

# Lab 5 - Solving Problems by Searching - Part II

AI701: Artificial Intelligence

September 21, 2021

This experiment uses the A\* search algorithm to solve the eight-digit problem.

## General Instructions

All written answers must be in order and clearly written.

You should modify the code in the code cells of the jupyter platform between

*# BEGIN\_YOUR\_CODE*

and

*# END\_YOUR\_CODE*

but you can add other helper functions outside this block if you want.

## Eight - digit problem

**Problem background:** There are eight numbers 1, 2, 3, 4, 5, 6, 7, and 8 placed on a 3×3 checkerboard. Each number occupies a grid and there is a space.

**Moving rules:** These numbers can be moved on the board. The moving rule is: the numbers adjacent to the space can be moved into the space.

**Solution goal:** The problem is: the specified initial game and target game are given in Fig.1. You need to use the search algorithm to make the initial game state transition to the target game state, and give the sequence of movement of the numbers.

2	8	3
1		4
7	6	5

Initial Game

8	1	3
2		4
7	6	5

Target Game

Figure 1: The initial state and target state of the eight-digit problem

## 1 Part A: A\* search algorithm

In Part A, you need to use the A\* search algorithm to solve the eight-digit problem. And you need to conduct more in-depth research on the heuristic search algorithm and the A\* algorithm as required.

1. Consider how to choose a suitable heuristic function for various problems. We have given the choice of heuristic function for the eight-digit problem. Please understand the benefits of this design.
2. The difference between A search algorithm and A\* search algorithm is the range of  $h(x)$ . Please think about the impact of their differences on search efficiency.
3. Complete the code according to your understanding on the jupyter platform, so that it can solve the eight-digit problem.
4. Read the concept of the admissibility of the algorithm, and consider how to prove the admissibility of the A\* search algorithm in conjunction with the hints.
5. Understand the heuristic ability of  $h(x)$  and think about how to prove the conclusion 1.
6. Please answer the reasons for extending the heuristic function to the evaluation function, and understand the role of  $g(x)$  in the evaluation function.
7. Understand the monotonic restriction of the heuristic function  $h(x)$  and prove the conclusion 2.