CS686 – assignment 2

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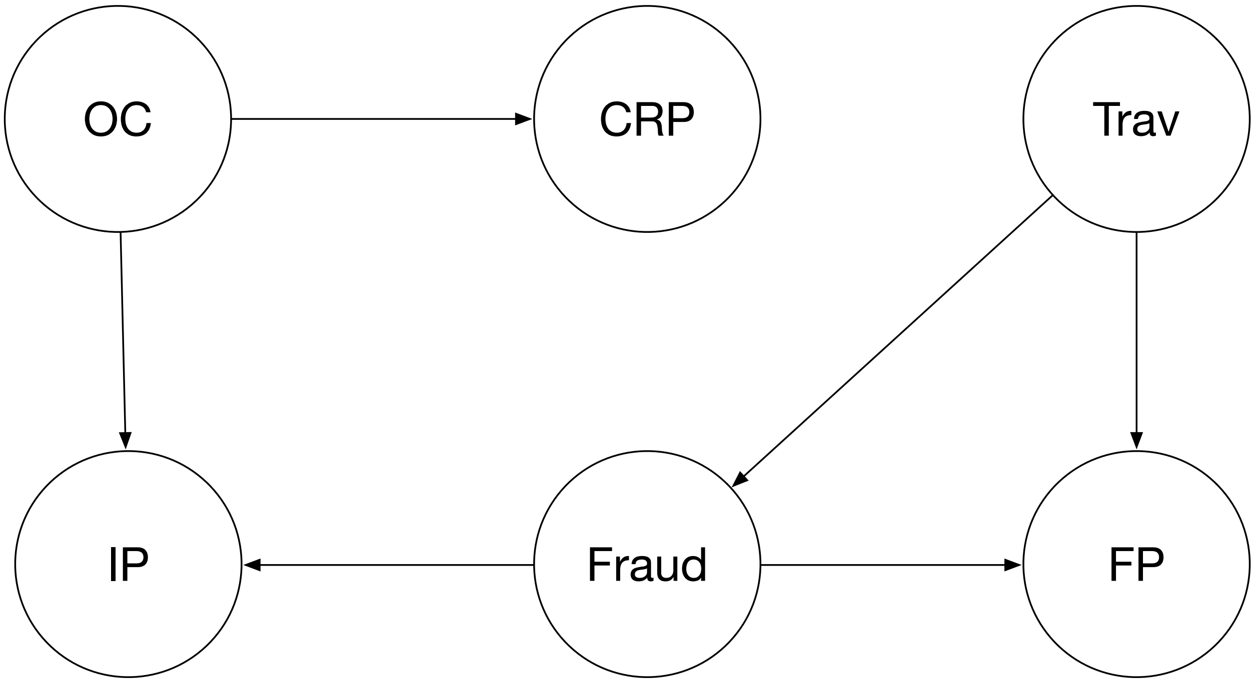
1. see the code attached
2.
   a)



Pr(OC)
0.8

Pr(Trav)
0.05

Trav	Pr(Fraud|Trav)
True	0.01
False	0.004

Trav	Fraud	Pr(FP|Trav, Fraud)
False	True	0.1
False	False	0.01
True	True	0.9
True	False	0.9

OC	Fraud	Pr(IP|OC, Fraud)
True	False	0.1

True	True	0.15
False	False	0.001
False	True	0.051

OC	Pr(CRP|OC)
True	0.1
False	0.01

b) Run the program that I provide, and the results will be calculated automatically and shown on the terminal.

$Pr(Fraud) = \Sigma_{Trav}\ Pr(Fraud, Trav)$
$= \Sigma_{Trav}\ Pr(Fraud|Trav)\ Pr(Trav)$
$= \Sigma_{Trav}\ f_1(Fraud, Trav)\ f_2(Trav)$
$= f_3(Fraud)$
$= [0.0043,\ 0.9957]$

Factor:

$f_1(Fraud, Trav) = Pr(Fraud|Trav)$
$f_2(Trav) = Pr(Trav)$
$f_3(Fraud) = \Sigma_{Trav}\ f_1(Fraud, Trav)\ f_2(Trav)$

$Pr(Fraud|fp, \sim ip, crp)$
$= aPr(fp, \sim ip, crp|Fraud)Pr(Fraud)$
$= a\Sigma_{Trav, OC}\ Pr(fp, \sim ip, crp, OC, Trav|Fraud)Pr(Fraud)$
$= a\Sigma_{OC}\ Pr(\sim ip|OC, Fraud)Pr(crp|OC)Pr(OC)\ \Sigma_{Trav}Pr(fp|Trav, Fraud)Pr(Trav)Pr(Fraud)$
$= a\Sigma_{OC}\ f_1(OC, Fraud)f_2(OC)f_3(OC)\ \Sigma_{Trav}f_4(Trav, Fraud)f_5(Trav)f_6(Fraud)$
$= af_7(Fraud)\ f_8(Fraud)$
$= [0.01430783, 0.98569217]$

Factor:

$f_1(OC, Fraud) = Pr(\sim ip|OC, Fraud)$
$f_2(OC) = Pr(crp|OC)$
$f_3(OC) = Pr(OC)$
$f_4(Trav, Fraud) = Pr(fp|Trav, Fraud)$
$f_5(Trav) = Pr(Trav)$
$f_6(Fraud) = Pr(Fraud)$
$f_7(Fraud) = \Sigma_{OC}\ f_1(OC, Fraud)f_2(OC)f_3(OC)$
$f_8(Fraud) = \Sigma_{Trav}f_4(Trav, Fraud)f_5(Trav)f_6(Fraud)$
a is the normalizing constant

c) $Pr(Fraud|fp, \sim ip, crp, trav)$
$= aPr(fp, \sim ip, crp, trav, OC|Fraud)Pr(Fraud)$
$= a\Sigma_{OC}\ Pr(fp, \sim ip, crp, trav, OC|Fraud)Pr(Fraud)$
$= a\Sigma_{OC}\ Pr(\sim ip|OC, Fraud)Pr(crp|OC)Pr(OC)Pr(fp|trav, Fraud)Pr(trav)Pr(Fraud)$

$= a\Sigma_{OC}\, f_1(OC, Fraud)f_2(OC)f_3(OC)\, f_4(Fraud)\, f_5()\, f_6(Fraud)$
$= af_7(Fraud)\, f_8(Fraud)$
$= [0.00945117, 0.99054883]$

Factor:

$f_1(OC, Fraud) = Pr(\sim ip|OC, Fraud)$
$f_2(OC) = Pr(crp|OC)$
$f_3(OC) = Pr(OC)$
$f_4(Fraud) = Pr(fp|trav, Fraud)$
$f_5() = Pr(trav) = 0.05$
$f_6(Fraud) = Pr(Fraud)$
$f_7(Fraud) = \Sigma_{OC}\, f_1(OC, Fraud)f_2(OC)f_3(OC)$
$f_8(Fraud) = f_4(Fraud)f_5()f_6(Fraud)$
a is the normalizing constant

d) If I were the thief, I would prefer to purchase a computer before I made the internet purchase. In this way, the probability of rejection would decrease.
Precisely, the calculation is shown as below:

$Pr(Fraud|ip)$
$= a\Sigma_{OC}Pr(ip, OC|Fraud)Pr(Fraud)$
$= a\Sigma_{OC}Pr(ip|OC, Fraud)Pr(Fraud)$
$= a\Sigma_{OC}f_1(OC, Fraud)f_2(Fraud)$
$= [0.00696213, 0.99303787]$

$Pr(Fraud|ip, crp)$
$= aPr(ip, crp|Fraud)Pr(Fraud)$
$= a\Sigma_{OC}Pr(ip|OC, Fraud)Pr(crp|OC)Pr(Fraud)$
$= a\Sigma_{OC}f_1(OC, Fraud)f_3(OC)f_2(Fraud)$
$= [0.0064889, 0.9935111]$

Factor:

$f_1(OC, Fraud) = Pr(ip|OC, Fraud)$
$f_2(Fraud) = Pr(Fraud)$
$f_3(OC) = Pr(crp|OC)$
a is the normalizing constant

Therefore, the probability decreased by about 0.0005

3.

a)

i. No, D and G are connected
ii. No, same as above
iii. Yes, B is not in the evidence so B blocks A and G

iv. No, there are undirected paths between C and G, and B cannot block the path between A and C because B is in the evidence, hence they are dependent
v. Yes, C blocks the path between B and G, so B and G are independent, hence A and G are independent
vi. No, there is an undirected path between C and G (C, E, F, G), and B cannot block the path between A and C because B is in the evidence, hence they are dependent
vii. No, C and G are dependent because E is in the evidence, and A and C are dependent given B, therefore A and G are dependent

b) C is in the query so it is relevant. And D, the parent of C, is relevant. A is not a descendent of relevant elements, so A is not relevant. E is a descendent, E and all its parents are relevant. So the relevant elements are {C, D, E, F}