Question #1

Written Problem (a3)

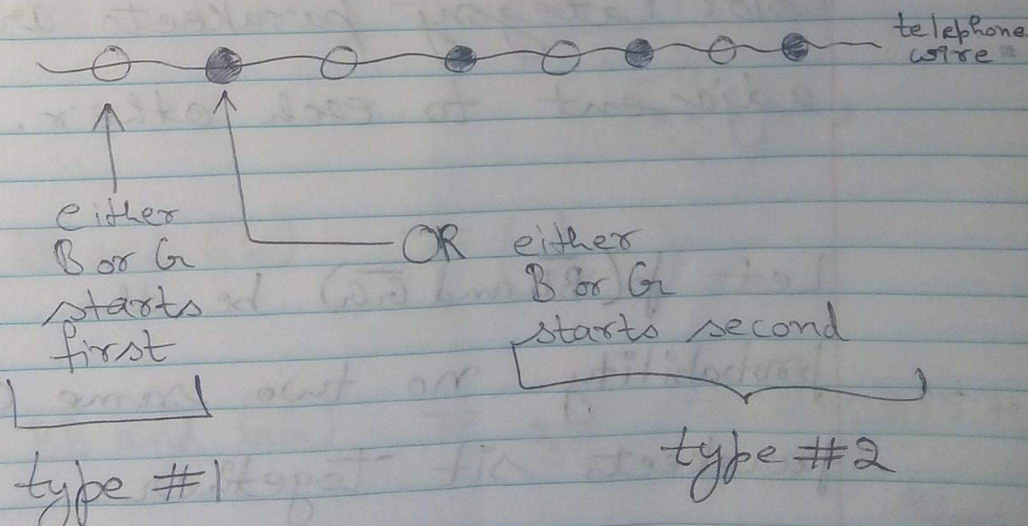
(1) Assumption : All parakeets are unique ;

Let B represent blue parakeets category;

Let G represents green parakeets' category;

We place B & G category parakeets in ~~two~~ patterns :

(a) B starts first, G starts 2nd ;
(b) G starts first, B starts 2nd ;



① Let B chooses either type #1 or type #2.
No. of ways for this = ${}^{2}C_{1} = 2$

② No. of ways of landing on type #1 position for 4 parakeets of a B or G category = 4!

So, either B parakeets lands at type #1 or type #2 positions such that No two same Color Category parakeets are adjacent to each other.

Let $p(\overline{BB} \text{ and } \overline{GG})$ be the probability no two same Color parakeets sit together.

$$p(\overline{BB} \text{ and } \overline{GG}) = \left(\frac{\text{favourable\_Case}}{\text{total\_Case}}\right)$$

5

$$\text{favourable\_Case} = {}^{2}C_{1} * 4! * 4!$$

$$= (2 * 4! * 4!)$$

4

$$\text{total\_case} = \left(\begin{array}{c}\text{No. of ways 8 parakeets} \\ \text{land at 8 positions} \\ \text{on the telephone wire}\end{array}\right)$$

$$= 8!$$

$$p(\overline{BB} \text{ and } \overline{GG}) = \left(\frac{\cancel{2} * \cancel{4!} * \cancel{4!}}{\cancel{8!}}\right)$$

$$5 \times \cancel{6} \times 7 \times \cancel{8}$$

$$p(\overline{BB} \text{ and } \overline{GG}) = \left(\frac{1}{5 \times 7}\right)$$

$$p(\overline{BB} \text{ and } \overline{GG}) = \frac{1}{35} = 0.02857$$

Ans

Question #2

Written Problem (a3)

Q-2)

(a) Probability a computing core is defective $= 0.3$

$$P(\text{core} = \text{defective}) = 0.3$$

Probability a computing core is correct $= (1 - 0.3)$

$$P(\text{core} = \text{correct}) = 0.7$$

$\boxed{\text{Assumption}}$: All computing cores are conditionally independent from each other.

$$P(\text{8 cores of CPU are correct}) = \left(P(\text{core} = \text{correct})\right)^8$$

or, $$P(\text{8 cores correct}) = \left(P(\text{core} = \text{correct})\right)^8$$

$$= (0.7)^8$$

$$= 0.0576$$

(Q-2)

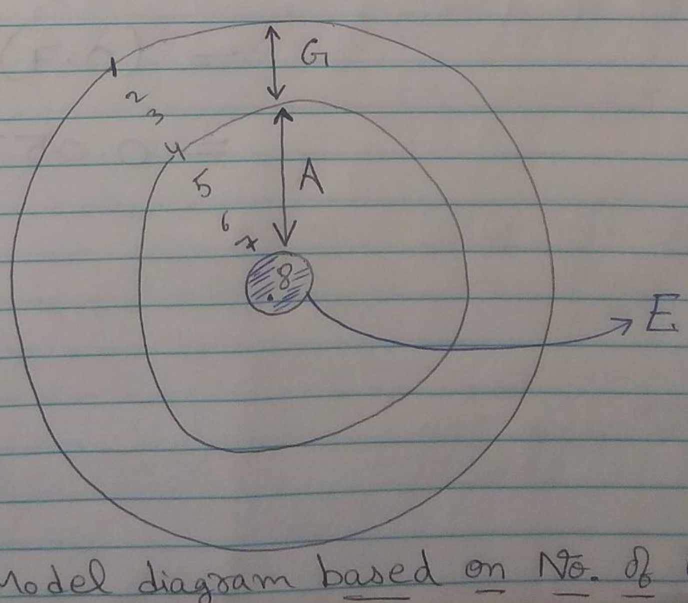
(b) Let A = Advance models
G = Great models
E = Extreme models

G = at least 1 functioning core

A = at least 4 functioning cores

E = exactly 8 functioning cores

<u>Assumption</u>: Manufacturer knows during CPU core testing that how many cores of a CPU are correct.



"<u>Business Model diagram based on No. of Working Cores</u>"

$P(1 \text{ CPU core working}) = {}^8C_1 \times (0.7)^1 \times (0.3)^7$

$= 8 \times (0.7)^1 \times (0.3)^7$

$= 0.00122472$

$P(2 \text{ CPU cores working}) = {}^8C_2 \times (0.7)^2 \times (0.3)^6$

$= \frac{8!}{2! \times 6!} \times (0.7)^2 \times (0.3)^6$

$= 28 \times (0.7)^2 \times (0.3)^6$

$= 0.01000188$

$P(3 \text{ CPU cores working}) = {}^8C_3 \times (0.7)^3 \times (0.3)^5$

$= \frac{8!}{3! \times 5!} \times (0.7)^3 \times (0.3)^5$

$= 56 \times (0.7)^3 \times (0.3)^5$

$= 0.04667544$

$P(\text{Great CPU}) = P(1 \text{ CPU core working}) + P(2 \text{ CPU cores working}) + P(3 \text{ CPU cores working})$

$P(\text{Great CPU}) = 0.00122472$
$+ 0.01000188$
$+ 0.04667544$

$P(\text{Great CPU}) = 0.05790204$

$P(4 \text{ CPU Cores Working}) = {}^8C_4 \times (0.7)^4 \times (0.3)^4$

$= \frac{8!}{4! \times 4!} \times (0.7)^4 \times (0.3)^4$

$= 70 \times (0.7)^4 \times (0.3)^4$

$= 0.1361367$

$P(5 \text{ CPU Cores Working}) = {}^8C_5 \times (0.7)^5 (0.3)^3$

$= 56 \times (0.7)^5 \times (0.3)^3$

$= 0.25412184$

$P(6 \text{ CPU Cores Working}) = {}^8C_6 \times (0.7)^6 \times (0.3)^2$

$= \frac{8!}{6! \times 2!} \times (0.7)^6 \times (0.3)^2$

$P(6 \text{ CPU Cores Working}) = 28 \times (0.7)^6 \times (0.3)^2$

$= 0.29647548$

$P(7 \text{ CPU Cores Working}) = {}^8C_7 \times (0.7)^7 \times (0.3)^1$

$= 8 \times (0.7)^7 \times (0.3)^1$

$= 0.19765032$

$P(\text{Advance CPU}) = P(4 \text{ cores working}) + P(5 \text{ Cores Working}) + P(6 \text{ Cores working}) + P(7 \text{ cores working})$

$= (0.1361367 + 0.25412184 + 0.29647548 + 0.19765032)$

$= 0.88438434$

$P(\text{Extreme CPU}) = P(8 \text{ Cores working})$

$= {}^8C_8 \times (0.7)^8 \times (0.3)^0$

$= (0.7)^8 = 0.05764801$

If 1000 CPUs are manufactured,

Great CPUs Expected $= 1000 \times P(\text{Great CPU})$

$= 1000 \times 0.05790204$

$\simeq 57.90$

$\simeq 58$ (approx.)

Advanced CPUs Expected $= 1000 \times P(\text{Advanced CPU})$

$= 1000 \times 0.88438434$

$\simeq 884.38$

$\simeq 884$ (approx.)

Extreme CPUs Expected $= 1000 \times P(\text{Extreme CPU})$

$= 1000 \times 0.05764801$

$\simeq 57.64$

$\simeq 58$ (approx.)

Q-2)

(c) Price of Great Model = \$50
Price of Advanced Model = \$100
Price of Extreme Model = \$1000

Total CPUs = 1000

58 Great CPUs Expected

884 Advanced CPUs Expected

58 Extreme CPUs Expected

Revenue for Great CPUs = 58 × \$50
= \$2900

Revenue for Advanced CPUs = \$100 × 884
= \$88400

Revenue for Extreme CPUs = \$1000 × 58
= \$58000

Total revenue expected = \$(2900 +
88 400 +
58 000)

= \$ 149,300

Question #3

(Q-3)

(a)

$P(J_1 = guilty \mid A = guilty)$ = probability Judge #1 votes guilty when Accused is given actually guilty

$= 0.7$

Similarly,

$P(J_2 = guilty \mid A = guilty) = 0.7$

$P(J_3 = guilty \mid A = guilty) = 0.7$

Now,

$P(J_1 = guilty \mid A = !guilty)$ = probability Judge #1 votes guilty when Accused is actually not guilty (or say innocent)

$= 0.2$

$P(J_2 = guilty \mid A = !guilty) = 0.2$

$P(J_3 = guilty \mid A = !guilty) = 0.2$

drawing the event diagram for finding other probability data for joint distribution table:

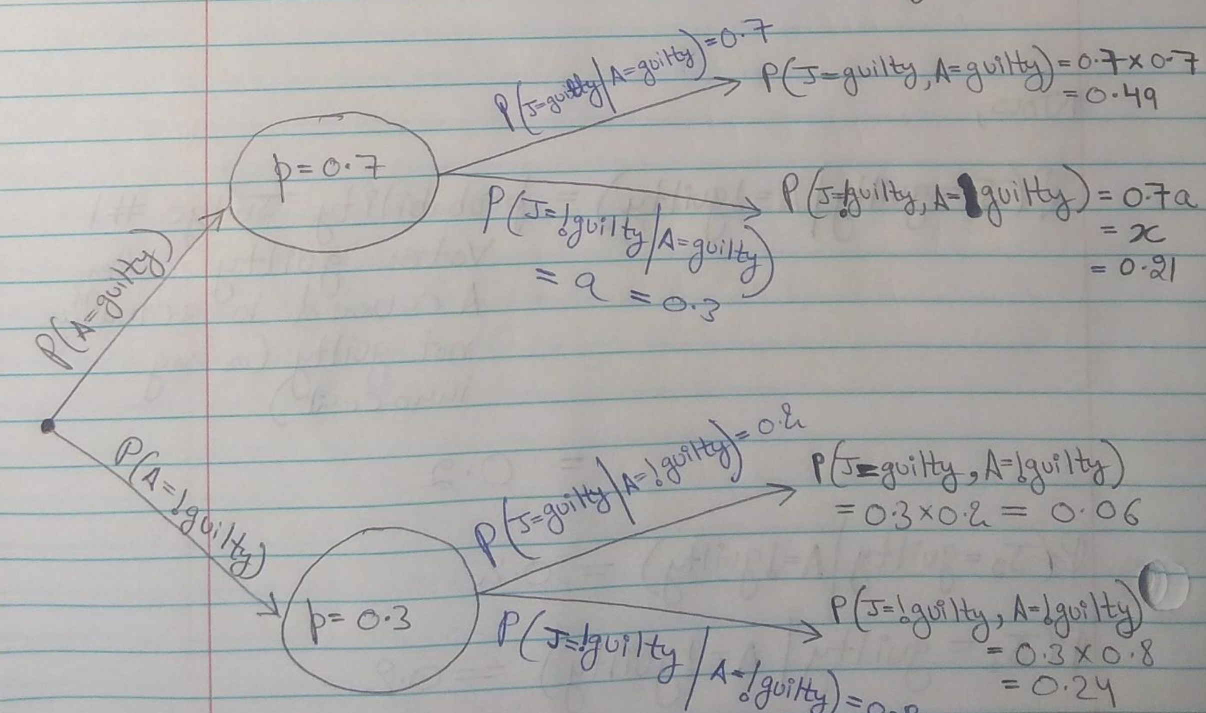
$P(A=guilty)$ = 70% of accused people are actually guilty

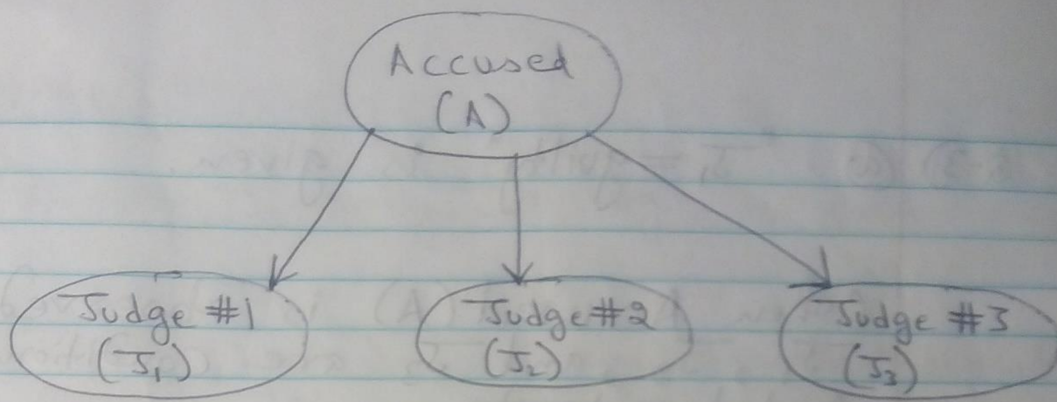
$= 0.7$

$P(A=!guilty) = 0.3$

$P(J=guilty \mid A=guilty) = 0.7$ (for any judge)

$P(J=guilty \mid A=!guilty) = 0.2$ (for any judge)





⟨Bayes Net⟩

↳ Accused (A) : Probability distribution

guilty	!guilty
0.7	0.3

↳ (Judge Vote) - (Accused) Joint Distribution:

		Accused	
		guilty	!guilty
Judge Vote (J)	guilty	0.49	0.06
	!guilty	0.21	0.24

(Q-3) (a) "J_1 = guilty" is given.

When Accused (A) is observed, J_1, J_2, and J_3 are conditionally independent.

So,

$$P(A=\text{guilty} \mid J_1=\text{guilty}) = \frac{P(A=\text{guilty}, J_1=\text{guilty})}{P(J_1=\text{guilty})}$$

$$= \frac{0.49}{0.49+0.06}$$

$$= \frac{0.49}{0.55}$$

$$= 0.89$$

Ans

Q-3> (b)

$(J_1 = guilty, J_2 = guilty, J_3 = guilty)$ is given.

J_1, J_2, and J_3 are conditionally independent when 'A' is observed.

$$P(A = guilty \mid J_1 = guilty, J_2 = guilty, J_3 = guilty) = \frac{\left(P(J_1 = guilty, J_2 = guilty, J_3 = guilty \mid A = guilty) * P(A = guilty) \right)}{P(J_1 = guilty, J_2 = guilty, J_3 = guilty)}$$

Short hand term,
Let $g = guilty$; $!g = !guilty$

$$P(A=g \mid J_1=g, J_2=g, J_3=g) = \frac{\left(P(J_1=g, J_2=g, J_3=g \mid A=g) * P(A=g) \right)}{P(J_1=g, J_2=g, J_3=g)} \quad (1)$$

Solving denominator,

$$P(J_1=g, J_2=g, J_3=g) = \{P(J_1=g \mid A=g) * P(J_2=g \mid A=g) * P(J_3=g \mid A=g) * P(A=g)\} + \{P(J_1=g \mid A=!g) * P(J_2=g \mid A=!g) * P(J_3=g \mid A=!g) * P(A=!g)\}$$

$$P(J_1=g, J_2=g, J_3=g) = \begin{pmatrix} 0.7 \times 0.7 \times 0.7 \times 0.7 & + \\ 0.2 \times 0.2 \times 0.2 \times 0.3 & \end{pmatrix}$$

$$= \left(7^4 \times 10^4 + 2^3 \times 3^1 \times 10^4\right)$$

put this to equation (1),

$$P(A=g \mid J_1=g, J_2=g, J_3=g) = \frac{(0.7 \times 0.7 \times 0.7) \times (0.7)}{\left(7^4 \times 10^4 + 2^3 \times 3^1 \times 10^4\right)}$$

$$= \frac{7^4 \times \cancel{10^4}}{7^4 \times \cancel{10^4} + 2^3 \times 3 \times \cancel{10^4}}$$

$$= \frac{2401}{2401 + 24}$$

$$= \left(\frac{2401}{2425}\right)$$

$$= 0.9901$$

Ans

(Q-3) (c)

$P(J_3=g \mid J_1=!g, J_2=!g)$ = given that Judge 1 & Judge 2 have voted innocent (or say not guilty, what is the probability that Judge 3 votes guilty?

For this probability, Accused (A) is not observed. It cannot be the case that J_1, J_2 & J_3 are conditionally independent.

Assume: J_1, J_2, J_3 are NOT independent entities in absence of Accused A.

$$P(J_3=g \mid J_1=!g, J_2=!g) = \left\{ \frac{P(J_2=!g, J_1=!g \mid J_3=g) \cdot P(J_3=g)}{P(J_2=!g, J_1=!g)} \right\}$$

using,

$$\boxed{P(J_2=!g, J_1=!g \mid J_3=g) = \frac{P(J_2=!g, J_1=!g, J_3=g)}{P(J_3=g)}}$$

we get...

$$P(J_3=g \mid J_1=!g, J_2=!g) = \left(\frac{P(J_2=!g, J_1=!g, J_3=g)}{P(J_2=!g, J_1=!g)} \right) \text{ --- } (1)$$

We know that J_1, J_2 & J_3 are NOT independent when A is not observed.

↳ We consider sum over missing variable values for each:

(a) $P(J_2 = !g, J_1 = !g, J_3 = g)$, and

(b) $P(J_2 = !g, J_1 = !g)$

Expanding (a),

$$P(J_2 = !g, J_1 = !g, J_3 = g) =$$

$$\{ P(J_2 = !g \mid A = g) \times P(J_3 = g \mid A = g) \times P(J_1 = !g \mid A = g) \times P(A = g) \; +$$

$$P(J_2 = !g \mid A = !g) \times P(J_3 = g \mid A = !g) \times P(J_1 = !g \mid A = !g) \times P(A = !g) \}$$

$$= \{ (0.3)(0.7)(0.3)(0.7) + (0.8)(0.2)(0.8)(0.3)$$

$$= (0.0441 + 0.0384) = 0.0825$$

Expanding (b),

$$P(J_2 = !g, J_1 = !g)$$

$$= \Big\{ P(J_2 = !g \mid A = g) \times P(J_1 = !g \mid A = g) \times \big(P(J_3 = !g \mid A = g) + P(J_3 = g \mid A = g) \big) \times P(A = g) \Big\} +$$

$$\Big\{ P(J_2 = !g \mid A = !g) \times P(J_1 = !g \mid A = !g) \times \big(P(J_3 = !g \mid A = !g) + P(J_3 = g \mid A = !g) \big) \times P(A = !g) \Big\}$$

$$= \Big\{ (0.3) \times (0.3) \times \big((0.3) + (0.7) \big) \times (0.7)$$

$$+$$

$$(0.8) \times (0.8) \times \big((0.8) + (0.2) \big) \times (0.3) \Big\}$$

$$= (0.3 \times 0.3 \times 0.7 + 0.8 \times 0.8 \times 0.3)$$

$$= (0.063 + 0.192)$$

$$= 0.255$$

Using Expansions (a) & (b) in equation 1,

$$P(J_3=g \mid J_1=!g, J_2=!g) = \left(\frac{0.0825}{0.255}\right)$$

$$= 0.3235$$

Ans

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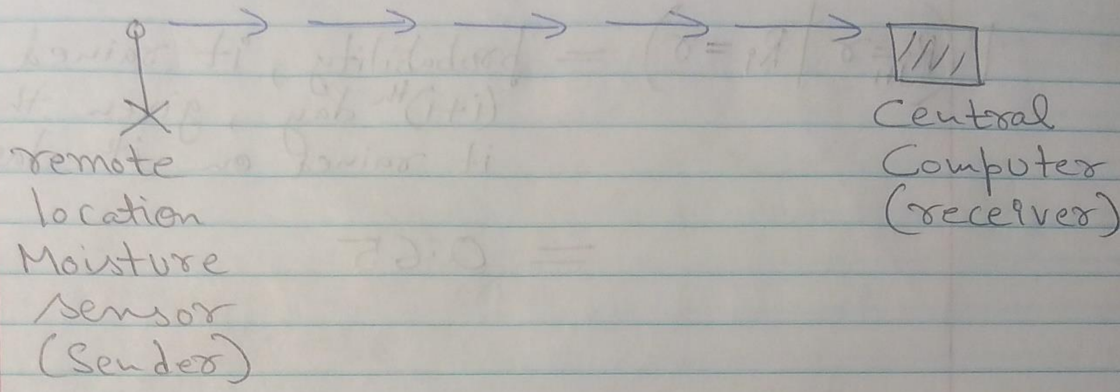
Question #4

(Q-4)



Conventions:

$R_i \rightarrow$ "rain" variable on i^{th} day;

$Rec_i \rightarrow$ "sensor received data" variable on i^{th} day.

$R_i = r \rightarrow$ it rained on i^{th} day; (Yes);
$R_i = !r \rightarrow$ it did NOT rain on i^{th} day; (NO);

$Rec_i = r \rightarrow$ Received value says it rained on i^{th} day; (or say Yes);

$Rec_i = !r \rightarrow$ Received value says it did NOT rain on i^{th} day; (or say NO);

Listing down given probabilities:

$P(R_{i+1} = r \mid R_i = r)$ = probability, it rained on $(i+1)^{th}$ day, given that it rained on i^{th} day

$= 0.65$

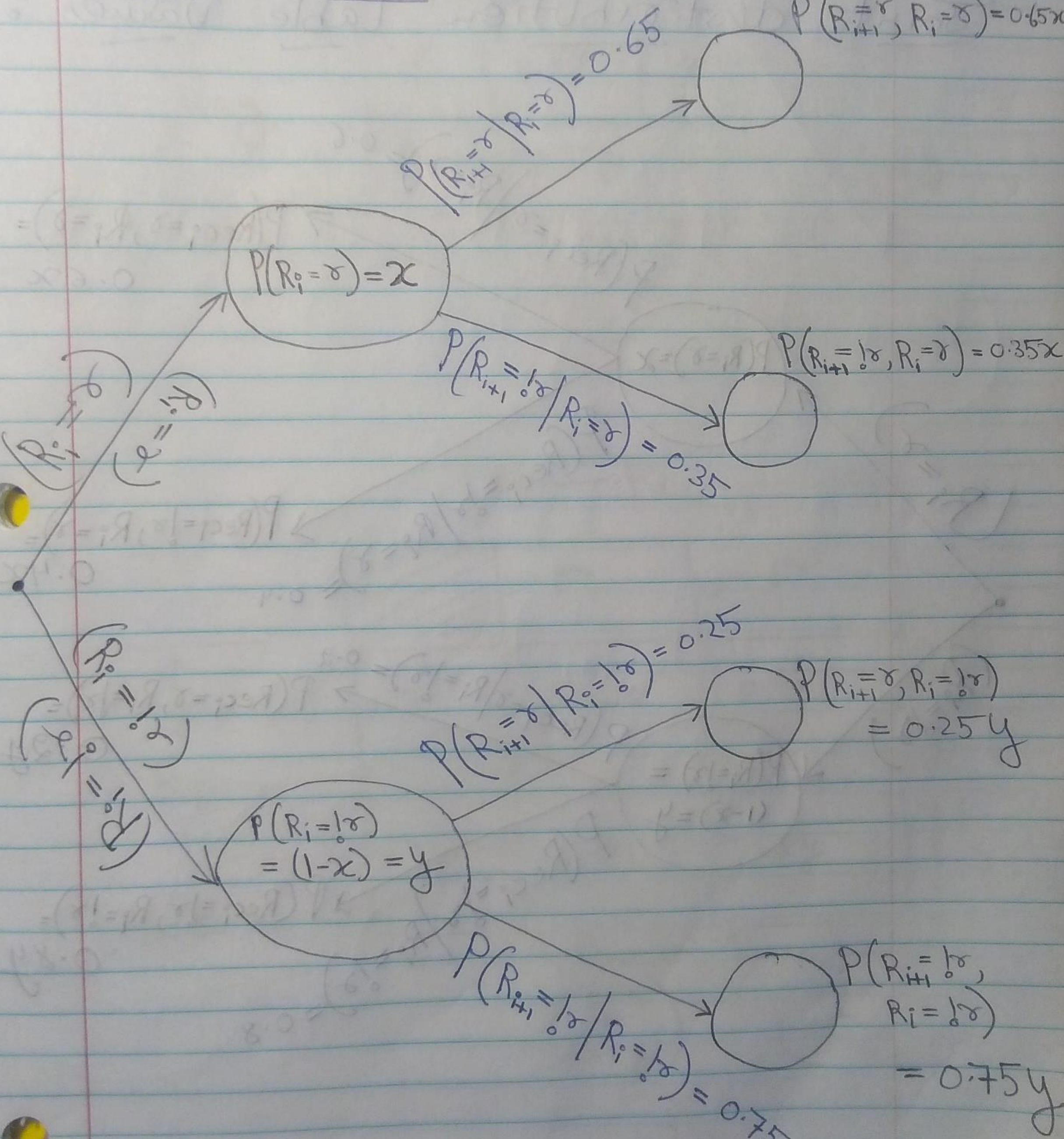
$P(R_{i+1} = r \mid R_i = !r)$ = probability, it rained on $(i+1)^{th}$ day, given that it did NOT rain on i^{th} day.

$= 0.25$

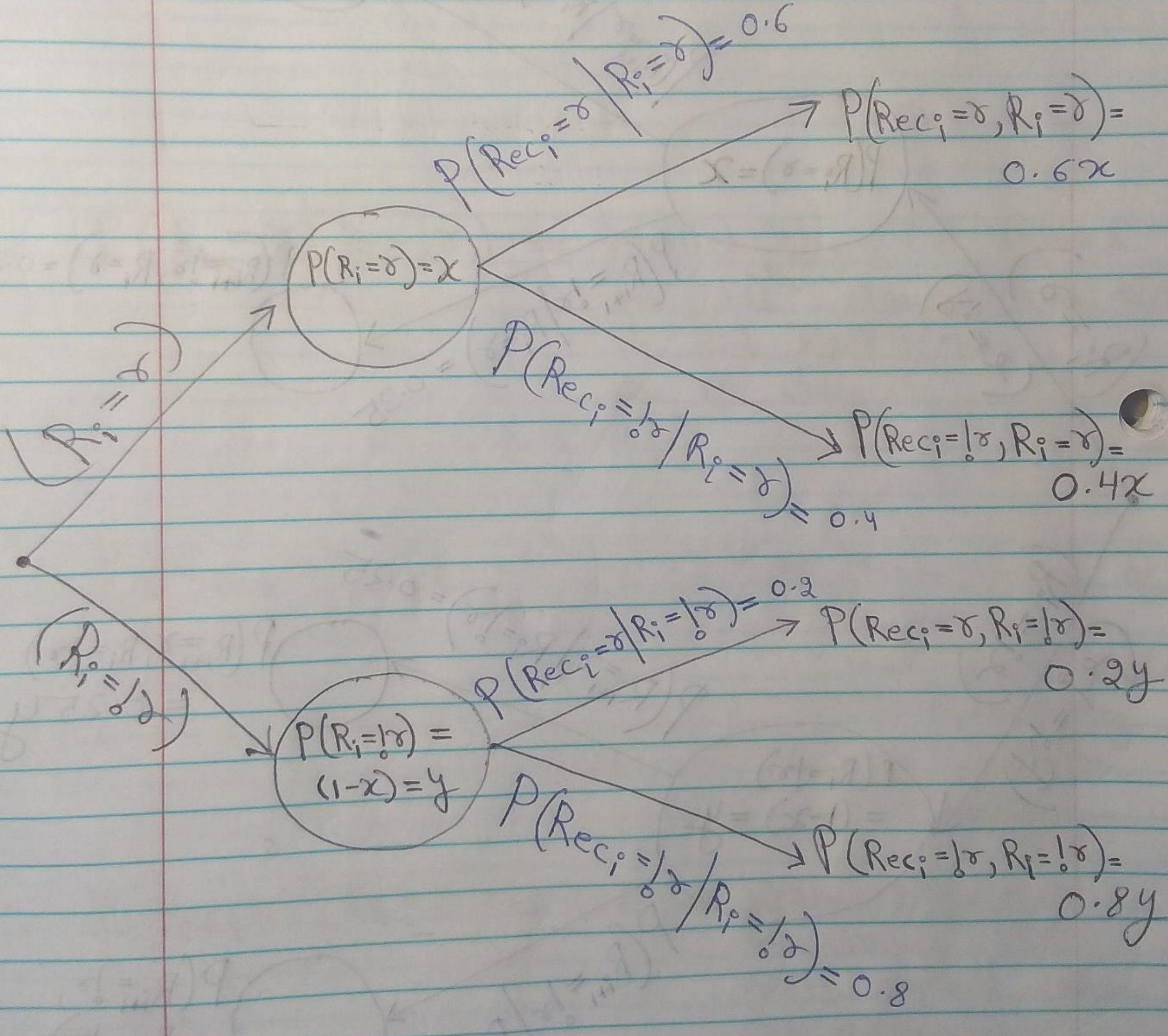
$P(Rec_i = !r \mid R_i = r) = 0.4$ = probability of receiving No rain signal when it actually rained on i^{th} day

$P(Rec_i = r \mid R_i = !r) = 0.2$ = probability of receiving YES rain signal when it actually did NOT rain on i^{th} day.

Making Rain Event Diagram to Calculate Joint distribution Table Values :



⇒ Making "Sensor Received data" Event diagram to Calculate Joint distribution Table values:



Joint distribution Tables:

$\leftarrow R_{i+1}$ day $\rightarrow$

R_i day	r	!r	
r	$0.65x$	$0.35x$	$\to x$
!r	$0.25y$	$0.75y$	$\to y$
	$\begin{pmatrix} 0.65x \\ + \\ 0.25y \end{pmatrix}$	$\begin{pmatrix} 0.35x \\ + \\ 0.75y \end{pmatrix}$	

$\leftarrow Rec_i \rightarrow$

R_i	r	!r	
r	$0.6x$	$0.4x$	x
!r	$0.2y$	$0.8y$	y
	$\begin{pmatrix} 0.6x \\ + \\ 0.2y \end{pmatrix}$	$\begin{pmatrix} 0.4x \\ + \\ 0.8y \end{pmatrix}$	

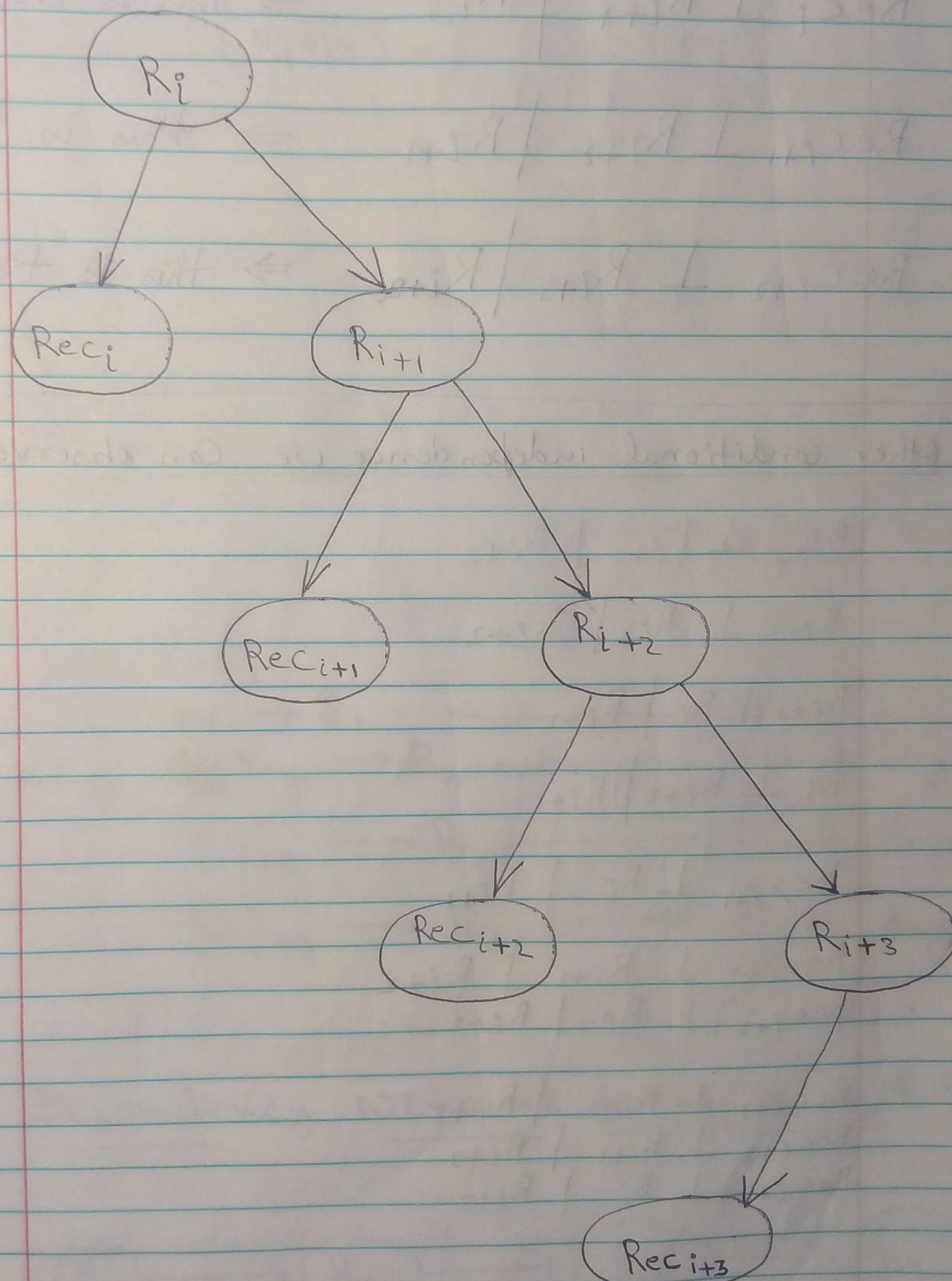
(Q-4) (a)

Draw bayes Network to model the system in terms of

↳ 4 unobserved Variables } → (R_i, R_{i+1}, R_{i+2}, R_{i+3})

↳ 4 observed Variables } → (Rec_i, Rec_{i+1}, Rec_{i+2}, Rec_{i+3})

Bayes Network



↳ Conditional Independence assumptions from the bayes Net :

① $Rec_{i_1} \perp R_{i_2} \mid R_{i_1}$

this is true for all i under following conditions :

$i_1 < i_2$
$i \leqslant i_1$

$i_1 : i, (i+1), (i+2)$
$i_2 : (i+1), (i+2), (i+3)$

$i \in$ Natural Number

② $R_{i_1} \perp R_{i_3} \mid R_{i_2}$

this is true for all i under following conditions :

$$i \leqslant i_1 < i_2 < i_3$$

$i_1 : i, (i+1)$
$i_2 : (i+1), (i+2)$
$i_3 : (i+2), (i+3)$

$i \in$ Natural Number

③ $Rec_{i_1} \perp Rec_{i_2} \mid R_{i_1}$

this is true under following conditions for i :

$$\boxed{i \leqslant i_1 < i_2}$$

$i_1 : \; i, \; i+1, \; i+2$
$i_2 : \; i+1, \; i+2, \; i+3$
$i \in$ Natural Number

④

$R_{i_1} \perp Rec_{i_3} \mid R_{i_2}$

this is true for all i under following conditions :

$$\boxed{i \leqslant i_1 < i_2 \leqslant i_3}$$

$i_1 : \; i, \; i+1, \; i+2$
$i_2 : \; i+1, \; i+2, \; i+3$
$i_3 : \; i+1, \; i+2, \; i+3$
$i \in$ Natural Number

Example

Conditional Independence Assumptions:

① $Rec_i \perp R_{i+1} \mid R_i$ ⇒ this is true

② $Rec_{i+1} \perp R_{i+2} \mid R_{i+1}$ ⇒ this is true

③ $Rec_{i+2} \perp R_{i+3} \mid R_{i+2}$ ⇒ this is true

Other conditional independence we can observe:

④ $R_{i+3} \perp R_{i+1} \mid R_{i+2}$

⑤ $R_{i+3} \perp R_i \mid R_{i+2}$

⑥ $R_{i+3} \perp R_i \mid R_{i+1}$

⑦ $R_i \perp R_{i+2} \mid R_{i+1}$

⑧ $Rec_{i+1} \perp R_i \mid R_{i+1}$

⑨ $Rec_{i+2} \perp R_{i+1} \mid R_{i+2}$

⑩ $Rec_{i+2} \perp R_i \mid R_{i+2}$

⑪ $Rec_{i+3} \perp R_{i+2} \mid R_{i+3}$

⑫ $Rec_{i+3} \perp R_{i+1} \mid R_{i+3}$

⑬ $Rec_{i+3} \perp R_i \mid R_{i+3}$

and many more...

Just for examples...

*

(Q-4)

(b)

Given $P(R_1 = !r) = 1$

ASSUMPTION: We know it did NOT rain on first day $(R_1 = !r)$. We are NOT at the computer center where we may have used sensor data. Ignoring Sensor data.

$$R_i \longrightarrow R_{i+1} \longrightarrow R_{i+2} \longrightarrow R_{i+3}$$

(Dependency Bayes Net)

$\Downarrow$

Let $i = 1$,

$\therefore$ $R_i \rightarrow R_1 \longrightarrow$ first day

$R_{i+1} \rightarrow R_2 \longrightarrow$ Second day

$R_{i+2} \rightarrow R_3 \longrightarrow$ third day

$R_{i+3} \rightarrow R_4 \longrightarrow$ fourth day

↳ Dependency Network for R_1, R_2, R_3 & R_4:

$$R_1 \longrightarrow R_2 \longrightarrow R_3 \longrightarrow R_4$$

we have to find $P(R_4 = r \mid R_1 = !r)$.

we're given $P(R_1 = !r) = 1$

↳ <u>Using</u> <u>Variable</u> <u>Elimination</u> <u>Method</u>:

① Non-query variables in sorted order:

$$Z = [\underbrace{R_2}_{Z_1}, \underbrace{R_3}_{Z_2}] \quad ; n=2$$

② Set of factors F of the form

$$P(Z_j \mid Pa(Z_j))$$

$$F = \{P(R_2 \mid R_1 = !r), P(R_3 \mid R_2), P(R_4 \mid R_3)\}$$

Note: we know the parameter value for R_1, which is $!r$;

③ For each Z_j in Z :

$(Z_1 = R_2)$

ⓐ $F' = \{ P(R_2 | R_1 = !r) , P(R_3 | R_2) \}$

here $V = \{ \cancel{R_1 = !r}, R_2 , R_3 \}$ as parameters in F' ;

ⓑ Take product of F' elements :

$$\text{pdt} Z_1 = P(R_3 | R_2) * P(R_2 | R_1 = !r)$$

ⓒ Sum $\text{pdt}Z_1$ over all values of $(Z_1 = R_2)$, producing a new element $\tau(R_3)$ (let's call it this), parameterized by $[\cancel{R_1 = !r}, R_3]$. We do this, so we can eliminate $Z_1 = R_2$ non-query variable.

$$\text{Sum} Z_1 = \sum_{R_2} P(R_3 | R_2) * P(R_2 | R_1 = !r)$$

What we know,

$$P(R_2 | R_1 = !r) \xrightarrow{R_2 = r} P(R_2 = r | R_1 = !r) = 0.25$$

$$P(R_2 | R_1 = !r) \xrightarrow{R_2 = !r} P(R_2 = !r | R_1 = !r) = 0.75$$

$$
\begin{tikzcd}
P(R_3 \mid R_2) \arrow[r, "R_2=r"] \arrow[dr, "R_2=!r"'] & P(R_3 \mid R_2=r) \\
& P(R_3 \mid R_2=!r)
\end{tikzcd}
$$

$$\text{Sum}Z_1 = \{ P(R_3 \mid R_2=r) \times (0.25) \; +$$

$$\cancel{P(R_3 \mid R_2=!r) \times (0.25) +}$$

$$\cancel{P(R_3 \mid R_2=r) \times (0.75) +}$$

$$P(R_3 \mid R_2=!r) \times (0.75) \}$$

↳ When $(R_3 = r)$:

$$\text{Sum}Z_1 (R_3 = r) = \{ (0.65)(0.25) \; + \; (0.25)(0.75) \}$$

$$= 0.35$$

↳ When $(R_3 = !r)$:

$$\text{Sum } Z_1 (R_3 = !r) = \{(0.35)(0.25) + (0.75)(0.75)\}$$

$$= 0.65$$

$\tau(R_3)$ Table :

(given $R_1 = !r$)

Rain on day3	
$R_3 = r$ (Yes)	$R_3 = !r$ (No)
0.35	0.65

(d) Remove elements of F' from F, then add $f = \tau(R_3)$ to F.

$$F = \{ P(R_4 | R_3), \tau(R_3) \}$$

Now, eliminate $(Z_2 = R_3)$:

ⓐ $F' = \{ P(R_4 | R_3),\ \tau(R_3) \}$

here $v = \{R_4, R_3\}$ as parameters in F'.

ⓑ take product F' elements:

$$pdtZ_2 = P(R_4|R_3) * \tau(R_3)$$

ⓒ Sum $pdtZ_2$ over all values of $(Z_2 = R_3)$, producing a new element, let's say, $\tau(R_4)$, parameterized by $[R_4]$. We do this so we can eliminate $Z_2 = R_3$ non-query variable.

$$SumZ_2 = \sum_{R_3} P(R_4|R_3) * \tau(R_3)$$

What we know:

$$\tau(R_3) \xrightarrow{R_3 = r} (0.35)$$

$$\tau(R_3) \xrightarrow{R_3 = \neg r} (0.65)$$

$P(R_4 \mid R_3) \longrightarrow P(R_4 \mid R_3 = r)$

$\qquad\qquad\quad \longrightarrow P(R_4 \mid R_3 = !r)$

$$\text{Sum } Z_2 = \left\{ P(R_4 \mid R_3 = r) \times (0.35) + P(R_4 \mid R_3 = !r) \times (0.65) \right\}$$

↳ when $(R_4 = r)$:

$$\text{Sum } Z_2 (R_4 = r) = \left\{ (0.65)(0.35) + (0.25)(0.65) \right\}$$

$$= (0.2275 + 0.1625) = 0.39$$

↳ When $(R_4 = !r)$:

$$\text{Sum } Z_2 (R_4 = !r) = \left\{ (0.35)(0.35) + (0.75)(0.65) \right\}$$

$$= (0.1225 + 0.4875) = 0.61$$

$\tau(R_4)$ table :

← rain on day 4 → (given $R_1 = !r$)

$R_4 = r$	$R_4 = !r$
0.39	0.61

(d) Remove elements of F' from F, then add $f = \tau(R_4)$ to F.

$$F = \{ \tau(R_4) \}$$

↳ Variable elimination algo terminates here.

output = $[\tau(R_4)]$ table.

↳ Now query $R_4 = r$ into $\tau(R_4)$ table,

we get $\boxed{\tau(R_4 = r) = 0.39}$

Ans

In case any text is not readable, and if allowed, please ask me questions. I can also provide the original notebook that has these solutions.

Regards,
Mayank