Name: _____

CptS 440/540 – Artificial Intelligence

Sample Exam I

No solution will be provided.

Duration: 75 minutes

Instructions: Clearly write your name at the top of this exam. Complete all problems on this exam. Write all your work on this exam. The exam is closed book, closed notes, and closed neighbor. No electronic devices are allowed, except your own calculator. Failure to turn in your exam at the end of 75 minutes will result in deduction of points. Anyone cheating on the exam will receive a zero.

Problem	Points Possible	Your Score
1	8	
2	6	
3	10	
4	16	
5	8	
6	10	
7	7	
8	10	
Total	75	

1. (8 points) We discussed four approaches to AI in class: acting humanly, thinking humanly, acting rationally, and thinking rationally. For each of the scenarios below, indicate which of these four approaches best describes the approach to AI described in the scenario.

   a. Choose the best action given the available resources.

   b. An approach best evaluated by the Turing Test.

   c. Mimic the human brain inside a computer.

   d. Represent all knowledge using logic and use it to prove theorems.

2. (6 points) We discussed several task environment properties in class. Six of them are shown below. Consider a variant of the Wumpus World game in which the Wumpus takes one of three actions (goforward, turnleft, turnright) every 10 milliseconds, whether the agent takes an action or not, with the goal of moving closer to the agent. For each task property below circle which of the two alternatives best describes this variant of the Wumpus World game.

   a. Fully-observable vs. Partially-observable

   b. Single-agent vs. Multi-agent

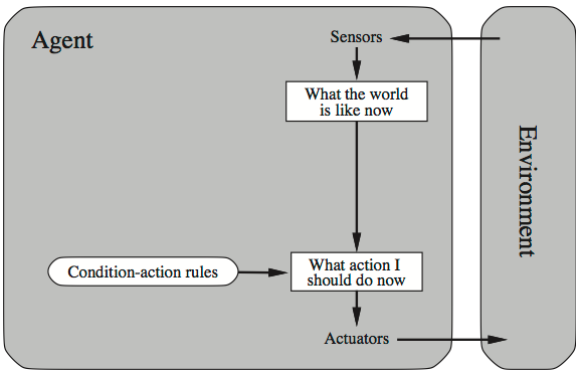
   c. Deterministic vs. Stochastic

   d. Episodic vs. Sequential

   e. Static vs. Dynamic

   f. Discrete vs. Continuous

3. (10 points) We discussed five different types of agents in class: reflex, model-based, goal-based, utility-based, and learning. Below are figures partially depicting each of these types of agents. Next to each figure label it with the agent type that best describes the figure.



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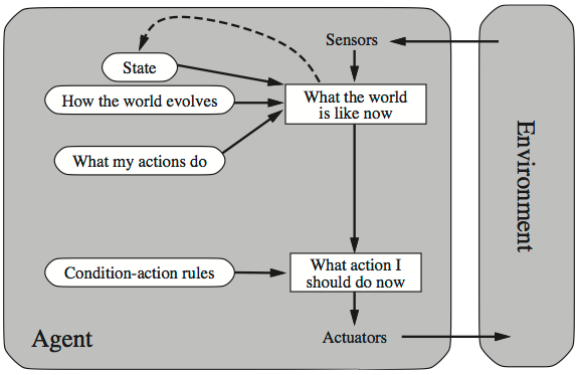

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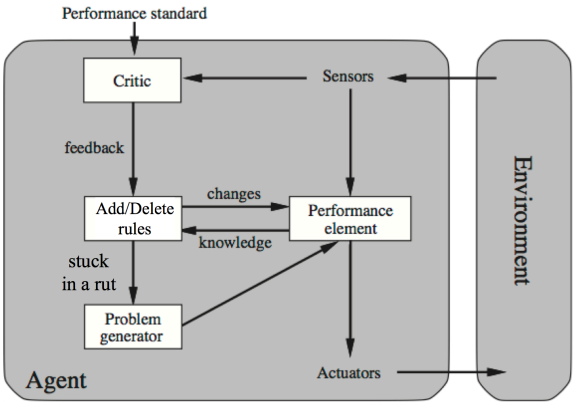

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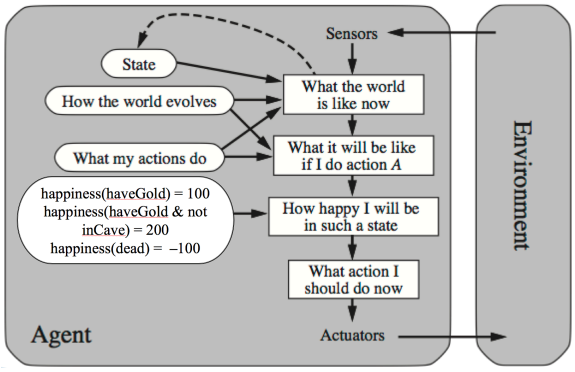

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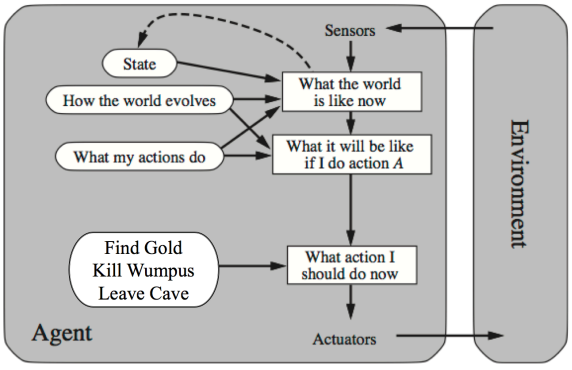

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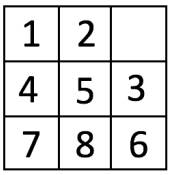
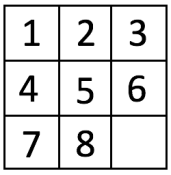
4. (16 points) Consider the following initial and goal states for the 8-puzzle problem. In the search algorithms below, when iterating over possible actions (i.e., moving the blank tile), always consider the actions in the order: Left, Right, Up, Down. Be sure to use the search algorithms as presented in the lecture notes and textbook.



Initial State



Goal State

a. (6 points) Draw the search tree showing all nodes generated by the Breadth-First Search algorithm to solve this problem.

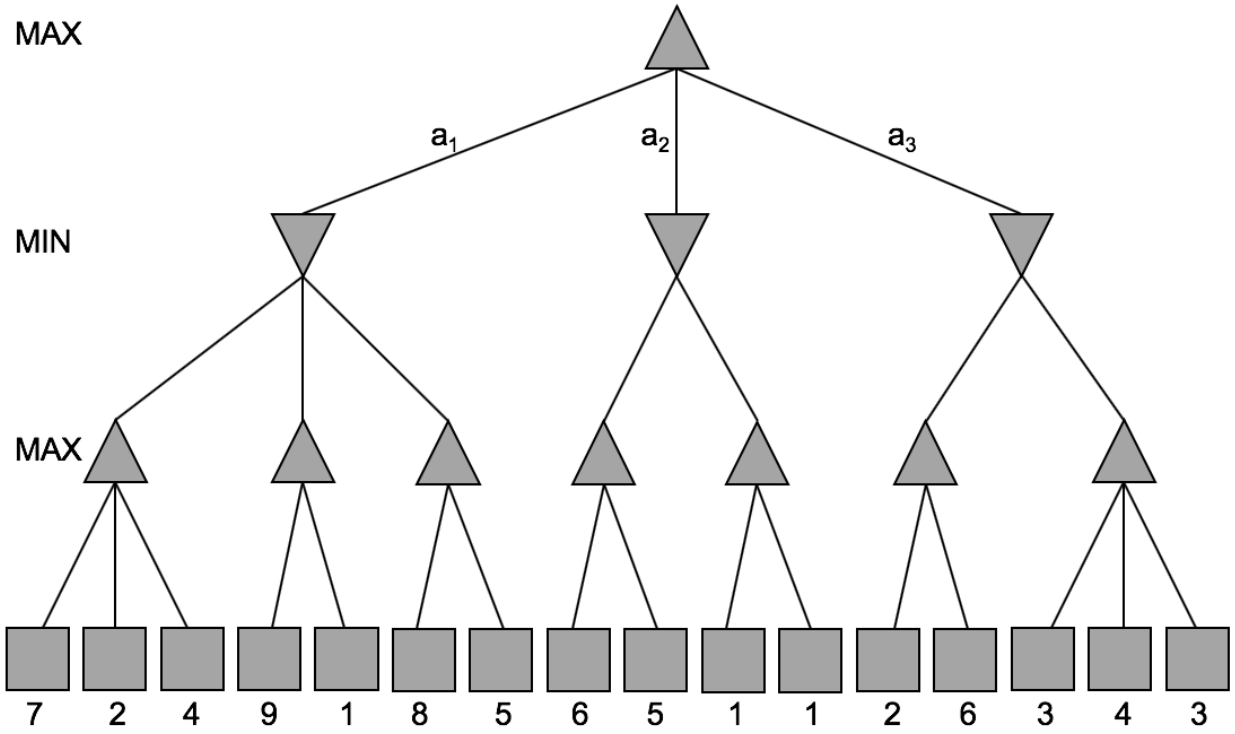
b. (2 points) How many total nodes are generated using Iterative-Deepening Search to solve this problem?

c. (8 points) Draw the search tree generated by the A* search algorithm to solve this problem using the city-block distance for the heuristic *h*. Next to every node, show the values of *f*, *g* and *h*.

5. (8 points) Consider a search problem with branching factor ***b*** and the optimal solution at a depth of ***d***. Fill in the following table for this search problem.

Search Method	**Time Complexity**	**Space Complexity**
Breadth-first search		
Iterative-deepening search		

6. (10 points) Perform Alpha-Beta-Search on the game tree below. Upward-pointing triangles are MAX nodes, downward-pointing triangles are MIN nodes, and squares are terminal nodes.
   - Put an "X" over each node that is pruned, i.e., not evaluated (including all nodes in a pruned subtree).
   - Put the final value next to all other nodes.
   - Indicate which action MAX should take: a_1, a_2 or a_3.



7. (7 points) Translate the following sentences into propositional logic using the atomic sentences: Color(Sky,Blue), Color(Sky,Gray), Shining(Sun), Shining(Moon).

    a. (2 points) If the sun is shining, then the sky is blue.

    b. (2 points) If the moon is not shining, then the sky is blue or gray.

    c. (3 points) Either the sun is shining, or the moon is shining, but not both.

8. (10 points) Using the following propositional knowledge base, show a resolution proof by refutation that "Shining(Sun) $\wedge$ Color(Sky,Blue)" is true.

   i. $\neg$ Shining(Moon) $\Rightarrow$ Shining(Sun)
   ii. Shining(Sun) $\wedge \neg$ Color(Sky,Gray) $\Rightarrow$ Color(Sky,Blue)
   iii. $\neg$ Shining(Moon)
   iv. $\neg$ Color(Sky,Gray)

   a. (5 points) Convert the knowledge base and negated query to CNF. Give each clause a number.

   b. (5 points) Show each resolution step by indicating the two clause numbers being resolved, and the resulting clause (give it a new number).