CS470/570

**Artificial Intelligence**

# Midterm #1

Closed notes/closed book

1. **(15 points)** Consider the following map:

Start

Waypoint A

Waypoint B

Goal

Assume that the straight line distance (not the shortest path) from Start to Goal is X and that the straight line path from Start to Waypoint A and from Waypoint B to the Goal are both approximately X/3. Finally, as shown, the shortest path from Waypoint A to Waypoint B is already known.

Assume you are using A\* search, with steps in each of the 4 cardinal directions (North, South, East, and West). Approximately how many fewer state evaluations are necessary if the waypoints are used than if they are not used? Show or explain your reasoning.

1. **(16 points)** For each of the following problems determine whether they are:
   1. Fully or partially observable
   2. Deterministic or stochastic
   3. Discrete or continuous
   4. Static or dynamic

I.e. for each problem you should have four answers. You may explain your answers:

1. Checkers
2. Poker
3. Pool/Billiards
4. Robot to solve 8-puzzles. In 8-puzzles you slide plastic pieces around in attempt to get them into a particular shape or order like:

|  |  |  |
| --- | --- | --- |
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 |  |

1. **(24 points)** Fill in the following table, the first one is done for you.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Search Algorithm** | **Complete** | **Optimal** | **Local** | **Informed** |
| Breadth first search | Yes | In number of actions | No | No |
| Depth first search |  |  |  |  |
| A\* |  |  |  |  |
| Simulated Annealing |  |  |  |  |
| Bidirectional |  |  |  |  |
| Iterative Deepening |  |  |  |  |
| Beam |  |  |  |  |

1. In Choose Your Own Adventure books (and old text based adventure games) the reader is given choices and then directed to a particular page based on their choice. For example, a page might read:

**“**You find yourself in a dusty hallway. Cobwebs hang from the ceiling. There is a door at the end of the hallway and another door on your right.

If you open the door at the end of the hallway turn to page 78.

If you open the door on your right turn to page 93.”

This sort of book (or game) can be represented as a map of locations. The last page of the exam has one such map (which you can tear off), with actions that move between states. In this case there is also a cost associated with taking each action; these costs are marked on the map in parentheses. Answer the following for that map.

The tree below shows the beginning of a search. First the Hallway state was expanded, then the Basement state, leading to the given tree. For each of the following search types which state will be expanded next?

If, for a given search type, it is not possible to determine exactly which state is expanded next, then list the set of possible states and explain why they are possible next states. If the search uses a heuristic, assume that the search uses Heuristic #1 (also on the last page).

Hallway

Library

Basement

Stairs

Study

Kitchen

1. **Depth first search (3 pts)**
2. **Breadth first search (3 pts)**

**(Problem 4 cont.)**

1. **Least cost search (3 pts)**
2. **Greedy/best first search (3 pts)**
3. **Draw the Complete A\* search tree (10 pts)**

**(Problem 4 cont.)**

1. **Of the two heuristics given under the map on the last page which one would you actually use? Why? (5 pts)**
2. **(10 points)** For each of the following problems determine whether it would be best treated as a/an:
3. uniformed search problem
4. informed search problem
5. local search problem

Explain why.

Deciding how to build a simple, toy house from blocks. There are relatively few blocks, <50. The order of the block placement matters, e.g. the roof can't go on before the walls. The agent can compare its work to an image of a finished toy house.

Designing a real house, including such details as plumbing, wiring, etc.. There are many (>1000) parts that could be combined. The order of placement doesn't matter because this is only a design. An 'architect' function will score each design.

1. **(8 points)** Consider an autonomous robot, such as the Mars rover, that has very limited on-board memory, but that can sit still for long periods of time to finish computations. What algorithm should it use for *uninformed search* problems in which repeated states may occur.

Map for problem 4. The Hallway is the start state. The goal state is Freedom. Note that each action from each room has an associated cost (in parentheses).

Secret door (70)

End 1

Open desk (10)

Stairs

Study

Exit Window (30)

Basement

Open door on right (20)

Library

Read book (60)

Kitchen

Open door at end (30)

Attic

Go up (70)

Hallway

Pull rope (10)

Climb (70)

Pull lever (10)

Freedom

Use door (15)

Follow ramp (60)

Climb chimney (40)

Light stove (20)

End 2

The following table gives two different heuristics for the previous map.

|  |  |  |
| --- | --- | --- |
| Room | Heuristic #1 distance to Freedom | Heuristic #2 distance to Freedom |
| Hallway | 100 | 120 |
| Stairs | 80 | 120 |
| Library | 80 | 90 |
| Basement | 50 | 130 |
| Kitchen | 40 | 40 |
| Study | 35 | 35 |
| Attic | 30 | 40 |
| End 1 | 40 | 40 |
| End 2 | 30 | 30 |
| Success | 0 | 0 |