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ML-II

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Task-1
Bayesian N/w Design

⇒ Binary random variables = c, t, r, b, d, f
⇒ N = 6

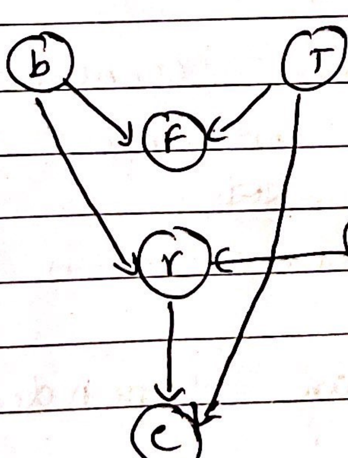
p(c, t, r, b, d, f)
Given, t → tank
b → battery
d → defective are independent. (p(t), p(b), p(d))

Starting engine t → tank & r → rotating the starter plays a direct role: p(c|t, r)

Now, for fuel guage to work, p(f|b, t)

Graph structure :

p(b=1)
0.2



p(t=3)

p(d=1)
0.1

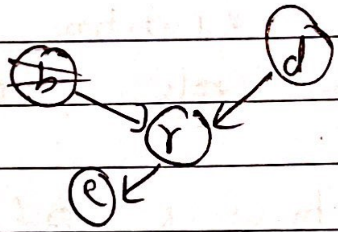
T	b	$p(f=1\mid t,b)$
0	0	0.01
0	1	0.5
1	0	0.9
1	1	0.95

t	r	$p(e=1\mid t,r)$
0	0	0.02
0	1	0.5
1	0	0.6
1	1	0.7

b	d	$p(r=1\mid b,d)$
0	0	0.01
0	1	0.02
1	0	0.4
1	1	0.9

Task-2
D-separation.

a) $d \perp e \mid b$

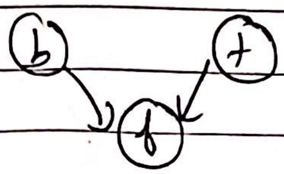


$x \perp y \mid z \iff p(x,y\mid z) = p(x\mid z)$

$d \rightarrow r \rightarrow e$ is a series connection.
d & e are not independent as r is not observed. ~~data~~.
when b is observed it is unblocked

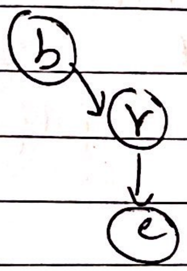
therefore, d & e are dependent.

b. $b \perp t | \phi$



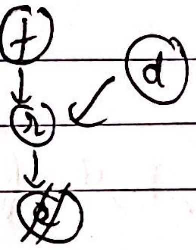
f is not observed. & b and t are independent & have converging connection.

c. $b \perp e | r$



r is observed, therefore b & e are independent in the serial connection.

d. $t \perp d | e$



It is not independent. This is a converging connection & e is observed. This connection is unblocked by the observation of the random variable e.

Task-3
Bayesian N/w Inference.

⇒ Given $f=0$, $t=0$

$$p(t=0/f=0) = \frac{p(t=0,\ f=0)}{p(f=0)}$$

To get $p(t=0/f=0)$ we need to sum all possible values, where
$p(t=1) = 0.3$ $\quad p(t=0) = 0.7$
$p(f=0/t,b)$ can be find from $p(f=1/t,b)$

t	b	$p(f=0/t,b)$
0	0	0.99
0	1	0.5
1	0	0.1
1	1	0.05

putting values in expression =

$$\sum^{e}\sum\sum^{b}\sum^{d} p(t=0, e, r, b, d, f=0)$$

$$\sum_{t}\sum_{e}\sum_{r}\sum_{b}\sum_{d} p(t, e, r, b, d, f=0)$$

$\in(\{0,1\}\ \{0,1\}\ \{0,1\}\ \{0,1\}\ \{0,1\})$

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$p(b)\, p(d)\, p(t=0) \sum p(e|t=0, r) \sum_{b} \sum_{a} p(r|b,d)$

$\sum p(f=0|t=0, b)$

$p(b)\, p(d)\, p(t=0) \sum_{a} \sum_{t} p(e|t, r) \sum_{b} \sum_{d} p(r|b,d)$

$\sum_{b} \sum_{t} p(f=0|t, b)$

f) $(0.2)(0.1)(0.7)(0.02+0.5)(0.01+0.02+0.4+0.9) \times (0.99+0.5)$

$(0.2)(0.1)(0.3)(0.02+0.5+0.6+0.7) \times (0.01+0.02+0.4+0.9)$
$\times (0.99+0.5+0.1+0.05$

$= 0.604$

therfore probability $(t=0, f=0) = 0.604$

Ans