Lab L1. Simulating a multi-server FIFO queue

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I. Lab Requirements

In the lab, the system need to simulate a 10 servers queue problem with different arriving clients per second. It require the number of servers remained 10, the arrival process of customers is a Poisson process at rate lambda in 5, 7, 9, 10, 12, 15 . And the length of waiting queue can not exceed over maximum waiting line size N= 1000. Meanwhile, the client's arrival interval and the server's service time will be randomly generated with an exponential distribution.

II. Approach

Before experimentation, it is necessary to define all the entities, clients, servers and measures of the multi-server queue simulation model. It also need to construct specific experiment method scalled "arrival events" and "departure events". 1.

A. Event Entities

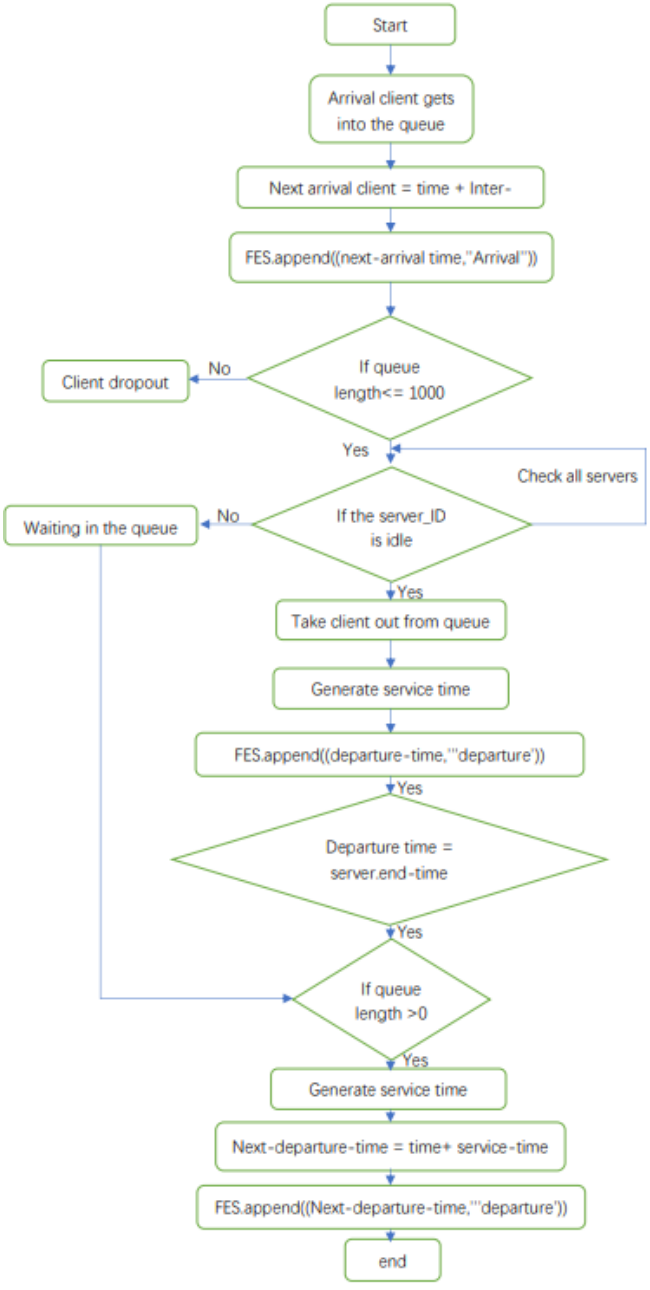
During the simulation, a client class, a server class and a measurement class are needed to record all the data generated during the simulation. It has two properties in the client class, type and arrival-time. They record the status and the time per client in the queue, respectively. The server class has three properties: serverID, service-time and end-time, which are used to record all messages when the server starts working. There are 10 servers in the simulation. All servers will save service information from each server target, which includes the service time and end time for each client that selects that server. The Measurement class is responsible for collecting information about the data generated in each loop of the simulation, including the total number of arriving and departing clients, the average number of clients, the total server time, and the average latency, etc,.

B. Arrival and Departure Event

The system uses two events, arrival and departure, to complete the entire simulation process. When a client obtains a service, a random service time with exponential distribution and a random arrival interval with Poisson distribution will be generated, respectively. After that, the client and the server will be assigned different working times to simulate how the client gets the service from the queue list.

C. The process of multi-server FIFO queue

There are 10 servers in the simulation and all servers are on a first-come-first-served basis (FIFO). At the beginning, clients are put into a waiting queue and the system checks if



Gambar 1. The process of multi-server FIFO queue

TABEL I
MULTI-SERVER FIFO QUEUE

number of arrival per second	*Number of arrivals*	*Number of departures*	*average delay*	*dropping probability*
5	100004.0	100000.0	0.007020	0.00
7	140698.0	140692.0	0.076313	0.00
9	179753.0	179738.0	0.673508	0.00
10	199627.0	199344.0	21.383145	0.11
12	239618.0	200646.0	1632.266474	1.17
15	299476.0	199518.0	3331.279616	1.48

the length of the waiting queue is less than 1000. after the service is finished, all server classes are updated and a new record is generated in the FES list. If all servers are busy, clients in the queue will have to wait until the most recent client leaves to be served. This will create a delay for the clients waiting in the queue. When the servers turn idle, the first customer in the queue can be taken out and receive new service.

III. CONCLUSIONS

In the simulation, the system employs 5, 7, 9, 10, 12 and 15 different lamdas which means that the system will get 5, 7, 9, 10, 12 and 15 clients per second in different cycles respectively. And there always are 10 servers in every simulation. As the number of arriving clients increases, the results show that the total number of arriving clients is increasing, while the number of departing clients will gradually remain at a level after lamda exceeds the number of servers. Another interesting phenomenon is that latency hardly occurs until the number of clients arriving per second exceeds the number of servers, and the longer the simulation time, the worse the results. 1.