Homework #1: Chapters 1, 2, 3

The following exercises are due at the beginning of class on February 11. 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) A software agent that can play a computerized version of the following traditional game of solitaire (also known as Klondike): Out of a standard 52 playing card deck, seven *tableau* piles of cards are created, ranging from one to seven cards, with the top card upturned and the other cards hidden. There are four *foundation* piles that must be built up by suit from Ace to King. The tableau piles can be built in descending order by alternate colors (e.g, a black 7 can go on a red 8). Partial or complete piles can be moved to another tableau as long as they continue to build the pile down by alternate colors. If all visible cards in a pile are moved, the next card can be turned over. Empty tableau piles can be filled by a pile with a King. In addition to moving cards and piles, the agent can turn three cards from the deck, and play the third card (by moving it to a valid foundation or tableau pile). The agent wins if it moves all cards into the foundation piles.

    b) An autonomous exploration robot that seeks out signs of life on Mars.

    c) A credit card fraud detection agent that examines an individual's transaction history and reports suspicious activity. The agent receives information about the individual and a complete set of transaction information from the time that the person opened a card to date. It must then decide if the transactions show a pattern of fraud.

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 41-45. Be sure that your choices accurately reflect the way you have specified your environment, especially the sensors and actuators. 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. *[20 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.

5. *[20 points]* Consider the problem of coloring a two-dimensional map using only four colors, such that no two adjacent areas have the same color. Give the initial state, goal test, actions, transition model, and path cost function for this problem, making only those distinctions necessary to ensure a valid solution. Choose a formulation that is precise enough to be implemented. You may use precise English, mathematics or pseudo-code to specify the functions ACTION(s) and RESULT(s,a), as long as this specification is clear and unambiguous. You do not need to provide a solution (i.e., successful sequence of actions) for the problem.

6. *[20 points]* Consider the 8-puzzle with the initial and goal states shown below. Use breadth-first graph search to solve this problem. Recall, that in a graph search, any state that has already been expanded will not be added to the frontier. Show your search tree, explicitly showing the puzzle grid at each node, and labeling 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 any other nodes after you have found the goal state).

Initial State

2		3
1	8	4
7	6	5

Goal State

1	2	3
8		4
7	6	5