

Office Queue Management System

The Office Queue Management is a system that manages the queues for desk services open the public (e.g., post office, medical office). In the same office, various counters can handle different types of services (e.g., shipping or accounts management).

The office consists of a set of counters that are usually identified by numbers (e.g. Counter 1, 2 etc.)

Each counter can handle different types of services, which are defined at configuration time. The definition consist of a tag name that identifies the service type and an estimate of the average time needed to process that service type (known as service time). A counter can serve more than one service type.

Clients come to the office because they have a need, corresponding to one of the service types that the office can to handle. When at the office they specify the service type and receive a ticket with a number. Ticket numbers are unique for the whole office. The numbers will be used to call clients to the correct counter when their request can be served.

The system maintains different queues, one for each service type, so it is possible to know the number of people waiting for each type. Every morning the queues are reset.

When an officer at a counter is ready, he tells the system to call the next client. Based on the counter id (and the services it can offer) the system returns the ticket number that will be handled by that counter.

The next ticket to serve is selected with the following rule: select the first number from the longest queue among those corresponding to the service types the counter can offer. If two or more queues have the same length, the queue associated with request type having the lowest service time is selected.

If all the queues the counter can serve are empty, the system does nothing.

Selected tickets are considered served and removed from their queue (which is therefore shortened by one).

The system sends notifications concerning the length of the queues and the tickets called to the counters. When a new ticket is issued, one queue changes, therefore, the system shows on the main display board a queue length has changed (and possibly notify all the interested customers).

Each time a new ticket is served the following actions must be performed:

- show on the main display board that a new ticket number is being served at a given counter;
- show on the main display board that the length of the queue associated with the type of served ticket has been shortened

The system should also provide an estimate of the waiting (minimum) time for the holder of a given ticket number. The waiting time is evaluated as:

$$T_r = t_r \cdot \left(\frac{n_r}{\sum_i \frac{1}{k_i} \cdot s_{i,r}} + \frac{1}{2} \right)$$

where:

- t_r is the service time for request type r
- n_r is the number of people in queue for request type r
- k_i is the number of different types of requests served by counter i
- $s_{i,r}$ is an indicator variable equal to 1 if counter i can serve request r , 0 otherwise.

As an example:

John enters the post office to deposit money. There are two counters that can offer that service, one exclusively the other as an alternative to sending packages. There are 4 people waiting for the same service.

If we assume the service time is 5 min, the expected waiting time would be

$$T_r = 5 \cdot \left(\frac{4}{1 + 1/2} + \frac{1}{2} \right) = 5 \cdot \left(\frac{8}{3} + \frac{1}{2} \right) = 15 : 50$$

A manager in the office must be able to know how many customers have been served for each service type. In addition the system should provide the number of customers each counter has served, further divided by service type. Stats must be provided per day, week, month.