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CS - 050 (BE)
Section - B

Primary Naming Server

Solution:-

We know that

$$X_t = \begin{cases} 0 & \text{both machine working} \\ 1 & \text{Primary server failed} \\ 2 & \text{Secondary Server failed} \\ 3 & \text{Both machine failed.} \end{cases}$$

Let,

Probability of failure of primary server = P_{fps} = 0.08
Probability of working primary server = P_{wps} = 1-0.08 = 0.92
Probability of failure of secondary server = P_{fss} = 0.1
" " working " " " = P_{wss} = 1-0.1 = 0.9

a) One-step transition matrix

$$P = \begin{array}{c} 0 \\ 1 \\ 2 \\ 3 \end{array} \begin{bmatrix} P_{00} & P_{01} & P_{02} & P_{03} \\ P_{10} & P_{11} & P_{12} & P_{13} \\ P_{20} & P_{21} & P_{22} & P_{23} \\ P_{30} & P_{31} & P_{32} & P_{33} \end{bmatrix}$$

So,

$P_{00} = P_{wps} \times P_{wss} = 0.92 \times 0.9 = 0.828$

$P_{01} = P_{fps} \times P_{wss} = 0.08 \times 0.9 = 0.072$

$P_{02} = P_{wps} \times P_{fss} = 0.092 \; (0.92 \times 0.1)$

$P_{03} = P_{fps} \times P_{fss} = 0.08 \times 0.1 = 0.008$

and

$P_{10} = P_{wss} = 0.9$

$P_{11} = 0$

$P_{12} = P_{fss} = 0.1$

$P_{13} = 0$

$P_{20} = P_{wps} = 0.92$

$P_{21} = P_{fps} = 0.08$

$P_{22} = 0$

$P_{23} = 0$

$P_{30} = 1$

$P_{31} = 0$

$P_{32} = 0$

$P_{33} = 0$

Hence

$$P = \begin{bmatrix} 0.828 & 0.072 & 0.092 & 0.008 \\ 0.9 & 0 & 0.1 & 0 \\ 0.92 & 0.08 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

b) Steady state probabilities = ?

$$\begin{bmatrix} \pi_0 \\ \pi_1 \\ \pi_2 \\ \pi_3 \end{bmatrix} = \begin{bmatrix} \pi_0 & \pi_1 & \pi_2 & \pi_3 \end{bmatrix} \begin{bmatrix} 0.828 & 0.072 & 0.092 & 0.008 \\ 0.9 & 0 & 0.1 & 0 \\ 0.92 & 0.08 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

So,

$$\pi_0 = 0.828\pi_0 + 0.9\pi_1 + 0.92\pi_2 + \pi_3$$

$$0.172\pi_0 - 0.9\pi_1 - 0.92\pi_2 - \pi_3 = 0 \quad \text{—— (1)}$$

$$\pi_1 = 0.072\pi_0 + 0.08\pi_2$$

$$0.072\pi_0 - \pi_1 + 0.08\pi_2 = 0 \quad \text{—— (2)} \checkmark$$

$$\pi_2 = 0.092\pi_0 + 0.1\pi_1$$

$$0.092\pi_0 + 0.1\pi_1 - \pi_2 = 0 \quad \text{—— (3)} \checkmark$$

$$\pi_3 = 0.008\pi_0$$

$$0.008\pi_0 - \pi_3 = 0 \quad \text{—— (4)} \checkmark$$

$$\pi_0 + \pi_1 + \pi_2 + \pi_3 = 1 \quad \text{—— (5)} \checkmark$$

$$|A| = \begin{vmatrix} 0.072 & -1 & 0.08 & 0 \\ 0.092 & 0.1 & -1 & 0 \\ 0.008 & 0 & 0 & -1 \\ 1 & 1 & 1 & 1 \end{vmatrix}$$

$$|A| = 1.178496$$

$$|A_0| = \begin{vmatrix} 0 & -1 & 0.08 & 0 \\ 0 & 0.1 & -1 & 0 \\ 0 & 0 & 0 & -1 \\ 1 & 1 & 1 & 1 \end{vmatrix}$$

$$|A_0| = 0.992$$

$$\pi_0 = \frac{|A_0|}{|A|} = \frac{0.992}{1.1784} = 0.8417$$

c)

eq 4 =>

$$0.008\pi_0 - \pi_3 = 0$$
$$0.008(0.8417) = \pi_3$$
$$\pi_3 = 0.006734$$

Using eq ② and ③

$$0.072(0.8417) - \pi_1 + 0.08\pi_2 = 0$$
$$-\pi_1 + 0.08\pi_2 = -0.0606$$

$$0.092(0.8417) + 0.1\pi_1 - \pi_2 = 0$$
$$0.1\pi_1 - \pi_2 = -0.0774$$

$$|A| = \begin{vmatrix} -1 & 0.08 \\ 0.1 & -1 \end{vmatrix} = 1 - 0.008 = 0.992$$

$$\pi_1 = \frac{|A_1|}{|A|} = \begin{vmatrix} -0.0606 & 0.08 \\ -0.0774 & -1 \end{vmatrix}$$

$$\pi_1 = 0.06734$$

$$-\pi_1 + 0.08\pi_2 = -0.0606$$
$$0.8\pi_2 = 0.0061$$
$$\pi_2 = 0.08418$$

c) $n = 2$

$$\begin{array}{c} 0 \\ 1 \\ 2 \\ 3 \end{array} \begin{bmatrix} 0.84302 & 0.066976 & 0.0833 & 0.006 \\ 0.8372 & 0.0728 & 0.0828 & 0.007 \\ 0.83376 & 0.06624 & 0.0926 & 0.0073 \\ 0.828 & 0.072 & 0.092 & 0.008 \end{bmatrix}$$

Assuming initially both machine working

so $P_{03} = 0.0066$

and $n = 5$

$$\begin{bmatrix} 0.84175 & 0.06734 & 0.084176 & 0.00673 \\ 0.84125 & 0.067337 & 0.084176 & 0.06673 \\ 0.84176 & 0.067341 & 0.084176 & 0.06673 \\ 0.84176 & 0.007338 & 0.084167 & 0.0673 \end{bmatrix}$$

$P_{03} = 0.00673$

d) Average cost per second

$\pi_1 (0k) + \pi_1 (3k) + \pi_2 (2.5k) + \pi_3 (3k)$

$= 0.06734 (3k) + 0.08418 (2.5k + 0.006734 (4k)$

$= 0.439407k$

Question #1 :-

a) Cache size = 2KB = 2000B

i.e
the cache can have total 2000 bytes of data

∵ the bus is of 16 bit so it can fetch 2Bytes of data in 1 iteration that means in 1000 iterations, we can fetch 2000 Bytes of data from cache.

Assuming that memory references from x[1] to x[2000] are cache hits and all other memory references i.e x[2001] to x[2500] are cache miss

And for cache hit

```
int main()
{
    int start, finish, x, time;
    start = Read_virtual_clock();
    for (int i=0; i<5000; i++)
        value |=| x[i] { asm mov AX, x
finish = Read_virtual_
int time = finish - start; }
```

| Bandwidth = $\frac{800000}{time}$
| Bandwidth = 100 00 Bytes

~~return 0;~~ }

size of transfer = 50,000 × 16 bits = 800 000 bits

Note
x is
consider
memory
location
memo

b) cas
in
{

Ques
a)

F

Note

$//x$ is considered as a memory and we have consider that data of locations # 1-2000 of memory are in cache and the data of other locations like from 2001 to 4000 is in memory not cache.

b) Case of cache miss: cache size = 2KB = 2048B
Data bus = 16 bits

```
int main()
{
    int start, finish, time, [1050];
    start = Read-virtual-clock();
    for (int i = ; i <= 10,000; i++) { for (int j=0; j<1050; j++)
        asm mov AX, y[j]; }
    finish = Read-virtual-clock();
    time = finish - start;
}
```

Question # 02

a) $\lambda = 120\, packets/12\, sec$

$\lambda = 10\, packets/sec$

$k = 8\, packets/sec$

$$P(x=k) = \frac{\lambda^k e^{-\lambda}}{k!} = P(x=8) = \frac{10^8 e^{-10}}{8!} = 0.1125$$

b) $\lambda = 120$ packets / 12 sec

$\lambda = 10$ packets/ sec

for $1/2$ sec

$\lambda = 10 \times 0.5 \;/\; 1/2$ sec

$\lambda = 5/0.5$ sec or 5 pacckets/0.5sec

So, $P(x=8) = \dfrac{5^8 e^{-5}}{8!} = 0.06527$

c) $\lambda = 10$ packets/sec

$k = 8$ packets/sec

$$p(x>8) = 1 - P(x \le 8)$$
$$= 1 - \sum_{x=0}^{8} (x,10)$$
$$= 1 - 0.3328$$
$$= 0.6672$$

d) $\lambda = 10$ packets/sec

and

$$P(15 \le x \le 20) = \sum_{x=0}^{20} P(x,10) - \sum_{x=0}^{14} (x,10)$$
$$= 0.9984 - 0.9165$$
$$= 0.0819$$

Question #3

a) $\dfrac{1}{\lambda} = 50$ msec $\Rightarrow \lambda = 0.02$/msec

$P(t \le 30\text{msec}) = ?$

$P(t \leq T) = 1 - e^{-\lambda T}$

$P(t \leq 30\,msec) = 1 - e^{-0.02 \times 30} = 0.4511$

b) $\frac{1}{\lambda} = 50\,msec \Rightarrow \lambda = 0.02\,/msec$

$P(t > 50\,msec) = ?$

$P(t > 50\,msec) = 1 - P(t \leq 50\,msec)$

$= 1 - (1 - e^{-0.02 \times 50})$

$= 0.3678$

Question # 4

a) We can say

$$P = \begin{bmatrix} 0.05 & 0.8 & 0.07 & 0.08 \\ 0 & 0.75 & 0.15 & 0.1 \\ 0 & 0 & 0.6 & 0.4 \\ 0 & 0 & 0 & 0.1 \end{bmatrix}$$

b) Steady state probabilities = ?

$$\begin{bmatrix} \pi_0 \\ \pi_1 \\ \pi_2 \\ \pi_3 \end{bmatrix} = [\pi_0 \;\; \pi_1 \;\; \pi_2 \;\; \pi_3] \begin{bmatrix} 0.05 & 0.8 & 0.07 & 0.08 \\ 0 & 0.75 & 0.15 & 0.1 \\ 0 & 0 & 0.6 & 0.4 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$\pi_0 = 0.05\pi_0 + 0 + 0 + 0$ — 1

$\pi_1 = 0.8\pi_0 + 0.75\pi_1 + 0 + 0$ — 2

$\pi_2 = 0.07\pi_0 + 0.15\pi_1 + 0.6\pi_2 + 0 \rightarrow$ 3

$\pi_3 = 0.08\pi_0 + 0.1\pi_1 + 0.4\pi_2 + \pi_3 \rightarrow$ 4

Considering

$0.95\pi_0 = 0$ — (a)

$-0.8\pi_0 + 0.25\pi_1 = 0 \longrightarrow$ (b)

$-0.07\pi_0 - 0.15\pi_1 + 0.4\pi_2 = 0$ — (c)

$\pi_0 + \pi_1 + \pi_2 + \pi_3 = 1 \longrightarrow$ (d)

$$|A| = \begin{vmatrix} 0.95 & 0 & 0 & 0 \\ -0.8 & 0.25 & 0 & 0 \\ -0.07 & -0.15 & 0.4 & 0 \\ 1 & 1 & 1 & 1 \end{vmatrix} = 0.095$$

$$|A_0| = \begin{vmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.25 & 0 & 0 \\ 0 & -0.15 & 0.1 & 0 \\ 1 & 1 & 1 & 1 \end{vmatrix} = 0$$

$$|A_1| = \begin{vmatrix} 0.95 & 0 & 0 & 0 \\ -0.8 & 0 & 0 & 0 \\ -0.07 & 0 & 0.1 & 0 \\ 1 & 1 & 1 & 1 \end{vmatrix} = 0$$

$$|A_2| = \begin{vmatrix} 0.95 & 0 & 0 & 0 \\ -0.8 & 0.25 & 0 & 0 \\ -0.07 & -0.15 & 0 & 0 \\ 1 & 1 & 1 & 1 \end{vmatrix} = 0$$

$$|A_3| = \begin{vmatrix} 0.95 & 0 & 0 & 0 \\ -0.8 & 0.25 & 0 & 0 \\ -0.07 & -0.15 & 0.4 & 0 \\ 1 & 1 & 1 & 1 \end{vmatrix} = 0.095$$

Hence,

(c)

After 4 w

= 6.3

So,

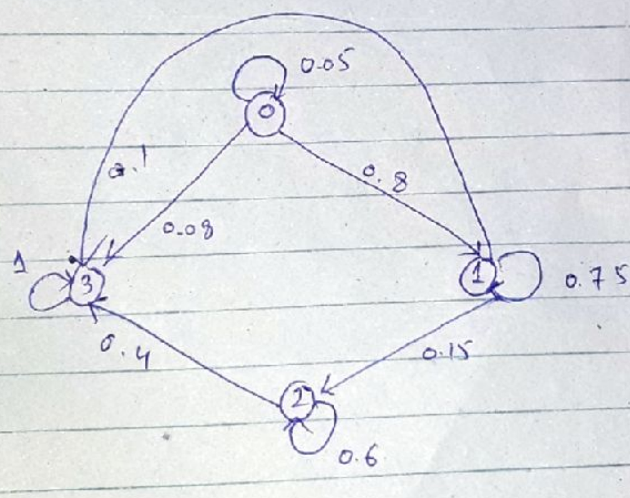
Hence, $\pi_0 = \frac{|A_0|}{|A|} = \frac{0}{0.095} = 0$

$\pi_1 = \frac{|A_1|}{|A|} = \frac{0}{0.095} = 0$

$\pi_2 = \frac{|A_2|}{|A|} = \frac{0}{0.095} = 0$

$\pi_3 = \frac{|A_3|}{|A|} = \frac{0.095}{0.095} = 1$

(c)



i) After 4 weeks, initial state = [1 0 0 0 1]

$$= \begin{bmatrix} 6.3\times10^{-6} & 0.3616 & 0.1895 & 0.4488 \\ 0 & 0.3164 & 0.1868 & 0.4967 \\ 0 & 0 & 0.1296 & 0.8704 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

So, $P_{01}^{4} = 0.3616$

e) $P_{13}^{4} = 0.4967$

f) Average cost $= \pi_0(0k) + \pi_1(2.5k) + \pi_2(5k)$
$+ \pi_3(80k)$
$= 0 + 0 + 0 + 1(80k)$
$= 80k$
$=$ Rs 80,000