University of Oum El Bouaghi
Faculty of Exact Sciences and Nature and Life Sciences
Department of Mathematics and Computer Science

2023-2024

Subject :	Level :	Exam :
Modeling, Simulation and Performance Evaluation	1st Year Master (Distributed Architectures)	Final
Unauthorized documents	Time : 01h 30mn	Scientific calculator allowed

Saturday May 11, 2024

Answer clearly and succinctly

Exercise 01 (Parallel machine : 05 Marks)

Consider a parallel machine (m processors) with an arrival rate of 21 tasks/s (according to the Poisson process) and a service rate (exponential) of 4 tasks/s, the utilization rate is 75%.

1. What is the number of processors m in this machine ?
2. What is the probability of finding all processors idle ?

We want to lower the utilization rate to 50% (maximum) :

3. How many processors (identical to those of the machine) should be added ?
4. What is the average number of running tasks ?

Exercise 02 (Queueing system : 05 Marks)

We want to design a client-server application where requests arrive according to the Poisson process at a rate of 5 requests/minute. The service time is exponential with a rate of 7 requests/minute. We want to guarantee the reception of 75% of the incoming requests.

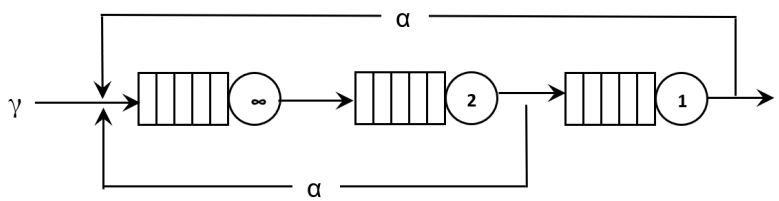
1. What is the minimal memory space we need to reach the objective, if each request needs 2 MB ?
2. What is the probability that the server becomes idle between the arrival of two requests, knowing that it was unoccupied when the first of the two arrived ?
3. What is the average number of daily processed requests ?
4. What is the average number of waiting requests ?

Exercise 03 (Queueing network : 10 Marks)

Consider the following Jackson network, where $\gamma = 5, m_1 = +\infty, m_2 = 2, m_3 = 1, \mu_1 = 1, \mu_2 = 5, \mu_3 = 10$

1. Give the internal and external routing probability matrices.
2. Find the effective arrival rates λ_i as a function of α.
3. Find the values of α that ensure network stability.

Let's take $\alpha = \frac{1}{5}$. Find in this case :



1. The average number of clients waiting at each station and in the network.
2. The average number of clients at each station and in the network.
3. The average residence time in each station and in the network.
4. The average waiting time at each station and in the network.
5. The probability that the network is not empty.

Note 1 : use at least 6 digits after the decimal point in all your calculations.
Note 2 : $e = 2.7182818$