Artificial Intelligence

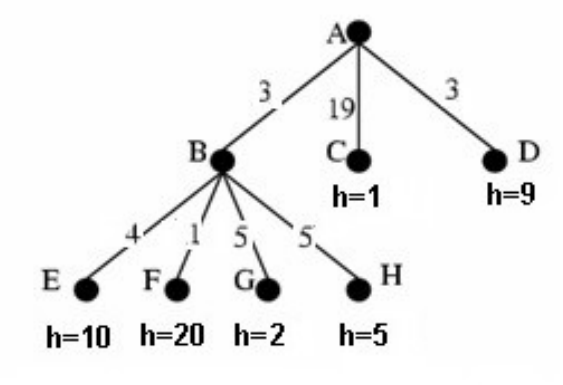
Exercise Sheet 2

Problem Solving using Informed Search

2. Problem Solving using Informed Search

2.1 Strategies for Uninformed/Informed Search

Assuming the following search tree in which each arc displays the cost of the corresponding operator, and the nodes contain the value of the heuristic function, indicate justifying, which node is expanded next using each of the following methods:



a) Breadth-First Search ("Pesquisa em Largura");
b) Depth-First Search ("Pesquisa em Profundidade");
c) Uniform Cost Search ("Pesquisa de Custo Uniforme");
d) Greedy Search ("Pesquisa Gulosa");
e) A* Algorithm Search ("Pesquisa com Algoritmo A*")

2.2 Solving the N-Puzzle Problem

The objective of this exercise is the application of search methods, with emphasis on informed search methods and the A* algorithm, to solve the well-known N-Puzzle problem. The desired objective state for the puzzle is as follows (0 represents the empty space):

```
9Puzzle          16Puzzle
 1 2 3           1  2  3  4
 4 5 6           5  6  7  8
 7 8 0           9 10 11 12
                13 14 15  0
```

Starting from a given initial state, the goal is to determine which operations to perform to solve the puzzle, reaching the desired objective state.

a) Formulate the problem as a search problem indicating the state representation, operators (their names, preconditions, effects, and cost), initial state, and objective test.
b) Implement code to solve this problem using the "breath-first" strategy (in this case identical to "Uniform Cost").
c) Implement code to solve this problem using Greedy Search and using the A* Algorithm. Suppose the following heuristics for these methods: H1 - Number of

incorrected placed pieces; H2 - Sum of manhattan distances from incorrected placed pieces to their correct places.

d) Compare the results obtained concerning execution time and memory space occupied in solving the following problems using the previous methods:

```
Probl1      Probl2      Prob3         Prob4
1 2 3       1 3 6       1 6 2        5  1  3  4
5 0 6       5 2 0       5 7 3        2  0  7  8
4 7 8       4 7 8       0 4 8       10  6 11 12
                                     9 13 14 15
```

2.3 Solving the Two Buckets Problem with Informed Search

a) Implement code to solve this problem using Greedy Search and using the A* Algorithm.

b) Compare the results achieved with the results from exercise 1 (uninformed search).

2.4 Solving the Missionaries and Cannibals Problem with Informed Search

a) Implement code to solve this problem using Greedy Search and using the A* Algorithm.

b) Compare the results achieved with the results from exercise 1 (uninformed search).