C4 Artificial Intelligence (25 points)

Learning. (15 points) Assume that you are given the set of labeled training examples below, where each of three features has four possible values: a, b, c, or d. You wish to use decision tree learning based on information gain to learn a decision tree from this data.

	F1	F2	F3	Output
ex1	b	d	c	+
ex2	c	d	b	-
ex3	c	a	c	+
ex4	b	a	b	-
ex5	a	b	a	+
ex6	a	b	a	-
ex7	d	c	c	+

(a) [10 pts] Show the information gain formulas for each of the features. Show the formulas down to the level of placing numbers in – you do not need to do the calculation itself.

Which feature would be chosen as the root of the decision tree?

(b) [5 pts] Regardless of your answer to Part a, assume that F1 is chosen as the root node. Show the recursive calls to the decision tree learning algorithm, if any, that would result from this choice. Be sure to show all the arguments in these recursive calls (but do NOT perform the calculations needed in them).

Bayes Nets. (10 points). Consider the following Bayes net:
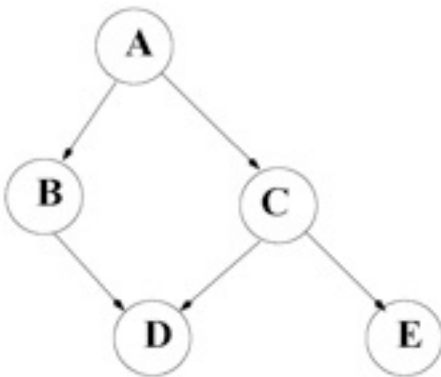
(a) [3 pts] Using the properties of the Bayes Net, what is the formula for the probability of the particular atomic event P(a, b, c, d, e)? Show detail down such that numbers could be plugged in from the conditional probability tables and a calculator could be used to get the answer.

(b) [7 pts] Write down the formula for calculating P(C | b, e). As above, show down to the level of detail that numbers from the conditional probability tables could be plugged in.