CSE 422 ASSIGNMENT 2

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SECTION: 06

(1) (a) $P(\text{cheat} \wedge \text{pass} | \text{study}) \neq P(\text{cheat} | \text{study}) * P(\text{pass} | \text{study})$

$$\Rightarrow \frac{P(\text{cheat} \wedge \text{pass} \wedge \text{study})}{P(\text{study})} \neq \frac{P(\text{cheat} \wedge \text{study})}{P(\text{study})} * \frac{P(\text{pass} \wedge \text{study})}{P(\text{study})}$$

$$\Rightarrow \frac{0.25}{0.45} \neq \frac{0.27}{0.45} * \frac{0.40}{0.45}$$

$$\Rightarrow 0.556 \neq 0.533$$

$\therefore$ cheat and pass are not conditionally independent given study.

(b) $P(\text{Pass or Cheat}) = P(\text{Pass}) + P(\text{cheat}) - P(\text{Pass} \wedge \text{cheat})$

$= 0.63 + 0.59 - 0.35$

$= 0.87$

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(2) (a) $P(\sim Cold) = 0.32 + 0.06 + 0.26 + 0.03$
$= 0.67$

(b) $$\frac{P(\sim Cloudy)}{P(\sim Rain \wedge \sim Cold)} = \frac{P(\sim Cloudy \wedge \sim Rain \wedge \sim Cold)}{P(\sim Rain \wedge \sim Cloud)}$$

$$= \frac{0.07}{0.04 + 0.07}$$

$$= 0.636$$

(c) $$\frac{P(\sim Rain\ )}{P(\sim Cloudy)} = \frac{P(\sim Rain \wedge \sim Cloudy)}{P(\sim Cloudy)}$$

$$= \frac{0.03 + 0.07}{0.26 + 0.03 + 0.10 + 0.07}$$

$$= 0.217$$

(d) $P(\sim Rain \text{ or } Cloudy) = P(\sim Rain) + P(Cloudy) - P(\sim Rain \wedge Cloudy)$
$= 0.2 + 0.54 - 0.1$
$= 0.64$

(3) (a) $P(\text{football} \wedge \text{left-handed person}) = 0.13$

(b) $\dfrac{P(\text{right-handed person})}{P(\text{cricket})} = \dfrac{P(\text{cricket} \wedge \text{right-handed person})}{P(\text{right-handed person})}$

$$= \frac{0.1}{0.1 + 0.1 + 0.26}$$

$$= 0.217$$

(c) $P(\text{football} \wedge \text{cricket}) = 0$

(d) $P(\text{right-handed or left handed})$

$= P(\text{right-handed}) + P(\text{left-handed}) - P(\text{right-handed} \wedge \text{left\_handed})$

$= 0.46 + 0.54 - 0$

$= 1$

(e) $P(\text{football} \wedge \text{Right-handed}) \neq P(\text{football}) * P(\text{Right-handed})$

$0.1 \neq (0.13 + 0.1) * (0.1 + 0.1 + 0.26)$

$0.1 \neq 0.115$

Football and right-handed depends on one another.

(4) Cov - Covid +ve

!Cov - Covid -ve

Pos - detected Covid +ve

!Pos — detected covid -ve

$P(Pos|Cov) = 0.92$

$P(!Pos|!Cov) = 1 - 0.92 = 0.08$

$P(Pos|!Cov) = 0.04$

$P(!Pos|!Cov) = 1 - 0.04 = 0.96$

$P(Cov) = 0.07$ $\quad P(!Cov) = 1 - 0.07 = 0.93$

$$P(Cov) = \frac{\cancel{P(Pos}}{P(Pos|Cov) * P(Cov) + P(Pos|!Cov) * P(!Cov)}$$

$$P(Cov) = \frac{\cancel{(0.92 * 0.07)}}{(0.92 * 0.07) + (0.04 * 0.93)}$$

~~= 0.634~~ 0

$P(Cov) = 0.1016$

(b) Learning phase

Outlook

	Yes	No
Overcast	2/5	0/3
Sunny	2/5	3/3
Rainy	1/5	0/3

Humidity

	Yes	No
Cool	2/5	0/3
mild	3/5	2/3
Hot	0/5	1/3

Temp

	Yes	No
Normal	4/5	0/3
High	1/5	3/3

Wind

	Yes	No
TRUE	3/5	1/3
FALSE	2/5	2/3

$P(\text{Play Tennis} = \text{Yes}) = \frac{5}{8}$ | $P(\text{Play Tennis} = \text{NO}) = \frac{3}{8}$

(a) P(Play Tennis = Yes | Outlook = Sunny, humidity = mild, Temp = ~~High~~ Normal, Wind = True)

= P(Outlook = Sunny | Play Tennis = Yes) *
P(humidity = mild | Play Tennis = Yes) *
P(Temp = ~~High~~ Normal | Play Tennis = Yes) *
P(Wind = True | Play Tennis = Yes) * P(Play Tennis = Yes)

$= (2/5)(3/5)(4/5)(3/5)(5/8)$

= [illegible]

= ~~0.00276~~ ~~0.018~~ 0.072

P(Play Tennis = No | Outlook = sunny, humidity = mild,
Temp = High, Wind = True)

= P(Outlook = Sunny | Play Tennis = No) *
P(humidity = mild | play Tennis = No) *
P(Temp = High | Play Tennis = No) *
P(~~Te~~ Wind = True | Play Tennis = No) * P(Play Tennis = No)

= (3/3)(2/3)(0/3)(1/3)(3/8)

= ~~0.0169~~ 0.~~0833~~ 0

probability of playing tennis ~~&~~ > probability of not playing tennis.

∴ Player is not going to play tennis.

(b) P(Play Tennis = Yes | outlook = overcast, humidity = hot)

= P(outlook = overcast | Play Tennis = Yes) * P(Humidity = hot | Play Tennis = Yes)
* P(Play Tennis = Yes)

= (2/2)(0/1)(5/8)

= 0

P(Play Tennis = No | outlook = overcast, humidity = hot)

= P(outlook = overcast | Play Tennis = No) * P(humidity = hot | Play Tennis = No)
* P(Play Tennis = No)

= (0/2)(1/1)(3/8)

= 0

No decision can be made

(b)(a) $E(\text{Edibible}) = -P(\text{Edible} = \text{Yes}) \log_2 P(\text{Edible} = \text{Yes})$

$$- P(\text{Edible} = \text{No}) \log_2 P(\text{Edible} = \text{No})$$

$$= -\left(\frac{9}{16} \log_2 \frac{9}{16}\right) - \left(\frac{7}{16} \log_2 \frac{7}{16}\right)$$

$$= 0.989$$

Using color:-

$E(\text{color} = \text{Yellow}) = -P(\text{Edible} = \text{Yes} \mid \text{Color} = \text{Yellow}) \log_2 P(\text{Edible} = \text{Yes} \mid \text{Color} = \text{Yellow})$

$$- P(\text{Edible} = \text{NO} \mid \text{Color} = \text{Yellow}) \log_2 P(\text{Edible} = \text{No} \mid \text{Color} = \text{Yellow})$$

$$= -\left(\frac{8}{13} \log_2 \frac{8}{13}\right) - \left(\frac{5}{13} \log_2 \frac{5}{13}\right)$$

$$= 0.961$$

$P(\text{color} = \text{Yellow}) = \frac{13}{16}$

$E(\text{color} = \text{Green}) = -P(\text{Edible} = \text{Yes} \mid \text{Color} = \text{Green}) \log_2 P(\text{Edible} = \text{Yes} \mid \text{Color} = \text{Green})$

$$- P(\text{Edible} = \text{No} \mid \text{Color} = \text{Green}) \log_2 P(\text{Edible} = \text{No} \mid \text{Color} = \text{Green})$$

$$= -\left(\frac{1}{3} \log_2 \frac{1}{3}\right) - \left(\frac{2}{3} \log_2 \frac{2}{3}\right)$$

$$= 0.918$$

$P(\text{color} = \text{Green}) = \frac{3}{16}$

Using size,

$$E(size = small) = -\frac{6}{8}\log_2\frac{6}{8} - \frac{2}{8}\log_2\frac{2}{8}$$

$$= 0.811$$

$$P(size = small) = \frac{8}{16}$$

$$E(size = large) = -\frac{3}{8}\log_2\frac{3}{8} - \frac{5}{8}\log_2\frac{5}{8}$$

$$= 0.954$$

$$P(size = large) = \frac{8}{16}$$

Using shape,

$$E(shape = Round) = -\frac{6}{12}\log_2\frac{6}{12} - \frac{6}{12}\log_2\frac{6}{12}$$

$$= 1$$

$$P(shape = Round) = \frac{12}{16}$$

$$E(shape = Irregular) = -\frac{3}{4}\log_2\frac{3}{4} - \frac{1}{4}\log_2\frac{1}{4}$$

$$= 0.811$$

$$P(shape = Irregular) = \frac{4}{16}$$

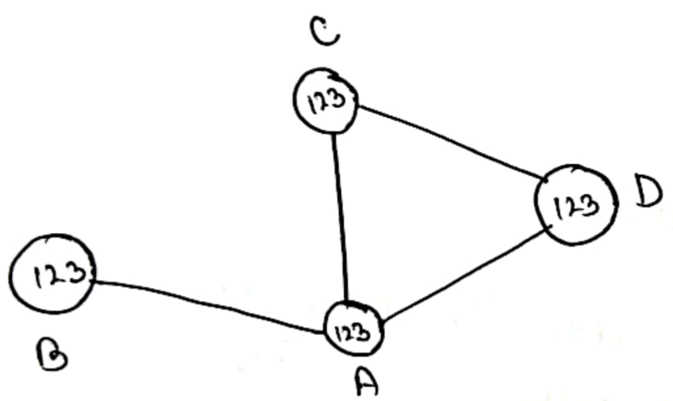
(7) (a) variable = {A, B, C, D}

domain = {1, 2, 3}

constraint = no two adjacent regions can have same digit

goal = All regions have number

(b)



Since all regions have same domain, most constrained variable cannot be used.

We can use most constraining variable.

C can reduce A and D

D can reduce A and C

A can reduce C, B and D

B can reduce A

Here, A can reduce maximum regions.
So, A is choosen to give a number.

(b) $IG(color) = E(Decision) - E(color = Yellow)\,P(color = Yellow) - E(color = Green)\,P(color = Green)$

$= 0.989 - (0.961 * 13/16) - (0.918 * 3/16)$

$= 0.0361$

$IG(size) = 0.989 - (0.811 * 8/16) - (0.954 * 8/16)$

$= 0.1065$

$IG(shape) = 0.989 - (1 * 12/16) - (0.811 * 4/16)$

$= 0.03625$

$IG(size) > IG(shape) > IG(color)$

size is a better feature as it has the highest IG than the other features so it has more information and no information conflicts.

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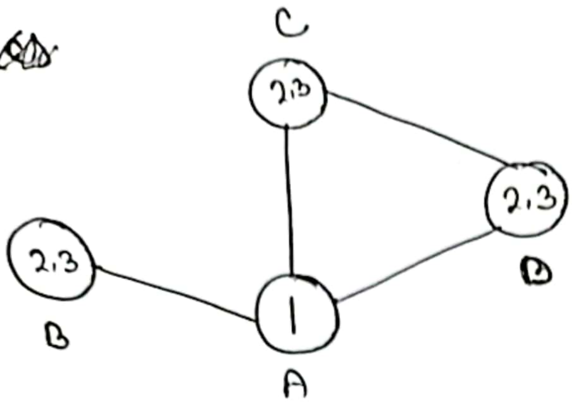
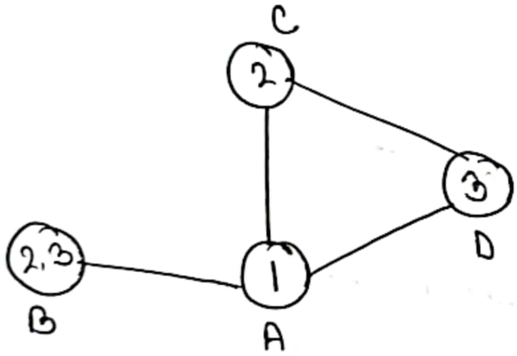
Ans.

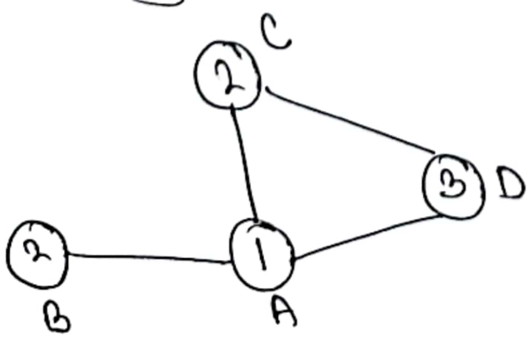


Again, domains are the same and most constraining variable needs to be used.
Now, B, C and D all can reduce maximum regions.
So, C is choosen randomly and assigned with 2



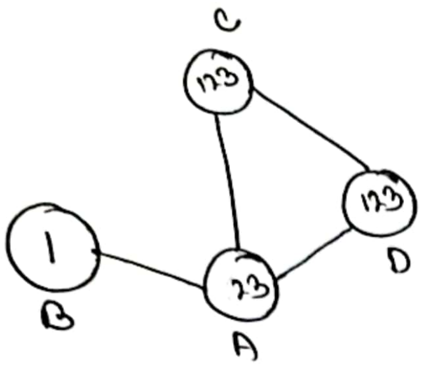
Domain of D < Domain of B.
So, most constrained variable is used and D has been assigned with 3.

Now, the remaining region B has been assigned with 2



order $\Rightarrow$ A $\rightarrow$ C $\rightarrow$ D $\rightarrow$ B

(c)



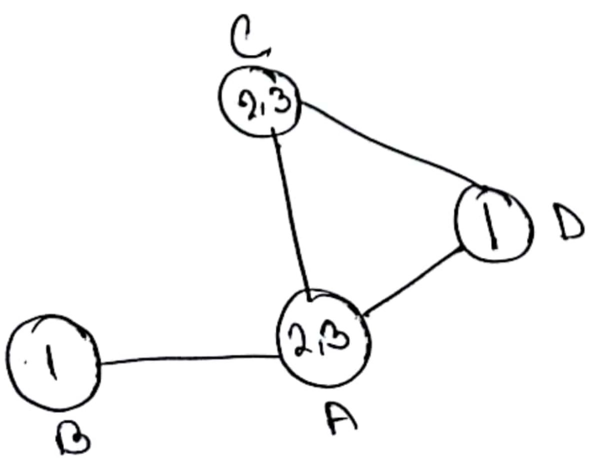
If D is assigned with 2, it can reduce A to {3} and C to {1,3}

If D is assigned with 3, it can reduce A to {2} and C to {1,2}

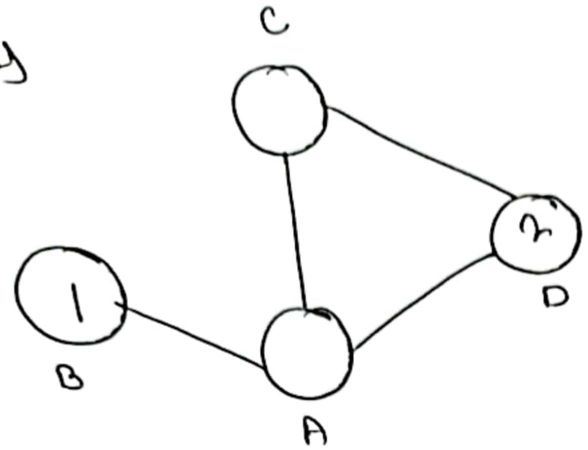
If D is assigned with 1, it can reduce C to {2,3} and cannot reduce A.

Thus, least number of regions have been reduced using D with 1.

D is assigned with 1.



(d)

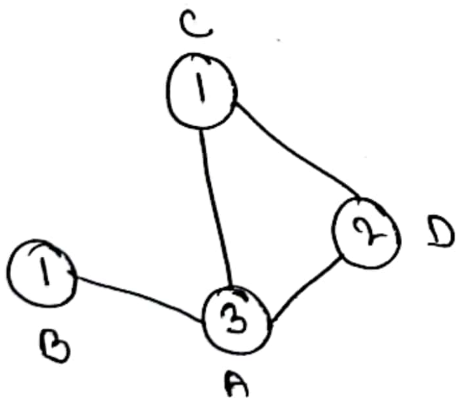


3	1	1,3	2
A	B	C	D

A is assigned with 3

3	1	1	2
A	B	C	D

C is assigned with 1



No region is empty after assigning and reducing every regions.
So, CSP remain arc consistent.