Homework #1: Chapters 1, 2, 3

The following exercises are due at the beginning of class on February 1. Please type your answers or neatly write them on your own paper. Each exercise will be graded for correctness, so start early and be sure you are confident in your answers. Also, remember that all work should be your own.

1. *[15 points]* Develop a PEAS description for the following task environments:
    a) A credit card fraud detection agent that monitors an individual's transactions and reports suspicious activity.
    b) A computer program that given an image of a fingerprint can find the best match in a database of criminal fingerprints
    c) An autonomous exploration robot that seeks out signs of life on Mars.

2. *[15 points]* For each of the agents described above, categorize it with respect to the six dimensions of task environments as described on pages 40-43. Give a short justification for each property.

3. *[10 points]* In what way is the table-driven agent better than the simple reflex-agent? How is the simple reflex-agent better than the table-driven agent?

4. *[25 points]* Sudoku is a popular logic puzzle. Consider a 4x4 puzzle like the one given below. The object is to place the numbers 1-4 in the blank squares such that every row contains exactly one of each of the digits, and likewise for every column and each of the 2x2 quadrants. Give the initial state, goal test, successor function, and cost function for this problem. Choose a formulation that is precise enough to be implemented. In particular, specify the successor function by describing each action using mathematics and/or pseudo-code to precisely describe what kinds of states each action can be used in and how the state is changed when it is applied. Assume that actions which would immediately violate a constraint of the puzzle are not allowed (e.g., placing a 4 in a quadrant that already has a 4). You do not need to provide a solution (i.e., successful sequence of actions) for the sample puzzle.

    Initial State

4		1	
1			4
2		3	
3		4	

5. *[10 points]* Consider a search problem in which every state has exactly 10 successor states, none of which can be reached from any other state. Assume the maximum depth of a search is 9, and the shallowest solution is at depth 7. Note, the depth of the root is considered to be 1.
    a) If we use breadth-first search, what is maximum number nodes that could be generated, and what is the maximum number of nodes that would need to be stored in memory at any given time?
    b) Answer part (a) for depth-first search.

6. *[25 points]* Consider the 8-puzzle with the initial and goal states shown below. Use breadth-first search to solve this problem. In order to reduce unnecessary search, you can ignore moves that return you to the state you just came from. Show your search tree, and label each node with the order in which it is expanded. To save yourself some unnecessary work, you may stop as soon as you have generated the goal state (i.e., you don't need to expand it). Hint: Your tree should have 6 levels (including the root node), some of which may have almost 15 nodes, so be sure to leave room to fit it on one sheet of paper.

Initial State   Goal State

2	8	3
1	6	4
7		5

1	2	3
8		4
7	6	5