Homework #1: Chapters 1, 2, 3

The following exercises are due at the beginning of class on February 2. Each exercise will be graded for correctness, so please start early and be sure you are confident in your answers. Also, remember that all work should be your own. Note this homework is continued on the reverse side.

1. *[15 points]* Develop a PEAS description for the following task environments:
   a) An agent that can play the game FreeCell. FreeCell (found on MS Windows machines) is a single-person card game in which you deal all cards facing up at the start. The object is to move all the cards to four home cells, using four free cells as placeholders.
   b) A fruit and vegetable scanner at a grocery store.
   c) A robot that can help rescue workers locate the injured in a collapsed building.

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]* One of the problems with the table-driven agent is that the tables can get enormous. One way to reduce the table's size is to only do lookup based on the current percept, as opposed to the entire percept history. Under what conditions would this result in a rational agent? When is it better to use the entire percept history?

4. *[20 points]* Consider the following situation. Three cannibals and three missionaries must cross a river. Their boat can only hold two people at a time, but each missionary and each cannibal can row the boat. Find a way to get everyone to the other side, without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place. 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 formally (i.e., precisely describe what kinds of states each action can be used in and how the state is changed when an action is applied).

5. *[25 points]* Sudoku is a popular logic puzzle. Consider the 4x4 puzzle 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. Assume that the only legal action is entering a number into the next *available* square (proceeding from left to right in each row, and moving from top to bottom). This number must not already appear in the same row, column or quadrant (which would violate the puzzle's constraints). Use breadth-first search to solve this problem. Show your search tree, and label each node with the order in which it is expanded. Hint: Your tree should have 8 levels (not including the root node), so be sure to leave room to fit it on one sheet of paper.

Initial State

4		1	
1			4
2		3	
3		4	

6. *[15 points]* Suppose that LEGAL-ACTIONS(*s*) denotes the set of actions that are legal in state *s*, and RESULT(*a*, *s*) denotes the state that results from performing a legal action *a* in state *s*. Define SUCCESSOR-FN in terms of LEGAL-ACTIONS and RESULT, and *vice versa.* Your answer can be specified either mathematically or in pseudo-code.