NED UNIVERSITY OF ENGINEERING AND TECHNOLOGY

BE (CS) Batch: 2015-16

Spring Semester 2019 (14-04-2019) Computer Systems Modeling (CS-417)

Assignment II

Q1. Devise experiments, using software monitoring, to determine the following performance metrics for a computer system:-

a) The effective memory bandwidth between the processor and the data cache if all memory references are cache hits.

b) The effective memory bandwidth if all memory references are cache misses.

Note: Assuming a 16-bit data bus and a cache size of 2-KB only

Q2. Data packets transmitted by a modem over a phone line form a Poisson process at the rate of 120 packets every 12 sec. Calculate the probability (up to 4 decimal places) that

a) exactly 8 packets will be transmitted per second?
b) exactly 8 packets will be transmitted in half second?
c) more than 8 packets will be transmitted per second?
d) less than 8 packets will be transmitted per second?
e) between 15 and 20 packets (limits inclusive) will be transmitted per second?

Q3. A modem transmits a data packet over phone line every 50 milliseconds, on the average, following negative-exponential distribution. Calculate the probability (up to 4 decimal places) that the inter-arrival time of transmissions

a) does not exceed 30 msec. b) exceeds 50 msec. c) is between 30 msec and 50 msec.

Q4. A computer hardware production process contains a machine that deteriorates rapidly in both quality and output under heavy usage, so that it is inspected at the end of each week. Immediately after inspection, the condition of the machine is noted and classified into one of four possible states:-

State	Condition
0	Good as new
1	Operable – minimum deterioration
2	Operable – major deterioration
3	Inoperable and replaced by a good-as-new machine

After historical data on these inspection results are gathered, statistical analysis is done on how the state of the machine evolves from week to week. Given that a machine is good at the end of a week, there is 5%, 80% and 7% chance respectively that it is good, Operable (min det) and Operable (maj det) at the end of next week. If a machine is Operable (min det) at the end of a week, there is 75% chance to remain in this state at the end of next week whereas 15% chance to fall in the Operable (maj det) state. It was also estimated that if a machine is Operable (maj det) at the end of a week, there is 60% chance of it to retain this state at the end of next week. It is further established that if a machine becomes operable, it is impossible to revert back in previously better state. As the inoperable state is reached finally, repair is not possible and the older machine is replaced by a good one. Replacement is observed to take place in one week which results in production loss. The total cost of this loss and machine replacement is estimated to be Rs 80,000/- (see part (c) below).

a) Model the above process as a Markov chain (write probabilities up to 3 decimal places)
b) Find the steady-state probabilities for this Markov chain.
c) Sketch the state transition diagram.
d) If the system is running good now, what is the probability that the system is running Operable (min det) after 4 weeks?
e) If the system is running Operable (min det) now, what is the probability that the system is Inoperable after 4 weeks?
f) If the costs of being in states 0, 1, 2, 3, are Rs 0/-, 2.5/-, 5/-, and 80/- (000 omitted), respectively, what is the long-run expected average cost per week?

NOTE

i. Assignment is on individual basis
ii. To be prepared by hand
iii. Use Markov Chain Excel Sheet Solver for Q4 (d) & (e).
iv. Last date of submission: **Mon 29th April, 2019**

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