Artificial intelligence assignment 1; practicing basic and informed search algorithms.

Game of Chess

Problem

Consider the game of Chess (https://en.wikipedia.org/wiki/Chess). Approximately, how many different states can a chess game have? You may assume

1. We do not consider pawn promotion
2. We consider each pawn is a distinct piece
3. We consider only states with no captured pieces, i.e. all states will have 32 pieces
4. We do not consider pawn promotion, castling, or any other special cases.

State any other assumptions made and show your work. Your answer does not have to be mathematically correct, but should be in the right magnitude for the assumptions you have made and make sense based on your math.

Answer

Wolf, Goat, and Cabbage Problem

Problem

A farmer has just bought a wolf, a goat, and a cabbage. They must cross the river to get home, but their small rowboat can only carry the farmer and 1 animal or vegetable at a time. However, the farmer cannot leave the goat unsupervised with the cabbage, or the goat will eat the cabbage. Similarly, the farmer cannot leave the goat unsupervised with the wolf, or the wolf will eat the goat. Draw the full search space starting from the initial state below. Indicate with different colors or labels which states would not be further explored because something gets eaten, as well as which states would not be further explored because they are repeats of previous states (to avoid cycles)

Answer

Search Algorithms on a State Space Graph

Problem

Consider the following state space graph with Initial State S and Goal State G

1. Draw out the complete search tree, ignoring cycles by not allowing the same node in the path more than once. The tree has been started below to show formatting.

2. List the Node exploration order for a Breadth First Search. For grading simplicity, when there is a tie, explore the nodes alphabetically.

3. List the Node exploration order for a Depth First Search. For grading simplicity, when there is a tie, explore the nodes alphabetically.

4. The table below shows the estimated distance from each node to the goal. Using these as the heuristic h(n), list the Node exploration order for a Best-First Search. For grading simplicity, when there is a tie, explore the

5. Using the same table as the heuristic h(n), list the A* Node exploration order. For grading simplicity, when there is a tie, explore the nodes alphabetically. nodes alphabetically.

Answer

Search Trees on a Grid

Poblem

Consider the grid below with start state 50 and goal state 49:
Draw the search tree for the following algorithms a-d assuming:

1. Black squares are walls that cannot be passed through.

2. Break ties in the order N-E-S-W.

3. Each step has a uniform cost.

4. The heuristic is the Manhattan distance to the goal. (Don't count black wall tiles, but for heuristic estimate, go through them)

Answer

1. Breadth-First Search (5 layers)

2. Depth-First Search

3. Beam Search with W=2 (5 layers)

4. A*

5. What is the optimal path found by A*