

COMS 4701 Artificial Intelligence

Homework 2 - Conceptual

Due date: Feb 18, 2021

Justify all your work to receive full credit

Question 1: Heuristics

Let h_1 and h_2 be two admissible heuristics. Which of the following heuristics are admissible? Justify your answer.

1. $h(n) = \min\{h_1(n), h_2(n)\}$
2. $h(n) = \max\{h_1(n), h_2(n)\}$
3. $h(n) = w \cdot h_1(n) + (1 - w) \cdot h_2(n)$ with $0 \leq w \leq 1$

Question 2: The N-puzzle

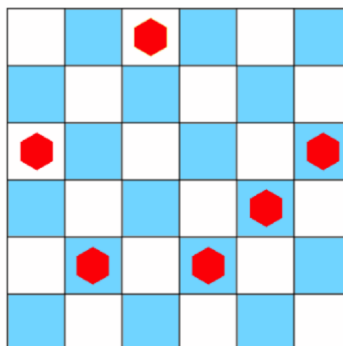
The 8-puzzle is a 3×3 board with 8 tiles (corresponding to $3^2 - 1$), numbered from 1 to 8, and one empty space. The 8-puzzle is a special case of the N-puzzle containing $N = m^2 - 1$ tiles and one empty space. Consider only reachable configurations. Possible reading material (available in courseworks): “Notes on the 15 Puzzle,” American Journal of Mathematics, Vol. 2, No. 4 (Dec., 1879), pp. 397-404. Feel free to research the topic in other sources, but cite your references.

1. Provide an upper bound on the size of the state space in the 8-puzzle game. Justify your answer. Examples of justification include drawing a partial search tree, refer to the paper with explanation or provide a more formal justification.

Question 3: Local Search

The 6-queen problem requires that you place 6 queens on a 6×6 chessboard, so as no queen attacks another one located in the same row, column or diagonal. We define the states to be any configuration of the board where we have one queen per column. The successor function moves a single queen to another square in the same column. For a state S, consider the evaluation function $\text{fitness}(S)$, as the number of non-attacking pairs of queens in state S.

- (a) How many possible states are there in total?
- (b) How many successor states are there for each state?
- (c) What is the fitness function for the following state:



- (d) We would like to use a genetic algorithm, where each state is represented by a sequence of 6 digits. Each digit represents the position of the queen in that column. For instance, the board above would be represented by the sequence **3 5 1 5 4 3**.

What genetic operator should we use to implement the successor function described in this problem? Consider only the operators of cross-over, selection and mutation.

Question 4: Local Search

Provide three advantages and three disadvantages of using local search algorithms. Explain.