

Homework #1: Chapters 1, 2, 3

The following exercises are due at the beginning of class on February 8. 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. Note performance measures must be specific enough that it is clear how to measure them, and sensors and actuators should be mechanisms.
 - a) A computerized psychotherapist that communicates with patients via instant messaging in an attempt to help the patient better understand his/her moods, feelings, behavior, and help the patient better respond to life's challenges.
 - b) A robot that can help rescue workers locate the injured in a collapsed building.
 - c) A grocery store scanner that digitally scans a fruit or vegetable and identifies it.
2. *[15 points]* For each of the agents described above, categorize it with respect to the six dimensions of task environments as described in Sect. 2.3.2 (you can omit known vs. unknown since it does not directly refer to the environment itself). 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]* 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. *[25 points]* Sudoku is a popular logic puzzle. Consider a simplified 4x4 puzzle (the usual puzzle is 9x9) 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 four 2x2 blocks. 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 block (which would violate the puzzle's constraints). Use breadth-first search to solve this problem. Show your search tree with each node showing the current grid and labeled with the order in which it was expanded. Hint: Your tree will be deep (8 levels not including the root node) but not very wide, so please consider this when deciding how to fit your answer on one sheet of paper.

Initial State

4			
	1		2
	4	3	
		2	4

5. *[10 points]* Suppose you are using a search algorithm to solve the 15-puzzle problem (i.e., the 4x4 version of the sliding-block puzzle described on p. 71). What are the benefits and drawbacks of using a depth first search? What are the benefits and drawbacks of using a breadth first search?
6. *[25 points]* The missionaries and cannibals problem is usually stated as follows. Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. 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. Assume there is no way to send the boat across without at least one person in it. Design a suitable representation for states and then give the initial state, goal test, set of actions, transition model, and cost function for this problem. Choose a formulation that is precise enough that it would be possible use a search algorithm to find a logical solution to the problem. 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 it is applied). Note, **you only have to define the problem formally**, you do not have to find the solution yourself.