Queue Management System

Requirement specification

We encounter many queues in our day to day lives at banks, hospitals, restaurants, super markets, movie theaters, etc. These queues often get chaotic, inefficient, frustrating for the customer, and even decrease the number of customers the business can serve. In this project, taking the example of a bank, we seek to build a queue management system which makes an efficient and frustration-free method to manage queues.

The users can enter a queue on this system, get the estimated waiting time, and later get the service from the teller on their turn. The system then records the waiting time of the customer and updates the statistics for future estimations.
In our implementation, we are taking the case where there are two tellers, and one common queue (called a M/M/2 queueing system). Here, the main components of the system are,

- **State**: Variables that describe the state of the system at any time. The state functions over time vary stepwise in this case.
- The state variables here would be: **Number-of-Customers-in-the-Queue** (an integer from 0 to n) and **Teller-Status** (busy or idle).
- **Clock**: Keeps track of the time in the live system.
- **Event tracker**: It tracks the previous events and contains the list of next events based on previous events.
- The system events here would be **Customer-Arrival** and **Customer-Departure**.
- **Statistics**: Variables store data statistical data about the user, like the time spent in line. This data is used in further uses of the program to predict the expected time.

GUI

The following would be the features of the GUI of this system,

- At the first screen, the user would see the current length of queue and estimated time of waiting, and a button to join the queue.
- After clicking the join button, the customer is added to the queue, the position in the queue, and the expected time to get to the teller is shown.
- There is also button to exit the queue at any time.
- If a person ahead in the line exits the queue before getting to the teller, the queue length would be decreased by one and new expected time of waiting will be shown.
- When customers get to the teller, they will be shown a message like "It's turn of user (user number)".

We will be using the queue data structure mainly to represent the queue. We will be mainly using the library num.py to build the backend, and pandas to store, analyze and display the statistics like estimated time. We will be building the GUI using the tkinter library.

Project Plan

We plan to start build the backend part of the system first. This would take about 2 - 3 weeks of man hours and will be done by three people. After we have built the backend sufficiently, or we are very sure about the inputs and outputs the backend will be taking, we will start building the GUI part. We expect this part to take about 2 weeks of man hours and will be done by 2 people.

We could need more some time for proper integration of various subprograms of the system, integrating the GUI and the backend, debugging, and testing. We estimate this would take about half to one week. So, the expected timeline would be,

- One week for the backend
- One week for the GUI part
- Half to one week for miscellaneous tasks and testing.

We expect the project to be completed in 2.5 to 3 weeks.

The following is a proposed distribution of work among the team members,

GUI

- Dheeraj Sai Ram: taking inputs and giving them to backend code.
- Saketh Gajawada: displaying the outputs received from backend part

Backend

- Pranav Vajreshwari: State variables and Simulation clock and
- Sathiya Naraayanan: Statistical information
- Ishaan Jalan: Initialization routine and Event routine

The exact implementation details, and the jobs of each person may change during the process, and this is only a tentative distribution.

References

- https://en.wikipedia.org/wiki/Discrete-event_simulation
- https://en.wikipedia.org/wiki/M/M/c_queue
- https://en.wikipedia.org/wiki/Queueing_theory
- https://numpy.org/
- https://pandas.pydata.org/
- https://docs.python.org/3/library/tkinter.html