

# CPSC 322, Practice Exercise

## Conditional Independence

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### 1 Directed Questions

- Describe the difference between *marginal* independence and *conditional* independence.
- Why are we more often interested in conditional independence?
- What are the three key components of a belief network?
- What is the independence assumption in a belief network?

### 2 Belief Networks and Conditional Independence

A bank has asked us to write a program that allows customers to check on the status of their credit card accounts. In particular, customers whose cards have been disabled should be able to use the software to determine why the card was disabled, and to assess which activities will likely lead to their card being disabled.

A card can become disabled when the account is over its limit, when the card has expired, or when a fraud alert has occurred. Fraud alerts often occur when a card is used internationally or when the card is used at a new vendor, e.g. a store where the customer has never shopped before.

This problem is represented in Figure 1. All of the variables are boolean. Note that *newVendor* is dependent on *internationalActivity*, as the probability of the vendor being new is much higher when the vendor is international.

- Is *cardholderContacted* conditionally independent of *internationalActivity* given *fraudAlert*? How can you tell from the belief network?
- Is *fraudAlert* conditionally independent of *newVendor* given *internationalActivity*? How can you tell from the belief network?
- In AISpace, load the associated xml file `credit_card_fraud.xml` using the 'Belief and Decision Networks' applet at <http://aispace.org/bayes/>. Examine the probability tables for this problem. Let's say you are travelling in Europe and have used your card there several times, and then the card stops working. You check your (perfectly reliable) voicemail and there is no message from the bank. What is the most likely cause for the card being disabled? In other words, what are the probabilities  $P(\text{overLimit} = \text{true})$ ,  $P(\text{fraudAlert} = \text{true})$  and  $P(\text{cardExpired} = \text{true})$  given the observations?
- Consider a separate scenario. You are preparing for an overseas trip where you plan to use your credit card, and you want to know how likely it is that using your card abroad will lead to your card being disabled. If it's a high probability, you should inform your credit card company of your travel plans in advance. Calculate the probability of your card being disabled.

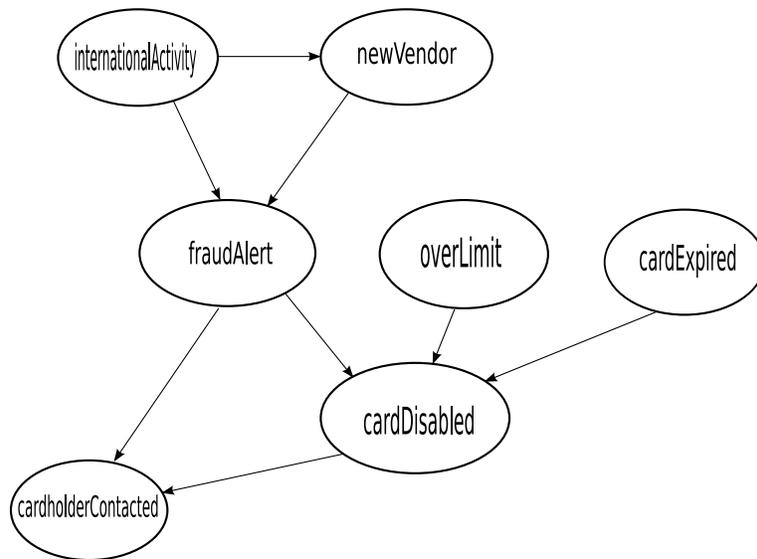


Figure 1: Belief Network for Credit Card Fraud

- Spend some time doing conditional independence quizzes in this applet (the right-most button in ‘Solve’ mode). This is a great way of getting familiar with conditional independence. You can use the credit card fraud network or any other network for the independence quiz. Spend some additional time playing around with this problem in AISpace, making observations and querying variables. The goal for now is to understand basic belief net structure and to have a good grasp of conditional independence. In the next practice exercise we’ll go over the algorithm for making these inferences (variable elimination) in detail.

### 3 Learning Goals

You can:

- Define and use marginal independence
- Define and use conditional independence
- Build a belief network for a simple domain