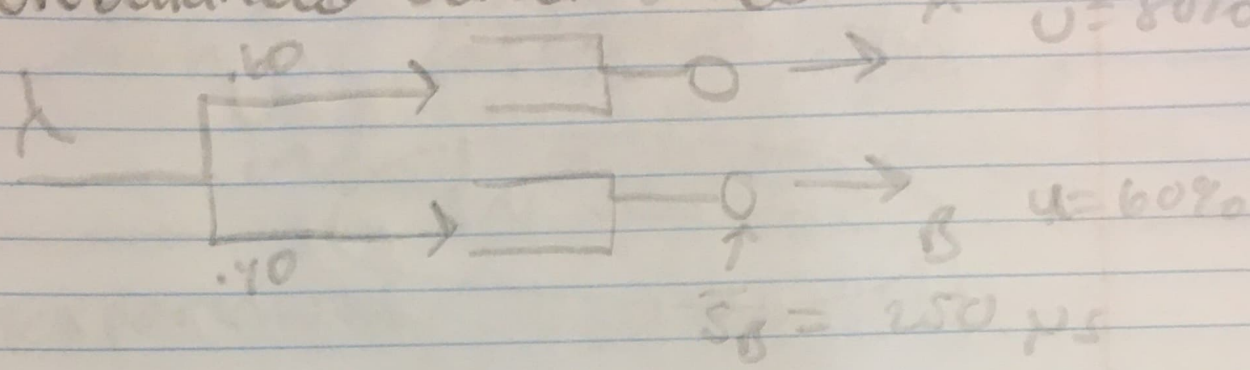
Jacob Buckelew

Simulation Sprint 4

Unbalanced server loads



$\bar{S}_A$? Utilization Law

$U = \lambda \bar{S}$ ← Find λ using B's information

$\frac{.60}{250} = \frac{\lambda \cdot 250}{250}$

$\lambda_B = .0024$ req/μs

↓

Now use FFL

$\lambda_K = V_K \lambda$

$\frac{.0024}{.40} = \frac{.40 \cdot \lambda}{.40}$

$\lambda = .006$ requests/μs

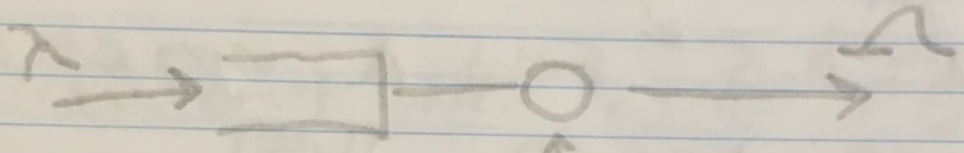
$\lambda_A = V_A \lambda \rightarrow \lambda_A = .60 \cdot (.006)$

$\lambda_A = .0030$ req/μs

$$\frac{.80}{.0036} = \frac{.0036\overline{5}}{.0036}$$

$$\bar{S} = 222 \text{ ms}$$

- Check My Math



↳ 2 accesses per job so 10 ms total avg time

$\bar{N} = 120$ $\quad \bar{R} = 1$ second

Little's Law:

$$\bar{N} = \Lambda \bar{R}$$

$$120 = \Lambda (1)$$

$\Lambda = 120$ accesses/sec $= \lambda$ by conservation

Utilization law:

$$u = \lambda \cdot \bar{S}$$

$u = 120 \text{ access/sec} \cdot .01 \text{ sec}$

$U = 1.12$

which is an error since U should fall between 0 and 1 in a normal system

---

Exponential

$$E[X] = \frac{1}{\lambda}$$

$$f_X(x) = \lambda e^{-\lambda x}$$

$1 - e^{-\lambda x} \rightarrow$ CDF

$e^{-\lambda x}$ CCDF $> x$

Yet More Lightbulbs:

$$f_X(x) = \lambda e^{-\lambda x}$$

x = lifetime of Lightbulb

$$\lambda = \frac{1}{2000} = .0005$$

use CCDF to find $P(x > 3000)$

$$CCDF = e^{-.0005(3000)}$$

$P(x > 3000) = .231$

Memoryless - Non-Persistence of Memory:

$$P(X > t+s \mid X > t) = e^{-\lambda s}$$

$$P(X > 3000 \mid X > 1000) = P(X > 2000)$$

$$P(X > 3000 \mid X > 2500) = P(X > 500)$$

$$P(X > 2000) \cdot P(X > 500)$$

$$e^{(-1/2000 \cdot 1000)} \cdot e^{(-1/2000 \cdot 500)}$$

$$= .2865$$

M/M/1 Queue

arrival_time	service_time	enter_service_time	departure_time	residence_time
1	3	1	4	3
3	2	4	6	3
5	4	6	10	5
7	1	10	11	4
8	1	11	12	4
13	2	13	15	2
14	1	15	16	2
17	3	17	20	3

enter_service_time = max(arrival_times[i], departure_times[i-1])

Avg. Residence Time($\bar{R}$) = 3.25