CS 188 Final Exam, 8-11am, Sat Dec 16, 1995

Make sure you have both pages of this exam. Good luck.
Questions 1–7 are worth 10 points each. Question 8 is worth 20 pts.

1. Consider the following two sentences.

$$\forall x[\text{boy}(x) \Rightarrow \exists y(\text{girl}(y) \wedge \text{likes}(x, y))]$$

$$\exists y[\text{girl}(y) \wedge \forall x(\text{boy}(x) \Rightarrow \text{likes}(x, y))]$$

   One of these sentences logically implies the other. Which one? Prove your claim using resolution. As always, convert to CNF before starting your resolution proof.

2. In partial order planning (such as using the POP planner we studied in class) a vary important idea is that of protecting **causal links**. In the course of the development of a plan, a newly introduced plan step can threaten a causal link. State two ways in which POP might resolve such a threat. Explain your answer with the help of a blocks world planning example.

3. Suppose that 5 percent of men and 0.25 percent of women are color blind.

   (a) Construct a belief network with 3 nodes (male, female, color-blind) to represent your knowledge of this domain. Make sure to draw arcs appropriately and indicate the conditional probability tables for each node. Assume that there are an equal number of males and females.

   (b) A color blind person is chosen at random. What is the probability of this person being male?

   (c) How does your answer to (b) change if the population consisted of twice as many males as females?

4. One of the main motivations for using belief networks is that they provide a nice decomposition of the joint probability distribution into a set of conditional probability tables. Explain how this results in a reduction in the number of probability values that need to be specified. Illustrate your answer with an example of a belief network with 4 binary valued nodes. Specify the number of probability values that would need to be specified in each of the two cases.

5. In computer vision, a major problem is the recovery of depth information that is lost in the process of perspective projection. State 5 different methods for extracting depth information from images. In each case, explain briefly with a diagram.

6. Discuss three factors that can make speech recognition difficult.

7. Give one example sentence each to illustrate the following:

   (a) A sentence that is syntactically legal but semantically meaningless.

   (b) Lexical ambiguity.

   (c) Syntactic ambiguity.

   (d) Semantic ambiguity that is not a syntactic ambiguity.

   (e) A speech act that is not an **inform** action.

8. Answer true or false, and give a short (one sentence) explanation for your answer. (No credit without the explanation.)

   (a) A$*$ is admissible if the heuristic $h = 0$ for all nodes.

   (b) It is possible to represent the XOR (exclusive-or) function of two inputs using a decision tree.

   (c) Every sentence in first order logic is either valid or unsatisfiable.

   (d) A$*$ may not terminate on graphs with cycles.

   (e) The most general unifier of $p(x, y, q(x, a))$ and $p(b, x, z)$ is $p(b, y, q(b, a))$

   (f) Modus Ponens is a special case of resolution.

   (g) Breadth–first search is a special case of uniform cost search.

   (h) Best–first search is guaranteed to find the minimum cost solution.

   (i) Default reasoning is a special case of non monotonic reasoning.

   (j) Semantic networks are a good way to do probabilistic reasoning.