CS 561 Assignment #1 Bayesian Networks

Due date: 20th November 2020 (Friday)

The aim of this assignment is to understand the Bayesian Networks and the inference techniques.

Consider the task of credit card fraud detection system, where the objective is to detect fraudulent credit card transactions. Typically a credit card holder's transactions follow a certain pattern. If there is disparity in the patterns then a fraud is likely to happen. In this assignment, you will be implementing a simple credit card fraud detection system using Python.

Part A: Designing the Bayesian Network (20 Marks)

The following information is provided to you:

When a customer is travelling abroad it is more likely for a transaction to be fraudulent due to various reasons such as card theft or lost card. On average, a customer is travelling abroad 5% of time. When the customer is traveling, then 88% of the transactions are foreign purchases regardless of the legitimacy of the transactions. On the other hand, when the customer is not travelling then mere 0.01% transactions are foreign transactions. Also, online transactions are more likely to be fraudulent when a customer does not own his/her laptop or smart phone. Currently, 70% of the customers own laptop or smart phone and for those customers, 40% of their transactions are done over internet. While for customers without their own device only 5% of transactions are online. Typically, 0.5 % transactions are legitimate when the purchase is made online in abroad, 20% legitimate transactions are online purchases made within the country, 15% legitimate transactions are purchases made in abroad at POS, 25% transactions are legitimate when purchase is made within country at POS.

Construct a Bayesian network using the following binary random variables and the probabilities as described above.

Fraud (F): current transaction is fraudulent

OwnsDevice (OD): customer owns a laptop or smart phone

Travel (T): customer is currently travelling

ForeignPurchase (FP): current transaction is a foreign purchase

OnlinePurchase (OP): current purchase is made online

For this part you can use Pomegranate Python package (https://pomegranate.readthedocs.io/en/latest/BayesianNetwork.html)

What to hand in: Show the graph defining the network and the conditional probability tables associated with each node in the graph. Also, explain the dependencies that you have considered while designing your network.

Part B: Inference in Bayesian Network

Implement either variable elimination method or Gibbs sampling to infer in your Bayesian Network. The following queries can be given:

(a) What is the prior probability of a fraudulent transaction (i.e. before we have information that the customer is travelling or whether the purchase is online purchase or not)?
(b) What is probability that the transaction is fraud when you are being given the information that the customer owns a smartphone?
(c) Finally, you came to know that the customer is in abroad. Now, what is the probability of the transaction being fraudulent?

You should be able to demonstrate the steps if the inference process.