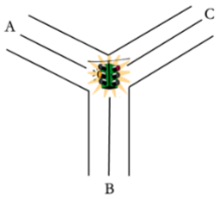
Project 4: Using a circular queue

Background

Traffic management in large cities and towns has always been a challenge for the traffic police departments all over the world. More so, when the population that uses personal vehicles is also very large in numbers. With recent advent of technological solutions, it is possible to build intelligent systems that enables better traffic management on busy multi-road junctions efficiently. These systems can gauge the number of vehicles on the roads and accordingly direct in what intervals of time should the traffic lights change.

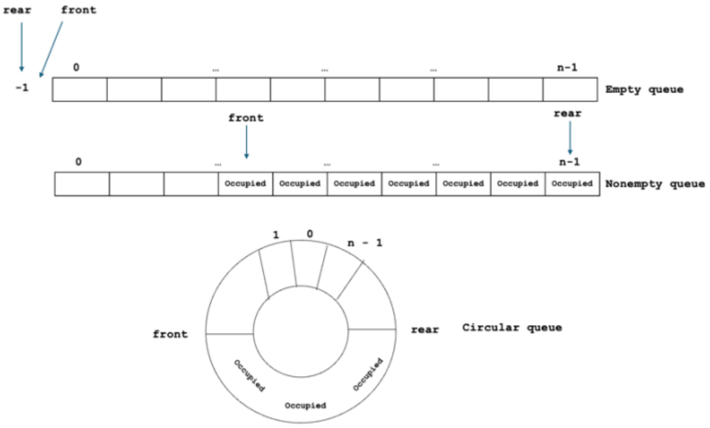
Your problem definition

A city metropolitan office of a large city that is thickly populated wishes to develop a smart traffic management system. Assume your team is assigned with the task of building this system. Before embarking on the ambitious project, your team decides to simulate and check how effective such systems will be. For this purpose, a junction that has 3 busy roads joining is chosen as shown in the figure.



The three roads shown in the figure are very long and each can accommodate two lanes each of incoming and outgoing traffic. Each lane on each road during busy hours can accommodate approximately 100 vehicles. Thus, each may have a maximum of 200 vehicles waiting to move at a given point in time. Vehicles arrive at random intervals on these roads. The task is to simulate how long the traffic light at the junction should stay red or green for a particular road.

Since time efficiency is a key factor, a circular queue using arrays has been chosen as the data structure. Here are some notes about how a circular queue will operate in the context of this problem. When vehicles leave the queue, the other vehicles are not moved up the queue. Instead, the front of the queue moves to the first vehicle in the queue. With large number of vehicles arriving regularly, the queue will become full very soon. As space is available in the front of the queue, the new vehicle arriving, after the 200th position is occupied, is added in an available position in the front of the queue. See the figure on the right.



You are required to do the following to solve the problem:

1. Read the data given from the file. The data is the random arrival of vehicles in each of the three roads. The time column provides the time in seconds – 0.56 indicates 4 seconds less than a minute.
2. Create three circular queues using array implementation with the size of the queue limited to 200. Managing the **front** and **rear** is a crucial aspect in circular queues, thus changing how you view if a queue is full or empty.
3. Simulate the movement of vehicles at the junction. Display the number of vehicles entering and leaving a road between traffic light changes.
4. Maintain your own algorithm to find out when the vehicles should leave a road. Display the number of times the traffic lights changed.
5. For academic purposes, this project uses the array implementation of circular queues. Is it possible to think of linked implementation of circular queues? Does that give any additional benefits over the use of an array? Write a note to argue your stance lucidly.