Artificial Intelligence DD2380, HT 2007
Homework 1

Due: 15:00 2006-09-17
Where: Box marked DD2380 at CSC students office Oscars Backe 2 or at lecture.

Instructions

Scope

This homework cover chapters 1-4.

Grading

In the spirit of the new goal oriented grading system this homework starts with some questions (part A) to check that you pass the threshold for receiving a passing grade. These questions can be answered with a single word or a few words at most. You need to get 66% of the answers correct on this part. **If you do not pass this threshold the rest of the homework will not be graded**. If you pass this threshold and pass pass the homework, the higher grades D-A are determined by your answers on the rest of the homework (parts B-D). You are to solve the homework individually and we expect you to follow the code of honour (http://www.csc.kth.se/utbildning/hederskodex/).

The max number of points on parts B-D is 85p. The grades (assuming you have passed part A) is given by

A	$\geq$75
B	$\geq$60
C	$\geq$40
D	$\geq$20

Part A

1. What is name of the test call that was devised to test for intelligence of a machine/system?
2. What does P in PEAS stand for?
3. What makes the agent design more difficult, when the task environment is sequential or episodic?
4. What makes the agent design more difficult, when the task environment is discrete or continuous?
5. What do you have to add to a simple reflex agent when the environment changes from fully observable to only partially observable?
6. What is the name of the function that can be introduced to help the agent decide which of two (or more) conflicting goals to choose?
7. In a learning agent there are components to judge how the agent is doing, to learn from this experience and to select actions based on what it know. This is not all though. With only these components the agent would only try what it already knows. What is missing (what is name of the element or what does it have to do if you do not know the name)?
8. When choosing a path cost in the search which of the components in the PEAS analysis is most relevant (P, E, A or S)?
9. Does the state of the system change in the vacuum cleaning world with 2 rooms if the robot is in a clean room and perform the Suck operation for one iteration?
10. Depending on the problem you want to solve different strategies should be considered. If you formulate the 8-queens problem as starting from an empty state (no queen on the board) and the incrementally place one queen after the other you call in an *incremental formulation*. If you instead start with all queen on the board in some configuration and instead move them around, what is this formulation called? In the 8-queen problem this other formulation cuts down the state space from $3 \cdot 10^{14}$ to 2057.
11. What is name of the touring problem where each city (could be something else of course) must be visited exactly once
12. What is the collection of nodes that have not yet been expanded in a search tree called?
13. What is a node with no successor nodes in a search tree called?
14. What do you call the search strategy in which all successor nodes on a given depth are expended before entering the next level?
15. The maximum number of successors to any node has a special name, what?

Part B

1. Propose your own agent example (not from the book) and make a PEAS description of it with a suitable level of detail. (10p)
2. Describe with your own words and give examples that illustrate the following properties of a task environment. Do this in general and not specifically for the example you gave above. You can use it to exemplify though if you want.
   (a) Observability? (5p)
   (b) Deterministic/Stochastic? (5p)
3. Discuss the implications of the above properties on the agent design. That is, once again in general and not for your particular example from above. (5p)

Part C

1. You are designing a search algorithm for an embedded application. Assume you have 100kbytes of memory and every node in the search tree requires 50 bytes. Also assume a branching factor of 4. Give an approximation of the maximum depth that the search tree can have if you use
   (a) standard breadth-first (5p)
   (b) standard depth-first search (5p)
2. Explain the difference between a node in the search tree and a state. (5p)
3. Unbounded search trees
   (a) Give an example of a problem with an unbounded search tree and (5p)
   (b) suggest how to deal with an unbounded search tree? (5p)

Part D

Your robot vacuum cleaner is about to run out of battery power and need a good path to get to the charging station. The robot has a map of the room and is therefore able to find a path there. It uses a fairly coarse representation of the room as shown in Figure 1. The charger is in $s21$ and the robot itself is in $s1$ to start with. Each step to a neighboring cell consumes one unit of the battery. The search routine in the robot always expands the node with the lowest index first if nodes are otherwise equal. It will also not loop back and forth between nodes like $s1$ - $s6$ - $s1$. The robot can only move up, down and to the sides in the map. It will stop the search when it find the goal (the first time).

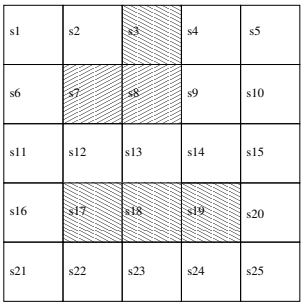

Figure 1: Shaded squares are known to be occupied.

1. A* search
   (a) Suggest an heuristic for A* search (5p)
   (b) What makes a heuristic good? (5p)
2. Draw the search tree for
   (a) breadth first search (5p)
   (b) depth first search (5p)
   (c) A* search (with the heuristic from above) (5p)
3. How many nodes are expanded for the different methods? If they are different, why? (5p)
4. Looking at the search results from the previous question, what is the minimum amount of battery power the robot must have left at least to reach the charger assuming that the time it takes to calculate the path and dock the charger can be neglected? Motivate why no less would be possible (do this without counting steps yourself)! (5p)