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 * COURSE: COMP 4190, SECTION: A01
 * INSTRUCTOR: Cuneyt Akcora
 * ASSIGNMENT: Assignment 2 - Bayesian networks, Q2
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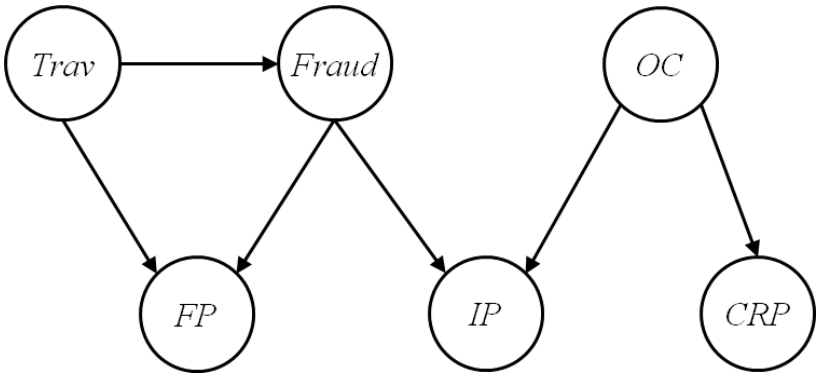
## 2-a:




| P(OC) | |
|---|---|
| +oc | 0.7 |
| -oc | 0.3 |

| P(Trav) | |
|---|---|
| +t | 0.05 |
| -t | 0.95 |

| P ( CRP \| OC ) | | |
|---|---|---|
| OC | CRP | |
| +oc | +crp | 0.1 |
| +oc | -crp | 0.9 |
| -oc | +crp | 0.01 |
| -oc | -crp | 0.99 |

| P ( Fraud \| Trav ) | | |
|---|---|---|
| Trav | Fraud | |
| +t | +f | 0.01 |
| +t | -f | 0.99 |
| -t | +f | 0.004 |
| -t | -f | 0.996 |

| P ( IP \| OC, Fraud ) | | | |
|---|---|---|---|
| OC | is Fraud | IP | |
| +oc | +f | + | 0.02 |
| +oc | +f | - | 0.98 |
| +oc | -f | + | 0.01 |
| +oc | -f | - | 0.99 |
| -oc | +f | + | 0.011 |
| -oc | +f | - | 0.989 |
| -oc | -f | + | 0.001 |
| -oc | -f | - | 0.999 |

| P ( FP \| Trav, Fraud ) | | | |
|---|---|---|---|
| Trav | is Fraud | FP | |
| +t | +f | +fp | 0.9 |
| +t | +f | -fp | 0.1 |
| +t | -f | +fp | 0.9 |
| +t | -f | -fp | 0.1 |
| -t | +f | +fp | 0.1 |
| -t | +f | -fp | 0.9 |
| -t | -f | +fp | 0.01 |
| -t | -f | -fp | 0.99 |

# 2-b:

Output:

Question 2-b(i) :==========

P(+fraud) = 0.0043

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Question 2-b(ii) :==========

After eliminate Variable : travel

the probability is [ 0.05401 0.00083 ]

After eliminate Variable : oc

the probability is [ 0.06960 0.06890 ]

P(¬fraud | fp, ¬ip, crp) = 0.98502

P( fraud | fp, ¬ip, crp) = 0.01498

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Q1:

$$P(+fraud, Trav) = P(Trav) * P(+|fraud\ Trav)$$

After the elimination, the program output $P(+fraud) = 0.0043$ as the prior probability.

Q2:

$$P\,(FRAUD\,|+fp,-ip,+crp\,)\;\alpha\;P(FRAUD,+fp,-ip,+crp)$$

$$= P(FRAUD,+fp,-ip,+crp,TRAV,OC)$$

$$= \sum_{Trav,OC} P(TRAV)\;P(OC)P(FRAUD\mid TRAV)\;P(+\mathrm{crp}\mid OC)\;P(+fp\mid TRAV,FRAUD)P(-ip\mid OC,FRAUD)$$

$$= \sum_{OC} P(OC)\;P(+\mathrm{crp}\mid OC)\;P(-ip\mid OC,FRAUD)\sum_{TRAV} P(TRAV)\;P(FRAUD\mid TRAV)P(+fp\mid TRAV,FRAUD)$$

$$= \sum_{OC} P(OC)\;P(+\mathrm{crp}\mid OC)\;P(-ip\mid OC,FRAUD)\;f1(+fp,FRAUD)$$

$$= f1(+fp,FRAUD)\sum_{OC} P(OC)\;P(+\mathrm{crp}\mid OC)\;P(-ip\mid OC,FRAUD)$$

$$= f1(+fp,FRAUD)\;f2(+\mathrm{crp},-ip\mid FRAUD)$$

The program took the factor FRAUD as variable, and +fp, -ip, +crp as evidence to process the inference.

After the normalization, the result is $P(+fraud\mid +fp,-ip,+crp) = 0.01498$