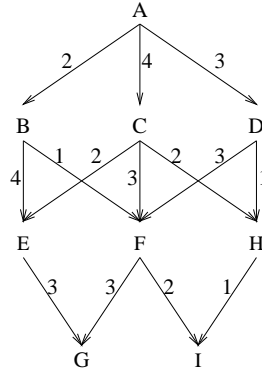


Graduate Comprehensive Exam: Artificial Intelligence (Spring 2002)

Answer all questions on the exam. You may use the back for additional space. Total: 100 points. Good Luck.

1. (15 pts) Given the following state space:



provide the order of states visited, the evaluation value (if any) associated with each visited state, the path found (sequence of states since operators are not specified) and the path cost for:

- (a) Iterative deepening search
- (b) Hill climbing
- (c) A*

The initial state is A and the goal state is G. The (admissible) heuristic value for A is 5, B,C,D is 2, E,F,H is 1, I is 5, and G is 0. If a tie occurs, states are visited in alphabetical order.

2. (25 pts) Logic reasoning

- (a) What does it mean if an inference rule is *sound*?
- (b) What does it mean if an inference rule is *complete*?
- (c) Describe the basic steps of resolution.
- (d) Resolution is based on what kind of proof procedure?
- (e) Describe how Skolemization works (with examples) and why it is needed in resolution?

3. (20 pts) Define the Constraint Satisfaction Problem. Formulate it in the specific context of the 8-queens problem. [An 8-queens problem is to put a queen on each row of an empty chess board, which is an 8x8 matrix, in such a way that no queen attacks any other queen. A queen on a chess board attacks any piece that exists on the same row, or on the same column, or on the same diagonal where the queen is located (and is unobstructed from the queen by another piece).]

4. (15 pts) In the context of Partial Order planning what are the "protected links?" What are the "threats?" Explain briefly how does a threat get resolved?

5. (25 pts) Given these data:

| Example | Color | Shape | Weight | Edible |
|---------|-------|--------|--------|----------|
| 1 | red | sphere | light | positive |
| 2 | blue | cube | light | negative |
| 3 | blue | cube | heavy | positive |
| 4 | red | cone | light | negative |
| 5 | green | sphere | light | positive |
| 6 | green | cone | heavy | negative |

- (a) Apply a learning algorithm to build a decision tree to determine the Edible attribute.
- (b) How does the algorithm select an attribute for each tree node?
- (c) How does the algorithm determine when to stop growing the tree?
- (d) What do you notice if Example 4 is a sphere not a cone? How does the change affect the learning algorithm?