

CS 561 - Artificial Intelligence

Assignment 1

Abhrajyoti Kundu 234101003

Gorachand Mondal 234101015

Bayesian Networks:

Based on the information provided in the question, the Bayesian Network can be drawn as given below.

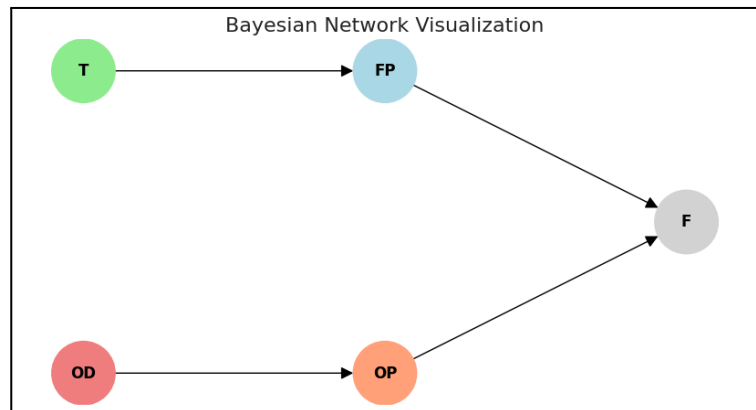
F = Fraud

T = Travel

OD = Owns Device

FP = Foreign Purchase

OP = Online Purchase



Conditional Probability Tables (CPTs):

Travel	
T=No	0.95
T=Yes	0.05

Owns Device	
OD=No	0.3
OD=Yes	0.7

Foreign Purchase given Travel		
	T=No	T=Yes
FP=No	0.9999	0.12
FP=Yes	0.0001	0.88

Online Purchase given Owns Device		
	OD=No	OD=Yes
OP=No	0.95	0.6
OP=Yes	0.05	0.4

Fraud given Foreign Purchase and Online Purchase				
	FP=No, OP=No	FP=No, OP=Yes	FP=Yes, OP=No	FP=Yes, OP=Yes
F=No	0.25	0.15	0.2	0.005
F=Yes	0.75	0.85	0.8	0.995

Assumptions made:

1. Independence assumptions between certain variables, such as Travel and Foreign Purchase.
2. Distributional assumptions for probabilities associated with each variable.
3. Absence of additional hidden variables influencing the observed variables.

Dependencies:

- **Travel (T)** : This variable depends on no other variable and is an independent root node with a prior probability of $P(T) = 0.05$.
- **Owns Device (OD)** : This is another root node that is independent of other variables, with a prior probability of $P(OD) = 0.7$.
- **Foreign Purchase (FP)** : This variable depends on Travel (T). The conditional probabilities are given by $P(FP | T)$, which are 0.88 for True and 0.0001 for False.
- **Online Purchase (OP)** : This variable depends on Owns Device (OD). The conditional probabilities are $P(OP | OD)$, which are 0.4 when OD is True and 0.05 when OD is False.
- **Fraud (F)** : This is a dependent variable that depends on both Foreign Purchase (FP) and Online Purchase (OP). The conditional probabilities are given by $P(F | FP, OP)$, with different probabilities for the combination of True and False values of FP and OP.

The Bayesian network is constructed using the `pomegranate` library, and visualization is achieved using `networkx`. Inference methods such as Gibbs sampling and Variable Elimination are employed to calculate probabilities under different scenarios.

Overall, the Bayesian network serves as a powerful tool for fraud detection by leveraging probabilistic reasoning to infer the likelihood of fraudulent activities based on observed variables.