VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“Jnana Sangama”, Belagavi , Karnataka, INDIA

A Project Report
on

Optimizing Dead mileage in Bangalore Metropolitan Transport Corporation

Submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Engineering
in
Computer Science and Engineering

Submitted By

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2021 – 2022

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CERTIFICATE

Certified that the Project Entitled **"Optimizing Dead Mileage in Bangalore Metropolitan Transport Corporation"** carried out by **MADHAN M**, bearing **USN 1GA18CS079, KIRAN SWAMY S**,bearing **USN 1GA18CS075, YUKTHA MARLA S**, bearing **USN 1GA18CS183** bonafide students of Global Academy of Technology, in partial fulfillment for the award of the **BACHELOR OF ENGINEERING** in **Computer Science and Engineering** from Visvesvaraya Technological University, Belagavi during the year 2021-2022. It is certified that all the corrections/suggestions indicated for Internal Assessment have been incorporated in the Report submitted to the department. The Partial Project report has been approved as it satisfies the academic requirements in respect of the project work prescribed for the said Degree.

Dr. N Guruprasad Professor Dept. of CSE GAT, Bengaluru.	Dr. Bhagyashri R Hanji Professor & Head Dept. of CSE GAT, Bengaluru.	Dr. N. Ranapratap Reddy Principal GAT, Bengaluru.

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DECLARATION

We, **MADHAN M**, bearing **USN 1GA18CS079, KIRAN SWAMY S**,bearing **USN 1GA18CS075, YUKTHA MARLA S**, bearing **USN 1GA18CS183** students of Eighth Semester B.E, Department of Computer Science and Engineering, Global Academy of Technology, Rajarajeshwari Nagar Bengaluru, declare that the Project Work entitled "**Optimizing Dead Mileage in Bangalore Metropolitan Transport Corporaton"** has been carried out by us and submitted in partial fulfillment of the course requirements for the award of degree in **Bachelor of Engineering** in **Computer Science and Engineering** from **Visvesvaraya Technological University, Belagavi** during the academic year **2021-2022**.

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ABSTRACT

In metropolitan cities, public transportation service plays a vital role in mobility of people, and it must introduce new routes more frequently due to the fast development of the city in terms of population growth and city size. Whenever there is introduction of new route or increase in frequency of buses, the non-revenue kilometres covered by the buses increases as depot and route starting/ending points are at different places. This non-revenue kilometres or dead kilometres depends on the distance between depot and route starting point/ending point. The dead kilometres not only result in revenue loss but also results in an increase in the operating cost because of the extra kilometres covered by buses. Reduction of dead kilometres is necessary for the economic growth of the public transportation system. Therefore, in this project, the attention is focused on minimizing dead kilometres by optimizing allocation of buses to depots depending upon the shortest distance between depot and route starting/ending points. An application/software is developed considering the parameters, which using transportation model from operations research, and applied to Bangalore Metropolitan Transport Corporation (BMTC) routes operating presently to obtain optimal bus allocation to depots. Operations research (O.R.) is defined as the scientific process of transforming data into insights to making better decisions. The transportation model is concerned with selecting the routes between supply and demand points to minimize costs of transportation subject to constraints of supply at any supply point and demand at any demand point. Presently the allocation of buses to depots is done manually which is time consuming as well as not optimal. Hence the focus is to create an application which allocates the buses in an optimal way, achieving the least dead kilometres.

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Last, but not least, we owe our debts to our parents, friends and also those who directly or indirectly have helped us to make the phase - 2 project work a success.

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GLOSSARY

BMTC	Bangalore Metropolitan Transport Corporation
IBFS	Initial Basic Feasible Solution
MDVSP	Multi-Depot Vehicle Scheduling Problem
LNS	Large Neighbourhood Search

CHAPTER 1

INTRODUCTION

1.1 Introduction to Project

- The public road transportation plays an important role in mobility of people in metropolitan cities. In most of the state in India, the road transport service is undertaken by the government, and it involves large amount of investment for providing facilities for maintenance, parking, and operation of routes. This is done by construction of depots, bus stations, and bus stop shelters.
- The depot is the main operating unit in any public road transportation where the buses are parked and maintained. The bus must travel from depot to route starting point to operate route as depot and route starting point at different places.
- In early days, dead kilometers percentage was minimum as operation of buses are very less compared with the present days and such problems were solved based on common sense and experience. But at present, the kilometers operated by public transportation is in terms of lakhs of kilometers, and the amount of fuel consumption is very high, which cannot be neglected. The dead kilometers not only result in revenue loss but also causes an increase in operating cost as it involves more fuel consumption, crew overtime, and increase in maintenance cost because of the extra distance covered by the buses.
- Therefore, the dead kilometers reduction is important for economic growth of the public road transport service.

1.2 Problem Definition

- The distance travelled by bus from depot to route starting point for operation of route and again from route ending point to depot after completion of routes where no passenger travel is known as “dead kilometers”.

- Operations research (O.R.) is defined as the scientific process of transforming data into insights to making better decisions.
- Operations research deals with employing techniques from other mathematical sciences, such as modelling, statistics, and optimization, operations research arrives at optimal or near-optimal solutions to complex decision-making problems.
- The transportation model is concerned with selecting the routes between supply and demand points in order to minimize costs of transportation subject to constraints of supply at any supply point and demand at any demand point.

1.3 Existing System

- Present BMTC buses to depot allocation are done manually, which is inefficient since the dead-mileage is not taken into consideration, and no software to maintain and schedule busses to depots. Automating the complete process of buses to depots considering the dead milage could save a lot from the budget allocated to transportation, increased reliability due to less errors and reuse the application when new buses or depots are added, instead of manually allocating the buses to depots.

1.4 Proposed System

- Our aim is to develop an application which does the allocation of buses to depots in an optimal way by using Operations Research techniques.
- We plan to use spreadsheet as an input to the application consisting of information about buses, depots and the respective cost/distance between bus and depot.
- We plan to use 4 Initial Basic Feasible Solution Approximation techniques which are North-West approximation, Row-Minima approximation, Least-Cost approximation, and Vogel's approximation.
- We plan to use transportation model to carry out the optimization process of allocation.

1.5 Objectives of the Project Work

- Develop algorithms for Initial Basic Feasible solution (IBFS).
- Use transportation model to find best allocation of buses.
- Develop an GUI application to allocate buses to depots in an optimal way, reducing dead mileage.

1.6 Scope of the Project Work

According to recent analysis, overall Corporation dead kilometers are 2.06% with dead kilometers of 31937.5 km per day, which is on the higher side as operating cost is more than Rs 40/- for each dead kilometers, which in turn costs more than 12.78 lakhs rupees per day to BMTC and when considering for a year, it costs around 46.6 crores and may be reduced by proper allocation of schedules to depots. Also automating the whole allocation process save time and reuse the application when new buses and depots are added instead of manually allocating again from the beginning for optimal allocation. Due to optimal allocation, achieving least dead kilometers can help in saving overall operations cost and reducing wear and tear of vehicles.

1.7 Project Report Outline

- **Chapter 1:** This chapter contain brief introduction about the project. The definitions, existing system, proposed system, objective, scope and outline of the project.
- **Chapter 2:** Gives brief overview of the paper and the research sources that have been studied to establish through an understanding of the under consideration.
- **Chapter 3:** This chapter describes the requirement specification of functional, non-functional, hardware and software components required to the system.
- **Chapter 4:** This chapter describe the overall in-depth information about the project. This chapter involve the basic theoretical information about each component and aspect

of the project such as system design, system architecture, data flow diagram and use case diagram.

- **Chapter 5:** This chapter includes installation of the software required and the issues faced while implementing. The algorithms that are implemented are also included.
- **Chapter 6:** This chapter includes testing of the modules implemented and the results obtained when testing the modules.
- **Chapter 7:** This chapter includes the final result of the implementation and result are discussed.
- **Chapter 8:** In this chapter, conclusion about the project is being discussed.

CHAPTER 2

LITERATURE SURVEY

A literature survey or a literature review in a project report shows the various analyses and research made in the field of interest and the results already published, taking into account the various parameters of the project and the extent of the project. Literature survey mainly carried out in order to analyze the background of the current project which helps to find out flaws in the existing system & guides on which unsolved problems we can work out. So, the following topics not only illustrate the background of the project but also uncover the problems and flaws which motivated to propose solutions and work on the Proposed System.

A literature survey is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews use secondary sources, and do not report new or original experimental work. Its main goals are to situate the current study within the body of literature and to provide context for the particular reader. Literature reviews are a basis for researching nearly every academic field. demic field.

Literature survey describes about the existing work on the given project. It deals with the problem associated with the existing system and also gives user a clear knowledge on how to deal with the existing problems and how to provide solution to the existing problems.

Objectives of Literature Survey

- Learning the definitions of the concepts.
- Access to latest approaches, methods and theories
- Discovering research topics based on the existing research
- It improves the quality of the literature survey to exclude sidetracks – Remember to explicate what is excluded.

2.1 System Study and Review of Literature

A. Solving a Large-Scale Multi-Depot Vehicle Scheduling Problem in Urban Bus Systems, 2018

- Proposed an improved model for the large-scale multi-depot vehicle scheduling problem (MDVSP).
- The results show that the improved Large Neighbourhood Search (LNS) algorithm can achieve very good performance in computational efficiency without deteriorating solution quality, which is important for large-scale systems.
- The proposed methodology is applied to a real-life case in China and several test instances.

B. Optimization of bus allocation to depots by minimizing dead kilometers, 2015

- They proposed a mathematical model to allocate buses manually.
- They have considered all real-world parameters and situations.
- Manually allocated buses to depots and did not automate them.

C. Roadmap for improving city bus systems in India, 2016

- Provided techniques for improving operational Process.
- Provided better proposals for bus route planning, tools, and modifications.
- Only analysis and proposals are given, specific solution is not provided.

D. Optimizing Dead Mileage in Urban Bus Routes, 2012

- This paper studies the buses assignment from their depots to their routes starting points in urban transportation network.
- It describes a computational study to solve the dead mileage minimization to optimality.
- Dakar Dem Dikk Case Study is given.

Chapter 3

SYSTEM REQUIREMENTS SPECIFICATION

3.1 Functional Requirements

The functional requirements for a system describe what the system should do. These requirements depend on the type of software being developed; the general approach taken by the organization when writing requirements. The functional system requirements describe the system function in detail, its inputs and outputs, exceptions and so on.

Functional requirements are as follows:

- To develop an application which allocates the buses to the depots to achieve the least dead kilometers.
- Implement the IBFS algorithms to find the initial solution which may or may be an optimal solution.
- Be able to accept spreadsheet and extract data from the input flawlessly.
- Provide proper visualization and simple User Interface.
- Developing a responsive application which notifies the user in every stage about the process and errors if encountered.

3.2 Non-Functional Requirements

Non functional requirements, as the name suggests, are requirements that are not directly concerned with the specific functions delivered by the system. They may relate to emergent system properties such as reliability, response time and store occupancy. Alternatively, they may define constraints on the system such as capabilities of I/O devices and the data representations used in system interfaces.

The non-functional requirements are as follows:

- It should be easier to access and load the application in any windows operating system.
- Responsive time of the application should reflect the real-time observations
- The application should never fail in any test cases for all proper inputs.
- The user should be able to upload the input data and be able to download the output easily.

3.3 Hardware Requirements

- **Processor:** Intel Core i5 or AMD FX 8 core series with clock speed of 2.4Ghz or above
- **RAM**: 6GB or above
- **Hard Disk**: 40 GB or above
- **Input device**: Keyboard or mouse or compatible pointing devices
- **Display**: XGA (1024*768 pixels) or higher resolution monitor with 32-bit colour settings
- **Miscellaneous**: USB interface, Power adapter, etc

3.4 Software Requirements

- **Operating System:** Windows 8 or above
- **Programming language:** Python 3.8
- **Development environment:** Visual Studio code
- **Database:** SQLite3

Chapter 4

SYSTEM DESIGN

This chapter describe the overall in-depth information about the project. This chapter involve the basic theoretical information about each component and aspect of the project such as system design, system architecture, data flow diagram and use case diagram.

System design is the process of defining the architecture, components, modules, interface, and data for a system to satisfy specified requirements. System design could see it has the application of systems theory to product development. There is some overlap with the disciplines of system analysis, system architecture, system engineering.

4.1 Design Overview

We want to design an application that takes a spreadsheet as an input, extract data from the input, apply any one of the IBFS algorithms, run optimization and display output.

4.2 System Architecture

The below figure 4.1 shows a general block diagram describing the activities performed by this project. The entire architecture has been implemented in modules which we will see in modules section.

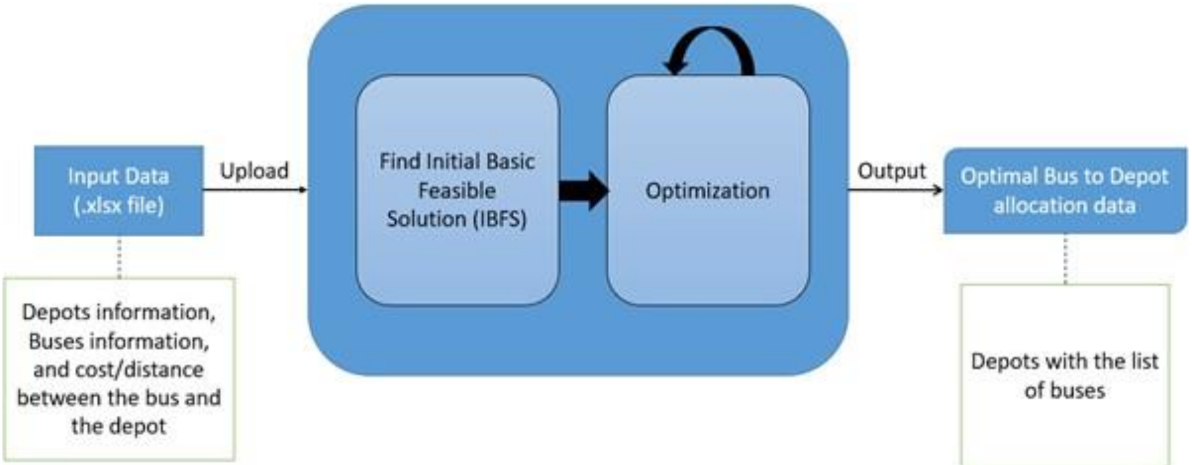


Fig 4.1 System Architecture

4.3 Data Flow Diagram

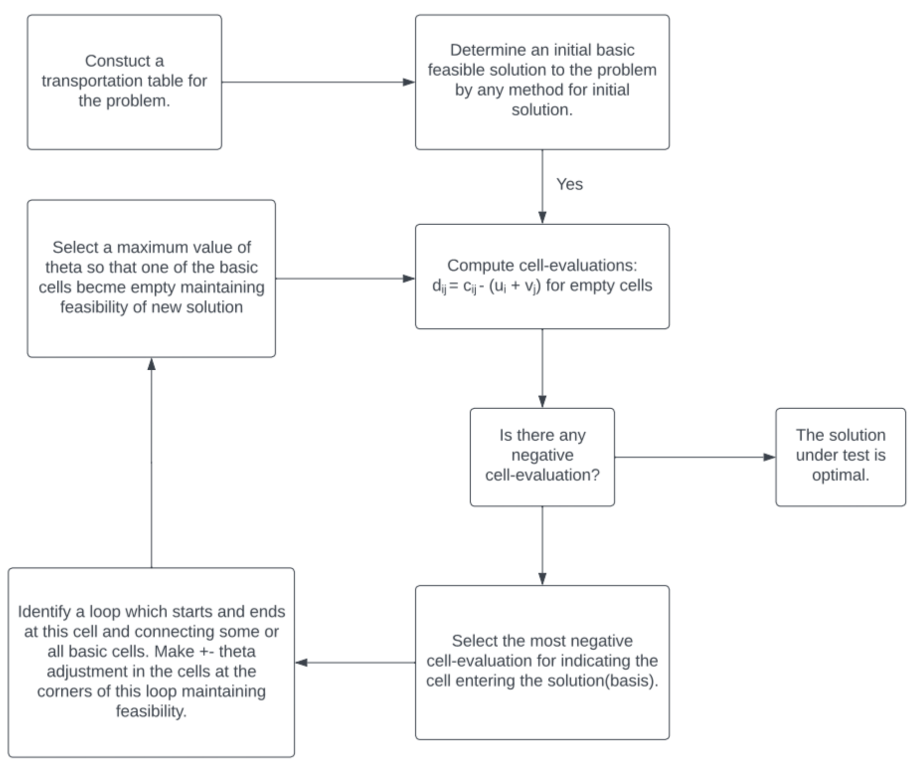


Fig 4.2 Data flow diagram

4.4 Use Case Diagram

A UML use case diagram is the primary form of system/software requirements for a new software program underdeveloped. Use cases specify the expected behavior, and not the exact method of making it happen. It is an effective technique for communicating system behavior in the user's terms by specifying all externally visible system behavior.

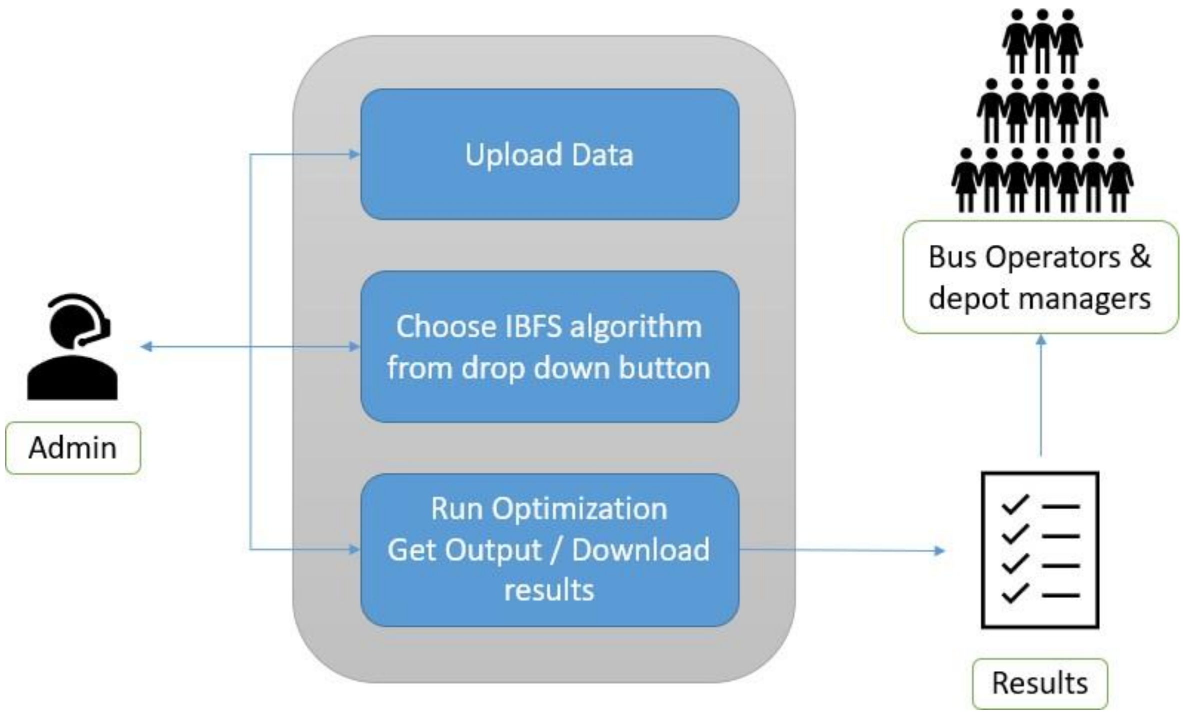


Figure 4.3 Use Case Diagram

Figure 4.2 discusses the use case diagram showing some internal and external factors to model interactions among different components. These internal and external agents are known as actors. Use case diagrams consist of actors, use cases and their relationships. The diagram is used to model the system and subsystem of an application. A single use case diagram captures much of the functionality of the system.

4.5 Modules of the Project

Module 1: Data preparation

Module 2: Find IBFS

Module 3: Optimization

Module 4: Format Output

4.5.1 Module 1

Module Name: -Data preparation

Functionality: -

- Collecting necessary data
- Structuring the data

4.5.2 Module 2

Module Name: - Find IBFS

Functionality: -

- Design IBFS algorithms
- Test the IBFS functions
- Integrate and use the functions in the application

4.5.3 Module 3

Module Name:- Optimization

Functionality:-

- Design algorithms for optimizations
- Apply optimization method on the data

4.5.4 Module 4

Module Name:- Format Output

Functionality:-

- Display and format output.

Chapter 5

IMPLEMENTATION

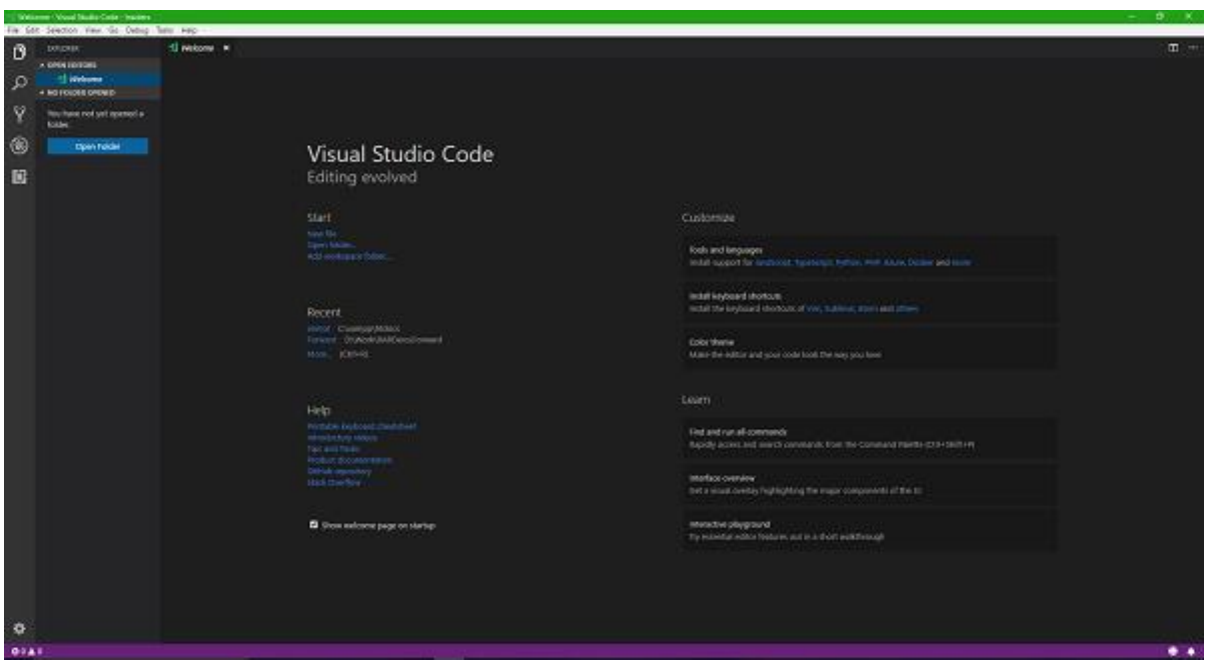
Implementation is the process of converting a new system design into an operational one. It is the key stage in achieving a successful new system. It must therefore be carefully planned and controlled. The implementation of a system is done after the development effort is completed.

5.1 Steps for Implementation

Step 1: Installation: First step is to download the Visual Studio Code installer. Once it is downloaded, run the installer (VSCodeUserSetup-{version}.exe). By default, VS Code is installed under C:\Users\{Username}\AppData\Local\Programs\Microsoft VS Code.

Opening Visual Studio Code:

On opening visual studio code you will see the below window.



Step 2:Installing python extension : Next, install the Python extension for VS Code from the Visual Studio Marketplace. For additional details on installing extensions . The Python extension is named **Python** and it's published by Microsoft.

Along with the Python extension, you need to install a Python interpreter. Which interpreter you use is dependent on your specific needs, but some guidance is provided below.

Install Python from python.org.

To verify that you've installed Python successfully on your machine, run one of the following commands (depending on your operating system):

- Linux/macOS: open a Terminal Window and type the following command:

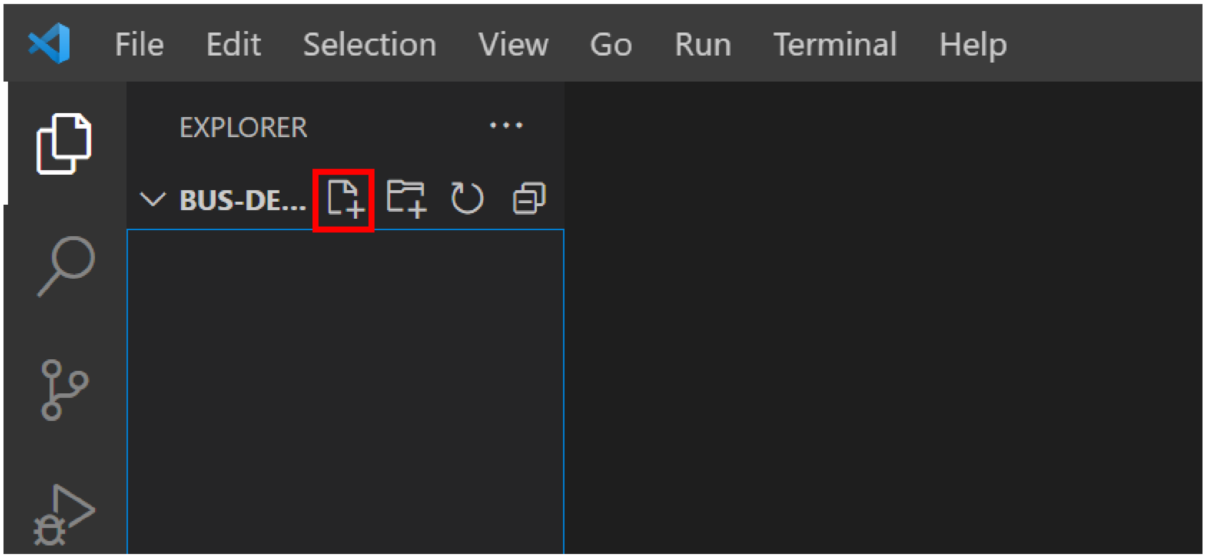
```
python3 --version
```

- Windows: open a command prompt and run the following command:

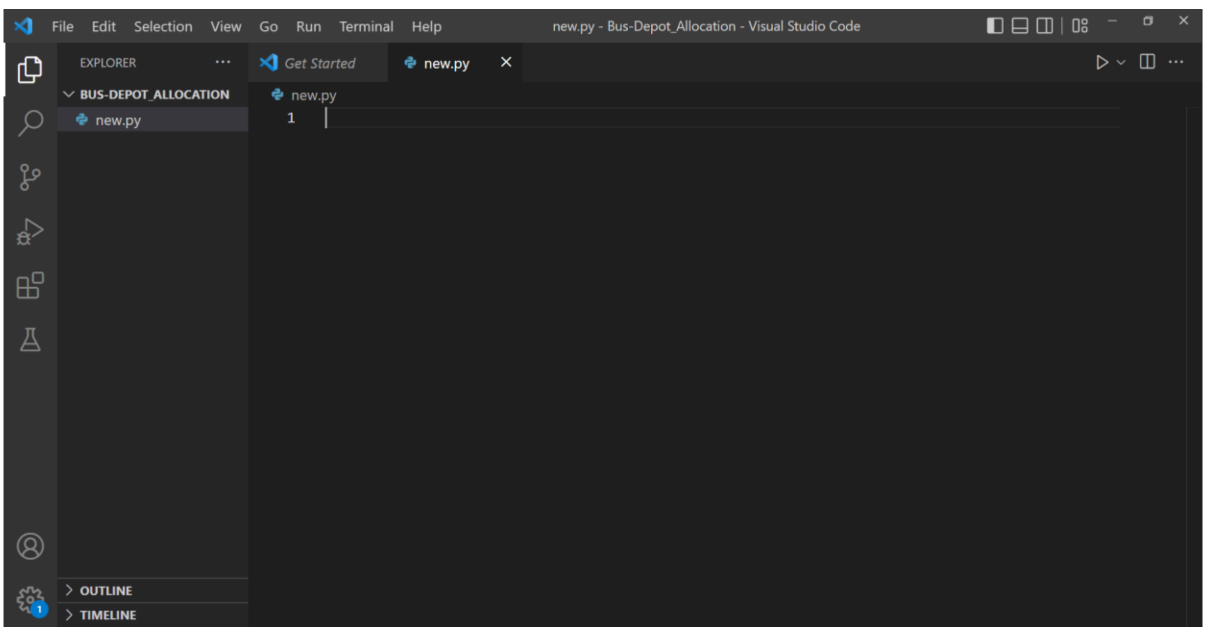
```
py -3 --version
```

If the installation was successful, the output window should show the version of Python that you installed.

Step 3: Creating new file : From the File Explorer toolbar, select the **Open Folder** button , create a folder where you want to save your files. From the File Explorer toolbar, select the **New File** button on the folder.



By using the .py file extension, you tell VS Code to interpret this file as a Python program, so that it evaluates the contents with the Python extension and the selected interpreter.



Step 4: Installing libraries using terminal : In order to install necessary libraries you need to click on new terminal and write command for installing the library.

```
pip install numpy
```

5.2 Implementation Issues

The implementation phase of software development is concerned with translating design specifications into source code. The primary goal of implementation is to write source code and internal documentation so that conformance of the code to its specifications can be easily verified and so that debugging testing and modification are eased. This goal can be achieved by making the source code as clear and straightforward as possible. Simplicity clarity and elegance are the hallmarks of good programs and these characteristics have been implemented in each program module.

The goals of implementation are as follows.

- Minimize the memory required.
- Maximize output readability.
- Maximize source text readability.
- Minimize the number of source statements.
- Minimize development time.

5.3 Algorithms

5.3.1 Row minima

```
def row_MinimaIBFS(fact, ware, weights):
    n = 0
    w = 0
    cost = 0
    ibfs = []
```

```
    arr = np.array([[0 for i in range(len(ware))] for i in
range(len(fact))])
    while  n < len(fact) and w < len(ware):
        if max(ware) > fact[n]:
            w = ware.index(max(ware))
            arr[n][w] = fact[n]
            ware[w] -= fact[n]
            fact[n] = 0
            n += 1
        elif max(ware) < fact[n]:
            w = ware.index(max(ware))
            arr[n][w] = ware[w]
            fact[n] -= ware[w]
            ware[w] = 0
        else:
            w = ware.index(max(ware))
            arr[n][w] = max(ware)
            fact[n] = 0
            ware[w] = 0
            n += 1
            w + 1
    for i in range(len(arr)):
        for j in range(len(arr[0])):
            cost += arr[i][j] * weights[i][j]
            if(arr[i][j]!=0):
                ibfs.append(((i, j), arr[i][j]))
    #print('total bfs cost is: ',cost)
    IBFS = cost
    return ibfs
```

5.3.2 North west

```
def north_west_corner(supply, demand,costs):
    supply_copy = supply.copy()
    demand_copy = demand.copy()
    i = 0
    j = 0
    cost =0
    bfs = []
    while len(bfs) < len(supply) + len(demand) - 1:
        s = supply_copy[i]
        d = demand_copy[j]
        v = min(s, d)
```

```
            supply_copy[i] -= v
            demand_copy[j] -= v
            bfs.append(((i, j), v))
            if supply_copy[i] == 0 and i < len(supply) - 1:
                i += 1
            elif demand_copy[j] == 0 and j < len(demand) - 1:
                j += 1
    arr = indexed_tuple_to_Array(bfs,len(demand),len(supply))
    for i in range(len(arr)):
        for j in range(len(arr[0])):
            cost += arr[i][j] * costs[i][j]
    IBFS = cost
    return bfs
```

Chapter 6

TESTING

This chapter gives the outline of all testing methods that are carried out to get a bug free system. Quality can be achieved by testing the product using different techniques at different phases of the project development. The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components sub assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

6.1 Test Environment

Testing is an integral part of software development. Testing process certifies whether the product that is developed compiles with the standards that it was designed to. Testing process involves building of test cases against which the product has to be tested.

6.2 Unit Testing of Modules

6.2.1 Module 1

Steps	Test Data	Expected Results	Observed Results	Remarks
Step 1	Data available	If data is available, then go to further execution	Check Successful	Pass

Table 6.1 Test Case for data

6.2.2 Module 2

Steps	Test Data	Expected Results	Observed Results	Remarks
Step 1	Calculate IBFS	Getting IBFS value from north west and row minima methods	Value obtained	Pass

Table 6.2 Test Case for IBFS

6.2.3 Module 3

Steps	Test Data	Expected Results	Observed Results	Remarks
Step 1	Optimization	Getting optimal cost	Value obtained	Pass

Table 6.3 Test Case for Optimization

6.2.4 Module 4

Steps	Test Data	Expected Results	Observed Results	Remarks
Step 1	Upload data	Selecting the data	As expected	Pass
Step 2	Select IBFS method from the drop down	Drop down option with IBFS methods to choose	As expected	Pass
Step 3	Click on allocate button	Display IBFS value, Optimal cost and allocation	As expected	Pass
Step 4	Click on detailed calculation	Display all the steps	As expected	Pass

Table 6.4 Test Case for UI

6.3 Integration Testing of Modules

6.3.1 Module 1

The data is passed to the backend. The IBFS methods are applied to the data uploaded. Based on the IBFS method choosen in the UI the value is calculated .Next optimization of the data takes. Optimization takes place until we get an optimal value. After getting the optimal value the optimal cost is calculated.

6.3.2 Module 2

The UI consists of option to upload the data . Based on the IBFS method selected , the IBFS value obtained from the algorithm is displayed along with the optimal solution. After getting the optimal cost the allocation of buses to depots is displayed. In order to view the steps we can click on detailed calculation. The allocated data can be downloaded using download result button.

6.4 System Testing

System Testing Software once validated must be combined with other system elements. System testing verifies that all the elements are proper and that overall system function performance is achieved. It also tests to find discrepancies between the system and its original objective, current specifications and system documentation

6.5 Functional Testing

Functional Testing is a type of software testing that validates the software system against the functional requirements/specifications. The purpose of Functional tests is to test each function of the software application, by providing appropriate input, verifying the output against the Functional requirements. The prime objective of Functional testing is checking the functionalities of the software system. It mainly concentrates on - Mainline functions: Testing the main functions of an application Basic Usability: It involves basic usability testing of the system. It checks whether a user can freely navigate through the screens without any difficulties.

Chapter 7

RESULTS

This section describes the screens of the “Optimizing Dead Mileage in Bangalore Metropolitan Transport Corporation”.

Snapshot1 : Uploading the data

The user has to first upload the data .

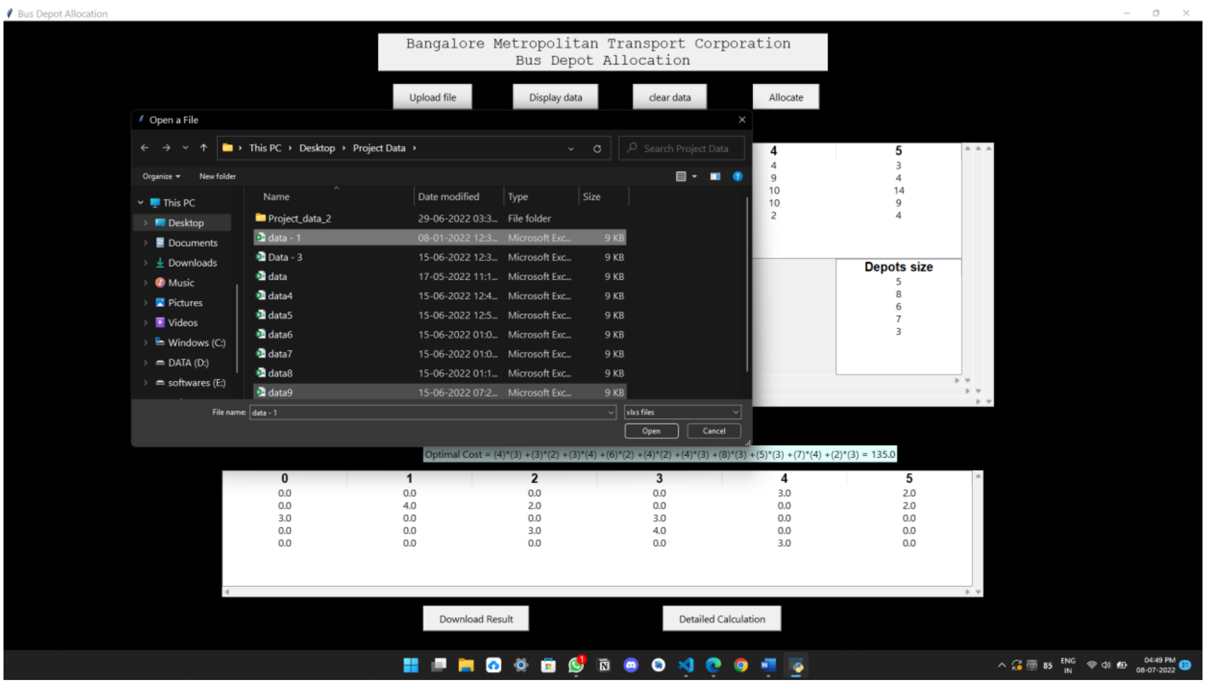


Fig 7.1 Snapshot of uploading data

Snapshot 2 : Getting IBFS AND Optimal cost

When you choose the IBFS method and click on allocate the IBFS value and optimal cost is displayed along with the allocation.

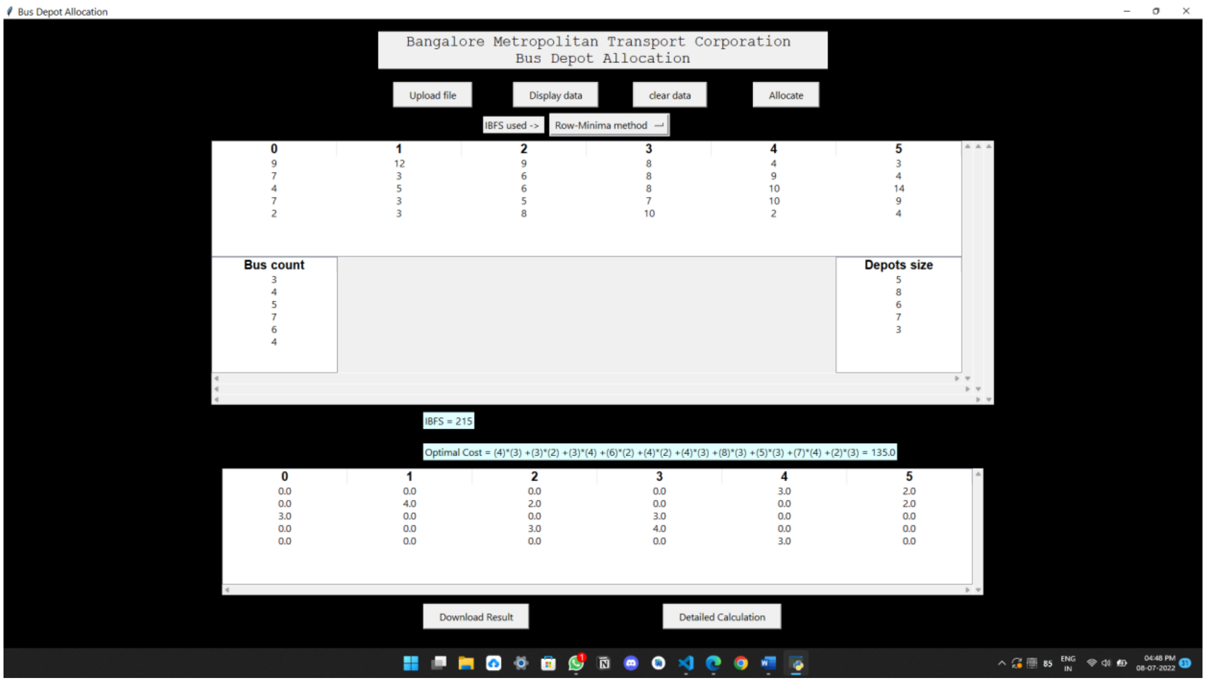


Fig 7.2 Snapshot of Allocation

Snapshot 3 : Detailed Calculation

To get steps of getting IBFS and optimal cost we can click on detailed calculation.

```
Detailed Steps
Balanced Demand: [3, 4, 5, 7, 6, 4]
Balanced Supply: [5, 8, 6, 7, 3]

IBFS Allocation using Row-Minima Method:
[[0 0 0 5 0 0]
 [0 0 2 0 6 0]
 [0 4 0 0 0 2]
 [3 0 3 1 0 0]
 [0 0 0 1 0 2]]
IBFS Value = (8)*(5) +(6)*(2) +(9)*(6) +(5)*(4) +(14)*(2) +(7)*(3) +(5)*(3) +(7)*(1) +(10)*(1) +(4)*(2) = 215
------------------------------------------------------------------------
ITERATION: 0
------------------------------------------------------------------------
Ui: [0, 0, 12, -1, 2]
Vj: [8, -7, 6, 8, 9, 2]

D(i,j):
[[ -1 -19 -3  0  5 -1]
 [  1 -10  0  0  0 -2]
 [ 16  0  12 12 11  0]
 [  0 -11  0  0 -2 -8]
 [  8 -8  0  0  9  0]]        Still not OPTIMAL, moving towards OPTIMALITY
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
New Allocation:
[[0 0 0 5 0 0]
 [0 0 2 0 6 0]
 [1 4 0 0 0 1]
 [2 0 3 2 0 0]
```

Fig 7.3.1 Snapshot of Allocation Steps

```
Detailed Steps
D(i,j):
[[ -6 -10 -4 -1  0  0]
 [ -3  0  0  0 -4  0]
 [  0 -2  0  0 -5 -10]
 [ -4 -1  0  0 -6 -6]
 [ -1 -3 -5 -5  0 -3]]        OPTIMAL, Stop here.
==================================================================
Final Allocation:
[[0. 0. 0. 0. 3. 2.]
 [0. 4. 2. 0. 0. 2.]
 [3. 0. 0. 3. 0. 0.]
 [0. 0. 3. 4. 0. 0.]
 [0. 0. 0. 0. 3. 0.]]

Optimal Cost = (4)*(3) +(3)*(2) +(3)*(4) +(6)*(2) +(4)*(2) +(4)*(3) +(8)*(3) +(5)*(3) +(7)*(4) +(2)*(3) = 135.0

IBFS = 215

Final Optimal Cost = 135.0

Final Optimal Allocation:
[[0. 0. 0. 0. 3. 2.]
 [0. 4. 2. 0. 0. 2.]
 [3. 0. 0. 3. 0. 0.]
 [0. 0. 3. 4. 0. 0.]
 [0. 0. 0. 0. 3. 0.]]
==================================================================
```

Fig 7.3.2 Snapshot of Allocation Steps

Snapshot 4 : Downloading Result

The allocation of buses to depots in optimal way can be downloaded.

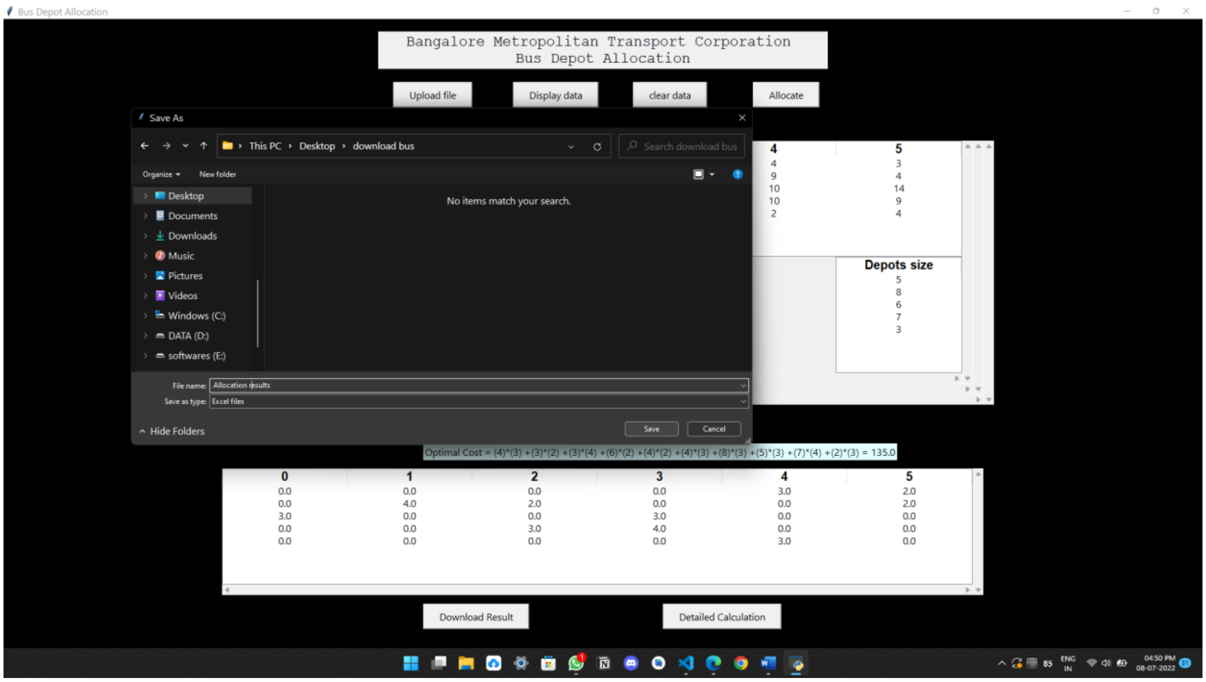


Fig 7.4 Snapshot of downloading result

Chapter 8

CONCLUSION

Present BMTC buses to depot allocation are done manually, which is inefficient since the dead-mileage is not taken into consideration, and no software to maintain and schedule busses to depots. Automating the complete process of buses to depots considering the dead milage could save a lot from the budget allocated to transportation, increased reliability due to less errors and reuse the application when new buses or depots are added, instead of manually allocating the buses to depots. This application first finds the initial basic feasible solution for the bus data, then uses transportation model of operation research to optimize it repetitively until certain conditions are met, then using the output allocation data is sent to all the depots managers and bus operators.

8.1 Future Enhancements

The project can be improvised in terms of the UI. It can also be integrated with webpage and can be migrated to cloud application.

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[4] Make best decisions through operations research, S.D Sharma

APPENDIX

Buddha Institute of Technology
CL-1 Sector-7, Gida, Gorakhpur, U.P-273209
Organizes
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Certificate of Participation

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Mr. **Madhan M** of Department Of CSE, Global Academy of Technology, Bengaluru, India has presented/contributed a paper titled "Optimizing Dead Mileage in Bangalore Metropolitan Transport Corporation" in the International Conference on "Innovative Researches in Engineering & Technology (IRET-2022)" in Joint Collaboration with Engineering Council of India, New Delhi and Buddha Institute of Technology, Gorakhpur held at Buddha Institute of Technology, Gorakhpur (U.P.), India, During April 21-22, 2022.

Dr. Saiyed Salim Sayeed	**Dr. Arvind Kumar Pandey**	**Mr. P.K Mishra**
Organizing Secretary, IRET-2022	Director, BIT	Chief Coordinator, ECI

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