Homework #3  
Advanced Artificial Intelligence  
Winter 2008  

Due Friday February 8, 2008 at 15:00 EST.


(0) Read Chapters 15, 16

(1) 30 points.

You are working in the VIS-O-MATIC television factory. You need to produce two types of TVs: in one country (country A), televisions are required to have a chip that blocks out any kind of polka music. Another country (country B) requires that the chip not be present. So each TV comes down a conveyor belt and either has the anti-polka chip installed, or a dummy chip installed.

For the first few problems, you can assume that you can tell with 100% accuracy what chip is installed. In the control room, there is a switch that controls what type of chip is installed; at the start of the day there's a 70% chance that it's in anti-polka mode, and 30% chance that it's in dummy mode. When the system is turned on, it starts installing chips into TVs on the conveyor belt. (You can assume that the state of the switch for any time t is the same as the kind of chip installed at time t -- that is, they are the same variable.

THIS IS A SIGNIFICANT HINT. IT MAKES THE PROBLEM MUCH SIMPLER.)

However, some devious professor has let their chimpanzee into the control room, and she starts flipping the switches in the control room. The switch can only be flipped between TVs (i.e. we don't install half of a chip). There is a 30% chance between every installation that the switch will be flipped (changing the type of chip installed).

1. Draw a Dynamic Bayes network (DBN) representing the situation. Remember the CPTs!
2. Assuming that this is a stationary process, how many parameters are there in this system?

Now, what if a second set of chips is installed, controlling the language? There are three chips (LanguageA/LanguageB/LanguageC), and set of push-buttons that controls them as well (pushing a button for a particular language will exclusively set the chip to that language -- only one button is active at a time). The probability of the buttons being in LanguageA mode at the beginning of the day is 60%, and LanguageC is 20%. Again, the
probability of the switch being flipped by the chimp is 30% between every TV (evenly divided between the other languages -- when in state "LanguageA" there's a 15% chance of LanguageB and 15% of LanguageC button pushing). The probability of the polka switch being flipped and language buttons being pushed is independent.

3. Now draw a dynamic Bayesian network for both production of both chips.
4. What is the probability that the machine will produce, at the beginning of the day, in order: {LanguageA/Anti-Polka, LanguageB/Anti-Polka, LanguageB/Dummy}

Now assume that you can't tell what kind of chips are inside the TV. However, you can weigh the TVs, and the chips will probabilistically affect the weight. Use the following table for P(Weight|Chip1, Chip2):

| Chip 1   | Chip 2   | P(weight=heavy|Chip1,Chip2) | P(weight=medium|Chip1,Chip2) | P(weight=light|Chip1,Chip2) |
|----------|----------|-----------------------------|-----------------------------|-----------------------------|
| Anti-Polka | LanguageA | 0.7                         | 0.2                         | 0.1                         |
| Anti-Polka | LanguageB | 0.5                         | 0.3                         | 0.2                         |
| Anti-Polka | LanguageC | 0.4                         | 0.3                         | 0.3                         |
| Dummy    | LanguageA | 0.3                         | 0.5                         | 0.2                         |
| Dummy    | LanguageB | 0.1                         | 0.6                         | 0.3                         |
| Dummy    | LanguageC | 0.1                         | 0.4                         | 0.5                         |

5. Draw the dynamic Bayes net (DBN) for this new situation.
6. If the first two TVs were heavy and light respectively, what are the probabilities of the chips inside these TVs?