CSCE 625 - Homework #7
due: Tuesday, Dec 8, 2015 (in class) - type it up and hand in a printout

1. Bayesian Inference

Consider two factors that influence whether a student passes a given test: a) being smart, and b) studying. Suppose 30% of students believe they are intrinsically smart. But since students do not know a priori whether they are smart enough to pass a test, suppose 40% of will study for it anyway. (assume Smart and Study are independent). The causal relationship of these variables on the probability of actually passing the test can be expressed in a conditional probability table (CPT) as follows:

P(pass|Smart,Study)	¬smart	smart
¬study	0.2	0.7
study	0.6	0.95

prior probabilities: P(smart)=0.3, P(study)=0.4

a) Calculate all the entries in the full joint probability table (JPT) [a 4x2 matrix, like Fig 13.3 in the textbook; it is OK to write a small computer program to do this; but you will probably want to write out the equation for calculating joint probabilities first]

b) From the JPT, compute the probability that a student is smart, given that they pass the test but did not study.

c) From the JPT, compute the probability that a student did not study, given that they are smart but did not pass the test.

d) Compute the marginal probability that a student will pass the test given that they are smart.

e) Compute the marginal probability that a student will pass the test given that they study.

2. Bayesian Networks. Consider the network shown in Figure 14.23 in the textbook.

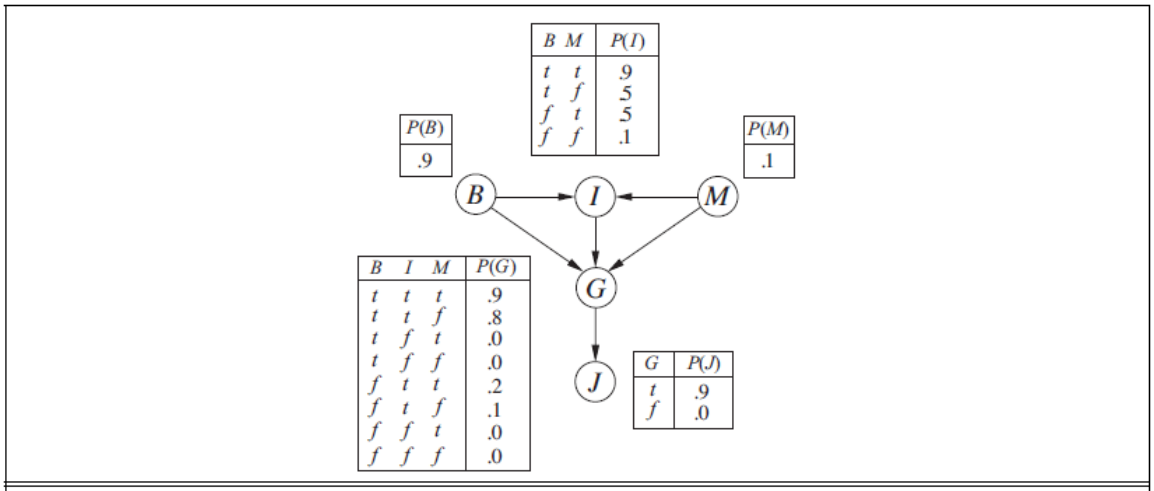


Figure 14.23 FILES: figures/politics.eps (Tue Nov 3 16:23:20 2009). A simple Bayes net with Boolean variables $B = BrokeElectionLaw$, $I = Indicted$, $M = PoliticallyMotivatedProsecutor$, $G = FoundGuilty$, $J = Jailed$.

a) Using equation 14.2 in the textbook (p. 513), write out the expression for the joint probability for any state (combination of truth values for B, I, M, G, and F).

b) Compute the entire joint probability table (JPT, with 32 entries).

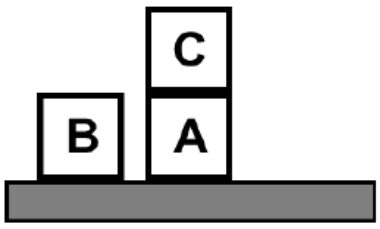
c) Calculate the probability that someone goes to jail given that they broke the law, have been indicted, and face a politically motivated prosecutor, p(J|B,I,M). Do this calculation numerically using entries in the JPT.

3. Using Situation Calculus, write axioms to describe the following actions (treat 'You' as 'for any person p'):

a. Starting a car. You have to be at the car and have the key, and the car has to have a charged battery and non-empty gas tank. Afterwards, the car will be running, and you will still be at the car and have the key after starting the engine. Add a Frame Axiom that says that starting this car will not changes whether any other car is out of gas (tank empty).

b. Buying something from a seller (or vendor 'v'). The product must be available (i.e. owned by) the seller. You have to have enough money beforehand (more than the cost of them item). Afterwards, you own it, but you have less money (i.e. minus the cost of the item), and vice versa for the vendor. Also, add a Frame Axiom to express the fact that buying something doesn't change whether you own other things.

4. Find a plan for achieving **on(A,C)** by goal regression. At each step, indicate what you are doing and why. (note: you don't have to do backtracking, just assume the right choices are made at each choice point)



Start State

```
initial state:
     on(B,table)
     on(A,table)
     on(C,A)
     clear(B)
     clear(C)
     GE // or "gripper_empty"
goal: on(A,C)
```