UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Workbook:

Best-First Search
Greedy Search (graph search)

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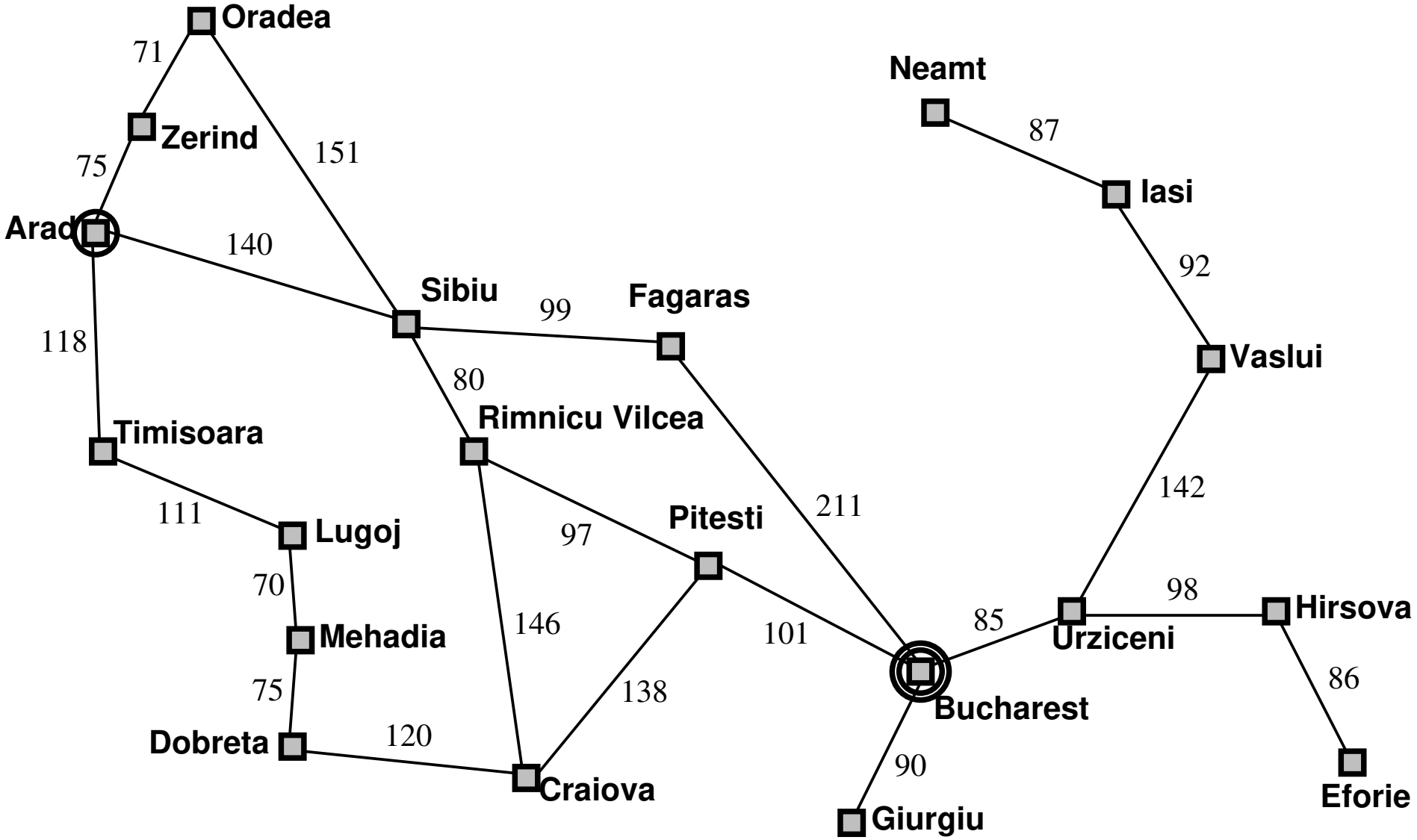
Learning objectives

- To describe greedy search (graph search).
- To draw the tree of greedy search (graph search).
- To apply greedy search (graph search) to a well-known problem.
- To analyze the quality of greedy search (graph search).

Problem: Shortest path between two points

Shortest path from Arad to Bucarest [1]:



Actions(Arad) = {Move(Sibiu), Move(Timisoara), Move(Zerind)}.

Problem: Shortest path between two points

Straight-line distances to Bucharest:

	Bucharest		Bucharest
Arad	366	Mehadia	241
Bucharest	0	Neamt	234
Craiova	160	Oradea	380
Drobeta	242	Pitesti	100
Eforie	161	Rimnicu	193
Fagaras	176	Sibiu	253
Giurgiu	77	Timisoara	329
Hirsova	151	Urziceni	80
Iasi	226	Vaslui	199
Lugoj	244	Zerind	374

1 Best-first algorithm (graph search) [2]

BF(G, s', h**)** // G weighed graph, s', f ***evaluation function***

$O = InitQueue(s', f(s'))$ // ***Open: priority queue*** f

$C = \emptyset$ // ***Closed:*** explored nodes

while not $EmptyQueue(O)$: // ***best-first:*** $s = \arg\min_{n \in O} f_n$

$s = Pop(O)$ // draws in favour of goal state

if $Goal(s)$ **return** s // solution found!

$C = C \cup \{s\}$ // s explored

for all $(s, n) \in Adjacents(G, s)$: // generation: n is child of s

$x = f(n)$ // possibly new f_n

if $n \notin C \cup O$: $Push(O, n, f_n \triangleq x)$

else if $n \in O$ **and** $x < f_n$: $Update(O, n, f_n \triangleq x)$

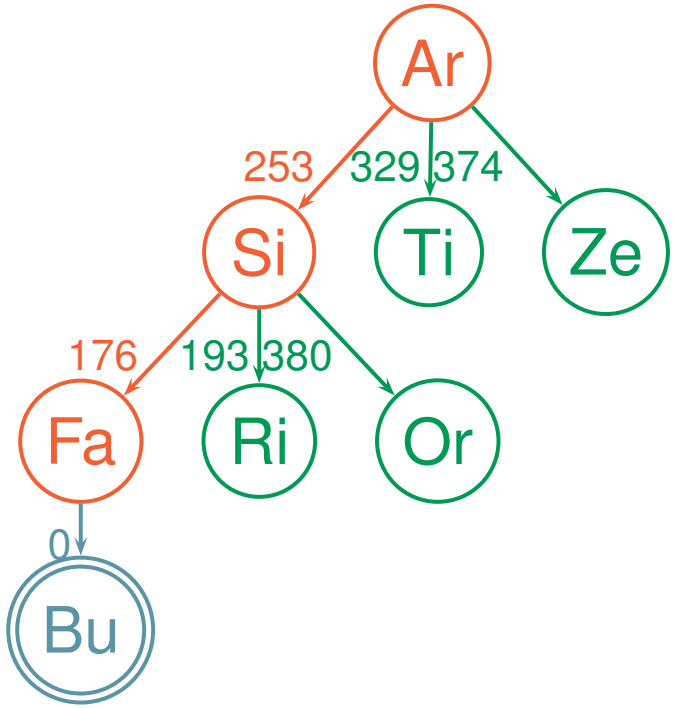
else if $n \in C$ **and** $x < f_n$: $C = C \setminus \{n\}$; $Push(O, n, f_n \triangleq x)$

return NULL // solution not found

- ***Question 1***: Write a trace of the ***BF*** algorithm (graph search) applied to the problem of finding the shortest path from Arad to Bucarest.

O	C	s
{Arad (c=366)}	{}	–
{Sibiu (c=253), Timisoara (c=329), Zerind (c=374)}	{Arad (c=366)}	Arad
{Fagaras (c=176), Rimnicu (c=193), Timisoara (c=329), Zerind (c=374), Oradea (c=380)}	{Arad (c=366), Sibiu (c=253)}	Sibiu
{Bucharest (c=0), Rimnicu (c=193), Timisoara (c=329), Zerind (c=374), Oradea (c=380)}	{Arad (c=366), Sibiu (c=253), Fagaras (c=176)}	Fagaras
{Rimnicu (c=193), Timisoara (c=329), Zerind (c=374), Oradea (c=380)}	{Arad (c=366), Sibiu (c=253), Fagaras (c=176)}	Bucharest

- ***Question 2***: Draw the search tree as a result of applying the ***BF*** algorithm (graph search) to the problem of finding the shortest path from Arad to Bucarest.



- ***Question 3***: Does the BF algorithm (graph search) find a solution? ***Yes***

- ***Question 4***: If the answer is "Yes":
  - What is the solution found? ***The solution path is: Arad, Sibiu, Fagaras, Bucharest***
  - What is the cost of this solution? ***450***
  - Is this the solution of minimum cost? ***No, because there is an alternative solution with lower cost of 418: Arad, Sibiu, Rimnicu, Pitesti, Bucharest***

References

[1] S. Russell and P. Norvig. *Artificial Intelligence: A Modern Approach*. Pearson, third edition, 2010.

[2] J. Pearl. *Heuristics: Intelligent Search Strategies for Computer Problem Solving*. Addison-Wesley, 1984.