Problem-solving by search exercises

(Source: https://aimacode.github.io/aima-exercises/, accessed in Oct 2023)

Exercise 01

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

1. Depth-first search always expands at least as many nodes as A search with an admissible heuristic.
2. h(n)=0 is an admissible heuristic for the 8-puzzle.
3. A is of no use in robotics because percepts, states, and actions are continuous.
4. Breadth-first search is complete even if zero step costs are allowed.
5. 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.

Exercise 02

Consider a state space where the start state is number 1 and each state k has two successors: numbers 2k and 2k+1.

1. Draw the portion of the state space for states 1 to 15.
2. Suppose the goal state is 11. List the order in which nodes will be visited for breadth-first search, depth-limited search with limit 3, and iterative deepening search.
3. How well would bidirectional search work on this problem? What is the branching factor in each direction of the bidirectional search?
4. Does the answer to 3 suggest a reformulation of the problem that would allow you to solve the problem of getting from state 1 to a given goal state with almost no search?
5. Call the action going from k to 2k Left, and the action going to 2k+1 Right. Can you find an algorithm that outputs the solution to this problem without any search at all?

Exercise 03

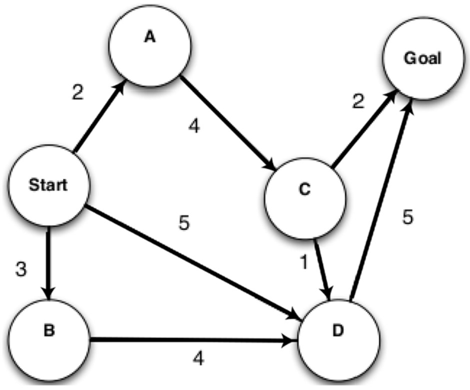
For each of the following assertions, say whether it is true or false and support your answer with examples or counterexamples where appropriate:

1. A hill-climbing algorithm that never visits states with lower value (or higher cost) is guaranteed to find the optimal solution if given enough time to find a solution.
2. For any local-search problem, hill-climbing will return a global optimum if the algorithm is run starting at any state that is a neighbor of a neighbor of a globally optimal state.

Exercise 04

(Source: https://inst.eecs.berkeley.edu/~cs188/, accessed in Nov 2022)

Para cada uma das seguintes estratégias de pesquisa, apresente a árvore de expansão dos estados e determine a ordem pela qual os estados são expandidos até ao objetivo. Assuma que os laços se resolvem de tal forma que os estados com ordem alfabética anterior sejam expandidos primeiro.



1. Pesquisa em profundidade (Depth-first search).
2. Pesquisa em largura (Breadth-first).
3. Pesquisa de custo uniforme.

Exercise 05

(Source: University of Freiburg – Department of Computer Science, accessed in Nov 2022)

Considere os seguintes exemplos do puzzle de 8 peças.

Estado inicial

1		5
2	6	3
7	4	8

Estado Final

1	2	3
4	5	6
7	8	

1. Formule o problema considerando que a deslocação de uma peça para uma célula livre adjacente tem um custo = 1.
2. Quais das seguintes heurísticas são admissíveis, assumindo que h*(n) = verdadeiro custo mínimo para o objetivo a partir de n?
   a) h(n) = 0
   b) h(n) = Número de peças em posição errada no estado n
   c) h(n) = soma das distâncias de Manhattan entre a posição de cada peça e o objetivo
   d) h(n) = 1
   e) h(n) = mínimo (2, h*[n])
   f) h(n) = h*(n)
   g) h(n) = máximo (2, h*[n])
3. Expanda o estado inicial dois níveis usando a procura A* e a heurística c).