CSci 5512
Midterm 1

Name: _____

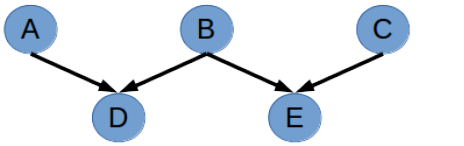
Student ID: _____

Instructions: The time limit is 75 minutes. Please write your answers in the space below. The exam is open book and notes. You may use electronic devices to ONLY look at either an e-book version or electronic notes. You may not use the internet, program/run code or any other outside resources. For all questions you must **show work**.

Problem (1) [10 points]
(1) Suppose you had two 6-sided dice. What is the probability that you roll the same number on both dice ("doubles")?
(2) Suppose your friend offered to play a game where if you roll the same number on both dice ("doubles") the dice roller gets the value shown from the watcher (so if you roll two "ones" you get 1+1=2 dollars). If it is not the same number (not "doubles") the watcher gets one dollar from the dice roller. Would you rather be the dice roller or watcher in this game?
(3) How much do you expect to win per dice roll for playing the game described in the previous part?

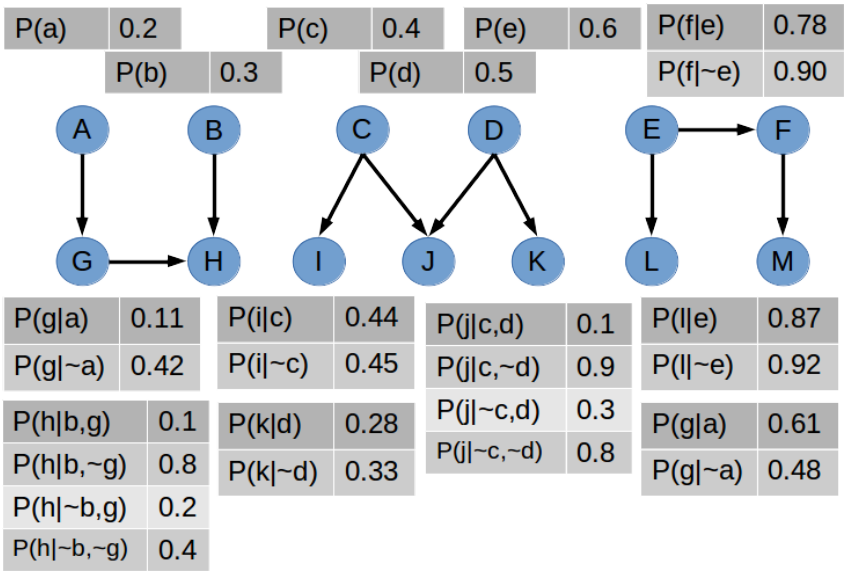
Problem (2) [25 points]
Use Variable Elimination to solve for $P(d, e|a, \neg c)$ in the Bayes net given below.

P(a)	0.2	P(b)	0.4	P(c)	0.6



P(d|a,b)	0.1	P(e|b,c)	0.15
P(d|a,~b)	0.5	P(e|b,~c)	0.38
P(d|~a,b)	0.3	P(e|~b,c)	0.72
P(d|~a,~b)	0.7	P(e|~b,~c)	0.44

Problem (3) [25 points]
You are running Gibbs sampling in the Bayes net below to find the probability: $P(j|\neg c, f, \neg k)$.



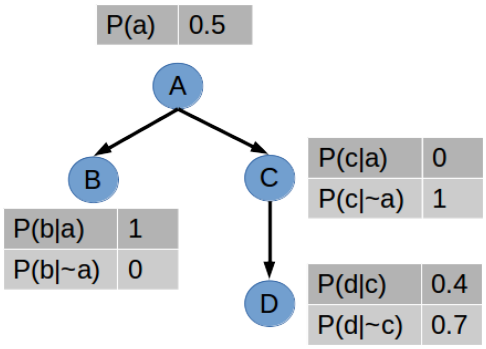
(1) If your current state is: $[a, \neg b, \neg c, \neg d, e, f, \neg g, h, \neg i, \neg j, \neg k, l, \neg m]$... what are all the possible nodes to pick to change?
(2) If you select the middle node (sorted alphabetically) from your answer in the previous question (breaking ties to earlier letters), what is the probability this node is true in the next sample?
(3) If you were looking for the probability of $P(j|\neg c, f, \neg k)$ (same as before), what could you do to greatly improve the accuracy per sample before blindly running the algorithm?

Problem (4) [25 points]
Suppose you have 4 variables ("A", "B", "C" and "D") and you want to make a Bayesian network. The only independencies are:

- "A" is independent (without condition) to "B"
- "C" is conditionally independent to "D" given "A"

Find the most efficient Bayes net to represent this. Also find how many numbers need to be stored across tables to hold the required information for the Bayes net you found.

Problem (5) [15 points]
(1) Suppose you want to find $P(d|b, \neg c)$ in the Bayes net below.
(1.1) Explain what happens if you run likelihood weighting. (Specifically for this problem, not a general description of the algorithm...)
(1.2) What is the easiest way to find this probability?



(2) Explain what happens when you run Gibbs sampling on a problem where all but one variable (the one who's probability you are finding) is given information (i.e. righthand side of the "|" in probability).