FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

Intelligent Bus System (IBS UPM)

TITLE : FINAL PROJECT (INTELLIGENT BUS SYSTEM)
COURSE : ARTIFICIAL INTELLIGENCE
COURSE CODE : CSC3600
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Meet Our Best Team

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Introduction

The implementation of a Genetic Algorithm (GA) is used to optimise bus routes in our university's bus system, Universiti Putra Malaysia (UPM). The current UPM bus system has various faults, including uneven route frequencies and the lack of a trustworthy bus schedule for students to refer to.

This implementation attempts to increase the consistency of bus frequencies and offer students with an effective transportation system within the university campus by applying the genetic algorithm to the bus route optimisation problem at UPM.

Problem Statement

- **Inconsistent bus frequencies**
- **Absence of a reliable bus schedule**
- **Minimization of waiting time**
- **Efficient transportation between bus stops**

The successful implementation of the GA for bus route optimization at UPM will lead to a more consistent bus service, improved transportation efficiency, and reduced waiting times for students.

Objectives

Optimize bus routes

Enhance transportation efficiency

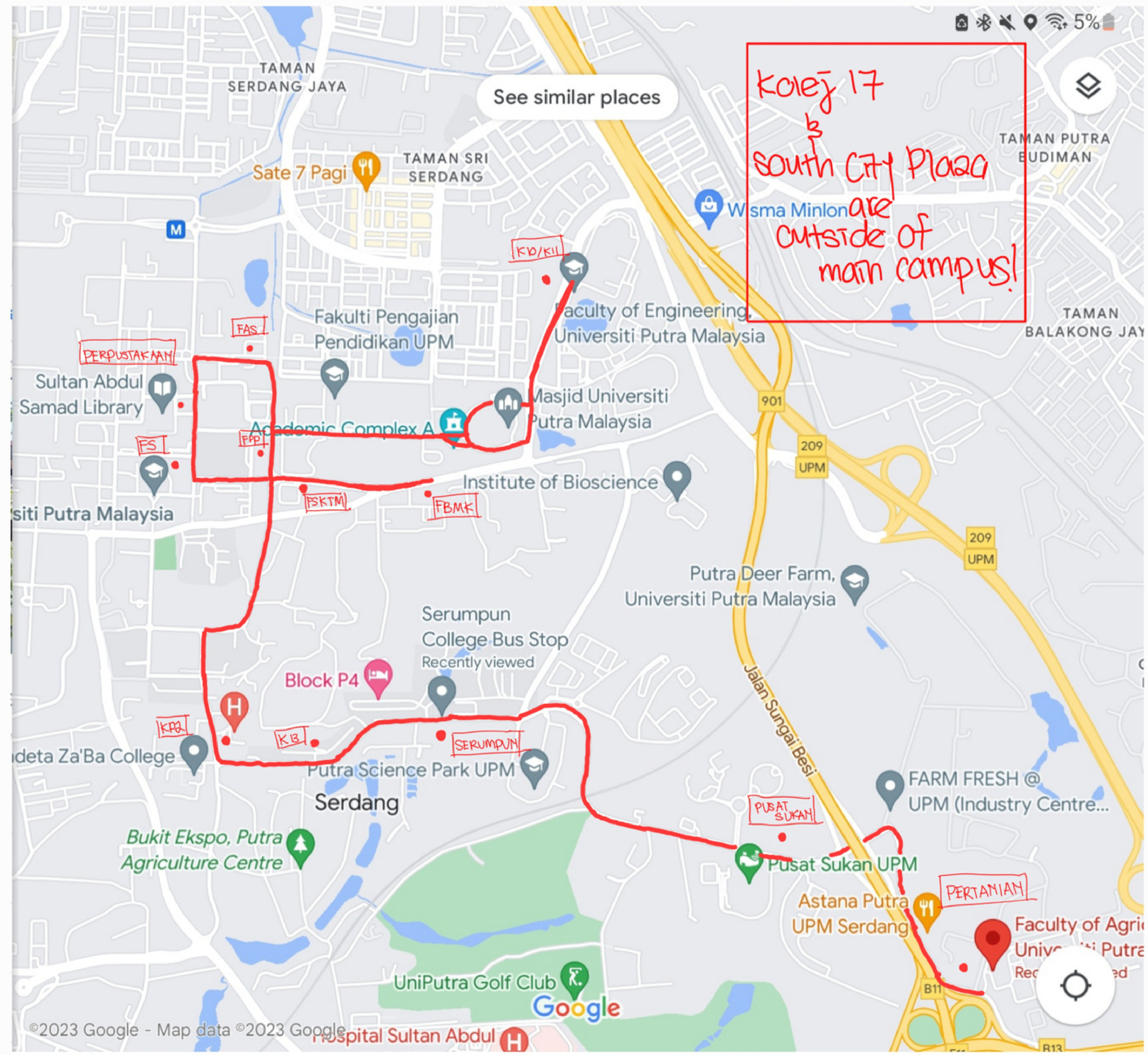
Minimize waiting time

Generate a reliable bus schedule

Improve consistency of bus frequencies

Track and analyze optimization results

Locations Covered



Bus Stops in UPM

How does Genetic Algorithm Works in Bus Routes Optimization?

Generation

Think of generations as different iterations of bus routes.

Population Size

The population size refers to the number of different bus routes that exist within each generation.

Max Route Size

The maximum route size is the limit on the number of bus stops a single route can have.

Mutation Probability

Mutation probability represents the likelihood of introducing random changes to the bus routes during each generation.

Copy Count

The copy count determines how many copies of the best-performing routes are carried forward to the next generation.

Pseudocode of GA

1. Choose initial population
2. Evaluate the fitness of each individual in the population

Repeat

3. Select best-ranking individuals to reproduce

4. Breed new generation through crossover and mutation (genetic operations) and give birth to offspring

5. Evaluate the individual fitnesses of the offspring

6. Replace worst ranked part of population with offspring

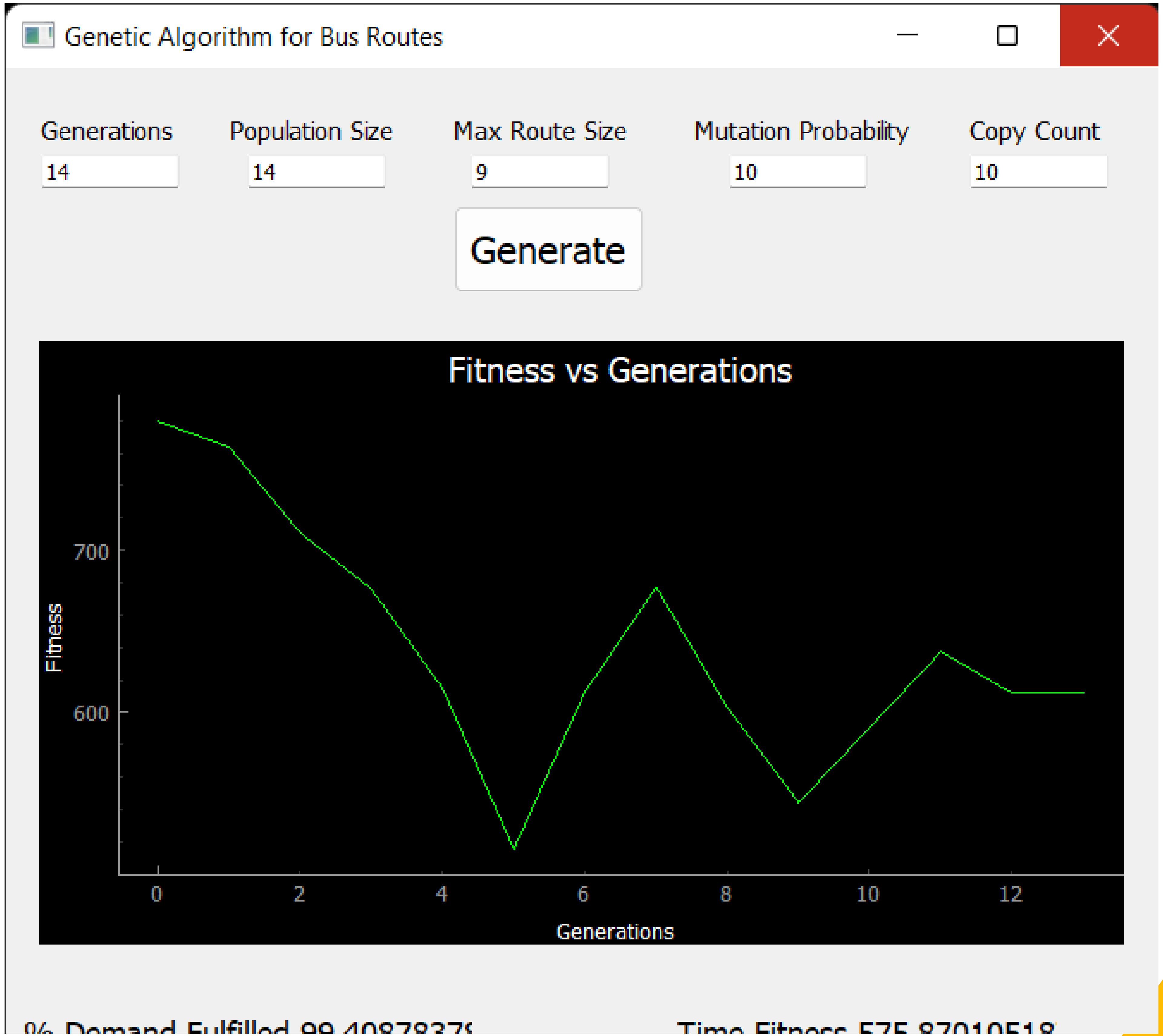
7. Until <terminating condition>

BusRouteOptimiser.py > RouteOptimizer > __init__

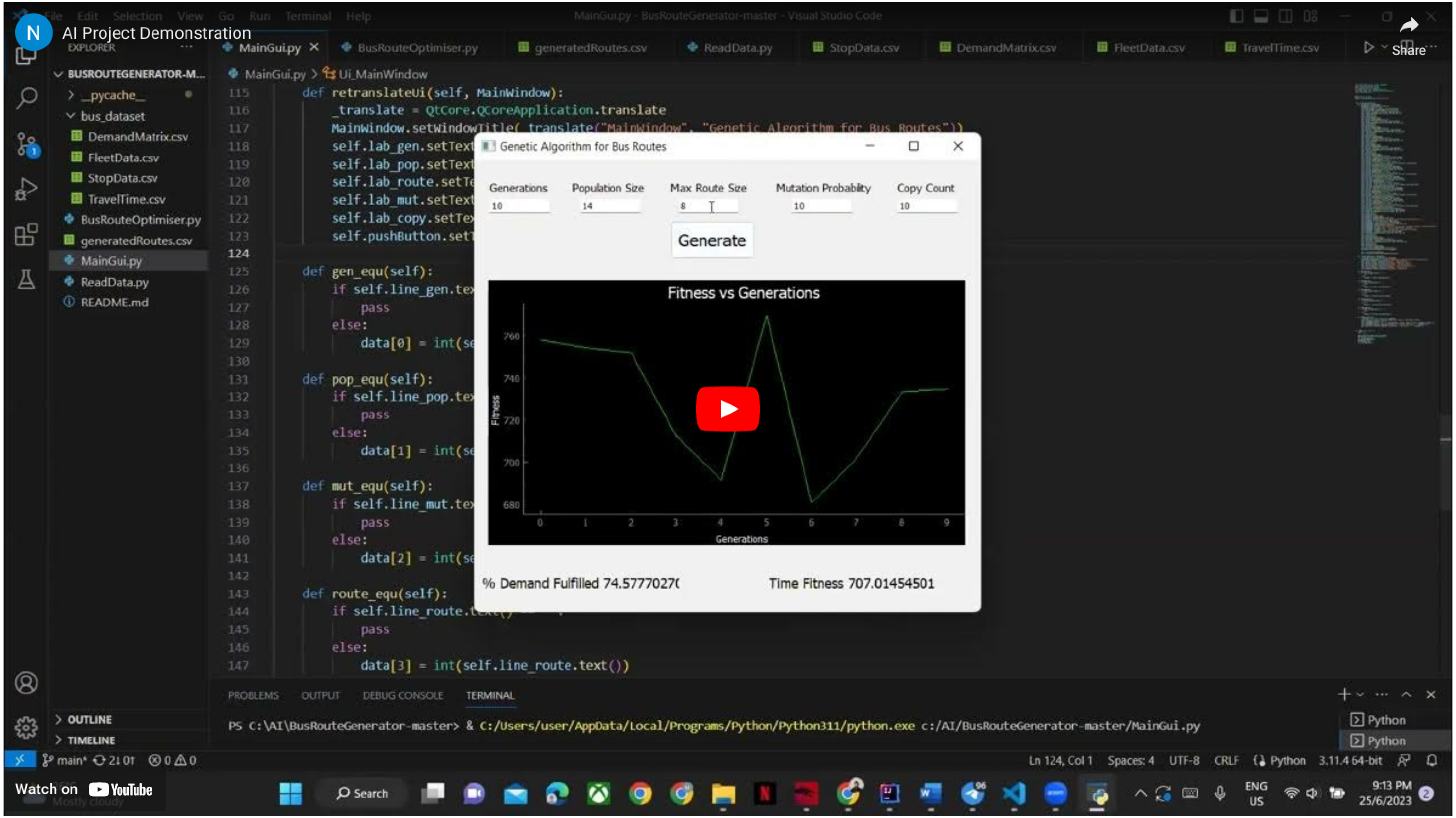
```python
import numpy as np
import math
import matplotlib.pyplot as plt
import random
import ReadData
import csv

fit=[0,0]
class RouteOptimizer:

    def __init__(self):
        self.busStops=None
        self.fleetSize=None
        self.linkData=None
        self.demandMat=None
        self.currPopulation=None
        self.maxRoute=None
        self.genCount=None
        self.startPopulation=None
        self.shortestTimeMat=None
        self.mutationProb=None
        self.copyCount=None


    def initialization(self): ...

    def evaluation(self,routeSet,store=0): ...

    def modify(self): ...

    def optimize(self): ...

def model_run(data): ...
```

Implementation in Our Codes

Code Demonstration



Code Demonstration



ADVANTAGES & DISADVANTAGES

Optimization Capability

- Genetic algorithms excel at solving optimisation problems
- Can search for better solutions and gradually converge towards an optimised route

Flexibility

- Genetic algorithms offer great flexibility when it comes to handling complex problems with multiple variables and constraints

Adaptability

- Generate fresh optimized routes using the updated information
- Generate efficient and effective bus routes that accommodate the latest changes and requirements.

Algorithm Complexity

- Make them resource-intensive and time-consuming
- Genetic algorithms may demand considerable computational resources

Dependence on Parameters

- Reliant on various parameters
- Selecting the right parameter values can be a difficult task

Limited Accuracy

- Provide approximate solutions rather than exact solutions
- Algorithm's effectiveness depends on the fitness evaluation function and the representation of the problem domain

Improvements

Limited Information

- Scarcity of information for optimization was a significant drawback.
- Limited data included bus stop details, stop frequency, travel times, bus capacity, and route limits per bus.

Implementation Approach

- Recognizing the availability of other tools, algorithms, and AI techniques is crucial for further improving the optimization process.
- Alternative optimization algorithms like Ant Colony Optimization, Simulated Annealing, or Particle Swarm Optimization can be explored.

Accuracy of Results

- The project's results relied on personal experience and feedback from a small group, along with travel time data from Google Maps.
- Conducting a comprehensive survey or gathering data from a wider range of UPM students is recommended for achieving more accurate and reliable results.

Basic Implementation

- The project should be considered as a starting point for enhancing the bus system at UPM, rather than a complete implementation.
- Further research, development, and collaboration with stakeholders are essential to address the limitations of the existing system.

Business Models

Software Licensing Model

A potential business model for the project is to license the bus route optimization software, allowing users or organizations to pay a fee for using the software and improving their transportation efficiency.

Consultancy and Implementation

The project can generate revenue by offering consultancy and implementation services to bus companies, transportation authorities, or educational institutions seeking to optimize their bus routes using genetic algorithms.

Partnerships and Collaborations

The project can form partnerships with bus service providers, transportation companies, or smart city initiatives to integrate the genetic algorithm optimization solution.

Conclusion

This project utilized a Genetic Algorithm (GA) to optimize bus routes at Universiti Putra Malaysia (UPM), aiming to improve transportation efficiency for students. However, limitations arose due to limited information on bus stop data, frequency, travel time, and capacity. Further improvements could be done to enhance the accuracy of optimization. To summarise, this project demonstrates the potential of GA for bus route optimization.

Syakila Mugi Ramesh Company

Thank You

For Your Attention

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