AI HOMEWORK

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3.6 Consider the n-queens problem using the "efficient" incremental formulation given on page 72. Explain why the state space has at least $\sqrt[3]{n!}$ states and estimate the largest n for which exhaustive exploration is feasible. (*Hint*: Derive a lower bound on the branching factor by considering the maximum number of squares that a queen can attack in any column.)

- Hint: Incremental formulation參考8-Queen Puzzle，Slide Pages : 17-19

以數學歸納法n=1，n=2 帶入棋盤計算State Space，並推得n=n之State Space Size

3.15 Which of the following are true and which are false? Explain your answers.

a. Depth-first search always expands at least as many nodes as A* search with an admissible heuristic.

b. $h(n) = 0$ is an admissible heuristic for the 8-puzzle.

c. A* is of no use in robotics because percepts, states, and actions are continuous.

d. Breadth-first search is complete even if zero step costs are allowed.

e. Assume that a rook can move on a chessboard any number of squares in a straight line, vertically or horizontally, but cannot jump over other pieces. Manhattan distance is an admissible heuristic for the problem of moving the rook from square A to square B in the smallest number of moves.

- Hint:

a.b.參考 Slide Page: 99,100，並探討DFS與A* Search演算法之目標

c.與 A* Search演算法特性有關

d.參考 Slide Page: 52-58

e.與棋盤上的rook走法有關，以及Mahattan distance之定義

3.22 Prove each of the following statements, or give a counterexample:

a. Breadth-first search is a special case of uniform-cost search.

b. Depth-first search is a special case of best-first tree search.

c. Uniform-cost search is a special case of A* search.

- Hint:

a. 參考 Slide Page: 57-60，探討當step costs都相同時，BFS與uniform-cost search之關係

b.探討DFS與BFS之關係，與depth有關

c.探討uniform-cost search與A*之關係，與h(n)有關

3.28 The **heuristic path algorithm** (Pohl, 1977) is a best-first search in which the evaluation function is $f(n) = (2 - w)g(n) + wh(n)$. For what values of w is this complete? For what values is it optimal, assuming that h is admissible? What kind of search does this perform for $w = 0$, $w = 1$, and $w = 2$?

- Hint: 參考Slide Page : 113之Evaluation function: f(n) = g(n) + h(n)，以及A*與greedy best-first search之特性

3.29 Consider the unbounded version of the regular 2D grid shown in Figure 3.9. The start state is at the origin, (0,0), and the goal state is at (x, y).

a. What is the branching factor b in this state space?

b. How many distinct states are there at depth k (for $k > 0$)?

c. What is the maximum number of nodes expanded by breadth-first tree search?

d. What is the maximum number of nodes expanded by breadth-first graph search?

e. Is $h = |u - x| + |v - y|$ an admissible heuristic for a state at (u, v)? Explain.

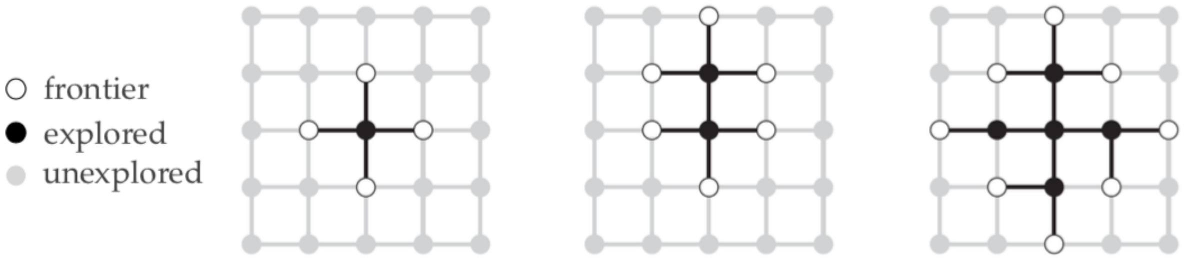
f. How many nodes are expanded by A* graph search using h?

g. Does h remain admissible if some links are removed?

h. Does h remain admissible if some links are added between nonadjacent states?

- Hint: Figure 3.9参考Slide page: 33

- The **frontier** separates the state space into **explored** and **unexplored** regions (**loop invariant proof**).



3.32 Prove that if a heuristic is consistent, it must be admissible. Construct an admissible heuristic that is not consistent.

- Hint : 參考Slide Page: 123-130

Thanks for Listening