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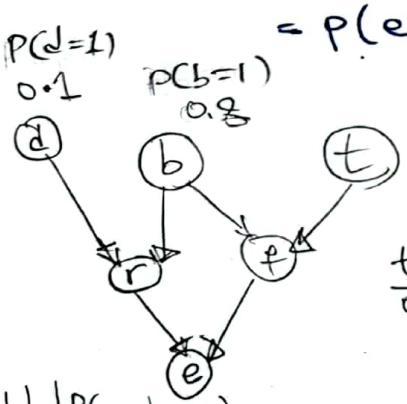
ex II

Task1) $P(b,t,f,d,r,e) = P(e|b,t,f,d,r)\,P(b,t,f,d,r)$

$= P(e|f,r)\,P(b,t,f,d)\,P(r|b,t,f,d)$

$= P(e|f,r)\,P(r|b,d)\,P(d|b,t,f)\,P(b,t,f)$

$= P(e|f,r)\,P(r|b,d)\,P(d)\,P(f|b,t)\,P(b)\,P(t)$



t	b	P(f=1|b,t)
0	0	0.01
0	1	0.15
1	0	0.12
1	1	0.9

d	b	P(r=1|b,d)
0	0	0.6
0	1	0.9
1	0	0.01
1	1	0.3

r	f	P(e=1|f,r)
0	0	0.02
0	1	0.46
1	0	0.3
1	1	0.95

Task 2)

(a) d ⊥ b: There is path from d to e that goes from r It is a serial path which r is not observed. So d and e are not independent.

(b) b ⊥ t | ∅:

There is a serial connection from b to t at r (which is not observed) - So those two are not independent.

(c) b ⊥ e | r:

There is a serial path from b to e at f which is not observed. So those two are not independent.

(d) t ⊥ d | e:

There is a diverging path from t to d from b which is not observed so they're not independent.

Task 3) (a) $P(f=0 \mid f=0) = \frac{P(t=0, f=0)}{\sum_f P(f=0)} = \frac{\sum_d \sum_b \sum_r \sum_e P(t=f=0, d, b, r, e)}{\sum_d \sum_b \sum_r \sum_e \sum_t P(f=0, d, b, r, e, t)}$ (I) (II)

For solving the (I) we have

t	f	d	b	r	e	P
		0	0	0	0	0.020
		0	0	0	1	0.0004
		0	0	1	0	0.014
		0	0	1	1	0.009
		0	1	0	0	0.017
		0	1	0	1	0.0003
		0	1	1	0	0.012
		0	1	1	1	0.005
		1	0	0	0	0.005
		1	0	0	1	0.0001
		1	0	1	0	0
		1	0	1	1	0
		1	1	0	0	0.013
		1	1	0	1	0.0002
		1	1	1	0	0.004
		1	1	1	1	0.001

$\sum_{\text{all rows}} = 0.096$ (III)

f	t	b	d	r	e	P
	0	0	0	0	0	0.020
	0	0	0	0	1	0.001
	0	0	0	1	0	0.031
	0	0	0	1	1	0.0006
	0	0	1	0	0	0.005
	0	0	1	0	1	0.0001
	0	0	1	1	0	0
	0	0	1	1	1	0
	0	1	0	0	0	0.017
	0	1	0	0	1	0.0003
	0	1	0	1	0	0.115
	0	1	0	1	1	0.049
	0	1	1	0	0	0.013
	0	1	1	0	1	0.0002
	0	1	1	1	0	0.004
	0	1	1	1	1	0.001
	1	0	0	0	0	0.043
	1	0	0	0	1	0.0008
	1	0	0	1	0	0.046
	1	0	0	1	1	0.019
	1	0	1	0	0	0.011
	1	0	1	0	1	0
	1	0	1	1	0	0
	1	0	1	1	1	0
	1	1	0	0	0	0.004
	1	1	0	0	1	0
	1	1	0	1	0	0.031
	1	1	0	1	1	0.018
	1	1	1	0	0	0.003
	1	1	1	0	1	0
	1	1	1	1	0	0.001
	1	1	1	1	1	0.0005

Sum of all rows = 0.425

(II), (1)

$$P(t=0 \mid f=0) = \frac{0.096}{0.425}$$

$$= 0.225$$

Task 4) from the equation 1 in the task 4 question and also D-sepration's definition, we get:

for any $x' \in V - \{x\} \cup m\}$ to be independant of x given m, any path from x' to x should be blocked by m.
for this to happen, we need to block every path to x, from it's parents and children which are considered Path types of serial and/or diverging and make sure no converging path to x is observed - (or it's descendents)

Hence the minimal set M would be the set of all parents and children: $M = pa(x) \cup chi(x)$
regarding we do not activate a converging path.