COMP SCI/SFWR ENG 4/6E03 — Assignment 3 Solutions

1. (a)

$$\begin{aligned} X &= \rho_{disk1}/E[D_{disk1}] \\ &= 0.66/((0.02)(5)) \\ &= 6.6 \end{aligned}$$

(b)

$$\begin{aligned} \rho_{disk2} &= E[D_{disk2}]X \\ &= (0.02)(6)(6.6) \\ &= 0.792 \end{aligned}$$

(c)

$$\begin{aligned} E[D_{cpu}] &= \rho_{cpu}/X \\ &= 0.43/6.6 \\ &= 0.065 \text{ seconds} \end{aligned}$$

2. (a) The demands are (in msec):

$$\begin{aligned} E[D_A] &= (5)(20) = 100 \\ E[D_B] &= (4)(30) = 120 \\ E[D_C] &= (10)(15) = 150 \end{aligned}$$

So, option (i) or (iii) improves the bottleneck. Option (i) results in $E[D_C] = (7)(15) = 105$, while option (iii) results in $E[D_C] = (10)(10) = 100$. So, option (iii) is preferred.

(b) We assume that the arrival rate to A and the throughput of A are equal. From Little's Law, the arrival rate λ_A is

$$\begin{aligned} \lambda_A &= E[N_A]/E[T_A] \\ &= 2/0.05 \\ &= 40. \end{aligned}$$

So, $X_A = 40$. Now,

$$X = X_A/E[V_A] = 8.$$

3. (a) The wording makes the answer to the first part somewhat trivial. In transactions per second, the disk's throughput is the same as the system throughput, or 2 transactions per second (7200/3600). For the utilization,

$$\begin{aligned}\rho_{disk} &= XE[D_{disk}] \\ &= (2)(0.09) \\ &= 0.18\end{aligned}$$

   (b) From (a),

$$E[D_{disk}] = 90 \text{ msec}$$

   (c)

$$\begin{aligned}E[T] &= \frac{M}{X} - E[Z] \\ E[Z] &= \frac{M}{X} - E[T] \\ &= \frac{500}{(6480/3600)} - 5 \\ &= 272.8\end{aligned}$$

4. (a)

$$\begin{aligned}E[Z] &= \frac{M}{X} - E[T] \\ &= \frac{50}{1.5} - 10 \\ &= 23.3\end{aligned}$$

   (b)

$$\begin{aligned}\rho_{cpu} &= XE[D_{cpu}] \\ &= (1.5)(0.52) \\ &= 0.78\end{aligned}$$

   (c)

$$\begin{aligned}E[N] &= XE[T] \\ &= (1.5)(10) \\ &= 15\end{aligned}$$