NTE Service System

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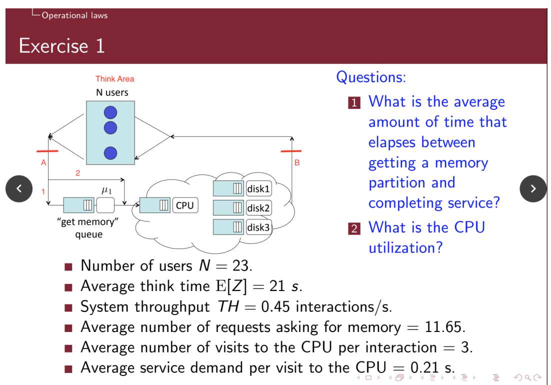
1 Exercise 1



1.1 Question 1

I want to compute on average how many users are in the Think Area. Since the system is stable TH = λ.
$\mathrm{E}[\mathrm{Q}_{think}] = TH \cdot \mathrm{E}[\mathrm{Z}] = 0.45 \cdot 21 = 9.45$ users

I want to compute the rate of users λ_1 that ask for memory:

$$\lambda_1 = \lambda \cdot \frac{\text{Average number of requests asking for memory}}{\text{Total number of users}} = \lambda \cdot \frac{E[Q_1]}{N} = 0.45 \cdot \frac{11.65}{23} = 0.228$$

To compute how "get memory" queue takes on average I apply Little's Law to branch 1:

$$E[Q_1] = \lambda_1 \cdot E[R_1] \rightarrow E[R_1] = \frac{E[Q_1]}{\lambda_1} = \frac{11.65}{0.228} = 51.1s$$

To compute how "get memory" takes on average I calculate the weighted average between the two branches. In the second branch there is no waiting so $\mathrm{E}[\mathrm{R}_2] = 0$

$E[R_{memory}] = \frac{E[Q_1]}{N} \cdot E[R_1] = \frac{11.65}{23} \cdot 51.1 \approx 26s$

(also Little's Law confirm: $E[Q_{memory}] = \lambda \cdot [R_{memory}]$)

I want to compute how many users there are in the cloud on average. I have already computed the average n. of users in the think area and I know the average number of users in the memory queue. So now I can just make the difference:

$E[Q_{service}] = N - E[Q_{think}] - E[Q_{memory}] = 23 - 9.45 - 11.65 = 1.9$users

To compute how the service in the cloud takes, I apply Little's Law considering the cloud as a blackbox:

$E[Q_{service}] = TH \cdot E[R_{service}] \to E[R_{service}] = \frac{E[Q_{service}]}{TH} = \frac{1.9}{0.45} \approx 4.2s$

What is the average amount of time that elapses between getting a memory partition and completing service? (So from A to B).

$E[R_{tot}] = E[R_{memory}] + E[R_{cloud}] = 26 + 4.2 = \mathbf{30.2s}$

Is it reasonable as a result? I apply the Little's Law to the entire system, considering also the average think time E[Z].

$N = TH \cdot E[R_{sys}] \to E[R_{sys}] = \frac{N}{TH} = \frac{23}{0.45} \approx 51.1s$

So the obtained result I think it is reasonable because $E[R_{sys}]$ is exactly the sum of the average think time E[Z] and the average time to get memory and completing the service $E[R_{tot}]$.

1.2 Question 2

To compute the throughput for the CPU I apply the Forced flow law:
I know the overall throughput and I know from the instruction the average number of visits to the CPU per interaction (E[V_{CPU}])

$TH_{CPU} = TH \cdot E[V_{CPU}] = 0.45 \cdot 3 = 1.35$visits/s

The mean service rate for the CPU is:

$\mu_{CPU} = \frac{1}{\text{Average service demand per visit to the CPU}} = \frac{1}{0.21} \approx 4.8$visits/s

What is the CPU utilization?

$\rho_{CPU} = \frac{TH_{CPU}}{\mu_{CPU}} = \frac{1.35}{4.8} \approx \mathbf{0.28}$