TRƯỜNG ĐẠI HỌC BÁCH KHOA TP.HCM
Khoa Khoa học & Kỹ thuật Máy tính

ARTIFICIAL INTELLIGENCE
Tutorial 3 Questions

HEURISTIC SEARCH AND GAME PLAYING

Question 1.

The **heuristic path algorithm** is a best-first search in which the objective function is

$$f(n) = (2 - w).g(n) + w.h(n)$$

For what values of w is this algorithm guaranteed to be optimal? (You may assume that h is admissible) What kind of search does this perform when $w = 0$? When $w = 1$? When $w = 2$?

Question 2. Prove each of the following statements:

a. Breadth-first search is a special case of uniform-cost search.
b. Breadth-first search, depth-first search, and uniform-cost search are special cases of best-first search.
c. Uniform-cost search is a special case of A* search.

Question 3.

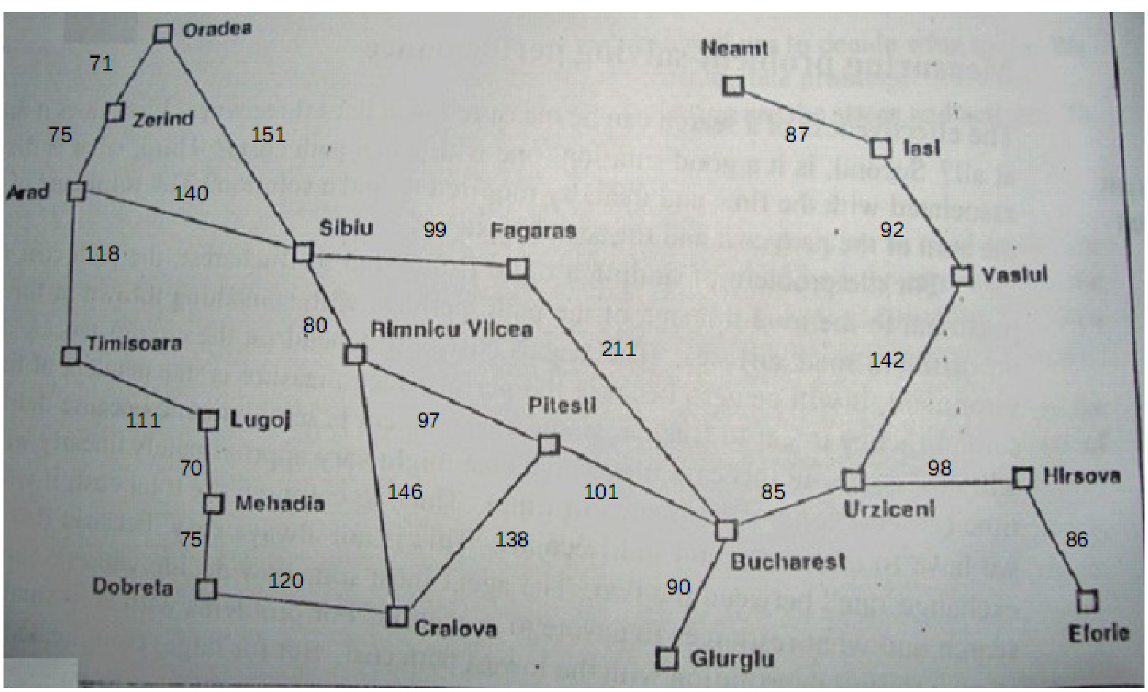

Figure 1 – A road map of Romania

Figure 1 gives a simplified road map of Romania, in which the road distances between cities are indicated. Meanwhile, Table 1 presents the straight-line distance from the cities to Bucharest.

Table 1 – The straight-line distances to Bucharest

Arad	366
Bucharest	0
Craiova	160
Dobreta	242
Eforie	161
Faragas	178
Giurgiu	77
Hirsova	151
Iasi	226
Lugoj	244
Mechadia	241
Neamt	234
Oradea	380
Pitesti	98
Rimnicu Vilcea	193
Sibiu	253
Timisoara	329
Urziceni	80
Vasloi	199
Zerin	374

a. Find a path from Arad to Bucharest using the greedy algorithm, in which the h function is defined as the straight-line distance given in Table 1. Present the total cost and the nodes (cities) to be expanded, in the corresponding order.

b. Find a path from Arad to Bucharest using the uniform-cost search algorithm, in which the g function is defined as the road distance given in Figure 1. Present the total cost and the nodes (cities) to be expanded, in the corresponding order.

c. Find a path from Arad to Bucharest using A* algorithm, whose g and f functions are as presented in Question 1a and 1b. Present the actual total cost and the nodes (cities) to be expanded, in the corresponding order.

d. Find a case that the greedy function will suffer infinitive loop when finding path between cities in Romania?

Question 4.

Given a tree of a game state as presented in Figure 2 (assume that node A is corresponding to the MAX's player). If directly applied in the nodes, the static function will yield the results as given in Table 2.

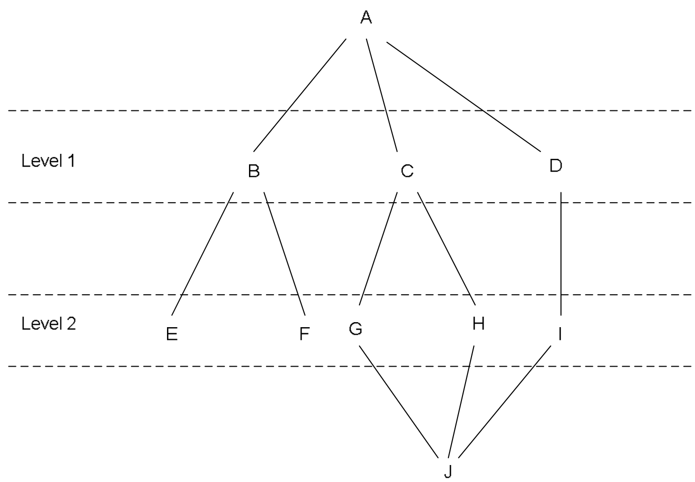

Figure 2 – A game-state tree

Table 2 – The results returned by the static function when directly applied

Node	Score
A	0.95
B	0.25
C	0.1
D	0.05
E	1.0
F	-1.0
G	-0.2
H	-0.7
I	0.75
J	-1.0

State the next move that the game playing program will choose if using a Minimax algorithm. Redraw the subtree with nodes associated with the corresponding evaluated scores. Suppose that the Minimax algorithm will be set to cover:

a. Up to level 1
b. Up to level 2
c. Unlimited depth.

Question 5.

Figure 3 presents a resultant tree when the Minimax algorithm is fully applied on the tree. In the best case of applying alpha-beta prunes (i.e. best nodes will be incidentally visited first), which nodes (and branches) will be cut-off?

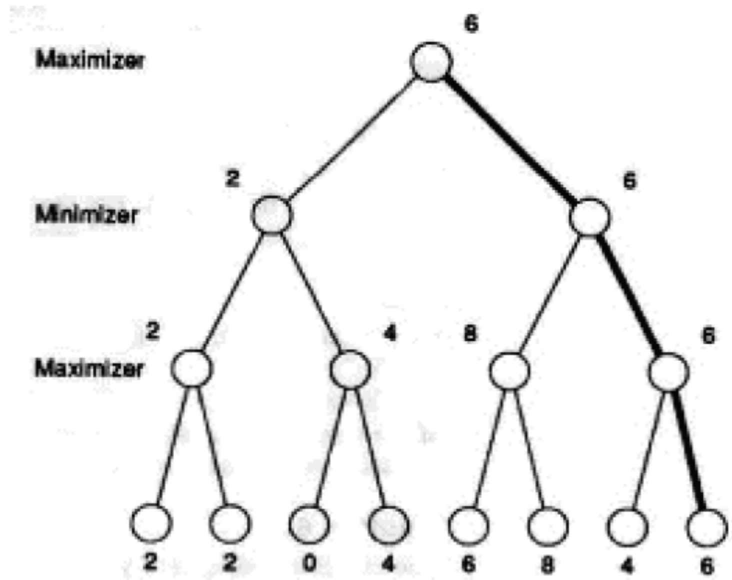

Figure 3 - A game-state tree with Minimax applied

Question 6.

Figure 4 presents a resultant Minimax-applied tree. What are the corresponding resultant trees when the alpha-beta prunes are applied in the following cases:

a. Normal case: nodes will be visited from left to right when in the same levels
b. Best case
c. Worst case

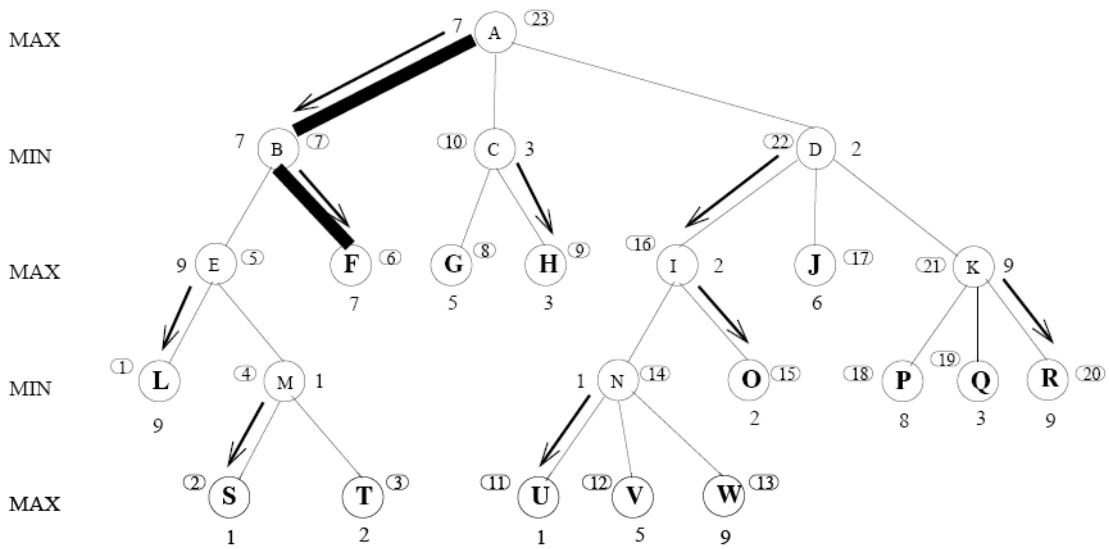

Figure 4 - A resultant Minimax-applied tree

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