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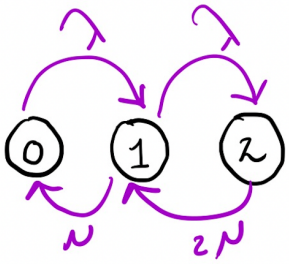
Final Exam ISE 560

Problem 1

(a)
The state space S={0,1,2}.
(b)
Let $\{X(t), t \geq 0\}$. X: # of calls in the system



(c)

R = $\begin{matrix} i|j & 0 & 1 & 2 \\ 0 & 0 & \lambda & 0 \\ 1 & \mu & 0 & \lambda \\ 2 & 0 & 2\mu & 0 \end{matrix}$

(d)

Arrival rate λ and Service rate μ	Values of $r_i = \Sigma_{j=0}^{2} r_{i,j}$	System of Equations
$\lambda = \frac{9}{hr}; \mu = \frac{5}{hr}$	$r_0 = \lambda = 9$ $r_1 = \mu + \lambda = 14$ $r_2 = 2\mu = 10$	$p_0 + p_1 + p_2 = 1$ $p_0 r_0 = p_1 \mu$ $p_1 r_1 = p_0 \lambda + p_2 2\mu$ $p_2 r_2 = p_1 \lambda$

Using MATLAB to compute the steady state probabilities for state 0,1,and 2:
$p_0 = 0.2262$
$p_1 = 0.4072$
$p_2 = 0.3665$

Code:

```
lambda=9;
mu=5;
B=[1;0;0]
A = [1,1,1;lambda,-mu,0;-lambda,(mu+lambda),-2*mu]
p=A\B
```

(e)
Utilization of the 2 technicians is 0.57.That means, we are using 57% of the system capacity.

(f)
The probability that both technicians are idle is P0=0.226.

(g)
The probability that a caller receives a busy signal is the same as the probability of both technicians busy = 0.367.

(h)
P(4) =

```
B = 3×3
    0.2262    0.4072    0.3665
    0.2262    0.4072    0.3665
    0.2262    0.4072    0.3665
```

Then the probability that both technicians are busy at 12:00 pm the same day is 0.3665

Code attached after exercise (i).

(i)
The long run expected number of calls in the system is L = 1.14 calls.