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Workbook:

Depth-first search (graph search)

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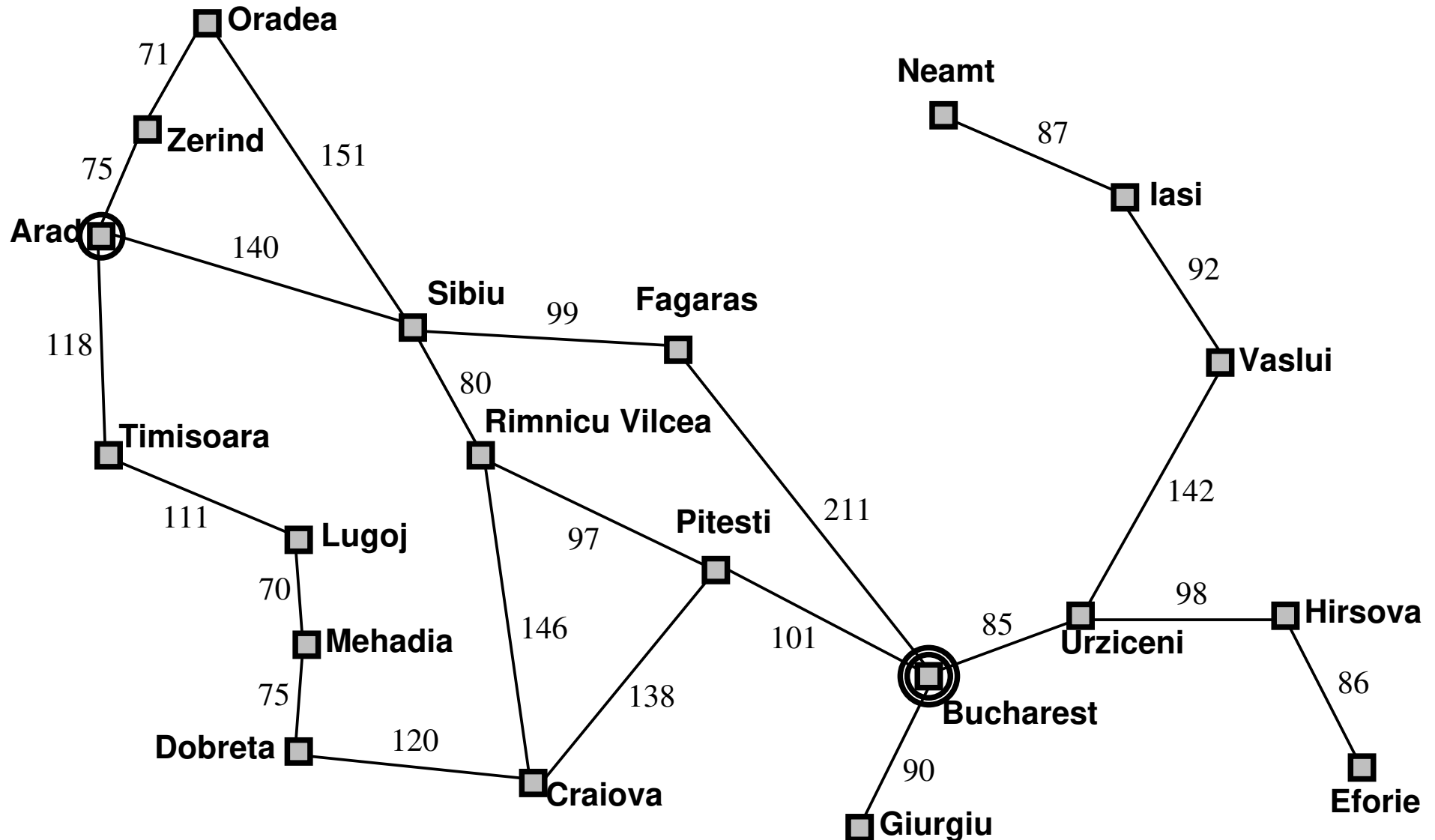
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Learning objectives

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

Problem: Shortest path between two points

Shortest path from Arad to Bucarest [1]:



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

Depth-first search (graph search) [1, 2]

Graph search: keeps track of explored nodes in a set C .

```
DFS( $G, s'$ )           // Depth-first search;  $G$  graph and  $s$  initial node
 $O = IniStack(s')$       // Open: search frontier-stack
 $C = \emptyset$           // Closed: set of explored nodes
while not  $EmptyStack(O)$ :
     $s = Pop(O)$           // selection LIFO (Last in, first out)
    if  $Goal(s)$  return  $n$            // solution found!
     $C = C \cup \{s\}$            //  $s$  already explored
    forall  $(s, n) \in Adjacents(G, s)$ : // generation:  $n$  child of  $s$ 
        if  $n \notin C \cup O$ :           //  $n$  not found unit now
             $Push(O, n)$            //  $n$  is added to the stack
return NULL                // no solution found
```

- ▶ **Question 1:** Write a trace of the **DFS** algorithm (graph search) applied to the problem of finding the shortest path from Arad to Bucarest.
- ▶ **Question 2:** Draw the search tree as a result of applying the **DFS** algorithm (graph search) to the problem of finding the shortest path from Arad to Bucarest.
- ▶ **Question 3:** Does the DFS algorithm (graph search) find a solution?
- ▶ **Question 4:** If the answer is “Yes”:
 - ▷ What is the solution found?
 - ▷ What is the cost of this solution?
 - ▷ Is this the solution of minimum cost?
 - ▷ What type of solution is found by the DFS algorithm (graph search)?

References

- [1] S. Russell and P. Norvig. *Artificial Intelligence: A Modern Approach*. Pearson, third edition, 2010.
- [2] Bernhard Korte and Jens Vygen. *Combinatorial Optimization: Theory and Algorithms*. Springer, 2018.