="nav-item">
31     <a class="nav-link" data-toggle="pill" href="#home" onclick="
window.location.href='home.html'">Home</a>
32   </li>
33   <li class="nav-item">
34     <a class="nav-link" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
35   </li>
36   <li class="nav-item">
37     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
"window.location.href='analysis.html'">Historical Analysis</a>
38   </li>
39   <li class="nav-item">
40     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
41   </li>
42   <li class="nav-item">
43     <a class="nav-link active" data-toggle="pill" href="#compare"
onclick="window.location.href='compare.html'">Compare Stocks</a>
44   </li>
45   <li class="nav-item">
46     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
47   </li>
48   <li class="nav-item">
49     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'>Logout</a>
50   </li>
51 </ul>
52
53
54 <!-- Tab panes -->
55 <div class="tab-content">
56   <div class="tab-pane container fade" id="home"> </div>
57   <div class="tab-pane container fade" id="prediction"></div>
58   <div class="tab-pane container fade" id="analysis"></div>
59   <div class="tab-pane container fade" id="movers"></div>
60   <div class="tab-pane container active" id="compare">
61     <div class="container mx-auto">
62       <form id="send_data" method="post" action="/compareResult.
html" autocomplete="off" >
63         {% csrf_token %}
64         <div class="form-row mt-5 mx-auto ">
65           <div class="form-group col mx-auto">
66             <label for="inputStock"><b> First Stock </b></label>
67           </div>
68           <div class="form-group col mx-auto">
69             <select id="inputStock" class="form-control custom-
select" name="Stock Name" required autofocus>
70               <!-- <option selected>Choose...</option> -->
71               {% for entry in stocknames %}
72               <option value={{entry}}

```

```

73         {% if entry == selectedStock1 %}selected="selected
74     "{% endif %}>
75         {{ entry}}</option>
76         {% endfor %}
77     </select>
78 </div>
79     <div class="form-group col mx-auto">
80         <label for="inputStock"><b> Second Stock </b></label>
81     >
82         </div>
83         <div class="form-group col mx-auto">
84             <select id="inputStock2" class="form-control
85 custom-select" name="Stock Name2" required autofocus>
86                 <!-- <option selected>Choose...</option> -->
87                 {% for entry in stocknames %}
88                 <option value={{entry}}
89                 {% if entry == selectedStock2 %}selected="
90 selected"{% endif %}>
91                 {{ entry}}</option>
92                 {% endfor %}
93             </select>
94         </div>
95         <div class="form-group col mx-auto">
96             <label for="inputType"><b>Select Type </b></label>
97         </div>
98         <div class="form-group col mx-auto">
99             <select id="inputType" class="form-control custom-
100 select" name="Input Type" required>
101                 <!-- <option selected>Choose...</option> -->
102                 <option value="Table">
103                 Table</option>
104                 <option value="Line"> Line graph</option>
105                 <option value="Candle"> Candle-stick graph</option>
106             </select>
107         </div>
108     </div>
109 </div>
110 <div class="form-row mx-auto ">
111     <div class="form-group col mx-auto">
112         <label for="inputTo"><b>Select Dates </b></label>
113     </div>
114     <div class="form-group col mx-auto">
115         <input id="date_from" name="date_from" required>
116     </div>
117     <div class="form-group col mx-auto">
118         <input id="date_to" name="date_to" required>
119     </div>
120 </div>
121 <div class="form-group col mx-auto">

```

```

122         <button type="submit" class="btn btn-primary">
123 Compare</button>
124     </div>
125
126
127 </div>
128
129
130
131 </form>
132
133
134 <div class="container-fluid">
135
136     <div class="row">
137
138         <div class="text-center col-md-6 " style="height:
139 100%; width: 80%;">
140
141             <div class="mr-2 overflow-auto ">
142                 {% autoescape off %}
143                 {{ plot_div1 |safe}}
144                 {% endautoescape off %}
145             </div>
146
147             <div class=" text-center col-md-6 " style="height:
148 100%; width: 80%;">
149                 <div class="ml-2 overflow-auto" >
150                     {% autoescape off %}
151                     {{ plot_div2 | safe }}
152                     {% endautoescape off %}
153                 </div>
154             </div>
155         </div>
156
157     </div>
158 </div>
159
160
161 </div>
162 <div class="tab-pane container fade" id="measure"></div>
163 </div>
164 <script>
165     // Init jquery ui datepickers
166     $(document).ready(() => {
167         $("#date_from").datepicker({
168             dateFormat: 'yy-mm-dd',
169             timepicker: false,
170             maxDate: "today",
171             minDate: new Date(2015, 1 - 1, 1),
172             onSelect: function(selected)

```

```

173         { $("#date_to").datepicker("option", "minDate", selected)
174     ;
175         }
176         });
177         $("#date_to").datepicker({
178             dateFormat: 'yy-mm-dd',
179             timepicker: false,
180             maxDate: "today",
181             minDate: new Date(2015, 1 - 1, 1),
182             onSelect: function(selected)
183             { $("#date_from").datepicker("option", "maxDate",
184               selected);
185             }
186         });
187         // Get http query string and return an associative array
188         function getUrlVars() {
189             var vars = [], hash;
190             var hashes = window.location.href.slice(window.
191               location.href.indexOf('?') + 1).split('&');
192             for(var i = 0; i < hashes.length; i++)
193             {
194                 hash = hashes[i].split('=');
195                 vars.push(hash[0]);
196                 vars[hash[0]] = hash[1];
197             }
198             return vars;
199         }
200         $(document).ready(function() {
201             var data = getUrlVars();
202             // For each key, set the right value to each input
203             $("#inputStock").val(data['stock1']);
204             $("#inputStock2").val(data['stock2']);
205             $("#inputType").val(data['type']);
206             console.log( data['stock1']);
207             console.log( data['stock2']);
208             console.log( data['date_from']);
209             console.log( data['date_to']);
210             $("#date_from").datepicker("setDate", data['
211               date_from']);
212             $("#date_to").datepicker("setDate", data['date_to'])
213         ;
214         })
215         // Prevent default html submit
216         $(document).on("submit", "#send_data", function(e) {
217             e.preventDefault();
218             // Create your "data to pass" object
219             var data = {
220                 stock1: $("#inputStock").val(),
221                 stock2: $("#inputStock2").val(),

```

```

222         type: $("#inputType").val(),
223         date_from: formatDate($("#date_from").datepicker
("getDate")),
224         date_to: formatDate($("#date_to").datepicker("
getDate"))
225     }
226     // Relocate and create a query string with $.param
227     window.location.href= $("#send_data").attr("action")
+ "?" + $.param(data);
228     });
229
230     // Transform date from js.toDateString() to serverside
friendly date string
231     function formatDate(date) {
232         var d = new Date(date),
233             month = '' + (d.getMonth() + 1),
234             day = '' + d.getDate(),
235             year = d.getFullYear();
236
237             if (month.length < 2)
238                 month = '0' + month;
239             if (day.length < 2)
240                 day = '0' + day;
241
242             return [year, month, day].join('-');
243     }
244     </script>
245
246
247
248 </body>
249 </html>

```

Code A.2.3.15: compareResultLine.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Home Page</title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
">
7     <style>
8     body {
9         background: #e6ffff;
10        background: linear-gradient(to right,#e6ffff , #33ffff);
11    }
12
13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
15 <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
.2/themes/smoothness/jquery-ui.css">
16

```



```

17
18 <script src="https://code.jquery.com/jquery-2.2.4.min.js"
    integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTXxZKRutelT44="
    crossorigin="anonymous"></script>
19 <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
    integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
    crossorigin="anonymous"></script>
20
21 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
    bootstrap.min.js"></script>
22
23
24 </head>
25 <body>
26
27 <!-- Nav pills -->
28
29 <ul class="nav nav-pills nav-justified">
30   <li class="nav-item">
31     <a class="nav-link" data-toggle="pill" href="#home" onclick="
        window.location.href='home.html'">Home</a>
32   </li>
33   <li class="nav-item">
34     <a class="nav-link" data-toggle="pill" href="#prediction"
        onclick="window.location.href='prediction.html'">Stock Price
        Prediction</a>
35   </li>
36   <li class="nav-item">
37     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
        window.location.href='analysis.html'">Historical Analysis</a>
38   </li>
39   <li class="nav-item">
40     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
        window.location.href='movers.html'"> Market Movers</a>
41   </li>
42   <li class="nav-item">
43     <a class="nav-link active" data-toggle="pill" href="#compare"
        onclick="window.location.href='compare.html'">Compare Stocks</a>
44   </li>
45   <li class="nav-item">
46     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
        window.location.href='measure.html'">Measure Trends</a>
47   </li>
48   <li class="nav-item">
49     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
        window.location.href='/'>Logout</a>
50   </li>
51 </ul>
52
53
54 <!-- Tab panes -->
55 <div class="tab-content">
56   <div class="tab-pane container fade" id="home"> </div>
57   <div class="tab-pane container fade" id="prediction"></div>

```

```

58 <div class="tab-pane container fade" id="analysis"></div>
59 <div class="tab-pane container fade" id="movers"></div>
60 <div class="tab-pane container active" id="compare">
61 <div class="container mx-auto">
62 <form id="send_data" method="post" action="compareResult.
html" autocomplete="off" >
63     {% csrf_token %}
64     <div class="form-row mt-5 mx-auto ">
65         <div class="form-group col mx-auto">
66             <label for="inputStock"><b> First Stock </b></label>
67         </div>
68         <div class="form-group col mx-auto">
69             <select id="inputStock" class="form-control custom-
select" name="Stock Name" required autofocus>
70                 <!-- <option selected>Choose...</option> -->
71                 {% for entry in stocknames %}
72                 <option value={{entry}}
73                 {% if entry == selectedStock1 %}>selected
"% endif %">
74                 {{ entry}}</option>
75                 {% endfor %}
76             </select>
77         </div>
78         <div class="form-group col mx-auto">
79             <label for="inputStock"><b> Second Stock </b></label
>
80         </div>
81         <div class="form-group col mx-auto">
82             <select id="inputStock2" class="form-control
custom-select" name="Stock Name2" required autofocus>
83                 <!-- <option selected>Choose...</option> -->
84                 {% for entry in stocknames %}
85                 <option value={{entry}}
86                 {% if entry == selectedStock2 %}>selected="
selected"% endif %">
87                 {{ entry}}</option>
88                 {% endfor %}
89             </select>
90         </div>
91         <div class="form-group col mx-auto">
92             <label for="inputType"><b>Select Type </b></label>
93         </div>
94         <div class="form-group col mx-auto">
95             <select id="inputType" class="form-control custom-
select" name="Input Type" required>
96                 <!-- <option selected>Choose...</option> -->
97                 <option value="Table">
98                 Table</option>
99                 <option value="Line"> Line graph</option>
100                <option value="Candle"> Candle-stick graph</option>
101            </select>
102
103        </div>
104

```

```

105         </div>
106
107         <div class="form-row mx-auto ">
108             <div class="form-group col mx-auto">
109
110                 <label for="inputTo"><b>Select Dates </b></label>
111             </div>
112             <div class="form-group col mx-auto">
113                 <input id="date_from" name="date_from" required>
114
115             </div>
116             <div class="form-group col mx-auto">
117                 <input id="date_to" name="date_to" required>
118
119             </div>
120
121
122             <div class="form-group col mx-auto">
123
124                 <button type="submit" class="btn btn-primary">
Compare</button>
125             </div>
126
127
128         </div>
129
130
131
132     </form>
133
134     <div class="row mx-md-n5 mt-5">
135
136         <div class=" text-center col overflow-auto px-md-5"
style="height: 500px; width: 100%;">
137             <label><b>First Stock : {{selectedStock1}} </b></label>
>
138
139                 {% autoescape off %}
140                 {{ dataDf1 | safe }}
141                 {% endautoescape off %}
142
143             </div>
144
145             <div class=" text-center col overflow-auto px-md-5"
style="height: 500px; width: 100%;">
146                 <label><b>Second Stock : {{selectedStock2}} </b></
label>
147
148                 {% autoescape off %}
149                 {{ dataDf2 | safe }}
150                 {% endautoescape off %}
151
152             </div>
153     </div>

```

```

154
155
156     </div>
157     <div class="tab-pane container fade" id="measure"></div>
158 </div>
159     <script>
160         // Init jquery ui datepickers
161         $(document).ready(() => {
162             $("#date_from").datepicker({
163                 dateFormat: 'yy-mm-dd',
164                 timepicker: false,
165                 maxDate: "today",
166                 minDate: new Date(2015, 1 - 1, 1),
167                 onSelect: function(selected)
168             {   $("#date_to").datepicker("option", "minDate", selected)
169             ;
170                 }
171             });
172             $("#date_to").datepicker({
173                 dateFormat: 'yy-mm-dd',
174                 timepicker: false,
175                 maxDate: "today",
176                 minDate: new Date(2015, 1 - 1, 1),
177                 onSelect: function(selected)
178             {   $("#date_from").datepicker("option", "maxDate", selected)
179             ;
180                 }
181             });
182             // Get http query string and return an associative array
183             function getUrlVars() {
184                 var vars = [], hash;
185                 var hashes = window.location.href.slice(window.
186                 location.href.indexOf('?') + 1).split('&');
187                 for(var i = 0; i < hashes.length; i++)
188                 {
189                     hash = hashes[i].split('=');
190                     vars.push(hash[0]);
191                     vars[hash[0]] = hash[1];
192                 }
193                 return vars;
194             }
195             $(document).ready(function() {
196                 var data = getUrlVars();
197                 // For each key, set the right value to each input
198                 $("#inputStock").val(data['stock1']);
199                 $("#inputStock2").val(data['stock2']);
200                 $("#inputType").val(data['type']);
201                 console.log( data['stock1']);
202                 console.log( data['stock2']);
203                 console.log( data['date_from']);
204                 console.log( data['date_to']);

```

```

205         $("#date_from").datepicker("setDate", data['
date_from']);
206         $("#date_to").datepicker("setDate", data['date_to'])
;
207     })
208
209
210     // Prevent default html submit
211     $(document).on("submit", "#send_data", function(e) {
212         e.preventDefault();
213         // Create your "data to pass" object
214         var data = {
215             stock1: $("#inputStock").val(),
216             stock2: $("#inputStock2").val(),
217             type: $("#inputType").val(),
218             date_from: formatDate($("#date_from").datepicker
("getDate")),
219             date_to: formatDate($("#date_to").datepicker("
getDate"))
220         }
221         // Relocate and create a query string with $.param
222         window.location.href= $("#send_data").attr("action")
+ "?" + $.param(data);
223     });
224
225     // Transform date from js.toDateString() to serverside
friendly date string
226     function formatDate(date) {
227         var d = new Date(date),
228             month = '' + (d.getMonth() + 1),
229             day = '' + d.getDate(),
230             year = d.getFullYear();
231
232         if (month.length < 2)
233             month = '0' + month;
234         if (day.length < 2)
235             day = '0' + day;
236
237         return [year, month, day].join('-');
238     }
239     </script>
240
241
242
243 </body>
244 </html>

```

Code A.2.3.16: compareResultTable.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Home Page</title>
5     <meta charset="utf-8">

```

```

6   <meta name="viewport" content="width=device-width, initial-scale=1
    ">
7   <style>
8   body {
9       background: #e6ffff;
10      background: linear-gradient(to right,#e6ffff , #33ffff);
11  }
12
13  </style>
14  <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
    bootstrap/4.4.1/css/bootstrap.min.css">
15  <link rel="stylesheet" href="https://code.jquery.com/ui/1.12.0-rc
    .2/themes/smoothness/jquery-ui.css">
16
17
18  <script src="https://code.jquery.com/jquery-2.2.4.min.js"
    integrity="sha256-BbhdLvQf/xTY9gja0Dq3HiwQF8LaCRTxZKRutelT44="
    crossorigin="anonymous"></script>
19  <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.min.js"
    integrity="sha256-VazP97ZCwtekAsvgPBSUwPFKdrwD3unUfSGVYrahUqU="
    crossorigin="anonymous"></script>
20
21  <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
    bootstrap.min.js"></script>
22
23
24 </head>
25 <body>
26
27   <!-- Nav pills -->
28
29   <ul class="nav nav-pills nav-justified">
30     <li class="nav-item">
31       <a class="nav-link" data-toggle="pill" href="#home" onclick="
        window.location.href='home.html'">Home</a>
32     </li>
33     <li class="nav-item">
34       <a class="nav-link" data-toggle="pill" href="#prediction"
        onclick="window.location.href='prediction.html'">Stock Price
        Prediction</a>
35     </li>
36     <li class="nav-item">
37       <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
        window.location.href='analysis.html'">Historical Analysis</a>
38     </li>
39     <li class="nav-item">
40       <a class="nav-link" data-toggle="pill" href="#movers" onclick="
        window.location.href='movers.html'"> Market Movers</a>
41     </li>
42     <li class="nav-item">
43       <a class="nav-link active" data-toggle="pill" href="#compare"
        onclick="window.location.href='compare.html'">Compare Stocks</a>
44     </li>
45     <li class="nav-item">

```

```

46     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
47     </li>
48     <li class="nav-item">
49     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'">Logout</a>
50     </li>
51 </ul>
52
53
54 <!-- Tab panes -->
55 <div class="tab-content">
56     <div class="tab-pane container fade" id="home"> </div>
57     <div class="tab-pane container fade" id="prediction"></div>
58     <div class="tab-pane container fade" id="analysis"></div>
59     <div class="tab-pane container fade" id="movers"></div>
60     <div class="tab-pane container active" id="compare">
61     <div class="container mx-auto">
62         <form id="send_data" method="post" action="/compareResult.
html" autocomplete="off" >
63             {% csrf_token %}
64             <div class="form-row mt-5 mx-auto ">
65                 <div class="form-group col mx-auto">
66                     <label for="inputStock"><b> First Stock </b></label>
67                 </div>
68                 <div class="form-group col mx-auto">
69                     <select id="inputStock" class="form-control custom-
select" name="Stock Name" required autofocus>
70                         <!-- <option selected>Choose...</option> -->
71                         {% for entry in stocknames %}
72                         <option value={{entry}}
73                         {% if entry == selectedStock1 %}selected="selected
74                         "{% endif %}>
75                             {{ entry}}</option>
76                         {% endfor %}
77                     </select>
78                 </div>
79                 <div class="form-group col mx-auto">
80                     <label for="inputStock"><b> Second Stock </b></label>
81                 </div>
82                 <div class="form-group col mx-auto">
83                     <select id="inputStock2" class="form-control
custom-select" name="Stock Name2" required autofocus>
84                         <!-- <option selected>Choose...</option> -->
85                         {% for entry in stocknames %}
86                         <option value={{entry}}
87                         {% if entry == selectedStock2 %}selected="
selected"{% endif %}>
88                             {{ entry}}</option>
89                         {% endfor %}
90                     </select>
91                 </div>
</div>

```

```

92         <label for="inputType"><b>Select Type </b></label>
93     </div>
94     <div class="form-group col mx-auto">
95         <select id="inputType" class="form-control custom-
96         select" name="Input Type" required>
97             <!-- <option selected>Choose...</option> -->
98             <option value="Table">
99                 Table</option>
100             <option value="Line"> Line graph</option>
101             <option value="Candle"> Candle-stick graph</option>
102         </select>
103     </div>
104
105 </div>
106
107 <div class="form-row mx-auto ">
108     <div class="form-group col mx-auto">
109
110         <label for="inputTo"><b>Select Dates </b></label>
111     </div>
112     <div class="form-group col mx-auto">
113         <input id="date_from" name="date_from" required>
114
115     </div>
116     <div class="form-group col mx-auto">
117         <input id="date_to" name="date_to" required>
118
119     </div>
120
121     <div class="form-group col mx-auto">
122
123         <button type="submit" class="btn btn-primary">
124         Compare</button>
125     </div>
126
127 </div>
128
129
130
131 </form>
132     <div class="text-center mt-5"> <b> You have selected same
133     stocks, Please select different.</b></div>
134 </div>
135
136 </div>
137 <div class="tab-pane container fade" id="measure"></div>
138 </div>
139 <script>
140     // Init jquery ui datepickers
141     $(document).ready(() => {
142         $("#date_from").datepicker({

```



```

143         dateFormat: 'yy-mm-dd',
144         timepicker: false,
145         maxDate: "today",
146         minDate: new Date(2015, 1 - 1, 1),
147     onSelect: function(selected)
148     {   $("#date_to").datepicker("option", "minDate", selected)
149     ;
150     }
151     });
152     $("#date_to").datepicker({
153         dateFormat: 'yy-mm-dd',
154         timepicker: false,
155         maxDate: "today",
156         minDate: new Date(2015, 1 - 1, 1),
157     onSelect: function(selected)
158     {   $("#date_from").datepicker("option", "maxDate",
159     selected);
160     }
161     });
162     });
163     // Get http query string and return an associative array
164     function getUrlVars() {
165         var vars = [], hash;
166         var hashes = window.location.href.slice(window.
167         location.href.indexOf('?') + 1).split('&');
168         for(var i = 0; i < hashes.length; i++)
169         {
170             hash = hashes[i].split('=');
171             vars.push(hash[0]);
172             vars[hash[0]] = hash[1];
173         }
174         return vars;
175     }
176     $(document).ready(function() {
177         var data = getUrlVars();
178         // For each key, set the right value to each input
179         $("#inputStock").val(data['stock1']);
180         $("#inputStock2").val(data['stock2']);
181         $("#inputType").val(data['type']);
182         console.log( data['stock1']);
183         console.log( data['stock2']);
184         console.log( data['date_from']);
185         console.log( data['date_to']);
186         $("#date_from").datepicker("setDate", data['
187     date_from']);
188         $("#date_to").datepicker("setDate", data['date_to'])
189     ;
190     })
191     // Prevent default html submit
192     $(document).on("submit", "#send_data", function(e) {

```

```

192         e.preventDefault();
193         // Create your "data to pass" object
194         var data = {
195             stock1: $("#inputStock").val(),
196             stock2: $("#inputStock2").val(),
197             type: $("#inputType").val(),
198             date_from: formatDate($("#date_from").datepicker(
199                 "getDate")),
200             date_to: formatDate($("#date_to").datepicker("
201                 getDate"))
202         }
203         // Relocate and create a query string with $.param
204         window.location.href= $("#send_data").attr("action")
205         + "?" + $.param(data);
206     });
207
208     // Transform date from js.toDateString() to serverside
209     friendly date string
210     function formatDate(date) {
211         var d = new Date(date),
212             month = '' + (d.getMonth() + 1),
213             day = '' + d.getDate(),
214             year = d.getFullYear();
215
216         if (month.length < 2)
217             month = '0' + month;
218         if (day.length < 2)
219             day = '0' + day;
220
221         return [year, month, day].join('-');
222     }
223 </script>
224 </body>
225 </html>

```

Code A.2.3.17: compareSameStock.html

3. For finding trend in stock data

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Home Page</title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
7     ">
8     <style>
9     body {
10         background: #e6ffff;
11         background: linear-gradient(to right,#e6ffff , #33ffff);
12     }

```

```

13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
15 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
jquery.min.js"></script>
16 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
/1.16.0/umd/popper.min.js"></script>
17 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
18 </head>
19 <body>
20
21 <!-- Nav pills -->
22
23 <ul class="nav nav-pills nav-justified">
24   <li class="nav-item">
25     <a class="nav-link " data-toggle="pill" href="#home" onclick="
window.location.href='home.html'">Home</a>
26   </li>
27   <li class="nav-item">
28     <a class="nav-link" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
29   </li>
30   <li class="nav-item">
31     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
"window.location.href='analysis.html'">Historical Analysis</a>
32   </li>
33   <li class="nav-item">
34     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
35   </li>
36   <li class="nav-item">
37     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
window.location.href='compare.html'">Compare Stocks</a>
38   </li>
39   <li class="nav-item">
40     <a class="nav-link active" data-toggle="pill" href="#measure"
onclick="window.location.href='measure.html'">Measure Trends</a>
41   </li>
42   <li class="nav-item">
43     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'">Logout</a>
44   </li>
45 </ul>
46
47
48 <!-- Tab panes -->
49 <div class="tab-content">
50   <div class="tab-pane container fade" id="home"> </div>
51   <div class="tab-pane container fade" id="prediction"></div>
52   <div class="tab-pane container fade" id="analysis"></div>
53   <div class="tab-pane container fade" id="movers"></div>
54   <div class="tab-pane container fade" id="compare"></div>

```

```

55 <div class="tab-pane container active" id="measure">
56 <div class="container mx-auto">
57 <form method="POST" action="/measureResults.html">
58   {% csrf_token %}
59   <div class="form-row mx-auto my-5 mt-4">
60     <div class="form-group col-md-3 mx-auto my-auto">
61       <label for="inputStock"><b> Stock Name </b></label>
62       <select id="inputStock" class="form-control custom-select "
name="Stock Name" required autofocus>
63         <!-- <option selected>Choose...</option> -->
64         {% for entry in stocknames %}
65         <option value={{entry}}
66           {% if entry == selectedStock %}selected="selected"{%
endif %}>
67           {{ entry}}</option>
68         {% endfor %}
69       </select>
70     </div>
71     <div class="form-group col-md-2 mx-auto my-auto">
72       <label for="inputType1"><b>Select Average Type </b></label>
73       <select id="inputType1" class="form-control custom-select "
name="selected Average" required>
74         <option {% if selectedType == "Simple Moving Average (SMA) "
}%}selected="selected"{% endif %}>
75         Simple Moving Average (SMA)</option>
76         <option {% if selectedType == "Exponential Moving Average (
EMA) " %}selected="selected"{% endif %}>
77         Exponential Moving Average (EMA)</option>
78
79       </select>
80     </div>
81     <div class="form-group col-md-2 mx-auto my-auto">
82       <label for="inputType"><b>Select Type </b></label>
83       <select id="inputType" class="form-control custom-select "
name="selected Type" required>
84         <option {% if selectedType == "Table" %}selected="
selected"{% endif %}>
85         Table</option>
86         <option {% if selectedType == "Line graph" %}selected="
selected"{% endif %}>
87         Line graph </option>
88
89       </select>
90     </div>
91     <div class="form-group col-md-2 mx-auto my-auto">
92       <label for="inputRange"><b>Select Range </b></label>
93       <select id="inputRange" class="form-control custom-select "
name="selected Range" required>
94
95         <option {% if selectedRange == "5" %}selected="selected"{%
endif %}>
96         5</option>
97         <option {% if selectedRange == "10" %}selected="selected"{%
endif %}>

```

```

98         10</option>
99         <option {% if selectedRange == "20" %}selected="selected"{%
100     endif %}>
101         20</option>
102         <option {% if selectedRange == "30" %}selected="selected"{%
103     endif %}>
104         30</option>
105         <option {% if selectedRange == "40" %}selected="selected"{%
106     endif %}>
107         40</option>
108         <option {% if selectedRange == "50" %}selected="selected"{%
109     endif %}>
110         50</option>
111         <option {% if selectedRange == "100" %}selected="selected"{%
112     endif %}>
113         100</option>
114         <option {% if selectedRange == "200" %}selected="selected"{%
115     endif %}>
116         200</option>
117         <option {% if selectedRange == "300" %}selected="selected"{%
118     endif %}>
119         300</option>
120         <option {% if selectedRange == "400" %}selected="selected"{%
121     endif %}>
122         400</option>
123         <option {% if selectedRange == "500" %}selected="selected"{%
124     endif %}>
125         500</option>
126
127     </select>
128 </div>
129 <div class="form-group col-md-2 mx-auto my-auto">
130     <label><b> Click below </b> </label>
131     <button type="submit" class="btn btn-primary"> Visualize</
132 button>
133 </div>
134 </div>
135 </div>
136 </form>
137 </div>
138
139 </div>
140 </div>
141 </body>
142 </html>

```

Code A.2.3.18: measure.html

```

1 <!DOCTYPE html>
2 <html lang="en">

```

```

3 <head>
4   <title>Home Page</title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1
7     ">
8   <style>
9   body {
10     background: #e6ffff;
11     background: linear-gradient(to right,#e6ffff , #33ffff);
12   }
13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
15   bootstrap/4.4.1/css/bootstrap.min.css">
16 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
17   jquery.min.js"></script>
18 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
19   /1.16.0/umd/popper.min.js"></script>
20 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
21   bootstrap.min.js"></script>
22 </head>
23 <body>
24 <!-- Nav pills -->
25
26 <ul class="nav nav-pills nav-justified">
27   <li class="nav-item">
28     <a class="nav-link " data-toggle="pill" href="#home" onclick="
29       window.location.href='home.html'">Home</a>
30   </li>
31   <li class="nav-item">
32     <a class="nav-link" data-toggle="pill" href="#prediction"
33       onclick="window.location.href='prediction.html'">Stock Price
34       Prediction</a>
35   </li>
36   <li class="nav-item">
37     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
38       window.location.href='analysis.html'">Historical Analysis</a>
39   </li>
40   <li class="nav-item">
41     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
42       window.location.href='movers.html'"> Market Movers</a>
43   </li>
44   <li class="nav-item">
45     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
46       window.location.href='compare.html'">Compare Stocks</a>
47   </li>
48   <li class="nav-item">
49     <a class="nav-link active" data-toggle="pill" href="#measure"
50       onclick="window.location.href='measure.html'">Measure Trends</a>
51   </li>
52   <li class="nav-item">
53     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
54       window.location.href='/'>Logout</a>

```

```

44     </li>
45 </ul>
46
47
48 <!-- Tab panes -->
49 <div class="tab-content">
50     <div class="tab-pane container fade" id="home"> </div>
51     <div class="tab-pane container fade" id="prediction"></div>
52     <div class="tab-pane container fade" id="analysis"></div>
53     <div class="tab-pane container fade" id="movers"></div>
54     <div class="tab-pane container fade" id="compare"></div>
55     <div class="tab-pane container active" id="measure">
56     <div class="container mx-auto">
57     <form method="POST" action="/measureResults.html">
58         {% csrf_token %}
59         <div class="form-row mx-auto my-5 mt-4">
60         <div class="form-group col-md-3 mx-auto my-auto">
61             <label for="inputStock"><b> Stock Name </b></label>
62             <select id="inputStock" class="form-control custom-select"
name="Stock Name" required autofocus>
63                 <!-- <option selected>Choose...</option> -->
64                 {% for entry in stocknames %}
65                 <option value={{entry}}
66                     {% if entry == selectedStock %}selected="selected"{%
endif %}>
67                     {{ entry}}</option>
68                 {% endfor %}
69             </select>
70         </div>
71         <div class="form-group col-md-2 mx-auto my-auto">
72             <label for="inputType"><b>Select Average Type </b></label>
73             <select id="inputType" class="form-control custom-select"
name="selected Average" required>
74                 <option {% if selectedAverage == "Simple Moving Average (SMA)
" %}selected="selected"{% endif %}>
75                     Simple Moving Average (SMA)</option>
76                 <option {% if selectedAverage == "Exponential Moving
Average (EMA) " %}selected="selected"{% endif %}>
77                     Exponential Moving Average (EMA)</option>
78
79             </select>
80         </div>
81         <div class="form-group col-md-2 mx-auto my-auto">
82             <label for="inputType"><b>Select Type </b></label>
83             <select id="inputType" class="form-control custom-select"
name="selected Type" required>
84                 <option {% if selectedType == "Table" %}selected="
selected"{% endif %}>
85                     Table</option>
86                 <option {% if selectedType == "Line graph" %}selected="
selected"{% endif %}>
87                     Line graph </option>
88
89             </select>

```

```

90     </div>
91     <div class="form-group col-md-2 mx-auto my-auto">
92         <label for="inputRange"><b>Select Range </b></label>
93         <select id="inputRange" class="form-control custom-select"
name="selected Range"    required>
94
95             <option {% if selectedRange == "5" %}>selected="{selected}"{%
endif %}>
96                 5</option>
97             <option {% if selectedRange == "10" %}>selected="{selected}"{%
endif %}>
98                 10</option>
99             <option {% if selectedRange == "20" %}>selected="{selected}"{%
endif %}>
100                 20</option>
101             <option {% if selectedRange == "30" %}>selected="{selected}"{%
endif %}>
102                 30</option>
103             <option {% if selectedRange == "40" %}>selected="{selected}"{%
endif %}>
104                 40</option>
105             <option {% if selectedRange == "50" %}>selected="{selected}"{%
endif %}>
106                 50</option>
107             <option {% if selectedRange == "100" %}>selected="{selected}"{%
endif %}>
108                 100</option>
109             <option {% if selectedRange == "200" %}>selected="{selected}"{%
endif %}>
110                 200</option>
111             <option {% if selectedRange == "300" %}>selected="{selected}"{%
endif %}>
112                 300</option>
113             <option {% if selectedRange == "400" %}>selected="{selected}"{%
endif %}>
114                 400</option>
115             <option {% if selectedRange == "500" %}>selected="{selected}"{%
endif %}>
116                 500</option>
117
118
119         </select>
120     </div>
121     <div class="form-group col-md-2 mx-auto my-auto">
122         <label><b> Click below </b> </label>
123         <button type="submit" class="btn btn-primary"> Visualize</
button>
124     </div>
125 </div>
126
127
128 </form>
129 </div>
130

```



```

131
132     </div>
133 </div>
134
135 </body>
136 </html>

```

Code A.2.3.19: measureResults.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Home Page</title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1
7     ">
8   <style>
9   body {
10     background: #e6ffff;
11     background: linear-gradient(to right,#e6ffff , #33ffff);
12   }
13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
15   bootstrap/4.4.1/css/bootstrap.min.css">
16 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
17   jquery.min.js"></script>
18 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
19   /1.16.0/umd/popper.min.js"></script>
20 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
21   bootstrap.min.js"></script>
22 </head>
23 <body>
24
25 <!-- Nav pills -->
26
27 <ul class="nav nav-pills nav-justified">
28   <li class="nav-item">
29     <a class="nav-link " data-toggle="pill" href="#home" onclick="
30       window.location.href='home.html'">Home</a>
31   </li>
32   <li class="nav-item">
33     <a class="nav-link" data-toggle="pill" href="#prediction"
34       onclick="window.location.href='prediction.html'">Stock Price
35       Prediction</a>
36   </li>
37   <li class="nav-item">
38     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
39       window.location.href='analysis.html'">Historical Analysis</a>
40   </li>
41   <li class="nav-item">
42     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
43       window.location.href='movers.html'"> Market Movers</a>
44   </li>

```

```

36     <li class="nav-item">
37     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
window.location.href='compare.html'">Compare Stocks</a>
38     </li>
39     <li class="nav-item">
40     <a class="nav-link active" data-toggle="pill" href="#measure"
onclick="window.location.href='measure.html'">Measure Trends</a>
41     </li>
42     <li class="nav-item">
43     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'">Logout</a>
44     </li>
45 </ul>
46
47
48 <!-- Tab panes -->
49 <div class="tab-content">
50     <div class="tab-pane container fade" id="home"> </div>
51     <div class="tab-pane container fade" id="prediction"></div>
52     <div class="tab-pane container fade" id="analysis"></div>
53     <div class="tab-pane container fade" id="movers"></div>
54     <div class="tab-pane container fade" id="compare"></div>
55     <div class="tab-pane container active" id="measure">
56     <div class="container mx-auto">
57     <form method="POST" action="/measureResults.html">
58         {% csrf_token %}
59         <div class="form-row mx-auto my-5 mt-4">
60         <div class="form-group col-md-3 mx-auto my-auto">
61             <label for="inputStock"><b> Stock Name </b></label>
62             <select id="inputStock" class="form-control custom-select"
name="Stock Name" required autofocus>
63                 <!-- <option selected>Choose...</option> -->
64                 {% for entry in stocknames %}
65                 <option value={{entry}}
66                     {% if entry == selectedStock %}selected="selected"{%
endif %}>
67                     {{ entry}}</option>
68                 {% endfor %}
69             </select>
70         </div>
71         <div class="form-group col-md-2 mx-auto my-auto">
72             <label for="inputType1"><b>Select Average Type </b></label>
73             <select id="inputType1" class="form-control custom-select"
name="selected Average" required>
74                 <option {% if selectedAverage == "Simple Moving Average (SMA)
" %}selected="selected"{% endif %}>
75                 Simple Moving Average (SMA)</option>
76                 <option {% if selectedAverage == "Exponential Moving
Average (EMA)" %}selected="selected"{% endif %}>
77                 Exponential Moving Average (EMA)</option>
78
79             </select>
80         </div>
81         <div class="form-group col-md-2 mx-auto my-auto">

```

```

82         <label for="inputType"><b>Select Type </b></label>
83         <select id="inputType" class="form-control custom-select"
name="selected Type" required>
84             <option {% if selectedType == "Table" %}>selected="
selected"{% endif %}>
85                 Table</option>
86             <option {% if selectedType == "Line graph" %}>selected="
selected"{% endif %}>
87                 Line graph </option>
88
89         </select>
90     </div>
91     <div class="form-group col-md-2 mx-auto my-auto">
92         <label for="inputRange"><b>Select Range </b></label>
93         <select id="inputRange" class="form-control custom-select"
name="selected Range" required>
94
95             <option {% if selectedRange == "5" %}>selected="selected"{%
endif %}>
96                 5</option>
97             <option {% if selectedRange == "10" %}>selected="selected"{%
endif %}>
98                 10</option>
99             <option {% if selectedRange == "20" %}>selected="selected"{%
endif %}>
100                 20</option>
101             <option {% if selectedRange == "30" %}>selected="selected"{%
endif %}>
102                 30</option>
103             <option {% if selectedRange == "40" %}>selected="selected"{%
endif %}>
104                 40</option>
105             <option {% if selectedRange == "50" %}>selected="selected"{%
endif %}>
106                 50</option>
107             <option {% if selectedRange == "100" %}>selected="selected"{%
endif %}>
108                 100</option>
109             <option {% if selectedRange == "200" %}>selected="selected"{%
endif %}>
110                 200</option>
111             <option {% if selectedRange == "300" %}>selected="selected"{%
endif %}>
112                 300</option>
113             <option {% if selectedRange == "400" %}>selected="selected"{%
endif %}>
114                 400</option>
115             <option {% if selectedRange == "500" %}>selected="selected"{%
endif %}>
116                 500</option>
117
118
119         </select>
120     </div>

```

```

121     <div class="form-group col-md-2 mx-auto my-auto">
122         <label><b> Click below </b> </label>
123         <button type="submit" class="btn btn-primary"> Visualize</
button>
124     </div>
125 </div>
126
127
128     <div class="overflow-auto mx-auto mt-5" style="height: 500
px; width: 90%;">
129
130         {% autoescape off %}
131         {{ dataDf1 }}
132         {% endautoescape off %}
133     </div>
134
135
136 </form>
137 </div>
138
139
140 </div>
141 </div>
142
143 </body>
144 </html>

```

Code A.2.3.20: measureResultLine.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Home Page</title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
">
7     <style>
8     body {
9         background: #e6ffff;
10        background: linear-gradient(to right,#e6ffff , #33ffff);
11    }
12
13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
15 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
jquery.min.js"></script>
16 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
/1.16.0/umd/popper.min.js"></script>
17 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
18 </head>
19 <body>
20

```

```

21 <!-- Nav pills -->
22
23 <ul class="nav nav-pills nav-justified">
24   <li class="nav-item">
25     <a class="nav-link " data-toggle="pill" href="#home" onclick="
26       window.location.href='home.html'">Home</a>
27   </li>
28   <li class="nav-item">
29     <a class="nav-link" data-toggle="pill" href="#prediction"
30       onclick="window.location.href='prediction.html'">Stock Price
31       Prediction</a>
32   </li>
33   <li class="nav-item">
34     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
35       window.location.href='analysis.html'">Historical Analysis</a>
36   </li>
37   <li class="nav-item">
38     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
39       window.location.href='movers.html'"> Market Movers</a>
40   </li>
41   <li class="nav-item">
42     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
43       window.location.href='compare.html'">Compare Stocks</a>
44   </li>
45   <li class="nav-item">
46     <a class="nav-link active" data-toggle="pill" href="#measure"
47       onclick="window.location.href='measure.html'">Measure Trends</a>
48   </li>
49   <li class="nav-item">
50     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
51       window.location.href='/'>Logout</a>
52   </li>
53 </ul>
54
55 <!-- Tab panes -->
56 <div class="tab-content">
57   <div class="tab-pane container fade" id="home"> </div>
58   <div class="tab-pane container fade" id="prediction"></div>
59   <div class="tab-pane container fade" id="analysis"></div>
60   <div class="tab-pane container fade" id="movers"></div>
61   <div class="tab-pane container fade" id="compare"></div>
62   <div class="tab-pane container active" id="measure">
63     <div class="container mx-auto">
64       <form method="POST" action="/measureResults.html">
65         {% csrf_token %}
66         <div class="form-row mx-auto my-5 mt-4">
67           <div class="form-group col-md-3 mx-auto my-auto">
68             <label for="inputStock"><b> Stock Name </b></label>
69             <select id="inputStock" class="form-control custom-select"
70               name="Stock Name" required autofocus>
71               <!-- <option selected>Choose...</option> -->
72               {% for entry in stocknames %}
73                 <option value={{entry}}

```

```

66         {% if entry == selectedStock %}selected="selected"{%
endif %}>
67         {{ entry}}</option>
68     {% endfor %}
69 </select>
70 </div>
71 <div class="form-group col-md-2 mx-auto my-auto">
72     <label for="inputType1"><b>Select Average Type </b></label>
73     <select id="inputType1" class="form-control custom-select"
name="selected Average" required>
74         <option {% if selectedAverage == "Simple Moving Average (SMA)
" %}selected="selected"{% endif %}>
75             Simple Moving Average (SMA)</option>
76         <option {% if selectedAverage == "Exponential Moving
Average (EMA) " %}selected="selected"{% endif %}>
77             Exponential Moving Average (EMA)</option>
78
79     </select>
80 </div>
81 <div class="form-group col-md-2 mx-auto my-auto">
82     <label for="inputType"><b>Select Type </b></label>
83     <select id="inputType" class="form-control custom-select"
name="selected Type" required>
84         <option {% if selectedType == "Table" %}selected="
selected"{% endif %}>
85             Table</option>
86         <option {% if selectedType == "Line graph" %}selected="
selected"{% endif %}>
87             Line graph </option>
88
89     </select>
90 </div>
91 <div class="form-group col-md-2 mx-auto my-auto">
92     <label for="inputRange"><b>Select Range </b></label>
93     <select id="inputRange" class="form-control custom-select"
name="selected Range" required>
94
95         <option {% if selectedRange == "5" %}selected="selected"{%
endif %}>
96             5</option>
97         <option {% if selectedRange == "10" %}selected="selected"{%
endif %}>
98             10</option>
99         <option {% if selectedRange == "20" %}selected="selected"{%
endif %}>
100             20</option>
101         <option {% if selectedRange == "30" %}selected="selected"{%
endif %}>
102             30</option>
103         <option {% if selectedRange == "40" %}selected="selected"{%
endif %}>
104             40</option>
105         <option {% if selectedRange == "50" %}selected="selected"{%
endif %}>

```

```

106         50</option>
107         <option {% if selectedRange == "100" %}selected="selected"{%
endif %}>
108         100</option>
109         <option {% if selectedRange == "200" %}selected="selected"{%
endif %}>
110         200</option>
111         <option {% if selectedRange == "300" %}selected="selected"{%
endif %}>
112         300</option>
113         <option {% if selectedRange == "400" %}selected="selected"{%
endif %}>
114         400</option>
115         <option {% if selectedRange == "500" %}selected="selected"{%
endif %}>
116         500</option>
117
118
119     </select>
120 </div>
121 <div class="form-group col-md-2 mx-auto my-auto">
122     <label><b> Click below </b> </label>
123     <button type="submit" class="btn btn-primary"> Visualize</
button>
124 </div>
125 </div>
126
127
128
129 <div class="row d-flex justify-content-center">
130
131     <!--Grid column-->
132     <div class="col-md-6">
133
134         <div class="text-center overflow-auto" style="height:
500px; width: 40%;">
135
136             {% autoescape off %}
137             {{ dataDf1 }}
138             {% endautoescape off %}
139         </div>
140
141     </div>
142     <!--Grid column-->
143
144 </div>
145
146
147 </form>
148 </div>
149
150
151 </div>
152 </div>

```

```

153
154 </body>
155 </html>

```

Code A.2.3.21: measureResultTable.html

4. For market movers- gainers and losers

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Movers Page</title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1">
7   <style>
8     body {
9       background: #e6ffff;
10      background: linear-gradient(to right,#e6ffff , #33ffff);
11    }
12
13  </style>
14  <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
15    bootstrap/4.4.1/css/bootstrap.min.css">
16  <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
17    jquery.min.js"></script>
18  <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
19    /1.16.0/umd/popper.min.js"></script>
20  <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
21    bootstrap.min.js"></script>
22 </head>
23 <body>
24
25   <!-- Nav pills -->
26
27   <ul class="nav nav-pills nav-justified">
28     <li class="nav-item">
29       <a class="nav-link " data-toggle="pill" href="#home" onclick="
30         window.location.href='home.html'">Home</a>
31     </li>
32     <li class="nav-item">
33       <a class="nav-link" data-toggle="pill" href="#prediction"
34         onclick="window.location.href='prediction.html'">Stock Price
35         Prediction</a>
36     </li>
37     <li class="nav-item">
38       <a class="nav-link" data-toggle="pill" href="#analysis" onclick=
39         "window.location.href='analysis.html'">Historical Analysis</a>
40     </li>
41     <li class="nav-item">
42       <a class="nav-link active" data-toggle="pill" href="#movers"
43         onclick="window.location.href='movers.html'"> Market Movers</a>
44     </li>
45     <li class="nav-item">

```



```

37     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
window.location.href='compare.html'">Compare Stocks</a>
38 </li>
39 <li class="nav-item">
40     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
41 </li>
42 <li class="nav-item">
43     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'">Logout</a>
44 </li>
45
46 </ul>
47
48
49 <!-- Tab panes -->
50 <div class="tab-content">
51     <div class="tab-pane container fade" id="home"> </div>
52     <div class="tab-pane container fade" id="prediction"></div>
53     <div class="tab-pane container fade" id="analysis"></div>
54     <div class="tab-pane container active" id="movers">
55
56         <div class="container mx-auto">
57             <form method="post" action="/moversResult.html">
58                 {% csrf_token %}
59                 <div class="form-row mt-5 ">
60                     <div class="form-group col mx-auto my-auto ">
61                         <label for="inputType"><b>Select type </b></label>
62
63                     </div>
64
65                     <div class="form-group col mx-auto my-auto">
66
67                         <select id="inputType" class="form-control custom-select"
name="Duration" required>
68                             <!-- <option selected>Choose...</option> -->
69                             <option> Last day </option>
70                             <option> Weekly </option>
71                             <option> Monthly</option>
72                             <option> Yearly</option>
73                         </select>
74                     </div>
75                     <div class="form-group col mx-auto my-auto">
76                         <label for="inputRange"><b>Select Entry </b></label>
77
78                     </div>
79
80                     <div class="form-group col my-auto mr-5">
81
82                         <select id="inputRange" class="form-control custom-select"
name="Input Range" required>
83                             <!-- <option selected>Choose...</option> -->
84                             <option> Top 5 </option>
85                             <option> Top 10 </option>

```

```

86         <option> Top 20 </option>
87         <option> Top 30 </option>
88     </select>
89 </div>
90
91     <div class="form-group col mx-auto my-auto">
92
93         <button type="submit" class="btn btn-primary"> Get Gainers/
Losers</button>
94     </div>
95
96 </div>
97 <div class="form-row mt-5 mr-5 ">
98
99 </div>
100
101 </form>
102 </div>
103 </div>
104
105 <div class="tab-pane container fade" id="compare"></div>
106 <div class="tab-pane container fade" id="measure"></div>
107 </div>
108
109 </body>
110 </html>

```

Code A.2.3.22: movers.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Movers Page</title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
">
7     <style>
8     body {
9         background: #e6ffff;
10        background: linear-gradient(to right,#e6ffff , #33ffff);
11    }
12
13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
15 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
jquery.min.js"></script>
16 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
/1.16.0/umd/popper.min.js"></script>
17 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
18 </head>
19 <body>
20

```

```

21 <!-- Nav pills -->
22
23 <ul class="nav nav-pills nav-justified">
24   <li class="nav-item">
25     <a class="nav-link " data-toggle="pill" href="#home" onclick="
26       window.location.href='home.html'">Home</a>
27   </li>
28   <li class="nav-item">
29     <a class="nav-link" data-toggle="pill" href="#prediction"
30       onclick="window.location.href='prediction.html'">Stock Price
31       Prediction</a>
32   </li>
33   <li class="nav-item">
34     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
35       window.location.href='analysis.html'">Historical Analysis</a>
36   </li>
37   <li class="nav-item">
38     <a class="nav-link active" data-toggle="pill" href="#movers"
39       onclick="window.location.href='movers.html'"> Market Movers</a>
40   </li>
41   <li class="nav-item">
42     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
43       window.location.href='compare.html'">Compare Stocks</a>
44   </li>
45   <li class="nav-item">
46     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
47       window.location.href='measure.html'">Measure Trends</a>
48   </li>
49   <li class="nav-item">
50     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
51       window.location.href='/'>Logout</a>
52   </li>
53 </ul>
54
55 <!-- Tab panes -->
56 <div class="tab-content">
57   <div class="tab-pane container fade" id="home"> </div>
58   <div class="tab-pane container fade" id="prediction"></div>
59   <div class="tab-pane container fade" id="analysis"></div>
60   <div class="tab-pane container active" id="movers">
61
62     <div class="container mx-auto">
63       <form method="post" request="/moversResult.html">
64         {% csrf_token %}
65         <div class="form-row mt-5 ">
66           <div class="form-group col mx-auto my-auto ">
67             <label for="inputType"><b>Select type </b></label>
68
69           </div>
70
71           <div class="form-group col mx-auto my-auto">

```

```

66         <select id="inputType" class="form-control custom-select"
name="Duration" required>
67         <!-- <option selected>Choose...</option> -->
68         <option {% if selectedType == "Last day" %}>selected="
selected"{% endif %}>
69             Last day </option>
70             <option {% if selectedType == "Weekly" %}>selected="
selected"{% endif %}>
71                 Weekly </option>
72             <option {% if selectedType == "Monthly" %}>selected="
selected"{% endif %}>
73                 Monthly</option>
74
75         <option {% if selectedType == "Yearly" %}>selected="selected
"{% endif %}>
76             Yearly</option>
77         </select>
78     </div>
79     <div class="form-group col mx-auto my-auto">
80         <label for="inputRange"><b>Select Entry </b></label>
81
82     </div>
83
84     <div class="form-group col my-auto mr-5">
85
86         <select id="inputRange" class="form-control custom-select"
name="Input Range" required>
87         <!-- <option selected>Choose...</option> -->
88         <option {% if selectedRange == "Top 5" %}>
selected="selected"{% endif %}>
89             Top 5 </option>
90             <option {% if selectedRange == "Top 10" %}>
selected="selected"{% endif %}>
91                 Top 10 </option>
92             <option {% if selectedRange == "Top 20" %}>
selected="selected"{% endif %}>
93                 Top 20 </option>
94             <option {% if selectedRange == "Top 30" %}>
selected="selected"{% endif %}>
95                 Top 30 </option>
96         </select>
97     </div>
98
99     <div class="form-group col mx-auto my-auto">
100
101         <button type="submit" class="btn btn-primary"> Get Gainers/
Losers</button>
102     </div>
103
104 </div>
105
106
107 </form>
108 </div>

```

```

109     <div class="row mt-5 ml-5">
110         <div class=" col overflow-auto px-md-5">
111             <div class="col-md-12">
112                 <label class="text-center" for="Gainers"><b>
Gainers </b></label>
113             </div>
114
115
116
117         </div>
118         <div class=" col overflow-auto px-md-5">
119             <div class="col-md-12"> <label class="text-center"
for="Losers"><b> Losers </b></label> </div>
120         </div>
121
122     </div>
123     <div class="row mt-5">
124
125
126         <div class=" col-md-6 overflow-auto " style="height:
500px; width: 100%;">
127             <div class="col-md-12">
128                 {% autoescape off %}
129                 {{ dataDfHighValues| safe }}
130                 {% endautoescape off %}
131             </div>
132         </div>
133
134
135         <div class=" col-md-6 overflow-auto " style="height:
500px; width: 100%;">
136             <div class="col-md-12">
137                 {% autoescape off %}
138                 {{ dataDfLowValues| safe }}
139                 {% endautoescape off %}
140             </div>
141         </div>
142
143     </div>
144 </div>
145
146 <div class="tab-pane container fade" id="compare"></div>
147 <div class="tab-pane container fade" id="measure"></div>
148 </div>
149
150 </body>
151 </html>

```

Code A.2.3.23: moversResult.html

5. For predicting stock price

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>

```

```

4 <title>Home Page</title>
5 <meta charset="utf-8">
6 <meta name="viewport" content="width=device-width, initial-scale=1
  ">
7 <style>
8 body {
9     background: #e6ffff;
10    background: linear-gradient(to right,#e6ffff , #33ffff);
11 }
12
13 .div11 {
14     background-color: #66ffff;
15     width: 1330px;
16     border: 3px solid blue;
17     padding: 5px;
18     margin: 5px;
19     height:470px;
20
21 }
22
23 .div1 {
24     background-color: #66ffff;
25     width:450px;
26     border: 3px solid yellow;
27     padding: 5px;
28     margin: 5px;
29     height:450px;
30
31 }
32
33 </style>
34 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
  bootstrap/4.4.1/css/bootstrap.min.css">
35 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
  jquery.min.js"></script>
36 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
  /1.16.0/umd/popper.min.js"></script>
37 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
  bootstrap.min.js"></script>
38 </head>
39 <body>
40
41 <!-- Nav pills -->
42
43 <ul class="nav nav-pills nav-justified">
44     <li class="nav-item">
45         <a class="nav-link " data-toggle="pill" href="#home" onclick="
  window.location.href='home.html'">Home</a>
46     </li>
47     <li class="nav-item">
48         <a class="nav-link active" data-toggle="pill" href="#prediction"
  onclick="window.location.href='prediction.html'">Stock Price
  Prediction</a>
49     </li>

```

```

50     <li class="nav-item">
51         <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
window.location.href='analysis.html'">Historical Analysis</a>
52     </li>
53     <li class="nav-item">
54         <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
55     </li>
56     <li class="nav-item">
57         <a class="nav-link" data-toggle="pill" href="#compare" onclick="
window.location.href='compare.html'">Compare Stocks</a>
58     </li>
59     <li class="nav-item">
60         <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
61     </li>
62     <li class="nav-item">
63         <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'>Logout</a>
64     </li>
65 </ul>
66
67
68 <!-- Tab panes -->
69
70 <div class="tab-content">
71     <div class="tab-pane container active" id="prediction">
72         <div class="container mx-auto">
73             <form method="POST" action="/predictionResult.html">
74                 {% csrf_token %}
75                 <div class="form-row mx-5 my-5">
76                     <div class="form-group col-md-4 mx-4 my-4">
77                         <label for="inputStock"><b> Stock Name </b></label>
78                         <select id="inputStock" class="form-control custom-select"
name="Stock Name" required autofocus>
79                             <!-- <option selected>Choose...</option> -->
80                             {% for entry in stocknames %}
81                             <option value={{entry}}>{{ entry}}</option>
82                             {% endfor %}
83                         </select>
84                     </div>
85                     <div class="form-group col-md-3 mx-4 my-4">
86                         <label for="inputDay"><b>Select Day </b></label>
87                         <select id="inputDay" class="form-control custom-select"
name="Input Day" required>
88                             <!-- <option selected>Choose...</option> -->
89                             <option> Next Day prediction</option>
90                             <option> weekly prediction</option>
91                             <option> monthly prediction</option>
92                             <option> yearly prediction</option>
93                         </select>
94                     </div>
95                     <div class="form-group col-md-2 mx-4 my-4">
96                         <label><b> Click below </b> </label>

```

```

97         <button type="submit" class="btn btn-primary"> Check price
98     </button>
99 </div>
100
101
102 </form>
103 </div>
104
105 </div>
106 <div class="tab-pane container fade" id="home"> </div>
107 <div class="tab-pane container fade" id="analysis"></div>
108 <div class="tab-pane container fade" id="movers"></div>
109 <div class="tab-pane container fade" id="compare"></div>
110 <div class="tab-pane container fade" id="measure"></div>
111 </div>
112
113 </body>
114 </html>

```

Code A.2.3.24: prediction.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4     <title>Home Page</title>
5     <meta charset="utf-8">
6     <meta name="viewport" content="width=device-width, initial-scale=1
7         ">
8     <style>
9     body {
10         background: #e6ffff;
11         background: linear-gradient(to right,#e6ffff , #33ffff);
12     }
13
14     .div11 {
15         background-color: #66ffff;
16         width: 1330px;
17         border: 3px solid blue;
18         padding: 5px;
19         margin: 5px;
20         height:470px;
21     }
22
23     .div1 {
24         background-color: #66ffff;
25         width:450px;
26         border: 3px solid yellow;
27         padding: 5px;
28         margin: 5px;
29         height:450px;
30     }
31

```



```

32
33 </style>
34 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
35 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
jquery.min.js"></script>
36 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
/1.16.0/umd/popper.min.js"></script>
37 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
38 <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
39 </head>
40 <body>
41
42 <!-- Nav pills -->
43
44 <ul class="nav nav-pills nav-justified">
45   <li class="nav-item">
46     <a class="nav-link " data-toggle="pill" href="#home" onclick="
window.location.href='home.html'">Home</a>
47   </li>
48   <li class="nav-item">
49     <a class="nav-link active" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
50   </li>
51   <li class="nav-item">
52     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
window.location.href='analysis.html'">Historical Analysis</a>
53   </li>
54   <li class="nav-item">
55     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
56   </li>
57   <li class="nav-item">
58     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
window.location.href='compare.html'">Compare Stocks</a>
59   </li>
60   <li class="nav-item">
61     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
62   </li>
63   <li class="nav-item">
64     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'>Logout</a>
65   </li>
66 </ul>
67
68
69 <!-- Tab panes -->
70
71 <div class="tab-content">
72   <div class="tab-pane container active" id="prediction">
73     <div class="container mx-auto">

```

```

74 <form method="POST" action="/predictionResult.html">
75     {% csrf_token %}
76     <div class="form-row mx-5 my-5">
77         <div class="form-group col-md-4 mx-4 my-4">
78             <label for="inputStock"><b> Stock Name </b></label>
79             <select id="inputStock" class="form-control custom-select"
name="Stock Name" required autofocus>
80                 <!-- <option selected>Choose...</option> -->
81
82                 {% for entry in stocknames %}
83                 <option value="{{entry}}"
84                     {% if entry == selectedStock %>selected="
selected"{% endif %}>
85                     {{ entry}}
86                 </option>
87                 {% endfor %}
88             </select>
89         </div>
90         <div class="form-group col-md-3 mx-4 my-4">
91             <label for="inputDay"><b>Select Day </b></label>
92             <select id="inputDay" class="form-control custom-select"
name="Input Day" required>
93                 <!-- <option selected>Choose...</option> -->
94                 <option {% if selectedDay == "Next Day prediction" %}
selected="selected"{% endif %}>
95                     Next Day prediction</option>
96                 <option {% if selectedDay == "weekly prediction" %}selected
="selected"{% endif %}>
97                     weekly prediction</option>
98                 <option {% if selectedDay == "monthly prediction" %}selected
="selected"{% endif %}>
99                     monthly prediction</option>
100                 <option {% if selectedDay == "yearly prediction" %}selected
="selected"{% endif %}>
101                     yearly prediction</option>
102             </select>
103         </div>
104         <div class="form-group col-md-2 mx-4 my-4">
105             <label><b> Click below </b> </label>
106             <button type="submit" class="btn btn-primary"> Check price
</button>
107         </div>
108     </div>
109
110 <div>
111
112 </div>
113
114 <div class="overflow-auto mx-auto mt-5" style="height: 500px;
width: 100%;">
115     {% autoescape off %}
116         {{ plot_div }}
117     {% endautoescape off %}
118 </div>

```

```

119     </form>
120   </div>
121
122
123
124
125   </div>
126   <div class="tab-pane container fade" id="home"> </div>
127   <div class="tab-pane container fade" id="analysis"></div>
128   <div class="tab-pane container fade" id="movers"></div>
129   <div class="tab-pane container fade" id="compare"></div>
130   <div class="tab-pane container fade" id="measure"></div>
131 </div>
132
133 </body>
134 </html>

```

Code A.2.3.25: predictionResult.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Prediction Page</title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1">
7   <style>
8     body {
9       background: #e6ffff;
10      background: linear-gradient(to right,#e6ffff , #33ffff);
11    }
12
13    .div11 {
14      background-color: #66ffff;
15      width: 1330px;
16      border: 3px solid blue;
17      padding: 5px;
18      margin: 5px;
19      height:470px;
20
21    }
22
23    .div1 {
24      background-color: #66ffff;
25      width:450px;
26      border: 3px solid yellow;
27      padding: 5px;
28      margin: 5px;
29      height:450px;
30
31    }
32
33  </style>

```

```

34 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
35 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
jquery.min.js"></script>
36 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
/1.16.0/umd/popper.min.js"></script>
37 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
38 </head>
39 <body>
40
41 <!-- Nav pills -->
42
43 <ul class="nav nav-pills nav-justified">
44   <li class="nav-item">
45     <a class="nav-link " data-toggle="pill" href="#home" onclick="
window.location.href='home.html'">Home</a>
46   </li>
47   <li class="nav-item">
48     <a class="nav-link active" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
49   </li>
50   <li class="nav-item">
51     <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
"window.location.href='analysis.html'">Historical Analysis</a>
52   </li>
53   <li class="nav-item">
54     <a class="nav-link" data-toggle="pill" href="#movers" onclick="
window.location.href='movers.html'"> Market Movers</a>
55   </li>
56   <li class="nav-item">
57     <a class="nav-link" data-toggle="pill" href="#compare" onclick="
window.location.href='compare.html'">Compare Stocks</a>
58   </li>
59   <li class="nav-item">
60     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='measure.html'">Measure Trends</a>
61   </li>
62   <li class="nav-item">
63     <a class="nav-link" data-toggle="pill" href="#measure" onclick="
window.location.href='/'>Logout</a>
64   </li>
65 </ul>
66
67
68 <!-- Tab panes -->
69
70 <div class="tab-content">
71   <div class="tab-pane container active" id="prediction">
72     <div class="container mx-auto">
73       <form method="POST" action="/predictionResult.html">
74         {% csrf_token %}
75         <div class="form-row mx-5 my-5">

```

```

76     <div class="form-group col-md-4 mx-4 my-4">
77         <label for="inputStock"><b> Stock Name </b></label>
78         <select id="inputStock" class="form-control custom-select"
name="Stock Name" required autofocus>
79             <!-- <option selected>Choose...</option> -->
80
81             {% for entry in stocknames %}
82             <option value="{{entry}}"
83             {% if entry == selectedStock %}>selected="{{selected"}}{%
endif %}>
84                 {{ entry}}
85             </option>
86             {% endfor %}
87         </select>
88     </div>
89     <div class="form-group col-md-3 mx-4 my-4">
90         <label for="inputDay"><b>Select Day </b></label>
91         <select id="inputDay" class="form-control custom-select"
name="Input Day" required>
92             <!-- <option selected>Choose...</option> -->
93             <option selected="selected" > Next Day prediction</option>
94             <option selected="selected"> weekly prediction</option>
95             <option selected="selected"> monthly prediction</option>
96             <option selected="selected"> yearly prediction</option>
97         </select>
98     </div>
99     <div class="form-group col-md-2 mx-4 my-4">
100         <label><b> Click below </b> </label>
101         <button type="submit" class="btn btn-primary"> Check
price</button>
102     </div>
103 </div>
104     <div class="form-row mx-5 my-5">
105         <div class="form-group col-md-2 mx-auto my-auto">
106             <label><b> Selected stock: </b> </label>
107         </div>
108         <div class="form-group col-md-2 mx-auto my-auto"
>
109             <label><b> {{selectedStock}} </b> </label>
110         </div>
111         <div class="form-group col-md-2 mx-auto my-auto">
112             <label><b> Selected type: </b> </label>
113         </div>
114
115         <div class="form-group col-md-2 mx-auto my-auto">
116             <label><b> {{selectedDay}} </b> </label>
117         </div>
118
119     </div>
120
121     <div class="form-row mx-5 my-5">
122         <h1> No Data found for selected stock</h1>
123
124     </div>

```

```

125
126
127     </form>
128   </div>
129
130 </div>
131 <div class="tab-pane container fade" id="home"> </div>
132 <div class="tab-pane container fade" id="analysis"></div>
133 <div class="tab-pane container fade" id="movers"></div>
134 <div class="tab-pane container fade" id="compare"></div>
135 <div class="tab-pane container fade" id="measure"></div>
136 </div>
137
138 </body>
139 </html>

```

Code A.2.3.26: predictionResultNoData.html

6. For login and signup page

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4
5   <title>Login page</title>
6   <meta charset="utf-8">
7   <meta name="viewport" content="width=device-width, initial-scale=1
8     ">
9   <style>
10   body {
11     background: #e6ffff;
12     background: linear-gradient(to right,#e6ffff , #33ffff);
13   }
14
15   .labelclass{
16     margin-bottom: 2rem;
17   }
18
19   .center{
20     display: block;
21     margin-left: auto;
22     margin-right: auto;
23     width: 25%;
24     height: 25%;
25   }
26
27 </style>
28
29 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
30   bootstrap/4.4.1/css/bootstrap.min.css">
31 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
32   jquery.min.js"></script>
33 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
34   /1.16.0/umd/popper.min.js"></script>

```

```

32 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
    bootstrap.min.js"></script>
33
34
35 </head>
36
37
38 <body>
39     {% block body_block %}
40
41     <div class="container">
42
43     <div class="col-sm-9 col-md-7 col-lg-5 mx-auto">
44         <div class="card my-5">
45             <div class="card-body">
46
47                 {% if registered %}
48                 <h1>Thank you for registering!</h1>
49                 <a href="#login" onclick="window.location.href
50 = '/'"><h1> Login here again!</h1></a>
51
52                 {% else %}
53                 <h1> Register here </h1>
54                 <form enctype="multipart/form-data" method="POST"
55 autocomplete="off">
56                 {% csrf_token %}
57                 {{user_form.as_p}}
58
59                 <div class="labelclass">
60
61                     <div class="labelclass">
62                         <input type="submit" name="" value="
63 Register">
64
65                     </div>
66                     <a href="#login" onclick="window.location.
67 href= '/'"> Login instead!</a>
68                 </form>
69
70                 {% endif %}
71
72             </div>
73         </div>
74     </div>
75 </body>
76
77 </html>

```

Code A.2.3.27: signup.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4
5   <title>Login page</title>
6   <meta charset="utf-8">
7   <meta name="viewport" content="width=device-width, initial-scale=1
8     ">
9   <style>
10   body {
11     background: #e6ffff;
12     background: linear-gradient(to right,#e6ffff , #33ffff);
13   }
14
15   .labelclass{
16     margin-bottom: 2rem;
17   }
18
19   .center{
20     display: block;
21     margin-left: auto;
22     margin-right: auto;
23     width: 25%;
24     height: 25%;
25   }
26
27 </style>
28
29 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
30   bootstrap/4.4.1/css/bootstrap.min.css">
31 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
32   jquery.min.js"></script>
33 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
34   /1.16.0/umd/popper.min.js"></script>
35 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
36   bootstrap.min.js"></script>
37
38 </head>
39
40 <body>
41   <form method="post" autocomplete="off" >
42     {% csrf_token %}
43     <div class="container">
44
45       <div class="col-sm-9 col-md-7 col-lg-5 mx-auto">
46         <div class="card my-5">
47           <div class="card-body">
48             <h5 class="card-title text-center">Log In</h5>
49
50             <!--{{form.as_p}} -->

```



```

49         <div class="labelclass">
50             <label for="username"><b> User Name </b></label>
51                 <input type="text" id="username" name="
username" class="form-control" " required autofocus>
52         </div>
53         <div class="labelclass">
54             <label for="password"><b> Password </b></label>
55                 <input type="password" id="password" name="
password" class="form-control" placeholder="Password" required>
56         </div>
57
58
59         <div class="labelclass">
60             <button class="btn btn-lg btn-primary btn-block text
-uppercase" type="submit">Log in</button>
61         </div>
62         <a class="text-center" href="#signup" onclick="window.
location.href='signup.html'"> Sign Up</a>
63
64     </div>
65 </div>
66 </div>
67 </div>
68 </form>
69
70 </body>
71
72 </html>

```

Code A.2.3.28: Loginpage.html

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4
5     <title>Login page</title>
6     <meta charset="utf-8">
7     <meta name="viewport" content="width=device-width, initial-scale=1
">
8     <style>
9     body {
10         background: #e6ffff;
11         background: linear-gradient(to right,#e6ffff , #33ffff);
12     }
13
14     .labelclass{
15         margin-bottom: 2rem;
16     }
17
18     .center{
19         display: block;
20         margin-left: auto;
21         margin-right: auto;
22         width: 25%;

```

```

23     height: 25%;
24
25 }
26
27 </style>
28
29 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
    bootstrap/4.4.1/css/bootstrap.min.css">
30 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
    jquery.min.js"></script>
31 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
    /1.16.0/umd/popper.min.js"></script>
32 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
    bootstrap.min.js"></script>
33
34
35 </head>
36
37
38 <body>
39   <form method="post" autocomplete="off" >
40     {% csrf_token %}
41     <div class="container">
42
43       <div class="col-sm-9 col-md-7 col-lg-5 mx-auto">
44         <div class="card my-5">
45           <div class="card-body">
46
47             <h1> Incorrect credentials</h1>
48             <a class="text-center" href="#signup" onclick="window.
    location.href='LoginPage.html'"> <h1>Login back</h1></a>
49
50           </div>
51         </div>
52       </div>
53     </div>
54   </form>
55
56 </body>
57
58 </html>

```

Code A.2.3.29: invalidLogin.html

7. Home page

```

1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <title>Home Page</title>
5   <meta charset="utf-8">
6   <meta name="viewport" content="width=device-width, initial-scale=1
    ">
7   <style>
8   body {

```

```

9     background: #e6ffff;
10     background: linear-gradient(to right,#e6ffff , #33ffff);
11 }
12
13 </style>
14 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/
bootstrap/4.4.1/css/bootstrap.min.css">
15 <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/
jquery.min.js"></script>
16 <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js
/1.16.0/umd/popper.min.js"></script>
17 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.4.1/js/
bootstrap.min.js"></script>
18 </head>
19 <body>
20
21 <!-- Nav pills -->
22
23 <ul class="nav nav-pills nav-justified">
24     <li class="nav-item">
25         <a class="nav-link active" data-toggle="pill" href="#home"
onclick="window.location.href='home.html'">Home</a>
26     </li>
27     <li class="nav-item">
28         <a class="nav-link" data-toggle="pill" href="#prediction"
onclick="window.location.href='prediction.html'">Stock Price
Prediction</a>
29     </li>
30     <li class="nav-item">
31         <a class="nav-link" data-toggle="pill" href="#analysis" onclick="
>window.location.href='analysis.html'">Historical Analysis</a>
32     </li>
33     <li class="nav-item">
34         <a class="nav-link" data-toggle="pill" href="#movers" onclick="
>window.location.href='movers.html'"> Market Movers</a>
35     </li>
36     <li class="nav-item">
37         <a class="nav-link" data-toggle="pill" href="#compare" onclick="
>window.location.href='compare.html'">Compare Stocks</a>
38     </li>
39     <li class="nav-item">
40         <a class="nav-link" data-toggle="pill" href="#measure" onclick="
>window.location.href='measure.html'">Measure Trends</a>
41     </li>
42     <li class="nav-item">
43         <a class="nav-link" data-toggle="pill" href="#measure" onclick
="window.location.href='/'">Logout</a>
44     </li>
45 </ul>
46
47
48 <!-- Tab panes -->
49 <div class="tab-content">
50     <div class="tab-pane container active" id="home">

```

```

51 <div class="container">
52
53
54     <div class="card my-5">
55         <div class="card-body">
56             <h5 class="card-title text-center">Overview </h5>
57
58         </div>
59     </div>
60
61
62 </div>
63
64 </div>
65
66 <div class="tab-pane container fade" id="prediction"></div>
67 <div class="tab-pane container fade" id="analysis"></div>
68 <div class="tab-pane container fade" id="movers"></div>
69 <div class="tab-pane container fade" id="compare"></div>
70 <div class="tab-pane container fade" id="measure"></div>
71 </div>
72
73 </body>
74 </html>

```

Code A.2.3.30: home.html

A.2.4 Execution

The execution of Django project is done with the help of manage.py file and command used is - python manage.py runserver

```

1 #!/usr/bin/env python
2 """Django's command-line utility for administrative tasks."""
3 import os
4 import sys
5
6
7 def main():
8     os.environ.setdefault('DJANGO_SETTINGS_MODULE', 'Finance.settings')
9     try:
10         from django.core.management import execute_from_command_line
11     except ImportError as exc:
12         raise ImportError(
13             "Couldn't import Django. Are you sure it's installed and "
14             "available on your PYTHONPATH environment variable? Did you "
15             "forget to activate a virtual environment?"
16         ) from exc
17     execute_from_command_line(sys.argv)
18
19
20 if __name__ == '__main__':
21     main()

```

Code A.2.4.1: manage.py

A.2.5 Initial testing of jobs using ab-benchmark tool

```
1 #!/bin/bash
2
3 measure=0
4 mover=0
5 prediction=0
6 analysis=0
7 compare=0
8 measure=`ab -n 1 -c 1 http://127.0.0.1:7000/measure.html | grep Total:
   | awk '{print $3}'`
9 mover=`ab -n 1 -c 1 http://127.0.0.1:7000/movers.html | grep Total: |
   awk '{print $3}'`
10 prediction=`ab -n 1 -c 1 http://127.0.0.1:7000/prediction.html | grep
   Total: | awk '{print $3}'`
11 analysis=`ab -n 1 -c 1 http://127.0.0.1:7000/analysis.html | grep Total:
   | awk '{print $3}'`
12 compare=`ab -n 1 -c 1 http://127.0.0.1:7000/compare.html | grep Total: |
   awk '{print $3}'`
13 echo "measure, $measure"
14 echo "mover, $mover"
15 echo "prediction, $prediction"
16 echo "analysis, $analysis"
17 echo "compare, $compare"
18
19 measure=0
20 mover=0
21 prediction=0
22 analysis=0
23 compare=0
24 measure=`ab -n 1 -c 1 http://127.0.0.1:7000/measureResults.html | grep
   Total: | awk '{print $3}'`
25 mover=`ab -n 1 -c 1 http://127.0.0.1:7000/moversResult.html | grep Total
   : | awk '{print $3}'`
26 prediction=`ab -n 1 -c 1 http://127.0.0.1:7000/predictionResult.html |
   grep Total: | awk '{print $3}'`
27 analysis=`ab -n 1 -c 1 http://127.0.0.1:7000/analysisResult.html | grep
   Total: | awk '{print $3}'`
28 compare=`ab -n 1 -c 1 http://127.0.0.1:7000/compareResult.html | grep
   Total: | awk '{print $3}'`
29 echo "measure, $measure"
30 echo "mover, $mover"
31 echo "prediction, $prediction"
32 echo "analysis, $analysis"
33 echo "compare, $compare"
```

Code A.2.5.1: Execution time for all the types of job requests using ab-benchmark tool

Below is the output generated using above script -

Type of Job	GET Request(in ms)	POST Request(in ms)
measure	12	25
mover	2	22
prediction	7	21
analysis	10	20
compare	18	20

Table A.1: Execution time for all the types of job requests using ab-benchmark tool

A.3 Comparison of application hosted on IBM and AWS Cloud

A.3.1 Web application on IBM Cloud

A free tier account was created on IBM Cloud with basic services provided by the cloud to deploy web application. A Django application can be deployed by creating a cloud foundry app with the help of Django management script. Web application was successfully deployed on IBM Cloud and given below are images indicating the successful deployment of web application-

Figure A.4: Dashboard of web application hosted on IBM Cloud

```
(env3) dmp@workstation:~/dummy/testFinWeb/IBMCLOUD/SecondVersionUpdatedPrediction/Finance$ python manage.py bluemix init Finance3
/home/dmp/finance3/UpdatedPrediction/env3/lib/python3.7/site-packages/pandas_datareader/compat/_init_.py:7: FutureWarning:
pandas.utl.testing is deprecated. Use the functions in the public API at pandas.testing instead.

Project successfully configured for: Finance3
(env3) dmp@workstation:~/dummy/testFinWeb/IBMCLOUD/SecondVersionUpdatedPrediction/Finance$ bx app push -n 256M
Invoking 'cf push -n 256M'...

Pushing from manifest to org dmp@jaiswal / space dev as dmp@jaiswal@gmail.com...
Using manifest file /home/dmp/finance3/UpdatedPrediction/env3/lib/python3.7/site-packages/pandas_datareader/compat/_init_.py:7: FutureWarning:
Getting app info...
Updating app with these attributes...
  name: Finance3
  path: /home/dmp/finance3/UpdatedPrediction/env3/lib/python3.7/site-packages/pandas_datareader/compat/_init_.py:7: FutureWarning:
  disk quota: 1G
  health check type: port
  instances: 1
  memory: 256M
  stack: cflinuxfs3
  routes: finance3.myluemix.net

Updating app Finance3...
Mapping routes...
Comparing local files to remote cache...
Packaging files to upload...
Uploading files...
118.24 KiB / 118.24 KiB [=====] 100.00% 1s

Waiting for API to complete processing files...

Staging app and tracing logs...
  Downloading liberty-for-java_v3_41-20200207-0830...
  Downloading binary_buildpack...
  Downloading dotnet-core_v2_4-20190912-1554...
  Downloading dotnet-core_v2_5-20191209-1920...
  Downloading liberty-for-java_v3_36-20190905-1704...
  Downloaded dotnet-core_v2_4-20190912-1554
  Downloading liberty-for-java_v3_40-20200108-1523...
  Downloaded dotnet-core_v2_5-20191209-1920
  Downloading swift_buildpack_v2_0_18-20190303-1915...
  Downloaded liberty-for-java_v3_36-20190905-1704
  Downloading liberty-for-java...
  Downloaded liberty-for-java_v3_40-20200108-1523
  Downloading sdk-for-nodejs...
  Downloaded liberty-for-java_v3_41-20200207-0830
  Downloading dotnet-core...
  Downloaded liberty-for-java
  Downloading swift_buildpack...
```

Figure A.5: Deployment of web application on IBM Cloud- part 1

```
File Edit View Search Terminal Help
dmp@workstation: ~/dummy/testFinWeb/IBMCLOUD/SecondVersionUpdatedPrediction/Finance

Running setup.py install for msgpack-python: finished with status 'done'
Running setup.py install for putils: started
Running setup.py install for putils: finished with status 'done'
The script located in /tmp/content/09750302/dmp/finance3/bin which is not on PATH.
Consider adding this path to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
Running setup.py install for multitasking: started
Running setup.py install for multitasking: finished with status 'done'
The script located in /tmp/content/09750302/dmp/finance3/bin which is not on PATH.
Consider adding this path to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
Running setup.py install for retrying: started
Running setup.py install for retrying: finished with status 'done'
Running setup.py install for yfinance: started
Running setup.py install for yfinance: finished with status 'done'
Running setup.py install for static3: started
Running setup.py install for static3: finished with status 'done'
Running setup.py install for dj-static: started
Running setup.py install for dj-static: finished with status 'done'
The script located in /tmp/content/09750302/dmp/finance3/bin which is not on PATH.
Consider adding this path to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.

Successfully installed Click-7.0 ConfigArgParse-1.0 DateLine-4.3 Django-3.0.3 Flask-1.1.1 Jinja2-2.11.1 MarkupSafe-1.1.1 Pillow-7.0.0 Werkzeug-1.0.0 asgiref-3.2.3 certifi-2019.11.28 chardet-3.0.4 dj-st
atic-0.6.0 gevent-1.5.2 greenlet-0.4.15 gunicorn-19.1.1 idna-2.9 itsdangerous-1.1.0 joblib-0.14.1 locustio-0.14.4 lxml-4.5.0 msgpack-python-0.5.6 multitasking-0.0.9 numpy-1.18.
5 pandas-1.0.1 pandas-datareader-0.10.1 ply-4.0.1 putils-5.0 python-dateutil-2.8.1 pytz-2019.3 pyyaml-5.1.1 requests-2.23.0 retrying-1.3.3 schedule-0.6.0 scikit-learn-0.22.1 scipy-1.4.1 setuptools-45.2.0 six
-1.14.0 sqparse-0.3.0 static3-0.7.0 urllib3-1.25.8 yfinance-0.1.54 zope.interface-4.7.1

Running python /tmp/app/manage.py collectstatic --noinput --traceback
130 static files copied to /tmp/app/staticfiles...
Exit status 0
Uploading droplet, build artifacts cache...
Uploading droplet...
Uploading build artifacts cache...
Uploaded build artifacts cache (43.3M)
Uploaded droplet (169.6M)
Uploading complete
Cell d338ee1-rbf-4a02-b5bd-cad09f384f63 stopping instance 0726315d-0839-43f8-bbd3-98d299327d30
Cell d338ee1-rbf-4a02-b5bd-cad09f384f63 destroying container for instance 0726315d-0839-43f8-bbd3-98d299327d30
Cell d338ee1-rbf-4a02-b5bd-cad09f384f63 successfully destroyed container for instance 0726315d-0839-43f8-bbd3-98d299327d30

Waiting for app to start...

Name: Finance3
Requested state: started
Routes: finance3.myluemix.net
Last uploaded: Sat 22 Feb 17:22:59 CST 2020
Stack: cflinuxfs3
Buildpacks: python

Type: web
Instances: 1/1
Memory usage: 256M
Start command: python manage.py migrate && gunicorn Finance.wsgi --log-file -
State: since
CPU: 0.0%
Memory: 48K of 256M
Disk: 504.3M of 1G
Env: running
2020-02-22T17:23:17Z

(env3) dmp@workstation:~/dummy/testFinWeb/IBMCLOUD/SecondVersionUpdatedPrediction/Finance$
```

Figure A.6: Deployment of web application on IBM Cloud- part 2

A.3.2 Web application on AWS Cloud

A free tier account was created on AWS Cloud. Free tier account of AWS Cloud provides a variety of services and dashboard provide a lot of information for analysis. A Django application can be deployed with the help of AWS Elastic Beanstalk. Given below are images indicating the successful deployment of web application-

A.3.3 Stress load testing using ab-benchmark tool

Stress load testing was conducted after hosting the web application on both- IBM and AWS Cloud using Apache bechmarking tool. Below given is the shell script and its output.

```
1 #!/bin/bash
2
3
4 echo "Measure results" >> /home/dimple/Desktop/AbbenchmarkingResults.
  txt
5 echo "ibm , aws" >> /home/dimple/Desktop/AbbenchmarkingResults.txt
6
7 n=0
8 val=1
9 ibm=0
10 aws=0
11 # continue until $n equals 10
12 while [ $n -le 10 ]
13 do
14     val=$((2*n))
15     echo "ibm"
16     # ab -n 1024 -c $val http://finance3.mybluemix.net/measure.html | grep
      Total: | awk '{print $3}' >> /home/dimple/Desktop/
      AbbenchmarkingResults.txt
17     ibm=`ab -n 1024 -c $val http://finance3.mybluemix.net/measure.html |
      grep Total: | awk '{print $3}'`
18     echo "aws"
19     aws=`ab -n 1024 -c $val http://test-env.eba-eryefpmw.us-west-2.
      elasticbeanstalk.com/measure.html | grep Total: | awk '{print $3}'`
20     echo "$ibm , $aws " >> /home/dimple/Desktop/AbbenchmarkingResults.txt
21     echo "$n"
22     n=$(( n+ 1 )) # increments $n
23     sleep 2m
24 done
25
26 sleep 2m
27 echo " "
28 echo "Prediction results" >> /home/dimple/Desktop/AbbenchmarkingResults
  .txt
29 echo "ibm , aws" >> /home/dimple/Desktop/AbbenchmarkingResults.txt
30 n=0
31 val=1
32 ibm=0
33 aws=0
34 # continue until $n equals 10
35 while [ $n -le 10 ]
36 do
37     val=$((2*n))
38     echo "ibm"
39     ibm=`ab -n 1024 -c $val http://finance3.mybluemix.net/prediction.html
      | grep Total: | awk '{print $3}'`
40     echo "aws"
41     aws=`ab -n 1024 -c $val http://test-env.eba-eryefpmw.us-west-2.
```

```

        elasticbeanstalk.com/prediction.html | grep Total: | awk '{print $3}'
    ,`
42 echo "$ibm , $aws " >> /home/dimple/Desktop/AbbenchmarkingResults.txt
43 echo "$n"
44 n=$(( n+ 1 )) # increments $n
45 sleep 2m
46 done
47
48 sleep 2m
49 echo " "
50 echo "historical analysis results" >> /home/dimple/Desktop/
    AbbenchmarkingResults.txt
51 echo "ibm , aws" >> /home/dimple/Desktop/AbbenchmarkingResults.txt
52 n=0
53 val=1
54 ibm=0
55 aws=0
56 # continue until $n equals 10
57 while [ $n -le 10 ]
58 do
59     val=$((2**n))
60     echo "ibm"
61     ibm=`ab -n 1024 -c $val http://finance3.mybluemix.net/analysis.html |
        grep Total: | awk '{print $3}'`
62     echo "aws"
63     aws=`ab -n 1024 -c $val http://test-env.eba-eryefpmw.us-west-2.
        elasticbeanstalk.com/analysis.html | grep Total: | awk '{print $3}'`
64     echo "$ibm , $aws " >> /home/dimple/Desktop/AbbenchmarkingResults.txt
65     echo "$n"
66     n=$(( n+ 1 )) # increments $n
67     sleep 2m
68 done
69
70
71 sleep 2m
72 echo " "
73 echo "Market movers results" >> /home/dimple/Desktop/
    AbbenchmarkingResults.txt
74 echo "ibm , aws" >> /home/dimple/Desktop/AbbenchmarkingResults.txt
75 n=0
76 val=1
77 ibm=0
78 aws=0
79 # continue until $n equals 10
80 while [ $n -le 10 ]
81 do
82     val=$((2**n))
83     echo "ibm"
84     ibm=`ab -n 1024 -c $val http://finance3.mybluemix.net/movers.html |
        grep Total: | awk '{print $3}'`
85     echo "aws"
86     aws=`ab -n 1024 -c $val http://test-env.eba-eryefpmw.us-west-2.
        elasticbeanstalk.com/movers.html | grep Total: | awk '{print $3}'`
87     echo "$ibm , $aws " >> /home/dimple/Desktop/AbbenchmarkingResults.txt

```

```

88  echo "$n"
89  n=$(( n+ 1 )) # increments $n
90  sleep 2m
91  done
92
93  sleep 2m
94  echo " "
95  echo "Compare stock results" >> /home/dimple/Desktop/
    AbbenchmarkingResults.txt
96  echo "ibm , aws" >> /home/dimple/Desktop/AbbenchmarkingResults.txt
97  n=0
98  val=1
99  ibm=0
100 aws=0
101 # continue until $n equals 10
102 while [ $n -le 10 ]
103 do
104     val=$((2**n))
105     echo "ibm"
106     ibm=`ab -n 1024 -c $val http://finance3.mybluemix.net/compare.html |
        grep Total: | awk '{print $3}'`
107     echo "aws"
108     aws=`ab -n 1024 -c $val http://test-env.eba-eryefpmw.us-west-2.
        elasticbeanstalk.com/compare.html | grep Total: | awk '{print $3}'`
109     echo "$ibm , $aws " >> /home/dimple/Desktop/AbbenchmarkingResults.txt
110     echo "$n"
111     n=$(( n+ 1 )) # increments $n
112     sleep 2m
113 done

```

Code A.3.3.1: Shell script for load testing

Below is the output generated by shell script for load testing-

Total Number of	Measure Trends	Results
Concurrent Users	IBM(in ms)	AWS(in ms)
2	234	279
4	238	266
8	249	287
16	368	328
32	752	366
64	1434	446
128	2856	716
252	5241	1565
512	1280	-
1024	1070	-
Total Number of	Prediction	Results
Concurrent Users	IBM(in ms)	AWS(in ms)
2	178	-

4	179	-
8	191	-
16	188	297
32	20515	119
64	6617	120
128	1470	120
252	4568	121
512	695	126
1024	868	170
Total Number of	Historical Analysis	Results
Concurrent Users	IBM(in ms)	AWS(in ms)
2	228	119
4	234	120
8	240	119
16	318	121
32	564	121
64	1194	121
128	2589	121
252	4960	124
512	746	128
1024	1157	168
Total Number of	Market Movers	Results
Concurrent Users	IBM(in ms)	AWS(in ms)
2	106	119
4	110	120
8	2960	120
16	126	119
32	188	119
64	186	120
128	424	120
252	548	122
512	528	128
1024	587	168
Total Number of	Compare Stock	Results
Concurrent Users	IBM(in ms)	AWS(in ms)
2	336	119
4	345	119
8	419	119
16	632	119

32	1266	119
64	2574	120
128	4428	120
252	14250	122
512	1156	126
1024	1201	157

Table A.2: Shell script output for load testing

A.4 Generation of training dataset

To design and develop effective load balancing component using supervised machine learning technique, training dataset was required to train algorithm. Here, training dataset was generated using Locust, an open source load testing tool available to test how many concurrent users can be handled by a web-sites (or other systems). This is implemented by writing a locustfile. All the data generated using locust can be found here: <https://github.com/dimplejaishwal95?tab=repositories>. Below is the locustfile for designed financial web application -

```

1 from locust import HttpLocust, TaskSet, task
2 import random
3
4 class UserBehavior(TaskSet):
5
6     def on_start(self):
7         self.login()
8
9
10    def login(self):
11        response = self.client.get('')
12        csrftoken = response.cookies['csrftoken']
13        self.client.post('', {'username': 'dimple', 'password': 'admin', '
14        csrfmiddlewaretoken': csrftoken}, headers={'X-CSRFToken': csrftoken,
15        'Referer': self.parent.host + '' })
16
17    @task(1)
18
19    def prediction(self):
20        response = self.client.get('prediction.html')
21        csrftoken = response.cookies['csrftoken']
22        self.client.post('predictionResult.html', {"Stock Name": 'Amazon.com'
23        , "Input Day": 'Next Day prediction', 'csrfmiddlewaretoken':
24        csrftoken
25        }, headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
26        predictionResult.html'})
27
28    @task(6)

```

```

26 def prediction2(self):
27     response = self.client.get('prediction.html')
28     csrftoken = response.cookies['csrftoken']
29     self.client.post('predictionResult.html', {"Stock Name": 'Amazon.com',
        "Input Day": 'weekly prediction', 'csrfmiddlewaretoken': csrftoken
30
31 }, headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
        predictionResult.html'})
32
33
34 @task(7)
35
36 def prediction3(self):
37     response = self.client.get('prediction.html')
38     csrftoken = response.cookies['csrftoken']
39     self.client.post('predictionResult.html', {"Stock Name": 'Amazon.com',
        "Input Day": 'monthly prediction', 'csrfmiddlewaretoken':
40     csrftoken
41 }, headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
        predictionResult.html'})
42
43 @task(8)
44
45 def prediction4(self):
46     response = self.client.get('prediction.html')
47     csrftoken = response.cookies['csrftoken']
48     self.client.post('predictionResult.html', {"Stock Name": 'Amazon.com',
        "Input Day": 'yearly prediction', 'csrfmiddlewaretoken': csrftoken
49
50 }, headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
        predictionResult.html'})
51
52
53
54 @task(2)
55 def analysis(self):
56     response = self.client.get('analysis.html')
57     csrftoken = response.cookies['csrftoken']
58     self.client.post('analysisResult.html?stock=Apple&type=Table&
        date_from=2015-11-03&date_to=2020-02-20', {"Stock Name": 'Apple', "
        Input Type": 'Table',
59     "date_from": '2015-11-03', 'date_to' : '2020-02-20', '
        csrfmiddlewaretoken': csrftoken},
60
61     headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
        analysisResult.html?stock=Apple&type=Table&date_from=2015-11-03&
        date_to=2020-02-20'})
62
63 @task(9)
64 def analysis1(self):
65     response = self.client.get('analysis.html')

```

```

66     csrftoken = response.cookies['csrftoken']
67     self.client.post('analysisResult.html?stock=Apple&type=Line&
date_from=2015-11-03&date_to=2020-02-20', {"Stock Name": 'Apple', "
Input Type": 'Line',
68     "date_from": '2015-11-03', 'date_to' : '2020-02-20', '
csrfmiddlewaretoken': csrftoken})
69     , headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.
host + 'analysisResult.html?stock=Apple&type=Line&date_from
=2015-11-03&date_to=2020-02-20'})
70 @task(10)
71 def analysis2(self):
72     response = self.client.get('analysis.html')
73     csrftoken = response.cookies['csrftoken']
74     self.client.post('analysisResult.html?stock=Apple&type=Candle&
date_from=2015-11-03&date_to=2020-02-20', {"Stock Name": 'Apple', "
Input Type": 'Candle',
75     "date_from": '2015-11-03', 'date_to' : '2020-02-20', '
csrfmiddlewaretoken': csrftoken})
76     , headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.
host + 'analysisResult.html?stock=Apple&type=Candle&date_from
=2015-11-03&date_to=2020-02-20'})
77
78
79
80 @task(3)
81 def movers(self):
82     response = self.client.get('movers.html')
83     csrftoken = response.cookies['csrftoken']
84     self.client.post('moversResult.html', {"Duration": 'Last day', "Input
Range": 'Top 30', 'csrfmiddlewaretoken': csrftoken}, headers={'X-
CSRFToken': csrftoken , 'Referer': self.parent.host + 'moversResult.
html'})
85
86
87 @task(11)
88 def movers1(self):
89     response = self.client.get('movers.html')
90     csrftoken = response.cookies['csrftoken']
91     self.client.post('moversResult.html', {"Duration": 'Weekly', "Input
Range": 'Top 30', 'csrfmiddlewaretoken': csrftoken}, headers={'X-
CSRFToken': csrftoken , 'Referer': self.parent.host + 'moversResult.
html'})
92
93
94 @task(12)
95 def movers2(self):
96     response = self.client.get('movers.html')
97     csrftoken = response.cookies['csrftoken']
98     self.client.post('moversResult.html', {"Duration": 'Monthly', "Input
Range": 'Top 30', 'csrfmiddlewaretoken': csrftoken}, headers={'X-
CSRFToken': csrftoken , 'Referer': self.parent.host + 'moversResult.
html'})
99
100 @task(13)

```

```

101 def movers3(self):
102     response = self.client.get('movers.html')
103     csrftoken = response.cookies['csrftoken']
104     self.client.post('moversResult.html',{ "Duration":'Yearly', "Input
Range":'Top 30', 'csrfmiddlewaretoken': csrftoken}, headers={'X-
CSRFToken': csrftoken , 'Referer': self.parent.host + 'moversResult.
html'})
105
106
107 @task(4)
108 def compare(self):
109     response = self.client.get('compare.html')
110     csrftoken = response.cookies['csrftoken']
111     self.client.post('compareResult.html?stock1=American&stock2=Adobe&
type=Table&date_from=2015-02-02&date_to=2020-02-20',
112 { "stock1":'American', "stock2" : 'Adobe', "type":'Table', "date_from":'
2015-02-02', "date_to":'2020-02-20' , 'csrfmiddlewaretoken': csrftoken
},
113 headers={'X-CSRFToken': csrftoken , 'Referer': self.parent.host + '
compareResult.html?stock1=American&stock2=Adobe&type=Table&date_from
=2015-02-02&date_to=2020-02-20'})
114
115
116 @task(14)
117 def compare1(self):
118     response = self.client.get('compare.html')
119     csrftoken = response.cookies['csrftoken']
120     self.client.post('compareResult.html?stock1=American&stock2=Adobe&
type=Line&date_from=2015-02-02&date_to=2020-02-20',
121 { "stock1":'American', "stock2" : 'Adobe', "type":'Line', "date_from":'
2015-02-02', "date_to":'2020-02-20' , 'csrfmiddlewaretoken':
csrftoken },
122 headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
compareResult.html?stock1=American&stock2=Adobe&type=Line&date_from
=2015-02-02&date_to=2020-02-20'})
123
124 @task(15)
125 def compare2(self):
126     response = self.client.get('compare.html')
127     csrftoken = response.cookies['csrftoken']
128     self.client.post('compareResult.html?stock1=American&stock2=Adobe&
type=Candle&date_from=2015-02-02&date_to=2020-02-20',
129 { "stock1":'American', "stock2" : 'Adobe', "type":'Candle', "date_from":'
2015-02-02', "date_to":'2020-02-20', 'csrfmiddlewaretoken': csrftoken
},
130 headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
compareResult.html?stock1=American&stock2=Adobe&type=Candle&
date_from=2015-02-02&date_to=2020-02-20'})
131
132
133
134
135 @task(5)
136 def trends(self):

```



```

137     response = self.client.get('measure.html')
138     csrftoken = response.cookies['csrftoken']
139     self.client.post('measureResults.html', {"Stock Name": 'Bank', "
selected Average": 'Simple Moving Average (SMA)', "selected Type": '
Table', "selected Range": '500', 'csrfmiddlewaretoken': csrftoken},
headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
measureResults.html'})
140
141
142 @task(16)
143 def trends1(self):
144     response = self.client.get('measure.html')
145     csrftoken = response.cookies['csrftoken']
146     self.client.post('measureResults.html', {"Stock Name": 'Bank', "
selected Average": 'Simple Moving Average (SMA)', "selected Type": 'Line
graph', "selected Range": '500', 'csrfmiddlewaretoken': csrftoken},
headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
measureResults.html'})
147
148 @task(17)
149 def trends2(self):
150     response = self.client.get('measure.html')
151     csrftoken = response.cookies['csrftoken']
152     self.client.post('measureResults.html', {"Stock Name": 'Bank', "
selected Average": 'Exponential Moving Average (EMA)', "selected Type":
'Table', "selected Range": '500', 'csrfmiddlewaretoken': csrftoken},
headers={'X-CSRFToken': csrftoken, 'Referer': self.parent.host + '
measureResults.html'})
153
154 @task(18)
155 def trends3(self):
156     response = self.client.get('measure.html')
157     csrftoken = response.cookies['csrftoken']
158     self.client.post('measureResults.html', {"Stock Name": 'Bank', "
selected Average": 'Exponential Moving Average (EMA)', "selected Type":
'Line graph', "selected Range": '500', 'csrfmiddlewaretoken':
csrftoken}, headers={'X-CSRFToken': csrftoken, 'Referer': self.parent
.host + 'measureResults.html'})
159
160
161
162
163
164
165 class WebsiteUser(HttpLocust):
166     task_set = UserBehavior
167     wait_time = lambda self: random.expovariate(1)*1000
168
169

```

Code A.4.0.1: locustfile.py

The load testing using Locust is performed in an automated way for various number of users ranging from to 1 to 512 users, with varying number of concurrent users swarmed

on web application. The testing result generated comprises of two files- distribution.csv and requests.csv for every case, i.e., for a given total number of users with number of concurrent users. The testing last for a long time. Below is the shell script to automate the testing and the figure displays an example of resulted directory created-

```
1 #!/bin/bash
2 # A shell script to automate testing
3
4 for i in 1 2 4 8 16 32 64 128 256 512      ### Outer for loop ###
5 do
6     echo -n "For total number of users : $i"
7     echo " "
8     for j in 1 2 4 8 16 32 64 128 256 512 ## Inner for loop ###
9     do
10
11         if [ $j -le $i ]
12         then
13
14             echo -n "Number of concurrent users: $j"
15             echo " "
16             mkdir LocustTestCasesOutput/TotalUsers$i$j
17             locust --host=http://127.0.0.1:7000/ --no-web --clients $i --
18             hatch-rate $j --csv=LocustTestCasesOutput/TotalUsers$i$j/
19             TotalUsers$i$j --run-time 30min
20             sleep 1m
21
22         fi
23     done
24     echo " " ##### print the new line ###
25 done
```

Code A.4.0.2: automateLocust.sh

```

55 directories, 110 files
dimple@workstation:~/Desktop/LocustTestCasesOutput$ tree -L 2
.
├── TotalUsers11
│   ├── TotalUsers11_distribution.csv
│   └── TotalUsers11_requests.csv
├── TotalUsers1281
│   ├── TotalUsers1281_distribution.csv
│   └── TotalUsers1281_requests.csv
├── TotalUsers128128
│   ├── TotalUsers128128_distribution.csv
│   └── TotalUsers128128_requests.csv
├── TotalUsers12816
│   ├── TotalUsers12816_distribution.csv
│   └── TotalUsers12816_requests.csv
├── TotalUsers1282
│   ├── TotalUsers1282_distribution.csv
│   └── TotalUsers1282_requests.csv
├── TotalUsers12832
│   ├── TotalUsers12832_distribution.csv
│   └── TotalUsers12832_requests.csv
├── TotalUsers1284
│   ├── TotalUsers1284_distribution.csv
│   └── TotalUsers1284_requests.csv
├── TotalUsers12864
│   ├── TotalUsers12864_distribution.csv
│   └── TotalUsers12864_requests.csv
├── TotalUsers1288
│   ├── TotalUsers1288_distribution.csv
│   └── TotalUsers1288_requests.csv
└── TotalUsers161

```

Figure A.10: Directory Tree Structure for output generated by automateLocush.sh

```

dimple@node1:~/Project/LocustTestCasesOutputNodes$ ls -ls
total 220
4 TotalUsers11 4 TotalUsers12864 4 TotalUsers21 4 TotalUsers25632 4 TotalUsers3232 4 TotalUsers512128 4 TotalUsers51264 4 TotalUsers6464
4 TotalUsers1281 4 TotalUsers1288 4 TotalUsers22 4 TotalUsers2564 4 TotalUsers324 4 TotalUsers51216 4 TotalUsers5128 4 TotalUsers648
4 TotalUsers128128 4 TotalUsers161 4 TotalUsers2561 4 TotalUsers25664 4 TotalUsers328 4 TotalUsers5122 4 TotalUsers641 4 TotalUsers81
4 TotalUsers12816 4 TotalUsers1616 4 TotalUsers256128 4 TotalUsers2568 4 TotalUsers41 4 TotalUsers512256 4 TotalUsers6416 4 TotalUsers84
4 TotalUsers1282 4 TotalUsers162 4 TotalUsers25616 4 TotalUsers321 4 TotalUsers42 4 TotalUsers51232 4 TotalUsers642 4 TotalUsers88
4 TotalUsers12832 4 TotalUsers164 4 TotalUsers2562 4 TotalUsers3216 4 TotalUsers44 4 TotalUsers5124 4 TotalUsers6432 4 TotalUsers88
4 TotalUsers1284 4 TotalUsers168 4 TotalUsers256256 4 TotalUsers322 4 TotalUsers5121 4 TotalUsers512512 4 TotalUsers644
dimple@node1:~/Project/LocustTestCasesOutputNodes$

```

Figure A.11: Example of directory containing output generated by automateLocush.sh

Figure A.12: Example of locust output on web interface

A.5 Load Balancing Component

A.5.1 Installation of NGINX and setup NGINX for cluster

```

1 user nginx;
2 worker_processes auto;
3 error_log /var/log/nginx/error.log warn;
4 pid /var/run/nginx.pid;
5 events {
6     worker_connections 1024;
7 }
8 http {
9     include /etc/nginx/mime.types;
10    default_type application/octet-stream;
11    log_format main '$realip_remote_addr - $remote_addr - $remote_user
    [$time_local] "$request" '
12                    '$status $body_bytes_sent "$http_referer" '
13                    '"$http_user_agent" "$http_x_forwarded_for"';
14    log_format trial '$upstream_addr - "$http_x_forwarded_for" -
    $remote_addr - $remote_user [$time_local] "$request" , '
15                    '$status $body_bytes_sent , "$http_referer" '
16                    '"$http_user_agent" , $request_time ,
    $upstream_response_time';
17    access_log /var/log/nginx/access.log trial;
18    sendfile on;
19    #tcp_nopush on;
20    proxy_connect_timeout 1200;
21    proxy_send_timeout 1200;
22    proxy_read_timeout 1200;
23    send_timeout 1200;
24    set_real_ip_from 192.168.1.240/32;
25    set_real_ip_from 192.168.1.158/32;
26    set_real_ip_from 192.168.1.243/32;
27    real_ip_header X-Forwarded-For;
28    keepalive_timeout 600;
29    #gzip on;
30    include /etc/nginx/conf.d/Finance.conf;
31 }

```

Code A.5.1.1: Nginx Configuration file

A.5.2 Types of Load Balancing

A.5.2.1 Round Robin load balancing

```

1 # finance_nginx.conf - round robin
2 # the upstream component nginx needs to connect to
3 upstream django {
4     #server unix:/home/dimple/dummy/testFinWeb/secondTime/Finance/
    Finance.sock; # for a file socket
5     #server 127.0.0.1:8081; # for a web port socket (we'll use this
    first)
6
7     server 192.168.1.240:4001; #node 1
8     server 192.168.1.158:4002; #node 2
9     server 192.168.1.243:4003; #node 3
10
11
12 }

```

```

13
14 # configuration of the server
15 server {
16     # the port your site will be served on
17     listen      8082;
18     # the domain name it will serve for
19     server_name 192.168.1.167; # substitute your machine's IP address or
    FQDN
20     charset     utf-8;
21     # max upload size
22     client_max_body_size 75M;    # adjust to taste
23     location /static {
24         alias /home/dimple/dummy/testFinWeb/secondTime/Finance/static; #
    your Django project's static files - amend as required
25     }
26     # Finally, send all non-media requests to the Django server.
27     location / {
28         proxy_set_header Host $host;
29         uwsgi_pass  django;
30         uwsgi_read_timeout 1000;
31         include     /home/dimple/dummy/testFinWeb/secondTime/Finance/
    uwsgi_params; # the uwsgi_params file you installed
32         proxy_set_header X-Forwarded-Host $server_name;
33         proxy_set_header X-Real-IP $remote_addr;
34     }
35 }

```

Code A.5.2.1: Round Robin load balancing

A.5.2.2 *Least connected load balancing*

```

1 # finance_nginx.conf - least connection
2 # the upstream component nginx needs to connect to
3 upstream django {
4     #server unix:/home/dimple/dummy/testFinWeb/secondTime/Finance/
    Finance.sock; # for a file socket
5     #server 127.0.0.1:8081; # for a web port socket (we'll use this
    first)
6
7     least_conn;
8     server 192.168.1.240:4001; #node 1
9     server 192.168.1.158:4002; #node 2
10    server 192.168.1.243:4003; #node 3
11
12
13 }
14
15 # configuration of the server
16 server {
17     # the port your site will be served on
18     listen      8082;
19     # the domain name it will serve for
20     server_name 192.168.1.167; # substitute your machine's IP address or
    FQDN
21     charset     utf-8;

```

```

22 # max upload size
23 client_max_body_size 75M; # adjust to taste
24 location /static {
25     alias /home/dimple/dummy/testFinWeb/secondTime/Finance/static; #
26     your Django project's static files - amend as required
27 }
28 # Finally, send all non-media requests to the Django server.
29 location / {
30     proxy_set_header Host $host;
31     uwsgi_pass django;
32     uwsgi_read_timeout 1000;
33     include /home/dimple/dummy/testFinWeb/secondTime/Finance/
34     uwsgi_params; # the uwsgi_params file you installed
35     proxy_set_header X-Forwarded-Host $server_name;
36     proxy_set_header X-Real-IP $remote_addr;
37 }

```

Code A.5.2.2: Least connected load balancing

A.5.2.3 Session persistence load balancing

```

1 # finance_nginx.conf - ip hash
2 # the upstream component nginx needs to connect to
3 upstream django {
4     #server unix:/home/dimple/dummy/testFinWeb/secondTime/Finance/
5     Finance.sock; # for a file socket
6     #server 127.0.0.1:8081; # for a web port socket (we'll use this
7     first)
8
9     ip_hash;
10     server 192.168.1.240:4001; #node 1
11     server 192.168.1.158:4002; #node 2
12     server 192.168.1.243:4003; #node 3
13 }
14
15 # configuration of the server
16 server {
17     # the port your site will be served on
18     listen 8082;
19     # the domain name it will serve for
20     server_name 192.168.1.167; # substitute your machine's IP address or
21     FQDN
22     charset utf-8;
23     # max upload size
24     client_max_body_size 75M; # adjust to taste
25     location /static {
26         alias /home/dimple/dummy/testFinWeb/secondTime/Finance/static; #
27         your Django project's static files - amend as required
28     }
29     # Finally, send all non-media requests to the Django server.
30     location / {
31         proxy_set_header Host $host;

```

```

30     uwsgi_pass    django;
31     uwsgi_read_timeout 1000;
32     include       /home/dimple/dummy/testFinWeb/secondTime/Finance/
uwsgi_params; # the uwsgi_params file you installed
33     proxy_set_header X-Forwarded-Host $server_name;
34     proxy_set_header X-Real-IP $remote_addr;
35 }
36 }

```

Code A.5.2.3: Session persistence load balancing

A.5.2.4 Weighted load balancing

```

1 # finance_nginx.conf- Weighted load balancing
2 # the upstream component nginx needs to connect to
3 upstream django {
4     #server unix:/home/dimple/dummy/testFinWeb/secondTime/Finance/
Finance.sock; # for a file socket
5     #server 127.0.0.1:8081; # for a web port socket (we'll use this
first)
6     #weighted round robin
7
8
9     server 192.168.1.240:4001; #node 1
10    server 192.168.1.158:4002 weight=2; #node 2
11    server 192.168.1.243:4003 weight=2; #node 3
12 }
13 # configuration of the server
14 server {
15     # the port your site will be served on
16     listen      8082;
17     # the domain name it will serve for
18     server_name 192.168.1.167; # substitute your machine's IP address or
FQDN
19     charset     utf-8;
20     # max upload size
21     client_max_body_size 75M; # adjust to taste
22     location /static {
23         alias /home/dimple/dummy/testFinWeb/secondTime/Finance/static; #
your Django project's static files - amend as required
24     }
25     # Finally, send all non-media requests to the Django server.
26     location / {
27         proxy_set_header Host $host;
28         uwsgi_pass    django;
29         uwsgi_read_timeout 1000;
30         include       /home/dimple/dummy/testFinWeb/secondTime/Finance/
uwsgi_params; # the uwsgi_params file you installed
31         proxy_set_header X-Forwarded-Host $server_name;
32         proxy_set_header X-Real-IP $remote_addr;
33     }
34 }

```

Code A.5.2.4: Weighted load balancing

```

1 #!/bin/bash
2 # A shell script to automate testing
3 for i in 1 2 4 8 16 32 64 128 256 512      ### Outer for loop ###
4 do
5     echo -n "For total number of users : $i"
6     echo " "
7     for j in 1 2 4 8 16 32 64 128 256 512    ## Inner for loop ###
8     do
9         if [ $j -le $i ]
10        then
11            echo -n "Number of concurrent users: $j"
12            echo " "
13
14            #Replace "OUTPUT-DIRECTORY" with RoundRobin for round robin
15            approach
16            #Replace "OUTPUT-DIRECTORY" with LeastConn for least conn.
17            approach
18            #Replace "OUTPUT-DIRECTORY" with IpHash for session
19            persistence approach
20            #Replace "OUTPUT-DIRECTORY" with WeightedRoundRobin for
21            weighted round robin
22
23            mkdir /home/dimple/Desktop/TypesOfBalancer/
24            OUTPUT-DIRECTORY/TotalUsers$i$j
25            locust --host=http://192.168.1.167:8082/ --no-
26            web --clients $i --hatch-rate $j --csv=/home/dimple/Desktop/
27            TypesOfBalancer/OUTPUT-DIRECTORY/Tota
28            lUsers$i$j/TotalUsers$i$j --run-time 5min
29            sleep 30s
30        fi
31    done
32    echo " " ##### print the new line ###
33done

```

Code A.5.2.5: Locust stress testing for all types of load balancing approach

A.6 Data Analysis

A.6.1 Response time analysis for different types of job requests

Here is the example of response time analysis for different types of job requests when there are total 32 users accessing web application with 8 concurrent users at a time. The response time changes with the number of concurrent users accessing the application.

```

1 #!/usr/bin/env python
2 # coding: utf-8
3
4 # In[35]:
5
6
7 # Analyzing request time for each job for Total number of users: 32 with
8     number of concurrent users:8
9
10 import pandas as pd
11 import numpy as np

```



```

11 import matplotlib.pyplot as plt
12
13 def locustOutputNode(path):
14
15     completeOutput = []
16
17     stats = []
18     statsFile = path + '/TotalUsers328/TotalUsers328_stats.csv'
19     with open(statsFile, "r") as f1:
20         stats = f1.readlines() [1:]
21
22     #print(stats[0])
23
24     requiredOutput = []
25     for req in stats:
26         row = req.split(sep=',')
27         requiredOutput.append([row[0]+" "+row[1],int(row[2]),int(row[5])
28     ])
29
30
31
32     requiredOutputDf = pd.DataFrame(requiredOutput,columns=['Request
33     Name','Total Requests', 'Avg Response Time'])
34
35     return requiredOutputDf
36
37 pathNode1 = '/Users/dimplejaiswal/Downloads/LocustTestCasesOutputNode1-
38     master'
39
40 pathNode2 = '/Users/dimplejaiswal/Downloads/LocustTestCasesOutputNode2-
41     master'
42
43 pathNode3 = '/Users/dimplejaiswal/Downloads/LocustTestCasesOutputNode3-
44     master'
45
46 requiredOutputDf1 = locustOutputNode(pathNode1)
47
48 #print(requiredOutputDf1)
49
50 requiredOutputDf2 = locustOutputNode(pathNode2)
51
52 #print(requiredOutputDf2)
53
54 requiredOutputDf3 = locustOutputNode(pathNode3)
55
56 #print(requiredOutputDf3)
57
58 labels = requiredOutputDf2['Request Name']
59
60 ind = np.arange(len(labels))
61 width = 0.25
62
63 fig, ax = plt.subplots()

```

```

60 ax.barh(ind-width,requiredOutputDf1['Avg Response Time'].div(60,axis=0).
    apply(np.ceil), width, color='teal', label='Node 1')
61 ax.barh(ind,requiredOutputDf2['Avg Response Time'].div(60,axis=0).apply(
    np.ceil), width, color='gold', label='Node 2')
62 ax.barh(ind + width, requiredOutputDf3['Avg Response Time'].div(60,axis
    =0).apply(np.ceil), width, color='turquoise', label='Node 3')
63
64 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
    labels)])
65 ax.legend()
66
67 for i, v in enumerate(requiredOutputDf1['Avg Response Time'].div(60,axis
    =0).apply(np.ceil)):
68     ax.text(v , i - 0.35 , str(v), color='teal', fontweight='bold')
69
70 for i, v in enumerate(requiredOutputDf2['Avg Response Time'].div(60,axis
    =0).apply(np.ceil)):
71     ax.text(v , i, " " +str(v), color='gold', fontweight='bold')
72
73
74 for i, v in enumerate(requiredOutputDf3['Avg Response Time'].div(60,axis
    =0).apply(np.ceil)):
75     ax.text(v+ 20, i + 0.25,str(v), color='turquoise', fontweight='bold'
    )
76
77
78
79
80 ax.set_ylabel('Type of job request')
81 ax.set_xlabel('Average response time(in secs)')
82 ax.set_title('Average response time for different types of job requests
    for all nodes')
83
84
85 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
86 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
87
88 fig = plt.gcf()
89 fig.set_size_inches(15,15)
90 plt.show()
91
92 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/JobRequests/
    JobRequestsType.jpg')
93
94 plt.close(fig)
95
96
97 # In[ ]:

```

Code A.6.1.1: Response time analysis for different types of job requests

The above script creates the below given bar graph-

Figure A.13: Response time analysis for different types of job requests

A.6.2 Data analysis of data generated by Locust testing at all the nodes

```

1
2 import os
3 import pandas as pd
4 import numpy as np
5
6 def locustOutputNode(path):
7
8     fileNames = []
9
10    #path = '/Users/dimplejaiswal/Downloads/LocustTestCasesOutputNode1-
11    master'
12
13    for files in os.listdir(path):
14
15        fileNames.append(files)
16
17
18    #print(fileNames)
19
20    list1 = []
21    list2 = []
22    list4 = []
23    list8 = []

```

```

24 list16=[]
25 list32=[]
26 list64=[]
27 list128=[]
28 list256=[]
29 list512 = []
30
31 list1updated =[]
32 list2updated = []
33 list4updated = []
34 list8updated = []
35 list16updated = []
36 list32updated = []
37 list64updated = []
38 list128updated = []
39 list256updated = []
40 list512updated = []
41
42 fileNames.sort()
43
44 for i in fileNames:
45
46     if i.startswith("TotalUsers512"):
47         list512.append(i)
48         list512updated.append('512-'+i[13:])
49
50
51     elif(i.startswith("TotalUsers256")):
52         list256.append(i)
53         list256updated.append('256-'+i[13:])
54
55
56     elif(i.startswith("TotalUsers128")):
57         list128.append(i)
58         list128updated.append('128-'+i[13:])
59
60
61     elif(i.startswith("TotalUsers64")):
62         list64.append(i)
63         list64updated.append('64-'+i[12:])
64
65
66     elif(i.startswith("TotalUsers32")):
67         list32.append(i)
68         list32updated.append('32-'+i[12:])
69
70
71     elif(i.startswith("TotalUsers16")):
72         list16.append(i)
73         list16updated.append('16-'+i[12:])
74
75
76     elif(i.startswith("TotalUsers8")):
77         list8.append(i)
78         list8updated.append('8-'+i[11:])

```

```

78
79         elif(i.startswith("TotalUsers4")):
80             list4.append(i)
81             list4updated.append('4-'+i[11:])
82
83
84         elif(i.startswith("TotalUsers2")):
85             list2.append(i)
86             list2updated.append('2-'+i[11:])
87
88         elif(i.startswith("TotalUsers1")):
89             list1.append(i)
90             list1updated.append('1-'+i[11:])
91
92     allDirList = []
93
94
95     allDirList.append(sorted(list1, key=lambda x: int(x[10:])))
96     allDirList.append(sorted(list2, key=lambda x: int(x[10:])))
97     allDirList.append(sorted(list4, key=lambda x: int(x[10:])))
98     allDirList.append(sorted(list8, key=lambda x: int(x[10:])))
99     allDirList.append(sorted(list16, key=lambda x: int(x[10:])))
100    allDirList.append(sorted(list32, key=lambda x: int(x[10:])))
101    allDirList.append(sorted(list64, key=lambda x: int(x[10:])))
102    allDirList.append(sorted(list128, key=lambda x: int(x[10:])))
103    allDirList.append(sorted(list256, key=lambda x: int(x[10:])))
104    allDirList.append(sorted(list512, key=lambda x: int(x[10:])))
105
106
107    updatedDirList = []
108
109    #print(list512)
110    updatedDirList.append(sorted(list1updated, key=lambda x: int(x.split(
111    '-' ) [1] )))
111    updatedDirList.append(sorted(list2updated, key=lambda x: int(x.split(
112    '-' ) [1] )))
112    updatedDirList.append(sorted(list4updated, key=lambda x: int(x.split(
113    '-' ) [1] )))
113    updatedDirList.append(sorted(list8updated, key=lambda x: int(x.split(
114    '-' ) [1] )))
114    updatedDirList.append(sorted(list16updated, key=lambda x: int(x.
115    split('-') [1] )))
115    updatedDirList.append(sorted(list32updated, key=lambda x: int(x.
116    split('-') [1] )))
116    updatedDirList.append(sorted(list64updated, key=lambda x: int(x.
117    split('-') [1] )))
117    updatedDirList.append(sorted(list128updated, key=lambda x: int(x.
118    split('-') [1] )))
118    updatedDirList.append(sorted(list256updated, key=lambda x: int(x.
119    split('-') [1] )))
119    updatedDirList.append(sorted(list512updated, key=lambda x: int(x.
120    split('-') [1] )))
121

```

```

122     #print(updatedDirList)
123
124     completeOutput = []
125
126     for dir, updated in zip(allDirList, updatedDirList):
127
128         particularFile=[]
129         for file, updatedFile in zip(dir,updated):
130
131             statsFile = path+'/'+file+'/'+file+'_stats.csv'
132             with open(statsFile, "r") as f1:
133                 last_line = f1.readlines() [-1]
134
135                 #particularFile.append(file)
136
137             particularFile.append([''+updatedFile+'']+','+last_line)
138
139
140
141         completeOutput.append(particularFile)
142
143
144     #print(completeOutput)
145
146     requiredOutput = []
147
148     for op in completeOutput:
149
150         for req in op:
151             row = req.split(sep=',')
152             requiredOutput.append([row[0],int(row[3]),int(row[4]),int(
row[6])])
153
154
155
156     #print(len(requiredOutput))
157
158     requiredOutputDf = pd.DataFrame(requiredOutput,columns=['filename', '
Successful Requests', 'Total Failures', 'Avg Response Time'])
159
160
161     return requiredOutputDf
162
163
164
165
166 def main():
167
168     pathNode1 = '/Users/dimplejaiswal/Downloads/
LocustTestCasesOutputNode1-master'
169     pathNode2 = '/Users/dimplejaiswal/Downloads/
LocustTestCasesOutputNode2-master'
170     pathNode3 = '/Users/dimplejaiswal/Downloads/
LocustTestCasesOutputNode3-master'

```

```

171     requiredOutputDf1 = locustOutputNode(pathNode1)
172
173
174     print(requiredOutputDf1)
175
176     requiredOutputDf2 = locustOutputNode(pathNode2)
177
178     print(requiredOutputDf2)
179
180     requiredOutputDf3 = locustOutputNode(pathNode3)
181
182     print(requiredOutputDf3)
183
184
185     requiredOutputDf1 = np.asarray(requiredOutputDf1)
186     requiredOutputDf2 = np.asarray(requiredOutputDf2)
187     requiredOutputDf3 = np.asarray(requiredOutputDf3)
188
189
190     node1 = open('/Users/dimplejaiswal/Desktop/Thesis/Output Locust-
Nodes/Node1.csv', 'w')
191     np.savetxt(node1, requiredOutputDf1 ,fmt="%s", delimiter=",")
192
193     node2 = open('/Users/dimplejaiswal/Desktop/Thesis/Output Locust-
Nodes/Node2.csv', 'w')
194     np.savetxt(node2, requiredOutputDf2, fmt="%s", delimiter=",")
195
196     node3 = open('/Users/dimplejaiswal/Desktop/Thesis/Output Locust-
Nodes/Node3.csv', 'w')
197     np.savetxt(node3, requiredOutputDf3 ,fmt="%s", delimiter=",")
198
199     node1.close()
200     node2.close()
201     node3.close()
202
203 main()

```

Code A.6.2.1: Data preprocessing of data generated by Locust testing for all the nodes

```

1 [1-1], 6, 0, 1538
2 [2-1], 10, 0, 2584
3 [2-2], 10, 0, 2598
4 [4-1], 22, 0, 4445
5 [4-2], 16, 0, 3091
6 [4-4], 18, 0, 4253
7 [8-1], 36, 0, 3782
8 [8-2], 40, 0, 5866
9 [8-4], 41, 0, 7141
10 [8-8], 40, 0, 4596
11 [16-1], 84, 0, 9223
12 [16-2], 81, 0, 10468
13 [16-4], 79, 0, 13638
14 [16-8], 74, 0, 14094
15 [16-16], 84, 0, 19735

```

```

16 [32-1],156,0,22958
17 [32-2],154,0,29378
18 [32-4],144,0,33239
19 [32-8],168,0,27224
20 [32-16],156,0,28002
21 [32-32],150,0,33350
22 [64-1],281,0,83811
23 [64-2],304,0,47947
24 [64-4],294,0,61707
25 [64-8],309,1,58324
26 [64-16],283,0,75991
27 [64-32],296,0,70046
28 [64-64],285,1,70007
29 [128-1],422,0,24816
30 [128-2],408,1,18609
31 [128-4],398,0,12018
32 [128-8],393,3,8422
33 [128-16],391,32,13315
34 [128-32],394,11,11206
35 [128-64],409,45,10711
36 [128-128],401,87,17059
37 [256-1],939,333,23845
38 [256-2],256,256,2
39 [256-4],256,256,2
40 [256-8],256,256,2
41 [256-16],256,256,2
42 [256-32],256,256,2
43 [256-64],256,256,1
44 [256-128],256,256,1
45 [256-256],256,256,1
46 [512-1],512,512,2
47 [512-2],512,512,2
48 [512-4],512,512,2
49 [512-8],512,512,2
50 [512-16],512,512,2
51 [512-32],512,512,2
52 [512-64],512,512,1
53 [512-128],512,512,1
54 [512-256],512,512,1
55 [512-512],512,512,1

```

Code A.6.2.2: Output generated for node 1

```

1 [1-1],6,0,2791
2 [2-1],12,0,1682
3 [2-2],10,0,3640
4 [4-1],22,0,2494
5 [4-2],16,0,2805
6 [4-4],18,0,3677
7 [8-1],42,0,4858
8 [8-2],44,0,8346
9 [8-4],38,0,5364
10 [8-8],44,0,6809
11 [16-1],94,0,11356

```



```

12 [16-2],84,0,13217
13 [16-4],78,0,16534
14 [16-8],84,0,14181
15 [16-16],78,0,12154
16 [32-1],156,0,20078
17 [32-2],164,0,31302
18 [32-4],178,0,27179
19 [32-8],174,0,33402
20 [32-16],156,0,24808
21 [32-32],164,0,25787
22 [64-1],306,0,39016
23 [64-2],295,0,54318
24 [64-4],288,0,54895
25 [64-8],285,0,66219
26 [64-16],285,0,63028
27 [64-32],273,0,74610
28 [64-64],296,0,59679
29 [128-1],468,0,53657
30 [128-2],442,0,46789
31 [128-4],448,0,54223
32 [128-8],522,0,103238
33 [128-16],479,0,57692
34 [128-32],449,29,40761
35 [128-64],560,77,98671
36 [128-128],505,51,68397
37 [256-1],838,0,11541
38 [256-2],788,0,6115
39 [256-4],1038,393,7693
40 [256-8],256,256,2
41 [256-16],256,256,2
42 [256-32],256,256,2
43 [256-64],256,256,2
44 [256-128],256,256,2
45 [256-256],256,256,1
46 [512-1],512,512,2
47 [512-2],512,512,2
48 [512-4],512,512,2
49 [512-8],512,512,2
50 [512-16],512,512,2
51 [512-32],512,512,2
52 [512-64],512,512,2
53 [512-128],512,512,2
54 [512-256],512,512,1
55 [512-512],512,512,1

```

Code A.6.2.3: Output generated for node 2

```

1 [1-1],8,0,2462
2 [2-1],10,0,1600
3 [2-2],10,0,1373
4 [4-1],20,0,2696
5 [4-2],16,0,4141
6 [4-4],22,0,6068
7 [8-1],40,0,6551

```

```

8 [8-2],48,0,4088
9 [8-4],36,0,6561
10 [8-8],42,0,5321
11 [16-1],74,0,10074
12 [16-2],79,0,10662
13 [16-4],82,0,13332
14 [16-8],80,0,13925
15 [16-16],84,0,12007
16 [32-1],154,0,15863
17 [32-2],158,0,20274
18 [32-4],167,0,23559
19 [32-8],164,0,24415
20 [32-16],154,0,27298
21 [32-32],148,0,36396
22 [64-1],288,0,49543
23 [64-2],288,0,63897
24 [64-4],299,0,66759
25 [64-8],293,3,59379
26 [64-16],295,0,59410
27 [64-32],294,4,52515
28 [64-64],286,3,61900
29 [128-1],444,0,43831
30 [128-2],441,0,39964
31 [128-4],447,0,43556
32 [128-8],411,0,19314
33 [128-16],419,54,35547
34 [128-32],429,14,29379
35 [128-64],413,56,21306
36 [128-128],408,61,26423
37 [256-1],780,0,5381
38 [256-2],785,3,7295
39 [256-4],634,387,7497
40 [256-8],256,256,2
41 [256-16],256,256,2
42 [256-32],256,256,2
43 [256-64],256,256,2
44 [256-128],256,256,1
45 [256-256],256,256,1
46 [512-1],512,512,2
47 [512-2],512,512,2
48 [512-4],512,512,2
49 [512-8],512,512,2
50 [512-16],512,512,2
51 [512-32],512,512,2
52 [512-64],512,512,2
53 [512-128],512,512,1
54 [512-256],512,512,1
55 [512-512],512,512,1

```

Code A.6.2.4: Output generated for node 3

```

1 #!/usr/bin/env python
2 # coding: utf-8
3

```

```

4 # In[1]:
5
6
7 import pandas as pd
8 import numpy as np
9 import matplotlib.pyplot as plt
10
11
12 # In[2]:
13
14
15 #Total Requests analysis -Success rate of requests
16
17 col = ['filename', 'Total Requests', 'Total Failures', 'Avg Response Time'
18        ]
19 node1Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
20                          Locust-Nodes/Node1.csv', names = col)
21 node2Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
22                          Locust-Nodes/Node2.csv', names = col)
23 node3Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
24                          Locust-Nodes/Node3.csv', names = col)
25
26 #print(node1Data.head)
27 users = node1Data['filename'].tolist()
28
29 node1Data['Successful Requests'] = (node1Data['Total Requests'] -
30                                     node1Data['Total Failures']).div(0.01*(node1Data['Total Requests'] +
31                                     node1Data['Total Failures']),axis=0).apply(np.ceil)
32 node2Data['Successful Requests'] = (node2Data['Total Requests'] -
33                                     node2Data['Total Failures']).div(0.01*(node2Data['Total Requests'] +
34                                     node2Data['Total Failures']),axis=0).apply(np.ceil)
35 node3Data['Successful Requests'] = (node3Data['Total Requests'] -
36                                     node3Data['Total Failures']).div(0.01*(node3Data['Total Requests'] +
37                                     node3Data['Total Failures']),axis=0).apply(np.ceil)
38
39 labels = users
40 node1 = node1Data['Successful Requests'].tolist()
41 node2 = node2Data['Successful Requests'].tolist()
42 node3 = node3Data['Successful Requests'].tolist()
43
44 ind = np.arange(len(node1Data))
45 width = 0.3
46
47 fig, ax = plt.subplots()
48 ax.barh(ind-width,node1 , width, color='blue', label='Node 1')
49 ax.barh(ind,node2 , width, color='orange', label='Node 2')
50 ax.barh(ind + width, node3, width, color='green', label='Node 3')
51
52 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
53         node1Data)])
54 ax.legend()
55
56 ax.set_ylabel('Total number of users with different number of concurrent
57               users : [Total users - Concurrent users]')

```

```

46 ax.set_xlabel('Success request rate(in %)')
47 ax.set_title('Success request rate for all the nodes')
48
49
50 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
51 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
52
53 fig = plt.gcf()
54 fig.set_size_inches(15, 15)
55 plt.show()
56
57 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/Nodes/
    SuccessRate.jpg')
58 plt.close(fig)
59
60
61 # In[3]:
62
63
64 #Failure Analysis - failure rate
65
66 col = ['filename', 'Total Requests', 'Total Failures', 'Avg Response Time'
    ]
67 node1Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
    Locust-Nodes/Node1.csv', names = col)
68 node2Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
    Locust-Nodes/Node2.csv', names = col)
69 node3Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
    Locust-Nodes/Node3.csv', names = col)
70
71 #print(node1Data.head)
72 users = node1Data['filename'].tolist()
73
74 node1Data['Total ' ] = node1Data['Total Failures'].div((0.01*node1Data['
    Total Requests']), axis=0).apply(np.ceil)
75 node2Data['Total ' ] = node2Data['Total Failures'].div((0.01*node2Data['
    Total Requests']), axis=0).apply(np.ceil)
76 node3Data['Total ' ] = node3Data['Total Failures'].div((0.01*node3Data['
    Total Requests']), axis=0).apply(np.ceil)
77
78
79 labels = users
80 node1 = node1Data['Total '].tolist()
81 node2 = node2Data['Total '].tolist()
82 node3 = node3Data['Total '].tolist()
83
84 ind = np.arange(len(node1Data))
85 width = 0.3
86
87 fig, ax = plt.subplots()
88 ax.barh(ind-width, node1 , width, color='blue', label='Node 1')
89 ax.barh(ind, node2 , width, color='orange', label='Node 2')
90 ax.barh(ind + width, node3, width, color='green', label='Node 3')
91

```

```

92 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
    node1Data]))
93 ax.legend()
94
95 ax.set_ylabel('Total number of users with different number of concurrent
    users : [Total users - Concurrent users]')
96 ax.set_xlabel('Failure request rate(in %)')
97 ax.set_title('Failure request rate for all the nodes')
98
99
100 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
101 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
102
103 fig = plt.gcf()
104 fig.set_size_inches(15, 15)
105 plt.show()
106 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/Nodes/
    FailureRate.jpg')
107 plt.close(fig)
108
109
110 # In[4]:
111
112
113 #Response time analysis
114
115 col = ['filename', 'Total Requests', 'Total Failures', 'Avg Response Time'
    ]
116 node1Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
    Locust-Nodes/Node1.csv', names = col)
117 node2Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
    Locust-Nodes/Node2.csv', names = col)
118 node3Data = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/Output
    Locust-Nodes/Node3.csv', names = col)
119
120 #print(node1Data.head)
121 users = node1Data['filename'].tolist()
122
123 #converting to seconds from milliseconds
124
125 node1Data['Avg Response Time'] = node1Data['Avg Response Time'].div(60,
    axis=0).apply(np.ceil)
126 node2Data['Avg Response Time'] = node2Data['Avg Response Time'].div(60,
    axis=0).apply(np.ceil)
127 node3Data['Avg Response Time'] = node3Data['Avg Response Time'].div(60,
    axis=0).apply(np.ceil)
128 #print(node1Data.head)
129
130 labels = users
131 node1 = node1Data['Avg Response Time'].tolist()
132 node2 = node2Data['Avg Response Time'].tolist()
133 node3 = node3Data['Avg Response Time'].tolist()
134
135 ind = np.arange(len(node1Data))

```

```

136 width = 0.25
137
138 fig, ax = plt.subplots()
139 ax.barh(ind-width,node1 , width, color='blue', label='Node 1')
140 ax.barh(ind,node2 , width, color='orange', label='Node 2')
141 ax.barh(ind + width, node3, width, color='green', label='Node 3')
142
143 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
    node1Data)])
144 ax.legend()
145
146
147 for i, v in enumerate(node1):
148     ax.text(v , i-0.6 , ""+str(v), color='blue', fontweight='bold')
149
150 for i, v in enumerate(node2):
151     ax.text(v , i -0.1, "  "+str(v), color='orange', fontweight='bold')
152
153
154 for i, v in enumerate(node3):
155     ax.text(v , i+0.1 , "    "+str(v), color='green', fontweight='bold'
    )
156
157
158 ax.set_ylabel('Total number of users with different number of concurrent
    users : [Total users - Concurrent users]')
159 ax.set_xlabel('Average response time (in seconds)')
160 ax.set_title('Average response time(in seconds) for all the nodes')
161
162
163 fig = plt.gcf()
164 fig.set_size_inches(18, 16)
165 plt.show()
166 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/Nodes/
    ResponseTime.jpg')
167 plt.close(fig)
168
169
170 # In[ ]:

```

Code A.6.2.5: Analysis of data generated by locust for all nodes

Below are the figures generated using above script -

Figure A.14: Success request rate for all the nodes

Figure A.15: Failure request rate for all the nodes

Figure A.16: Average response time(in seconds) for all the nodes

A.6.3 Data analysis of data generated by Locust testing using different types of load balancing approach

```

1
2 import os
3 import pandas as pd
4 import numpy as np
5
6 def locustOutputNode(path):
7
8     fileNames = []
9
10     #path = '/Users/dimplejaiswal/Downloads/LocustTestCasesOutputNode1-master'
11
12

```

```

13     for files in os.listdir(path):
14
15         fileNames.append(files)
16
17
18     #print(fileNames)
19
20     list1 =[]
21     list2 = []
22     list4=[]
23     list8=[]
24     list16=[]
25     list32=[]
26     list64=[]
27     list128=[]
28     list256=[]
29     list512 = []
30
31     list1updated =[]
32     list2updated = []
33     list4updated = []
34     list8updated = []
35     list16updated = []
36     list32updated = []
37     list64updated = []
38     list128updated = []
39     list256updated = []
40     list512updated = []
41
42     fileNames.sort()
43
44     for i in fileNames:
45
46         if i.startswith("TotalUsers512"):
47             list512.append(i)
48             list512updated.append('512-'+i[13:])
49
50
51         elif(i.startswith("TotalUsers256")):
52             list256.append(i)
53             list256updated.append('256-'+i[13:])
54
55
56         elif(i.startswith("TotalUsers128")):
57             list128.append(i)
58             list128updated.append('128-'+i[13:])
59
60
61         elif(i.startswith("TotalUsers64")):
62             list64.append(i)
63             list64updated.append('64-'+i[12:])
64
65         elif(i.startswith("TotalUsers32")):
66             list32.append(i)

```

```

67         list32updated.append('32-'+i[12:])
68
69
70     elif(i.startswith("TotalUsers16")):
71         list16.append(i)
72         list16updated.append('16-'+i[12:])
73
74     elif(i.startswith("TotalUsers8")):
75         list8.append(i)
76         list8updated.append('8-'+i[11:])
77
78
79     elif(i.startswith("TotalUsers4")):
80         list4.append(i)
81         list4updated.append('4-'+i[11:])
82
83
84     elif(i.startswith("TotalUsers2")):
85         list2.append(i)
86         list2updated.append('2-'+i[11:])
87
88     elif(i.startswith("TotalUsers1")):
89         list1.append(i)
90         list1updated.append('1-'+i[11:])
91
92 allDirList = []
93
94
95 allDirList.append(sorted(list1, key=lambda x: int(x[10:])))
96 allDirList.append(sorted(list2, key=lambda x: int(x[10:])))
97 allDirList.append(sorted(list4, key=lambda x: int(x[10:])))
98 allDirList.append(sorted(list8, key=lambda x: int(x[10:])))
99 allDirList.append(sorted(list16, key=lambda x: int(x[10:])))
100 allDirList.append(sorted(list32, key=lambda x: int(x[10:])))
101 allDirList.append(sorted(list64, key=lambda x: int(x[10:])))
102 allDirList.append(sorted(list128, key=lambda x: int(x[10:])))
103 allDirList.append(sorted(list256, key=lambda x: int(x[10:])))
104 allDirList.append(sorted(list512, key=lambda x: int(x[10:])))
105
106
107 updatedDirList = []
108
109 #print(list512)
110 updatedDirList.append(sorted(list1updated, key=lambda x: int(x.split(
111     '-' ) [1] )))
111 updatedDirList.append(sorted(list2updated, key=lambda x: int(x.split(
112     '-' ) [1] )))
112 updatedDirList.append(sorted(list4updated, key=lambda x: int(x.split(
113     '-' ) [1] )))
113 updatedDirList.append(sorted(list8updated, key=lambda x: int(x.split(
114     '-' ) [1] )))
114 updatedDirList.append(sorted(list16updated, key=lambda x: int(x.
    split('-') [1] )))

```

```

115     updatedDirList.append(sorted(list32updated, key=lambda x: int(x.
116     split('-')[1])))
116     updatedDirList.append(sorted(list64updated, key=lambda x: int(x.
117     split('-')[1])))
117     updatedDirList.append(sorted(list128updated, key=lambda x: int(x.
118     split('-')[1])))
118     updatedDirList.append(sorted(list256updated, key=lambda x: int(x.
119     split('-')[1])))
119     updatedDirList.append(sorted(list512updated, key=lambda x: int(x.
120     split('-')[1])))
120
121
122     #print(updatedDirList)
123
124     completeOutput = []
125
126     for dir, updated in zip(allDirList, updatedDirList):
127
128         particularFile=[]
129         for file, updatedFile in zip(dir,updated):
130
131             statsFile = path+'/'+file+'/'+file+'_requests.csv'
132             with open(statsFile, "r") as f1:
133                 last_line = f1.readlines()[-1]
134
135                 #particularFile.append(file)
136
137             particularFile.append([''+updatedFile+'']+','+last_line)
138
139
140
141         completeOutput.append(particularFile)
142
143
144     #print(completeOutput)
145
146     requiredOutput = []
147
148     for op in completeOutput:
149
150         for req in op:
151             row = req.split(sep=',')
152             requiredOutput.append([row[0],int(row[3]),int(row[4]),int(
153             row[6])])
153
154
155
156     #print(len(requiredOutput))
157
158     requiredOutputDf = pd.DataFrame(requiredOutput,columns=['filename', '
159     Successful Requests', 'Total Failures', 'Avg Response Time'])
160
161     return requiredOutputDf

```

```

162
163
164
165
166 def main():
167
168
169     pathRoundRobin = '/Users/dimplejaiswal/Downloads/TypesOfBalancer-
master/WeightedRoundRobin'
170     pathWeightedRoundRobin = '/Users/dimplejaiswal/Downloads/
TypesOfBalancer-master/RoundRobin'
171     pathLeastConn = '/Users/dimplejaiswal/Downloads/TypesOfBalancer-
master/LeastConn'
172     pathIpHash = '/Users/dimplejaiswal/Downloads/TypesOfBalancer-master/
IpHash'
173
174     requiredOutputDf1 = locustOutputNode(pathRoundRobin)
175
176     print(requiredOutputDf1)
177
178     requiredOutputDf2 = locustOutputNode(pathWeightedRoundRobin)
179
180     print(requiredOutputDf2)
181
182     requiredOutputDf3 = locustOutputNode(pathLeastConn)
183
184     print(requiredOutputDf3)
185
186     requiredOutputDf4 = locustOutputNode(pathIpHash)
187
188     print(requiredOutputDf4)
189
190
191     requiredOutputDf1 = np.asarray(requiredOutputDf1)
192     requiredOutputDf2 = np.asarray(requiredOutputDf2)
193     requiredOutputDf3 = np.asarray(requiredOutputDf3)
194     requiredOutputDf4 = np.asarray(requiredOutputDf4)
195
196
197     roundRobin = open('/Users/dimplejaiswal/Desktop/Thesis/
TypesOfBalancerOutput/RoundRobin.csv', 'w')
198     np.savetxt(roundRobin, requiredOutputDf1, fmt="%s", delimiter=",")
199
200     weightedRoundRobin = open('/Users/dimplejaiswal/Desktop/Thesis/
TypesOfBalancerOutput/WeightedRoundRobin.csv', 'w')
201     np.savetxt(weightedRoundRobin, requiredOutputDf2, fmt="%s", delimiter=
",")
202
203     leastConn = open('/Users/dimplejaiswal/Desktop/Thesis/
TypesOfBalancerOutput/LeastConn.csv', 'w')
204     np.savetxt(leastConn, requiredOutputDf3, fmt="%s", delimiter=",")
205
206     ipHash = open('/Users/dimplejaiswal/Desktop/Thesis/
TypesOfBalancerOutput/IpHash.csv', 'w')

```

```

207     np.savetxt(ipHash,requiredOutputDf4 ,fmt="%s",delimiter=",")
208
209     roundRobin.close()
210     weightedRoundRobin.close()
211     leastConn.close()
212     ipHash.close()
213
214 main()

```

Code A.6.3.1: Data preprocessing of data generated by Locust testing using different types of load balancers

```

1  [1-1],89,0,2875
2  [2-1],167,0,3080
3  [2-2],164,0,3104
4  [4-1],336,0,3042
5  [4-2],332,0,3061
6  [4-4],328,0,3079
7  [8-1],533,0,3914
8  [8-2],524,0,3945
9  [8-4],598,0,3465
10 [8-8],563,0,3690
11 [16-1],665,0,6399
12 [16-2],644,0,6696
13 [16-4],614,0,7179
14 [16-8],616,0,6985
15 [16-16],633,0,6836
16 [32-1],679,0,12568
17 [32-2],721,0,11795
18 [32-4],671,0,13118
19 [32-8],640,0,13577
20 [32-16],583,0,14886
21 [32-32],725,0,12254
22 [64-1],774,0,20523
23 [64-2],851,0,19565
24 [64-4],797,0,20279
25 [64-8],657,0,24380
26 [64-16],658,0,25278
27 [64-32],764,0,22615
28 [64-64],695,0,24593
29 [128-1],912,0,27083
30 [128-2],799,0,38183
31 [128-4],919,0,29623
32 [128-8],801,0,39498
33 [128-16],887,0,33118
34 [128-32],815,0,39278
35 [128-64],953,0,35855
36 [128-128],854,0,38790
37 [256-1],1110,0,26977
38 [256-2],1182,3,35696
39 [256-4],1131,2,49022
40 [256-8],1074,0,55122
41 [256-16],1071,3,58303
42 [256-32],1015,440,44605

```

```

43 [256-64],1118,12,52878
44 [256-128],1095,62,51165
45 [256-256],1030,2,55963
46 [512-1],1010,0,27714
47 [512-2],1496,62,39907
48 [512-4],1736,40,44571
49 [512-8],1178,196,60659
50 [512-16],1410,312,54899
51 [512-32],1268,1049,50860
52 [512-64],990,314,58815
53 [512-128],1068,1327,65548
54 [512-256],1514,814,57610
55 [512-512],707,484,32568

```

Code A.6.3.2: Output generated using Round robin approach

```

1 [1-1],81,0,3137
2 [2-1],170,0,2992
3 [2-2],175,0,2936
4 [4-1],311,0,3317
5 [4-2],333,0,3065
6 [4-4],315,0,3262
7 [8-1],567,0,3651
8 [8-2],522,0,4032
9 [8-4],537,0,3893
10 [8-8],564,0,3715
11 [16-1],560,0,7621
12 [16-2],615,0,6956
13 [16-4],714,0,6009
14 [16-8],620,0,6883
15 [16-16],650,0,6774
16 [32-1],677,0,12268
17 [32-2],641,0,13517
18 [32-4],629,0,13948
19 [32-8],584,0,15184
20 [32-16],710,0,12584
21 [32-32],667,0,13154
22 [64-1],744,0,20952
23 [64-2],839,0,19446
24 [64-4],867,0,19872
25 [64-8],736,0,24623
26 [64-16],795,0,22033
27 [64-32],822,0,21155
28 [64-64],779,0,22300
29 [128-1],984,0,25058
30 [128-2],868,0,33669
31 [128-4],869,0,35861
32 [128-8],932,0,36678
33 [128-16],871,0,39241
34 [128-32],882,0,36714
35 [128-64],769,0,42762
36 [128-128],863,0,39014
37 [256-1],1047,0,31643
38 [256-2],1240,0,38363

```

```

39 [256-4],1126,0,48458
40 [256-8],781,47,51925
41 [256-16],1287,0,44757
42 [256-32],928,66,56667
43 [256-64],1058,2,60182
44 [256-128],965,49,66396
45 [256-256],1163,0,56242
46 [512-1],922,0,36002
47 [512-2],1396,4602,38204
48 [512-4],1433,4385,44277
49 [512-8],945,2883,54269
50 [512-16],981,564,55770
51 [512-32],809,3063,55165
52 [512-64],1424,1066,57746
53 [512-128],1376,234,64314
54 [512-256],903,860,54328
55 [512-512],1111,723,58535

```

Code A.6.3.3: Output generated using Least connection approach

```

1 [1-1],81,0,3218
2 [2-1],156,0,3354
3 [2-2],168,0,3050
4 [4-1],299,0,3486
5 [4-2],325,0,3161
6 [4-4],333,0,3081
7 [8-1],389,0,5537
8 [8-2],387,0,5614
9 [8-4],358,0,6085
10 [8-8],379,0,5772
11 [16-1],422,0,10282
12 [16-2],414,0,10674
13 [16-4],374,0,11702
14 [16-8],406,0,10779
15 [16-16],411,0,10912
16 [32-1],445,0,19693
17 [32-2],416,0,21399
18 [32-4],421,0,20608
19 [32-8],432,0,21093
20 [32-16],436,0,20888
21 [32-32],436,0,20762
22 [64-1],525,0,30880
23 [64-2],465,0,33217
24 [64-4],510,0,33057
25 [64-8],467,0,34202
26 [64-16],480,0,33588
27 [64-32],494,0,32292
28 [64-64],488,0,33092
29 [128-1],724,3,32634
30 [128-2],793,0,38906
31 [128-4],837,0,34552
32 [128-8],706,6,43257
33 [128-16],761,0,42235
34 [128-32],777,0,43550

```



```

35 [128-64], 776, 4, 42062
36 [128-128], 754, 0, 47027
37 [256-1], 806, 1, 31177
38 [256-2], 1097, 0, 46023
39 [256-4], 1105, 3, 48973
40 [256-8], 999, 35, 56189
41 [256-16], 1018, 19, 59811
42 [256-32], 926, 64, 57000
43 [256-64], 1039, 2, 59607
44 [256-128], 1162, 2, 51826
45 [256-256], 1103, 30, 50612
46 [512-1], 895, 0, 39556
47 [512-2], 1273, 10, 40786
48 [512-4], 1223, 136, 55957
49 [512-8], 1669, 649, 50050
50 [512-16], 1495, 90, 71144
51 [512-32], 1368, 4867, 53203
52 [512-64], 1736, 50, 71189
53 [512-128], 1552, 233, 71938
54 [512-256], 1463, 163, 66093
55 [512-512], 1496, 93, 57221

```

Code A.6.3.4: Output generated using Session persistence approach

```

1 [1-1], 87, 0, 2918
2 [2-1], 150, 0, 3511
3 [2-2], 154, 0, 3312
4 [4-1], 314, 0, 3281
5 [4-2], 306, 0, 3373
6 [4-4], 321, 0, 3209
7 [8-1], 552, 0, 3787
8 [8-2], 599, 0, 3378
9 [8-4], 527, 0, 3930
10 [8-8], 563, 0, 3732
11 [16-1], 587, 0, 7268
12 [16-2], 620, 0, 6910
13 [16-4], 573, 0, 7733
14 [16-8], 624, 0, 7125
15 [16-16], 591, 0, 7482
16 [32-1], 711, 0, 11844
17 [32-2], 628, 0, 13230
18 [32-4], 651, 0, 12919
19 [32-8], 664, 0, 12841
20 [32-16], 649, 0, 13179
21 [32-32], 644, 0, 13518
22 [64-1], 818, 0, 18817
23 [64-2], 718, 0, 22152
24 [64-4], 695, 0, 24666
25 [64-8], 716, 0, 23129
26 [64-16], 801, 0, 19356
27 [64-32], 729, 0, 22198
28 [64-64], 739, 0, 22699
29 [128-1], 879, 0, 27559
30 [128-2], 889, 0, 32573

```

```

31 [128-4],787,0,39084
32 [128-8],848,0,31089
33 [128-16],949,0,34357
34 [128-32],808,0,41147
35 [128-64],879,0,39000
36 [128-128],879,0,37284
37 [256-1],800,0,41097
38 [256-2],1327,0,35510
39 [256-4],1076,0,41651
40 [256-8],1143,0,46404
41 [256-16],1129,2,51404
42 [256-32],1134,0,51846
43 [256-64],1155,0,50362
44 [256-128],885,194,58239
45 [256-256],1115,0,48821
46 [512-1],863,0,40521
47 [512-2],1284,210,42360
48 [512-4],1626,2704,45548
49 [512-8],1549,117,48028
50 [512-16],1577,174,50672
51 [512-32],1430,831,64770
52 [512-64],1634,334,53733
53 [512-128],1584,113,56188
54 [512-256],933,290,57368
55 [512-512],1830,347,52060

```

Code A.6.3.5: Output generated using Weighted round robin approach

```

1 #!/usr/bin/env python
2 # coding: utf-8
3
4 # In[1]:
5
6
7 #Total Requests analysis for all the types of load balancers
8
9 import pandas as pd
10 import matplotlib.pyplot as plt
11 import numpy as np
12
13
14 # In[2]:
15
16
17 #Total Requests analysis -Success rate of requests
18
19 col = ['filename','Total Requests','Total Failures', 'Avg Response Time'
20        ]
21 roundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
22                               TypesOfBalancerOutput/RoundRobin.csv',names = col)
23 leastConnData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
24                               TypesOfBalancerOutput/LeastConn.csv',names = col)
25 ipHashData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
26                               TypesOfBalancerOutput/IpHash.csv',names = col)

```

```

23 weightedRoundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/
    Thesis/TypesOfBalancerOutput/WeightedRoundRobin.csv', names = col)
24
25 users = roundRobinData['filename'].tolist()
26
27 roundRobinData['Successful Requests'] = (roundRobinData['Total Requests
    ']).div(0.01*(roundRobinData['Total Requests'] + roundRobinData['
    Total Failures']),axis=0).apply(np.ceil)
28 leastConnData['Successful Requests'] = (leastConnData['Total Requests'])
    .div(0.01*(leastConnData['Total Requests'] + leastConnData['Total
    Failures']),axis=0).apply(np.ceil)
29 ipHashData['Successful Requests'] = (ipHashData['Total Requests']).div
    (0.01*(ipHashData['Total Requests'] + ipHashData['Total Failures']),
    axis=0).apply(np.ceil)
30 weightedRoundRobinData['Successful Requests'] = (weightedRoundRobinData
    ['Total Requests']).div(0.01*(weightedRoundRobinData['Total Requests
    ']+ weightedRoundRobinData['Total Failures']),axis=0).apply(np.ceil
    )
31
32 labels = users
33 roundRobin = roundRobinData['Successful Requests'].tolist()
34 leastConn = leastConnData['Successful Requests'].tolist()
35 ipHash = ipHashData['Successful Requests'].tolist()
36 weightedRoundRobin = weightedRoundRobinData['Successful Requests'].
    tolist()
37
38 ind = np.arange(len(roundRobinData))
39 width = 0.2
40
41 fig, ax = plt.subplots()
42 ax.barh(ind,roundRobin , width, color='blue', label='Round Robin')
43 ax.barh(ind+ width,leastConn , width, color='orange', label='Least
    Connection')
44 ax.barh(ind + (2*width), ipHash, width, color='green', label='Session
    Persistance')
45 ax.barh(ind+ (3*width),weightedRoundRobin , width, color='magenta',
    label='Weighted Round Robin')
46
47 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
    roundRobinData)])
48 ax.legend()
49
50 ax.set_ylabel('Total number of users with different number of concurrent
    users:[Total users - Concurrent users]')
51 ax.set_xlabel('Success request rate(in %)')
52 ax.set_title('Success request rate for different types of load balancers
    ')
53
54 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
55 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
56
57 fig = plt.gcf()
58 fig.set_size_inches(15, 15)
59 plt.show()

```

```

60 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/Balancers/
    SuccessRate.jpg')
61 plt.close(fig)
62
63
64 # In[3]:
65
66
67 #Total Requests analysis -Failure rate of requests
68
69 col = ['filename', 'Total Requests', 'Total Failures', 'Avg Response Time'
    ]
70 roundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
    TypesOfBalancerOutput/RoundRobin.csv', names = col)
71 leastConnData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
    TypesOfBalancerOutput/LeastConn.csv', names = col)
72 ipHashData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
    TypesOfBalancerOutput/IpHash.csv', names = col)
73 weightedRoundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/
    Thesis/TypesOfBalancerOutput/WeightedRoundRobin.csv', names = col)
74
75 users = roundRobinData['filename'].tolist()
76
77
78
79 roundRobinData['Total ' ] = (roundRobinData['Total Failures'] ).div
    (0.01*(roundRobinData['Total Requests'] + roundRobinData['Total
    Failures'])),axis=0).apply(np.ceil)
80 leastConnData['Total ' ] = (leastConnData['Total Failures']).div(0.01*(
    leastConnData['Total Requests'] + leastConnData['Total Failures']),
    axis=0).apply(np.ceil)
81 ipHashData['Total ' ] = (ipHashData['Total Failures'] ).div(0.01*(
    ipHashData['Total Requests'] + ipHashData['Total Failures']),axis=0)
    .apply(np.ceil)
82 weightedRoundRobinData['Total ' ] = (weightedRoundRobinData['Total
    Failures']).div(0.01*(weightedRoundRobinData['Total Requests'] +
    weightedRoundRobinData['Total Failures'])),axis=0).apply(np.ceil)
83
84 labels = users
85 roundRobin = roundRobinData['Total '].tolist()
86 leastConn = leastConnData['Total '].tolist()
87 ipHash = ipHashData['Total '].tolist()
88 weightedRoundRobin = weightedRoundRobinData['Total '].tolist()
89
90 ind = np.arange(len(roundRobinData))
91 width = 0.23
92
93 fig, ax = plt.subplots()
94 ax.barh(ind,roundRobin , width, color='blue', label='Round Robin')
95 ax.barh(ind+ width,leastConn , width, color='orange', label='Least
    Connection')
96 ax.barh(ind + (2*width), ipHash, width, color='green', label='Session
    Persistance')

```

```

97 ax.barh(ind+ (3*width),weightedRoundRobin , width, color='magenta',
    label='Weighted Round Robin')
98
99 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
    roundRobinData)])
100 ax.legend()
101
102 ax.set_ylabel('Total number of users with different number of concurrent
    users:[Total users - Concurrent users]')
103 ax.set_xlabel('Failure request rate(in %)')
104 ax.set_title('Failure request rate for different types of load balancers
    ')
105
106 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
107 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
108
109 fig = plt.gcf()
110 fig.set_size_inches(15, 16)
111 plt.show()
112
113 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/Balancers/
    FailureRate.jpg')
114
115 plt.close(fig)
116
117
118 # In[4]:
119
120
121 #Total Requests analysis - response time for requests
122
123 col = ['filename','Total Requests','Total Failures', 'Avg Response Time'
    ]
124 roundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
    TypesOfBalancerOutput/RoundRobin.csv',names = col)
125 leastConnData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
    TypesOfBalancerOutput/LeastConn.csv',names = col)
126 ipHashData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
    TypesOfBalancerOutput/IpHash.csv',names = col)
127 weightedRoundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/
    Thesis/TypesOfBalancerOutput/WeightedRoundRobin.csv',names = col)
128
129 users = roundRobinData['filename'].tolist()
130
131 roundRobinData['Avg Response Time'] = (roundRobinData['Avg Response
    Time'] ).div(60,axis=0).apply(np.ceil)
132 leastConnData['Avg Response Time'] = (leastConnData['Avg Response Time'
    ]).div(60,axis=0).apply(np.ceil)
133 ipHashData['Avg Response Time'] = (ipHashData['Avg Response Time'] ).div
    (60,axis=0).apply(np.ceil)
134 weightedRoundRobinData['Avg Response Time'] = (weightedRoundRobinData['
    Avg Response Time']).div(60,axis=0).apply(np.ceil)
135
136 labels = users

```

```

137 roundRobin = roundRobinData['Avg Response Time'].tolist()
138 leastConn = leastConnData['Avg Response Time'].tolist()
139 ipHash = ipHashData['Avg Response Time'].tolist()
140 weightedRoundRobin = weightedRoundRobinData['Avg Response Time'].tolist
    ()
141
142 ind = np.arange(len(roundRobinData))
143 width = 0.23
144
145 fig, ax = plt.subplots()
146 ax.barh(ind,roundRobin , width, color='blue', label='Round Robin')
147 ax.barh(ind+ width,leastConn , width, color='orange', label='Least
    Connection')
148 ax.barh(ind + (2*width), ipHash, width, color='green', label='Session
    Persistance')
149 ax.barh(ind+ (3*width),weightedRoundRobin , width, color='magenta',
    label='Weighted Round Robin')
150
151 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
    roundRobinData)])
152 ax.legend()
153
154 ax.set_ylabel('Total number of users with different number of concurrent
    users:[Total users - Concurrent users]')
155 ax.set_xlabel('Failure request rate(in %)')
156 ax.set_title('Failure request rate for different types of load balancers
    ')
157
158 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
159 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
160
161 fig = plt.gcf()
162 fig.set_size_inches(15, 16)
163 plt.show()
164
165 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/Balancers/
    ResponseTime.jpg')
166 plt.close(fig)
167
168
169 # In[ ]:

```

Code A.6.3.6: Analysis of data generated by locust using different types of load balancing technique

Below are the figures generated using above script -

Figure A.17: Success request rate for different types of load balancers

Figure A.18: Failure request rate for different types of load balancers

Figure A.19: Average response time(in seconds) for different types of load balancers

A.6.4 Analysis of logs generated by nginx

Nginx generates two types logs - access and error log. Given below script analyze logs generated while using different types of load balancing techniques.

```
1 #!/usr/bin/env python
2 # coding: utf-8
3
4 # In[ ]:
5
6
7 #access log analysis
8 #access log format : '$upstream_addr - "$http_x_forwarded_for" -
   $remote_addr - $remote_user [$time_local] "$request" , '$status','
```

```

    $body_bytes_sent' , '$http_referer' '$http_user_agent' , '
    $request_time' , '$upstream_response_time']
9
10
11 # In[ ]:
12
13
14 #192.168.1.243:4003 - "-" - 192.168.1.167 - - [29/Jun/2020:00:09:27
    -0500] "GET /movers.html HTTP/1.1" , 200 3745 , "-" "python-
    requests/2.23.0" , 0.004 , 0.004
15 #192.168.1.158:4002 - "-" - 192.168.1.167 - - [29/Jun/2020:00:09:39
    -0500] "POST /moversResult.html HTTP/1.1" , 200 16035 , "http
    ://192.168.1.167:8082/moversResult.html" "python-requests/2.23.0" ,
    14.671 , 14.671
16 #192.168.1.243:4003 - "-" - 192.168.1.167 - - [29/Jun/2020:00:09:40
    -0500] "GET /measure.html HTTP/1.1" , 200 46273 , "-" "python-
    requests/2.23.0" , 0.028 , 0.028
17 #192.168.1.240:4001 - "-" - 192.168.1.167 - - [29/Jun/2020:00:09:42
    -0500] "POST /moversResult.html HTTP/1.1" , 200 16064 , "http
    ://192.168.1.167:8082/moversResult.html" "python-requests/2.23.0" ,
    14.293 , 14.292
18 #192.168.1.243:4003 - "-" - 192.168.1.167 - - [29/Jun/2020:00:09:43
    -0500] "GET /prediction.html HTTP/1.1" , 200 40373 , "-" "python-
    requests/2.23.0" , 0.015 , 0.016
19
20
21 # In[1]:
22
23
24 import pandas as pd
25 import numpy as np
26 import matplotlib.pyplot as plt
27
28
29 # In[2]:
30
31
32 #Declaring empty dataframe to get total number of successful requests
    for all types of balancer
33
34 allBalancers = pd.DataFrame(columns=['Type of Load balancer', 'Total
    Requests'])
35
36
37 # In[3]:
38
39
40 #column with sub column attributes
41 #column 1 : upstream_address, http_x_forwarded_for, remote_addr ,
    remote_user, time_local and request in single string
42 #column 2 : status and body_bytes_sent
43 #column 3 : http_referer and http_user_agent
44 #column 4 : request_time
45 #column 5 : upstream_response_time

```

```

46
47 col = ['Column1', 'Column2', 'Column3', 'Column4', 'Column5',
48        'Column6', 'Column7', 'Column8', 'Column9', 'Column10']
49
50
51 #round robin - data preprocessing
52
53 roundRobinDf = pd.read_fwf("/Users/dimplejaiswal/Downloads/
    TypesOfBalancer-master/RoundRobin/logs/access.log", delimiter=" , ",
    names=col)
54 #roundRobinDf.head(-100)
55
56 roundRobinDf = roundRobinDf[roundRobinDf['Column2'].eq("-")]
57
58 actualCol = ['upstream_address', 'remote_addr', 'time_local', 'request', '
    status and body_bytes_sent', 'http_referer and http_user_agent', '
    request_time', 'upstream_response_time']
59
60 updatedRoundRobinDf = pd.DataFrame(columns = actualCol)
61 updatedRoundRobinDf[['upstream_address', 'remote_addr', 'time_local']] =
    roundRobinDf[['Column1', 'Column5', 'Column8']]
62 updatedRoundRobinDf[['request', 'status and body_bytes_sent', '
    http_referer and http_user_agent', 'request_time', '
    upstream_response_time']] = roundRobinDf.Column10.str.split(" , ",
    expand=True)
63 updatedRoundRobinDf['time_local'] = updatedRoundRobinDf['time_local'].
    str.replace('[', '')
64
65
66 print(len(roundRobinDf))
67
68 getUniqueNodeWithCountRR = updatedRoundRobinDf['upstream_address'].
    value_counts().rename_axis('upstream_address').reset_index(name='
    Total Requests')
69
70 percent = updatedRoundRobinDf['upstream_address'].value_counts(normalize
    =True).rename_axis('upstream_address').reset_index(name='Total
    Requests (in percent)')
71 getUniqueNodeWithCountRR['Total Requests (in Percent)'] = 100*percent['
    Total Requests (in percent)']
72
73 getUniqueNodeWithCountRR = getUniqueNodeWithCountRR.sort_values(by='
    upstream_address')
74
75
76 print(getUniqueNodeWithCountRR)
77
78
79 allBalancers = allBalancers.append( pd.Series(['Round Robin', len(
    roundRobinDf)] , index=allBalancers.columns), ignore_index=True)
80
81 print(allBalancers)
82
83

```

```

84 # In[4]:
85
86
87
88 col = ['Column1', 'Column2', 'Column3', 'Column4', 'Column5',
89        'Column6', 'Column7', 'Column8', 'Column9', 'Column10']
90
91
92 #Least Connection - data preprocessing
93
94 LeastConnDf = pd.read_fwf("/Users/dimplejaiswal/Downloads/
95     TypesOfBalancer-master/LeastConn/logs/access.log", delimiter=" , ",
96     names=col)
97
98
99 LeastConnDf = LeastConnDf[LeastConnDf['Column2'].eq("-")]
100
101 actualCol = ['upstream_address', 'remote_addr', 'time_local', 'request', '
102     status and body_bytes_sent', 'http_referer and http_user_agent', '
103     request_time', 'upstream_response_time']
104
105 updatedLeastConnDf = pd.DataFrame(columns = actualCol)
106
107 updatedLeastConnDf[['upstream_address', 'remote_addr', 'time_local']] =
108     LeastConnDf[['Column1', 'Column5', 'Column8']]
109
110 updatedLeastConnDf[['request', 'status and body_bytes_sent', 'http_referer
111     and http_user_agent', 'request_time', 'upstream_response_time']] =
112     LeastConnDf.Column10.str.split(" , ", expand=True)
113
114 updatedLeastConnDf['time_local'] = updatedLeastConnDf['time_local'].str.
115     replace('[', '')
116
117
118 print(len(LeastConnDf))
119
120
121 getUniqueNodeWithCountLC = updatedLeastConnDf['upstream_address'].
122     value_counts().rename_axis('upstream_address').reset_index(name='
123     Total Requests')
124
125 percent = updatedLeastConnDf['upstream_address'].value_counts(normalize
126     =True).rename_axis('upstream_address').reset_index(name='Total
127     Requests (in percent)')
128
129 getUniqueNodeWithCountLC['Total Requests (in Percent)'] = 100*percent['
130     Total Requests (in percent)']
131
132
133
134
135 getUniqueNodeWithCountLC = getUniqueNodeWithCountLC.sort_values(by='
136     upstream_address')
137
138 print(getUniqueNodeWithCountLC)
139
140
141 allBalancers = allBalancers.append( pd.Series(['Least Connection', len(
142     LeastConnDf)] , index=allBalancers.columns), ignore_index=True)
143
144
145
146
147 print(allBalancers)
148

```

```

123
124 # In[5]:
125
126
127
128 col = ['Column1', 'Column2', 'Column3', 'Column4', 'Column5',
129        'Column6', 'Column7', 'Column8', 'Column9', 'Column10']
130
131
132 #Ip hash - data preprocessing
133
134 IpHashDf = pd.read_fwf("/Users/dimplejaiswal/Downloads/TypesOfBalancer-
135                        master/IpHash/logs/access.log", delimiter=" ", names=col)
136
137 IpHashDf = IpHashDf[IpHashDf['Column2'].eq("-")]
138
139 actualCol = ['upstream_address', 'remote_addr', 'time_local', 'request', '
140              status and body_bytes_sent', 'http_referer and http_user_agent', '
141              request_time', 'upstream_response_time']
142
143 updatedIpHashDf = pd.DataFrame(columns = actualCol)
144 updatedIpHashDf[['upstream_address', 'remote_addr', 'time_local']] =
145     IpHashDf[['Column1', 'Column5', 'Column8']]
146 updatedIpHashDf[['request', 'status and body_bytes_sent', 'http_referer
147 and http_user_agent', 'request_time', 'upstream_response_time']] =
148     IpHashDf.Column10.str.split(" ", expand=True)
149 updatedIpHashDf['time_local'] = updatedIpHashDf['time_local'].str.
150     replace('[', '')
151
152 print(len(IpHashDf))
153
154
155 getUniqueNodeWithCountIP = updatedIpHashDf['upstream_address'].
156     value_counts().rename_axis('upstream_address').reset_index(name='
157     Total Requests')
158
159 percent = updatedIpHashDf['upstream_address'].value_counts(normalize =
160     True).rename_axis('upstream_address').reset_index(name='Total
161     Requests (in percent)')
162 getUniqueNodeWithCountIP['Total Requests (in Percent)'] = 100*percent['
163     Total Requests (in percent)']
164
165
166 getUniqueNodeWithCountIP = getUniqueNodeWithCountIP.sort_values(by='
167     upstream_address')
168 print(getUniqueNodeWithCountIP)
169
170
171 allBalancers = allBalancers.append( pd.Series(['Ip Hash', len(IpHashDf)]
172     , index=allBalancers.columns), ignore_index=True)
173 print(allBalancers)
174
175
176 # In[6]:

```

```

163
164
165
166 col = ['Column1', 'Column2', 'Column3', 'Column4', 'Column5',
167         'Column6', 'Column7', 'Column8', 'Column9', 'Column10']
168
169
170 # weighted round robin - data preprocessing
171
172 weightedRoundRobinDf = pd.read_fwf("/Users/dimplejaiswal/Downloads/
    TypesOfBalancer-master/WeightedRoundRobin/logs/access.log",
    delimiter=" ", names=col)
173 #roundRobinDf.head(-100)
174
175 weightedRoundRobinDf = weightedRoundRobinDf[weightedRoundRobinDf['
    Column2'].eq("-")]
176
177 actualCol = ['upstream_address', 'remote_addr', 'time_local', 'request', '
    status and body_bytes_sent', 'http_referer and http_user_agent', '
    request_time', 'upstream_response_time']
178
179 updatedWeightedRoundRobinDf = pd.DataFrame(columns = actualCol)
180 updatedWeightedRoundRobinDf[['upstream_address', 'remote_addr', '
    time_local']] = weightedRoundRobinDf[['Column1', 'Column5', 'Column8'
    ]]
181 updatedWeightedRoundRobinDf[['request', 'status and body_bytes_sent', '
    http_referer and http_user_agent', 'request_time', '
    upstream_response_time']] = weightedRoundRobinDf.Column10.str.split(
    " ", expand=True)
182 updatedWeightedRoundRobinDf['time_local'] = updatedWeightedRoundRobinDf[
    'time_local'].str.replace('[', '')
183
184
185 print(len(weightedRoundRobinDf))
186
187 getUniqueNodeWithCountWRR = updatedWeightedRoundRobinDf['
    upstream_address'].value_counts().rename_axis('upstream_address').
    reset_index(name='Total Requests')
188
189 percent = updatedWeightedRoundRobinDf['upstream_address'].value_counts(
    normalize =True).rename_axis('upstream_address').reset_index(name='
    Total Requests (in percent)')
190 getUniqueNodeWithCountWRR['Total Requests (in Percent)'] = 100*percent['
    Total Requests (in percent)']
191
192
193
194 getUniqueNodeWithCountWRR = getUniqueNodeWithCountWRR.sort_values(by='
    upstream_address')
195
196
197 print(getUniqueNodeWithCountWRR)
198
199

```

```

200 allBalancers = allBalancers.append( pd.Series(['Weighted Round Robin',
        len(weightedRoundRobinDf)] , index=allBalancers.columns),
        ignore_index=True)
201
202 print(allBalancers)
203
204
205 # In[8]:
206
207
208
209 x = allBalancers['Type of Load balancer']
210 y = allBalancers['Total Requests']
211
212 fig = plt.figure()
213 ax = fig.add_subplot(111)
214 ax.set_ylim(0,100000)
215 plt.plot(x,y,color='g')
216 for i,j in zip(x,y):
217     ax.annotate(str(j),xy=(i,j), color='blue',fontweight='bold')
218
219 ax.set_ylabel('Total number of successful requests')
220 ax.set_xlabel('Type of load balancer')
221 ax.set_title('Total number of successful requests made by different
        types of load balancers')
222 fig.set_size_inches(15, 8)
223 plt.show()
224 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/LogAnalysis/
        SuccessfulRequests.jpg')
225 plt.close(fig)
226
227
228 # In[9]:
229
230
231 labels = ['Round Robin','Least Connection','Ip Hash','Weighted Round
        Robin']
232
233 nodes = ['Node 2','Node 1','Node 3']
234 properArrangement = pd.DataFrame(columns = labels)
235 properArrangement['Round Robin'] = getUniqueNodeWithCountRR['Total
        Requests']
236 properArrangement['Least Connection'] = getUniqueNodeWithCountLC['Total
        Requests']
237 properArrangement['Ip Hash'] = getUniqueNodeWithCountIP['Total Requests'
        ]
238 properArrangement['Weighted Round Robin'] = getUniqueNodeWithCountWRR['
        Total Requests']
239 properArrangement['Type'] = nodes
240 properArrangement = properArrangement.set_index(['Type'])
241 properArrangement = properArrangement.swapaxes("index","columns")
242
243
244 x = np.arange(len(labels)) # the label locations

```

```

245 width = 0.25 # the width of the bars
246
247 fig, ax = plt.subplots()
248 rects1 = ax.bar(x - width/2, properArrangement[ 'Node 2'], width, label=
    'Node 2',color='yellow')
249 rects2 = ax.bar(x , properArrangement[ 'Node 1'],width, label='Node 1',
    color='magenta')
250 rects3 = ax.bar(x + width/2, properArrangement[ 'Node 3'], width, label=
    'Node 3',color='aqua')
251
252 # Add some text for labels, title and custom x-axis tick labels, etc.
253 ax.set_ylabel('Total number of successful requests')
254 ax.set_title('Total number of successful requets for every node using
    different types of load balancing techniques')
255 ax.set_xlabel('Type of load balancer')
256
257 ax.set_xticks(x)
258 ax.set_xticklabels(labels)
259 ax.legend()
260
261
262 def autolabel(rects):
263     """Attach a text label above each bar in *rects*, displaying its
    height."""
264     for rect in rects:
265         height = rect.get_height()
266         ax.annotate('{} '.format(height),
267                     xy=(rect.get_x() + rect.get_width() / 2, height),
268                     xytext=(0, 3), # 3 points vertical offset
269                     textcoords="offset points",
270                     ha='center', va='bottom',color='navy',fontweight='
    bold' )
271
272
273 autolabel(rects3)
274 autolabel(rects2)
275 autolabel(rects1)
276
277 fig.tight_layout()
278 fig = plt.gcf()
279 fig.set_size_inches(30, 10)
280 plt.show()
281
282 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/LogAnalysis/
    SuccesfulRequestForAllNodes.jpg')
283 plt.close(fig)
284
285 properArrangement
286
287
288 # In[ ]:
289
290
291 #error log

```



```

292
293 #2020/06/29 00:10:34 [warn] 14336#14336: *363657 an upstream response is
    buffered to a temporary file /var/cache/nginx/uwsgi_temp
    /5/07/0000008075 while reading upstream, client: 192.168.1.167,
    server: 192.168.1.167, request: "POST /compareResult.html?stock1=
    American&stock2=Adobe&type=Candle&date_from=2015-02-02&date_to
    =2020-02-20 HTTP/1.1", upstream: "uwsgi://192.168.1.158:4002", host:
    "192.168.1.167:8082", referrer: "http://192.168.1.167:8082/
    compareResult.html?stock1=American&stock2=Adobe&type=Candle&
    date_from=2015-02-02&date_to=2020-02-20"
294 #2020/06/29 00:12:24 [warn] 14336#14336: *363652 an upstream response is
    buffered to a temporary file /var/cache/nginx/uwsgi_temp
    /6/07/0000008076 while reading upstream, client: 192.168.1.167,
    server: 192.168.1.167, request: "POST /measureResults.html HTTP
    /1.1", upstream: "uwsgi://192.168.1.240:4001", host:
    "192.168.1.167:8082", referrer: "http://192.168.1.167:8082/
    measureResults.html"
295
296
297 # In[10]:
298
299
300 # error dataframe for all types of balancers
301 errorBalancers = pd.DataFrame(columns=['Type of load balancer','Total
    request failed'])
302
303
304 # In[11]:
305
306
307
308 #round robin error log
309
310 errorRR = []
311 with open("/Users/dimplejaiswal/Downloads/TypesOfBalancer-master/
    RoundRobin/logs/error.log",'r') as file:
312     errorRR = file.readlines()
313
314 print(len(errorRR))
315
316 errorRRDf = pd.DataFrame(columns=['Node','Total Request failed'])
317
318 countNode1 = 0
319 countNode2 = 0
320 countNode3 = 0
321 countCluster = 0
322 unreported=[]
323 for row in errorRR:
324     if 'upstream: "uwsgi://192.168.1.240:4001"' in row:
325         countNode1+=1
326     elif 'upstream: "uwsgi://192.168.1.158:4002"' in row:
327         countNode2+=1
328     elif 'upstream: "uwsgi://192.168.1.243:4003"' in row:
329         countNode3+=1

```

```

330     elif 'upstream: "uwsgi://django"' in row:
331         countCluster+=1
332     else:
333         unreported.append(row)
334 print(countNode1)
335 print(countNode2)
336 print(countNode3)
337 print(countCluster)
338 print(unreported)
339
340 errorRRDf = errorRRDf.append(pd.Series(['Node 1',countNode1], index=
    errorRRDf.columns), ignore_index=True)
341 errorRRDf = errorRRDf.append(pd.Series(['Node 2',countNode2], index=
    errorRRDf.columns), ignore_index=True)
342 errorRRDf = errorRRDf.append(pd.Series(['Node 3',countNode3], index=
    errorRRDf.columns), ignore_index=True)
343 errorRRDf
344
345 errorBalancers = errorBalancers.append(pd.Series(['Round Robin',
    countNode1+countNode2+countNode3] , index=errorBalancers.columns),
    ignore_index=True)
346 errorBalancers
347
348
349 # In[12]:
350
351
352 # weighted round robin error log
353
354 errorWRR = []
355 with open("/Users/dimplejaiswal/Downloads/TypesOfBalancer-master/
    WeightedRoundRobin/logs/error.log",'r') as file:
356     errorWRR = file.readlines()
357
358 print(len(errorWRR))
359
360 errorWRRDf = pd.DataFrame(columns=['Node','Total Request failed'])
361
362 countNode1 = 0
363 countNode2 = 0
364 countNode3 = 0
365 countCluster = 0
366 unreported =[]
367 for row in errorWRR:
368     if 'upstream: "uwsgi://192.168.1.240:4001"' in row:
369         countNode1+=1
370     elif 'upstream: "uwsgi://192.168.1.158:4002"' in row:
371         countNode2+=1
372     elif 'upstream: "uwsgi://192.168.1.243:4003"' in row:
373         countNode3+=1
374     elif 'upstream: "uwsgi://django"' in row:
375         countCluster+=1
376     else:
377         unreported.append(row)

```

```

378 print(countNode1)
379 print(countNode2)
380 print(countNode3)
381 print(countCluster)
382 print(unreported)
383
384 errorWRRDf = errorWRRDf.append(pd.Series(['Node 1',countNode1], index=
    errorWRRDf.columns), ignore_index=True)
385 errorWRRDf = errorWRRDf.append(pd.Series(['Node 2',countNode2], index=
    errorWRRDf.columns), ignore_index=True)
386 errorWRRDf = errorWRRDf.append(pd.Series(['Node 3',countNode3], index=
    errorWRRDf.columns), ignore_index=True)
387 errorWRRDf
388
389 errorBalancers = errorBalancers.append(pd.Series(['Weighted Round Robin'
    ,countNode1+countNode2+countNode3] , index=errorBalancers.columns),
    ignore_index=True)
390 errorBalancers
391
392
393 # In[13]:
394
395
396
397 # least conn error log
398
399 errorLC = []
400 with open("/Users/dimplejaiswal/Downloads/TypesOfBalancer-master/
    LeastConn/logs/error.log",'r') as file:
401     errorLC = file.readlines()
402
403 print(len(errorLC))
404
405 errorLCDf = pd.DataFrame(columns=['Node','Total Request failed'])
406
407 countNode1 = 0
408 countNode2 = 0
409 countNode3 = 0
410 countCluster = 0
411 unreported =[]
412 for row in errorLC:
413     if 'upstream: "uwsgi://192.168.1.240:4001"' in row:
414         countNode1+=1
415     elif 'upstream: "uwsgi://192.168.1.158:4002"' in row:
416         countNode2+=1
417     elif 'upstream: "uwsgi://192.168.1.243:4003"' in row:
418         countNode3+=1
419     elif 'upstream: "uwsgi://django"' in row:
420         countCluster+=1
421     else:
422         unreported.append(row)
423 print(countNode1)
424 print(countNode2)
425 print(countNode3)

```

```

426 print(countCluster)
427 print(unreported)
428
429 errorLCDf = errorLCDf.append(pd.Series(['Node 1',countNode1], index=
    errorLCDf.columns), ignore_index=True)
430 errorLCDf = errorLCDf.append(pd.Series(['Node 2',countNode2], index=
    errorLCDf.columns), ignore_index=True)
431 errorLCDf = errorLCDf.append(pd.Series(['Node 3',countNode3], index=
    errorLCDf.columns), ignore_index=True)
432 errorLCDf
433
434 errorBalancers = errorBalancers.append(pd.Series(['Least Connected',
    countNode1+countNode2+countNode3] , index=errorBalancers.columns),
    ignore_index=True)
435 errorBalancers
436
437
438 # In[14]:
439
440
441
442 # ip hash error log
443
444 errorIP = []
445 with open("/Users/dimplejaiswal/Downloads/TypesOfBalancer-master/IpHash/
    logs/error.log",'r') as file:
446     errorIP = file.readlines()
447
448 print(len(errorIP))
449
450 errorIPDf = pd.DataFrame(columns=['Node','Total Request failed'])
451
452 countNode1 = 0
453 countNode2 = 0
454 countNode3 = 0
455 countCluster = 0
456 unreported =[]
457 for row in errorIP:
458     if 'upstream: "uwsgi://192.168.1.240:4001"' in row:
459         countNode1+=1
460     elif 'upstream: "uwsgi://192.168.1.158:4002"' in row:
461         countNode2+=1
462     elif 'upstream: "uwsgi://192.168.1.243:4003"' in row:
463         countNode3+=1
464     elif 'upstream: "uwsgi://django"' in row:
465         countCluster+=1
466     else:
467         unreported.append(row)
468 print(countNode1)
469 print(countNode2)
470 print(countNode3)
471 print(countCluster)
472 print(unreported)
473

```

```

474 errorIPDf = errorIPDf.append(pd.Series(['Node 1',countNode1], index=
    errorIPDf.columns), ignore_index=True)
475 errorIPDf = errorIPDf.append(pd.Series(['Node 2',countNode2], index=
    errorIPDf.columns), ignore_index=True)
476 errorIPDf = errorIPDf.append(pd.Series(['Node 3',countNode3], index=
    errorIPDf.columns), ignore_index=True)
477 errorIPDf
478
479 errorBalancers = errorBalancers.append(pd.Series(['Ip Hash',countNode1+
    countNode2+countNode3] , index=errorBalancers.columns), ignore_index
    =True)
480 errorBalancers
481
482
483 # In[16]:
484
485
486
487 x = errorBalancers['Type of load balancer']
488 y = errorBalancers['Total request failed']
489
490 fig = plt.figure()
491 ax = fig.add_subplot(111)
492 ax.set_ylim(0,50000)
493 plt.plot(x,y,color='r')
494 for i,j in zip(x,y):
495     ax.annotate(str(j),xy=(i,j), color='blue',fontweight='bold')
496
497 ax.set_ylabel('Total number of failure requests ')
498 ax.set_xlabel('Type of load balancer')
499 ax.set_title('Total number of failure requests made by different types
    of load balancers')
500 fig.set_size_inches(15, 8)
501 plt.show()
502 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/LogAnalysis/
    FailureRequests.jpg')
503 plt.close(fig)
504
505
506 # In[17]:
507
508
509 labels = ['Round Robin','Least Connection','Ip Hash','Weighted Round
    Robin']
510
511 nodes = ['Node 2','Node 1','Node 3']
512 errorArrangement = pd.DataFrame(columns = labels)
513 errorArrangement['Round Robin'] = errorRRDf['Total Request failed']
514 errorArrangement['Least Connection'] = errorLCDf['Total Request failed']
515 errorArrangement['Ip Hash'] = errorIPDf['Total Request failed']
516 errorArrangement['Weighted Round Robin'] = errorWRRDf['Total Request
    failed']
517 errorArrangement['Type'] = nodes
518 errorArrangement = errorArrangement.set_index(['Type'])

```

```

519 errorArrangement = errorArrangement.swapaxes("index", "columns")
520
521
522 x = np.arange(len(labels)) # the label locations
523 width = 0.2 # the width of the bars
524
525 fig, ax = plt.subplots()
526 rects1 = ax.bar(x - width/2, errorArrangement[ 'Node 2'], width, label='
Node 2',color='yellow')
527 rects2 = ax.bar(x , errorArrangement[ 'Node 1'],width, label='Node 1',
color='crimson')
528 rects3 = ax.bar(x + width/2, errorArrangement[ 'Node 3'], width, label='
Node 3',color='orange')
529
530 # Add some text for labels, title and custom x-axis tick labels, etc.
531 ax.set_ylabel('Total number of failure requests')
532 ax.set_title('Total number of failure requets for every node using
different types of load balancing techniques')
533 ax.set_xlabel('Type of load balancer')
534
535 ax.set_xticks(x)
536 ax.set_xticklabels(labels)
537 ax.legend()
538
539
540 def autolabel(rects):
541     """Attach a text label above each bar in *rects*, displaying its
height."""
542     for rect in rects:
543         height = rect.get_height()
544         ax.annotate('{} '.format(height),
545                     xy=(rect.get_x() + rect.get_width() / 2, height+10),
546                     xytext=(0, 3), # 3 points vertical offset
547                     textcoords="offset points",
548                     ha='center', va='bottom',color='navy',fontweight='
bold' )
549
550
551 autolabel(rects3)
552 autolabel(rects2)
553 autolabel(rects1)
554
555 fig.tight_layout()
556 fig = plt.gcf()
557 fig.set_size_inches(35, 10)
558 plt.show()
559
560 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/Graphs/LogAnalysis/
FailureRequestsForAllNodes.jpg')
561 plt.close(fig)
562
563 errorArrangement
564
565

```

```
566 # In[ ]:
```

Code A.6.4.1: Analysis of logs generated by nginx using different types of load balancing technique

Following are the figures generated by executing above script-

Figure A.20: Total number of requests made by different types of load balancing technique

Figure A.21: Total number of successful requests for every node using different types of load balancing techniques

Figure A.22: Total number of requests failed by different types of load balancing technique

Figure A.23: Total number of failure requests for every node using different types of load balancing techniques

A.6.5 Data analysis of data generated by Locust testing for web application hosted on AWS cloud

```

1 import os
2 import pandas as pd
3 import numpy as np
4
5 def locustOutputNode(path):
6
7     fileNames = []
8
9     #path = '/Users/dimplejaiswal/Downloads/LocustTestCasesOutputNode1-
10     master'
11
12     for files in os.listdir(path):
13
14         fileNames.append(files)
15
16
17     #print(fileNames)
18
19     list1 = []
20     list2 = []
21     list4 = []
22     list8 = []
23     list16 = []
24     list32 = []
25     list64 = []

```

```

26 list128=[]
27 list256=[]
28 list512 = []
29
30 list1updated =[]
31 list2updated = []
32 list4updated = []
33 list8updated = []
34 list16updated = []
35 list32updated = []
36 list64updated = []
37 list128updated = []
38 list256updated = []
39 list512updated = []
40
41 fileNames.sort()
42
43 for i in fileNames:
44
45     if i.startswith("TotalUsers512"):
46         list512.append(i)
47         list512updated.append('512-'+i[13:])
48
49
50     elif(i.startswith("TotalUsers256")):
51         list256.append(i)
52         list256updated.append('256-'+i[13:])
53
54
55     elif(i.startswith("TotalUsers128")):
56         list128.append(i)
57         list128updated.append('128-'+i[13:])
58
59
60     elif(i.startswith("TotalUsers64")):
61         list64.append(i)
62         list64updated.append('64-'+i[12:])
63
64     elif(i.startswith("TotalUsers32")):
65         list32.append(i)
66         list32updated.append('32-'+i[12:])
67
68
69     elif(i.startswith("TotalUsers16")):
70         list16.append(i)
71         list16updated.append('16-'+i[12:])
72
73     elif(i.startswith("TotalUsers8")):
74         list8.append(i)
75         list8updated.append('8-'+i[11:])
76
77
78     elif(i.startswith("TotalUsers4")):
79         list4.append(i)

```

```

80         list4updated.append('4-'+i[11:])
81
82
83     elif(i.startswith("TotalUsers2")):
84         list2.append(i)
85         list2updated.append('2-'+i[11:])
86
87     elif(i.startswith("TotalUsers1")):
88         list1.append(i)
89         list1updated.append('1-'+i[11:])
90
91 allDirList = []
92
93
94 allDirList.append(sorted(list1, key=lambda x: int(x[10:])))
95 allDirList.append(sorted(list2, key=lambda x: int(x[10:])))
96 allDirList.append(sorted(list4, key=lambda x: int(x[10:])))
97 allDirList.append(sorted(list8, key=lambda x: int(x[10:])))
98 allDirList.append(sorted(list16, key=lambda x: int(x[10:])))
99 allDirList.append(sorted(list32, key=lambda x: int(x[10:])))
100 allDirList.append(sorted(list64, key=lambda x: int(x[10:])))
101 allDirList.append(sorted(list128, key=lambda x: int(x[10:])))
102 allDirList.append(sorted(list256, key=lambda x: int(x[10:])))
103 allDirList.append(sorted(list512, key=lambda x: int(x[10:])))
104
105
106 updatedDirList = []
107
108 #print(list512)
109 updatedDirList.append(sorted(list1updated, key=lambda x: int(x.split
110 ('-')[1])))
110 updatedDirList.append(sorted(list2updated, key=lambda x: int(x.split
111 ('-')[1])))
111 updatedDirList.append(sorted(list4updated, key=lambda x: int(x.split
112 ('-')[1])))
112 updatedDirList.append(sorted(list8updated, key=lambda x: int(x.split
113 ('-')[1])))
113 updatedDirList.append(sorted(list16updated, key=lambda x: int(x.
114 split('-')[1])))
114 updatedDirList.append(sorted(list32updated, key=lambda x: int(x.
115 split('-')[1])))
115 updatedDirList.append(sorted(list64updated, key=lambda x: int(x.
116 split('-')[1])))
116 updatedDirList.append(sorted(list128updated, key=lambda x: int(x.
117 split('-')[1])))
117 updatedDirList.append(sorted(list256updated, key=lambda x: int(x.
118 split('-')[1])))
118 updatedDirList.append(sorted(list512updated, key=lambda x: int(x.
119 split('-')[1])))
119
120
121 #print(updatedDirList)
122
123 completeOutput =[]

```

```

124
125     for dir, updated in zip(allDirList, updatedDirList):
126
127         particularFile=[]
128         for file, updatedFile in zip(dir,updated):
129
130             statsFile = path+'/'+file+'/'+file+'_requests.csv'
131             with open(statsFile, "r") as f1:
132                 last_line = f1.readlines() [-1]
133
134             #particularFile.append(file)
135
136             particularFile.append([''+updatedFile+'']+','+last_line)
137
138
139
140         completeOutput.append(particularFile)
141
142
143     #print(completeOutput)
144
145     requiredOutput = []
146
147     for op in completeOutput:
148
149         for req in op:
150             row = req.split(sep=',')
151             requiredOutput.append([row[0],int(row[3]),int(row[4]),int(
row[6])])
152
153
154
155     #print(len(requiredOutput))
156
157     requiredOutputDf = pd.DataFrame(requiredOutput,columns=['filename','
Successful Requests','Total Failures', 'Avg Response Time'])
158
159
160     return requiredOutputDf
161
162
163
164 def main():
165
166     pathAWS = '/Users/dimplejaiswal/Downloads/AWSTesting-master'
167
168
169     requiredOutputDf1 = locustOutputNode(pathAWS)
170
171     print(requiredOutputDf1)
172
173     requiredOutputDf1 = np.asarray(requiredOutputDf1)
174

```

```

175     AWS = open('/Users/dimplejaiswal/Desktop/Thesis/AWSComparision/
AWSOutput.csv', 'w')
176     np.savetxt(AWS, requiredOutputDf1 ,fmt="%s", delimiter=",")
177
178
179     AWS.close()
180
181 main()

```

Code A.6.5.1: Data preprocessing of data generated by Locust testing for application on AWS cloud

Below is the output generated by above script-

```

1 [1-1],46,8,5582
2 [2-1],52,39,1055
3 [2-2],6,2,689
4 [4-1],2,3,80648
5 [4-2],27,1,16605
6 [4-4],0,2,0
7 [8-1],6,0,293966
8 [8-2],86,31,12734
9 [8-4],44,132,19211
10 [8-8],1,1,194579
11 [16-1],1,1,246168
12 [16-2],0,12,0
13 [16-4],0,16,0
14 [16-8],0,16,0
15 [16-16],0,16,0
16 [32-1],38,1,2276
17 [32-2],0,3,0
18 [32-4],0,32,0
19 [32-8],0,32,0
20 [32-16],0,32,0
21 [32-32],0,32,0
22 [64-1],0,64,0
23 [64-2],0,64,0
24 [64-4],0,64,0
25 [64-8],0,64,0
26 [64-16],111,97,56099
27 [64-32],116,8,10222
28 [64-64],11,28,25307
29 [128-1],0,121,0
30 [128-2],0,128,0
31 [128-4],0,128,0
32 [128-8],0,128,0
33 [128-16],0,128,0
34 [128-32],0,128,0
35 [128-64],0,128,0
36 [128-128],0,128,0
37 [256-1],0,256,0
38 [256-2],0,256,0
39 [256-4],0,256,0
40 [256-8],0,256,0
41 [256-16],0,256,0

```

```

42 [256-32],0,256,0
43 [256-64],0,256,0
44 [256-128],0,256,0
45 [256-256],0,256,0
46 [512-1],0,300,0
47 [512-2],0,512,0
48 [512-4],0,512,0
49 [512-8],11,1041,17454
50 [512-16],0,512,0
51 [512-32],0,512,0
52 [512-64],247,4028,7951
53 [512-128],0,512,0
54 [512-256],0,512,0
55 [512-512],0,512,0

```

Code A.6.5.2: Output generated for node 1

```

1 #!/usr/bin/env python
2 # coding: utf-8
3
4 # In[1]:
5
6
7 import pandas as pd
8 import matplotlib.pyplot as plt
9 import numpy as np
10
11
12 # In[11]:
13
14
15 #Total Requests analysis -Success rate of requests
16
17
18 col = ['filename','Total Requests','Total Failures', 'Avg Response Time'
19       ]
19 roundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
20                               TypesOfBalancerOutput/RoundRobin.csv',names = col)
21 AWSdata = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
22                               AWSComparision/AWSOutput.csv', names = col)
23 users = roundRobinData['filename'].tolist()
24
25 roundRobinData['Successful Requests'] = (roundRobinData['Total Requests
26                                           ']).div(0.01*(roundRobinData['Total Requests'
27                                           ''] + roundRobinData['
28                                           Total Failures']),axis=0).apply(np.ceil)
29 AWSdata['Successful Requests'] = (AWSdata['Total Requests']).div(0.01*(
30     AWSdata['Total Requests'] + AWSdata['Total Failures']),axis=0).apply
31     (np.ceil)
32 labels = users
33
34
35 ind = np.arange(len(roundRobinData))
36 width = 0.2
37
38
39
40

```

```

31 fig, ax = plt.subplots()
32 ax.barh(ind,roundRobinData['Successful Requests'] , width, color='aqua',
33         label='Round Robin Method')
34
35
36
37 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
38         roundRobinData)])
39
40 ax.legend()
41
42 ax.set_ylabel('Total number of Users with different number of concurrent
43         users:[Total users - Concurrent users]')
44
45 ax.set_xlabel('Success request rate(in %)')
46
47 ax.set_title('Success request rate for round robin load balancing method
48         with AWS balancer')
49
50
51
52 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
53 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
54 #plt.grid()
55 #fig.tight_layout()
56 #plt.figure(figsize=(40,40))
57 fig = plt.gcf()
58 fig.set_size_inches(15, 15)
59 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/AWSComparision/
60         SuccessRate.jpg')
61 plt.show()
62 plt.close(fig)
63
64 # In[13]:
65
66
67 #Total Requests analysis -failure rate of requests
68 col = ['filename','Total Requests','Total Failures', 'Avg Response Time'
69        ]
70 roundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
71         TypesOfBalancerOutput/RoundRobin.csv',names = col)
72 AWSdata = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
73         AWSComparision/AWSOutput.csv', names = col)
74 users = roundRobinData['filename'].tolist()
75
76 roundRobinData['Failure Requests'] = (roundRobinData['Total Failures'])
77         .div(0.01*(roundRobinData['Total Requests'] + roundRobinData['Total
78         Failures']],axis=0).apply(np.ceil)
79 AWSdata['Failure Requests'] = (AWSdata['Total Failures']).div(0.01*(
80         AWSdata['Total Requests'] + AWSdata['Total Failures']],axis=0).apply
81         (np.ceil)
82 labels = users
83

```

```

72
73 ind = np.arange(len(roundRobinData))
74 width = 0.2
75
76 fig, ax = plt.subplots()
77 ax.barh(ind,roundRobinData['Failure Requests'] , width, color='red',
       label='Round Robin Method')
78 ax.barh(ind+ width,AWSdata['Failure Requests'] , width, color='gold',
       label='AWS Balancer')
79
80
81
82 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
       roundRobinData)])
83 ax.legend()
84
85 ax.set_ylabel('Total number of Users with different number of concurrent
       users:[Total users - Concurrent users]')
86 ax.set_xlabel('Failure request rate(in %)')
87 ax.set_title('Failure request rate for round robin load balancing method
       with AWS balancer')
88
89
90
91
92 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
93 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
94 #plt.grid()
95 #fig.tight_layout()
96 #plt.figure(figsize=(40,40))
97 fig = plt.gcf()
98 fig.set_size_inches(15, 15)
99 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/AWSComparision/
       FailureRate.jpg')
100 plt.show()
101 plt.close(fig)
102
103
104 # In[14]:
105
106
107 #Total Requests analysis -Success rate of requests
108 col = ['filename','Total Requests','Total Failures', 'Avg Response Time'
       ]
109 roundRobinData = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
       TypesOfBalancerOutput/RoundRobin.csv',names = col)
110 AWSdata = pd.read_csv('/Users/dimplejaiswal/Desktop/Thesis/
       AWSComparision/AWSOutput.csv', names = col)
111 users = roundRobinData['filename'].tolist()
112
113 roundRobinData['Avg Response Time'] = (roundRobinData['Avg Response
       Time']).div(60,axis=0).apply(np.ceil)
114 AWSdata['Avg Response Time'] = (AWSdata['Avg Response Time']).div(60,
       axis=0).apply(np.ceil)

```



```

115 labels = users
116
117
118 ind = np.arange(len(roundRobinData))
119 width = 0.2
120
121 fig, ax = plt.subplots()
122 ax.barh(ind,roundRobinData['Avg Response Time'] , width, color='lime',
123         label='Round Robin Method')
124 ax.barh(ind+ width,AWSdata['Avg Response Time'] , width, color='teal',
125         label='AWS Balancer')
126
127 ax.set(yticks=ind + width, yticklabels=labels, ylim=[2*width - 1, len(
128         roundRobinData)])
129 ax.legend()
130
131 ax.set_ylabel('Total number of Users with different number of concurrent
132         users:[Total users - Concurrent users]')
133 ax.set_xlabel('Average response time(in seconds)')
134 ax.set_title(' Average response time(in seconds) for round robin load
135         balancing method with AWS balancer')
136
137 plt.grid(True, 'major', 'y', ls='--', lw=1.5, c='k', alpha=.3)
138 plt.grid(True, 'major', 'x', ls='--', lw=1.5, c='k', alpha=.3)
139 #plt.grid()
140 #fig.tight_layout()
141 #plt.figure(figsize=(40,40))
142 fig = plt.gcf()
143 fig.set_size_inches(15, 15)
144 plt.savefig('/Users/dimplejaiswal/Desktop/Thesis/AWSComparision/
145         ResponseTime.jpg')
146 plt.show()
147 plt.close(fig)
148
149 # In[ ]:

```

Code A.6.5.3: Analysis of data generated by Locust testing for application on AWS cloud with application using round robin approach on local cluster

Below are the figures generated using above script -

Figure A.24: Success request rate for round robin load balancing method with AWS balancer

Figure A.25: Failure request rate for round robin load balancing method with AWS balancer

Figure A.26: Average response time(in seconds) for round robin load balancing method with AWS balancer