CSE 460 Final Exam

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I. Question (20 points)

Given the grammar G, solve the following questions.

Probability	Rule
0.6	NP → Det AdjString Noun
0.4	NP → Det NounNounCompound
0.5	AdjString → Adj AdjString
0.5	AdjString → ϵ
1.0	NounNounCompound → Noun Noun
0.8	Det → the
0.2	Det → a
0.5	Adj → small
0.5	Adj → green
0.6	Noun → village
0.4	Noun → green

where ϵ represents the empty string.

- (4 points) What is the longest NP that can be generated by this grammar?
- Which of the following have a nonzero probability of being generated as complete NP? What are their probabilities?
  - (4 points) a small green village
  - (4 points) a green green green
  - (4 points) a small village green
- (4 points) What is the probability of generating "the green green"

II. Question (16 points)

Assume you are given the following three features of used cars, with the possible values Age $\in$ {Old, New}, Size $\in$ {Tiny, Large}, Repairs $\in$ {Zero, One, Two}. Assume decision tree construction algorithm is used on the following examples. Show the resulting tree.

Age	Size	Repairs	ClassInfo
O	T	2	+
N	T	2	-
O	L	1	-
N	L	1	-
O	L	0	+

III. Question (10 points)

Assume you are trying to find the values for X_1 through X_4 that maximize the following function:

$$f = 5X_1 - 3X_2X_3 + X_3 - 2X_4$$

You decide to use a genetic algorithm and create the initial population:

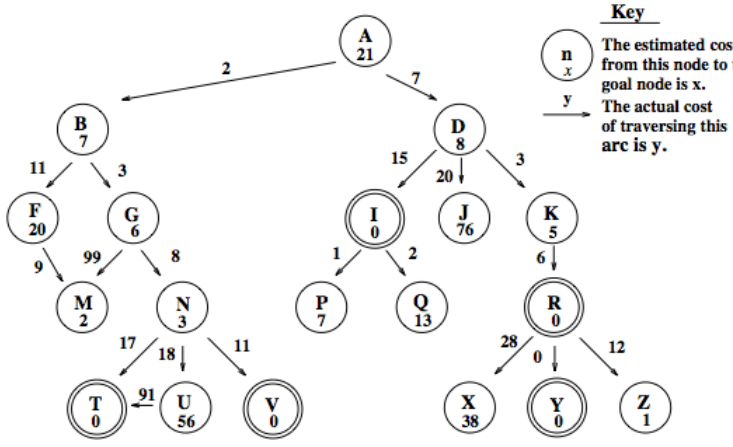
X_1	X_2	X_3	X_4
0	1	1	0
1	1	0	0
1	0	1	1
0	0	0	1

Briefly show and explain how you might create the next generation of the population.

IV. Question (16 points)

Consider the search graph drawn below. The initial state is at the top, and goal states are represented by double circles. For each of the search strategies listed below, indicate which goal state is reached (if any) and list, in order, the states explored. Assume that the NEXT-STATES function returns a states successors in the same left-to-right order as in the search graph.

- (4 points) Depth-First Search
- (4 points) Breadth-First Search
- (4 points) Iterative Deepening
- (4 points) A^* Search



V. Question (12 points)

Let the following propositional symbols have the following meaning: Express each of the following

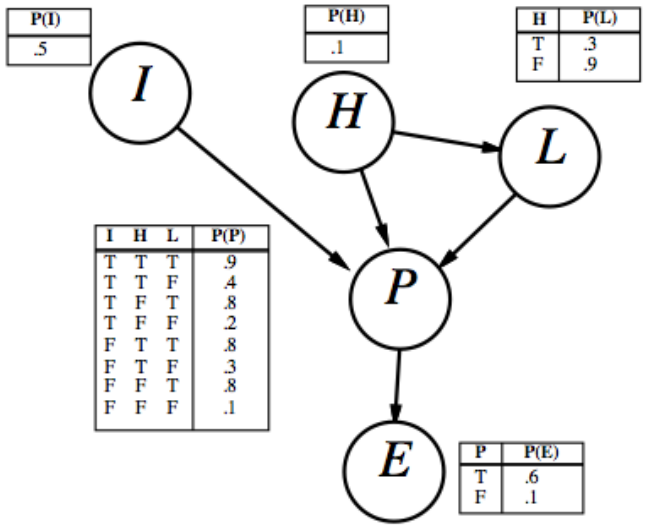
Symbol	Sentence
A	John was in a car accident.
S	John is sick.
I	John is injured.
D	John needs to see a doctor.

English sentences in propositional logic.

- (4 points) John was in a car accident, but he isnt injured.
- (4 points) John needs to see a doctor if he is sick or injured.
- (4 points) If John wasnt in an accident and isnt sick, then he doesnt need a doctor.

VI. Question (14 points)

Consider the simple Bayes net with boolean variables I = Intelligent, H = honest, P = popular, L = LostOfCampaignFunds, E = Elected.



- (6 points) Which, if any of the following are asserted by the network structure?
  - $P(I, L) = P(I)P(L)$
  - $P(E|P, L) = P(E|P, L, H)$
  - $P(P|I, H) \neq P(P|I, H, L)$
- (4 points) Calculate the value of P(i, h, ¬ l, p, ¬e).
- (4 points) Calculate the probability that someone is elected given that they are honest, have few campaign funds, and is intelligent.

VII. Question (12 points)

Consider a perceptron that has two real-valued inputs and an output unit with a sigmoidal activation function. All the initial weights and the bias (threshold) equal 0.5. Assume the teacher has said that the output should be 1 for the input x_1 = 0.7 and x_2 = -0.3.

Show how the perceptron learning rule would alter this neural network upon processing this training example. Let ν (the learning rate) be 0.1, and be sure to adjust the output units bias during training.