

# AI - Assignment 1- Part 1

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## 1 Introduction

a) Create an interface so as to create and visualize the 50 eight-neighbor grids you are going to use for the experiment.

b) (i) Manually compute and show a shortest grid path and a shortest any angle path for the example search problem from figure 7.

Shortest grid path =  $(1 + 1.4 + 1.4) = 3.8$  units  
Shortest any angle path =  $(1.4 + 2.23) = 3.63$  units

(ii) Manually compute and show traces of A\* with the h-values from Equation 1.

Using A\* the shortest path is from A4 to B3 to C2 to C1 A4 -  $g(n) = 0$ ,  $h(n) = 3.8$ ,  $A4 = 0 + 3.8 = 3.8$  B3 -  $g(n) = 1.4$ ,  $h(n) = 2.4$ ,  $B3 = 1.4 + 2.4 = 3.8$  C2 -  $g(n) = 1$ ,  $h(n) = 2$ ,  $C2 = 1 + 2 = 3$  C1 -  $g(n) = 3.8$ ,  $h(n) = 0$ ,  $C1 = 0 + 3.8 = 3.8$

The shortest path using A\* =  $3.8 + 3.8 + 3 + 3.8 = 14.4$  units

(iii) Manually compute and show traces of Theta\*. Using Theta\* the shortest path is from A4 to B3 to C1 A4 -  $g(n) = 0$ ,  $h(n) = 1.4$ ,  $A4 = 1.4$  B3 -  $g(n) = 1.4$ ,  $h(n) = 2.24$ ,  $B3 = 3.64$  C1 -  $g(n) = 2.24$ ,  $h(n) = 0$ ,  $C1 = 2.24$

The shortest path using Theta\* =  $1.4 + 3.64 + 2.24 = 7.28$  units

c) Implement the A\* algorithm for a given start and goal location for the grid environments. Describe in your report what you had to implement in order to have the A\* algorithm working.

d) Implement the Theta\* algorithm for a given start and goal location for the grid environments. Describe in your report what you had to implement in order to have the Theta\* algorithm working.

e) Give a proof (=concise but rigorous argument) why A\* with the h-values from equation 1 is guaranteed to find the shortest grid paths.

When using A\* we use the formula  $f(n) = g(n) + h(n)$  to compute the shortest distance where  $g(n)$  is the distance from the initial state to node  $n$  which we can manually compute using addition and  $h(n)$  is the distance from the current node to the final state. The  $h$  values that we have obtained from Equation 1 provide us with the shortest path because it is admissible which means that it never overestimates the distance it will take to reach the goal state. Hence it is also optimally efficient and cost efficient.

f) Implement your own binary heap and use it in both algorithms. Discuss your implementation in your final report. If you do execute this extra credit step, make sure that any run times you report in your answers below how your own implementation of a binary heap has influenced the running times.