NAME________________________

Computer Science and Engineering 151
Introduction to Artificial Intelligence
Homework 2

True/False
1. Please explain your answer briefly (i.e. one sentence).

______ Inference in Bayesian networks can be made efficient by variable elimination.

______ The number of entries in a complete joint probability table is exponential in the number of random variables represented.

______ The number of entries in a Conditional Probability Table (CPT) of a Bayesian network goes up as the square of the number of parents of the node.

______ There are particular formulations of Bayesian networks that support efficient inference – however, the expressibility is restricted.

______ A *query* of a Bayesian network consists of a variable that we want to know the marginal distribution of, and some evidence, which consists of particular settings of some of the variables.

______ A continuous variable may be more efficiently represented by a parameterized functional form than by a CPT of discretized values.

______ A *linear Gaussian* is a Gaussian distribution where the mean of the distribution depends linearly on some other variable.

Bayes' Rule

2. (Adapted from *Probability and Statistics* by Spiegel, Schiller and Srinivasan

Each of three identical jewelry boxes has two drawers. In each drawer of the first box there is a gold watch. In each drawer of the second box there is a silver watch. In one drawer of the third box there is a gold watch while in the other there is a silver watch.

First, construct random variables and the associated conditional probability tables for this problem. Make sure to be clear what your random variables are.

Second, answer the following question (showing your work): If we select a box at random, open one of the drawers and find it to contain a silver watch, what is the probability that the other drawer has the gold watch?

Uncertainty (10 points)

3. Given the table below:

	toothache		¬ toothache	
	catch	¬ catch	catch	¬ catch
cavity	0.108	0.012	0.072	0.008
¬ cavity	0.016	0.064	0.144	0.576

- What is the marginal probability of a cavity?
- What is the probability of not toothache and cavity?
- What is the probability of not cavity, given no toothache?
- What is the probability of not catch, given toothache, but no cavity?

4. (Problem 14.2 from R&N): In your local nuclear power station, there is an alarm that senses when a temperature gauge exceeds a certain threshold. The gauge measures the temperature of the core. Consider the Boolean variables **A** (alarms sounds), **FA** (alarm is faulty), **FG** (the gauge is faulty), and the multivalued nodes **G** (gauge reading) and **T** (actual core temperature).
i) Draw a Bayesian net for this domain, given the unhappy situation that the gauge is more likely to fail when the core temperature is high.

ii) Is your network a polytree?
iii) Suppose there are just two possible and actual measured temperatures, *Normal* and *High*; and that the gauge gives the incorrect temperature $x\%$ of the time when it is working, but $y\%$ of the time when it is faulty. Give the conditional probability table associated with **G**.

Hint: You can treat **G** like a boolean random variable now, so you only have to give the entry for one reading of the gauge.
3. (b) Show the evaluation tree for $P(C|D = T, B = F)$ for the enumeration algorithm