Fundamentos de Algoritmos e Estrutura de Dados – Aula 06 - Grafos

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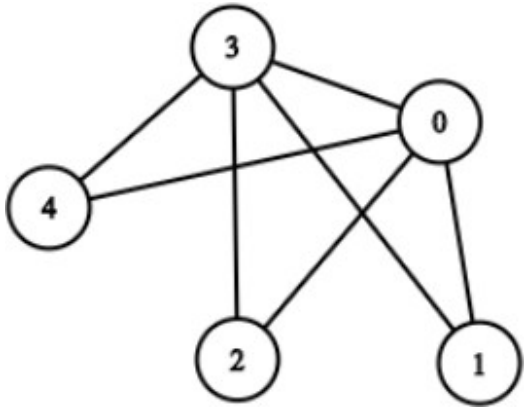
Plano de Aula

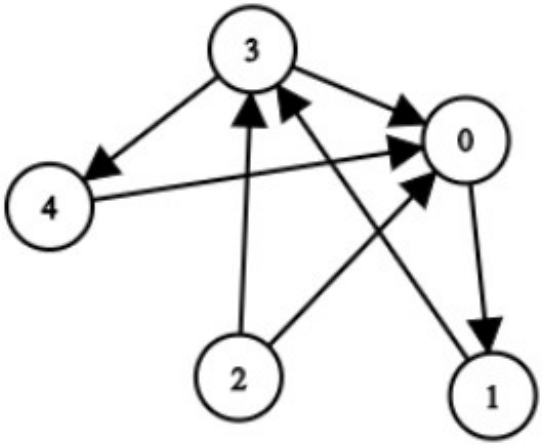
- **Grafos**
  - **Busca Profundidade**
  - **Busca Largura**
  - **Busca A***
- **Dijkstra**

Grafos

- **Conjunto de Vértices e Arestas**
  - **Direcionado ou Não**
  - **Define graus de relacionamento entre objetos (arestas**

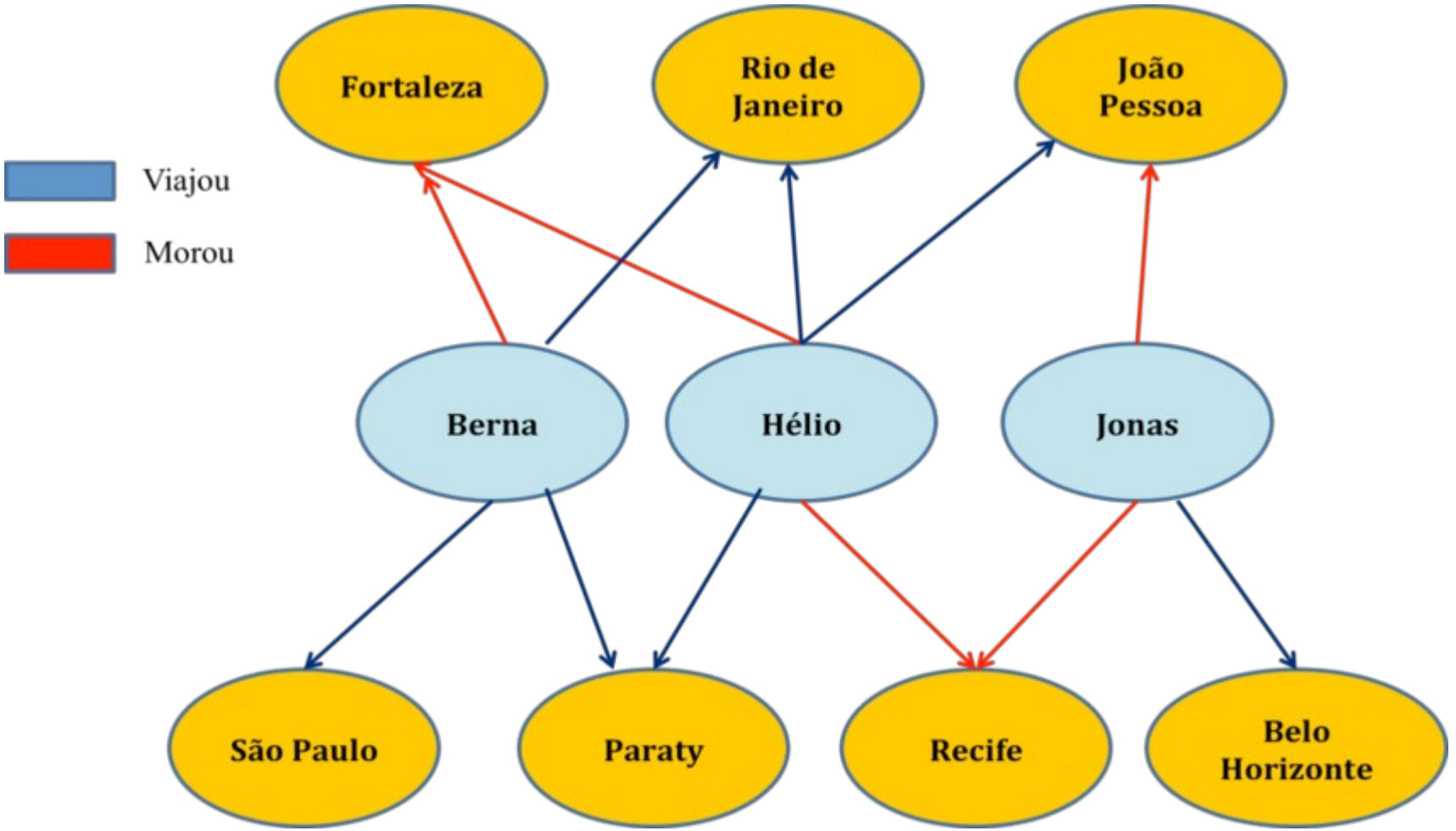


- **Utilizado na modelagem de problemas**
  - **Redes Sociais**
    - **Relacionamento entre Empresas, Pessoas, etc**
  - **Roteamento**
    - **Redes de Computadores**
    - **Rotas Rodoviárias, Aéreas, Malha Elétrica….**

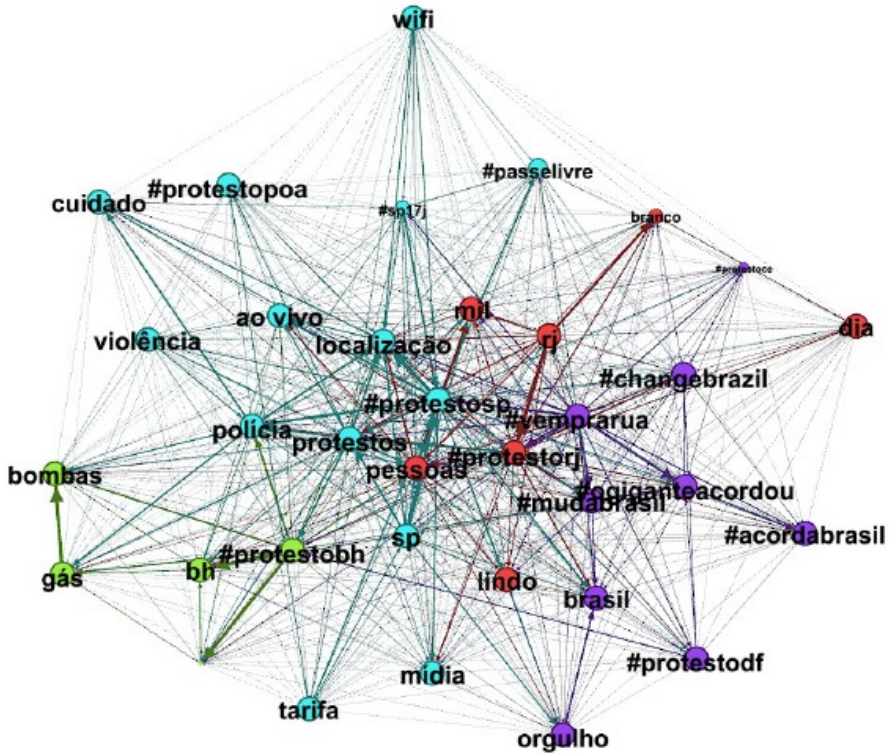


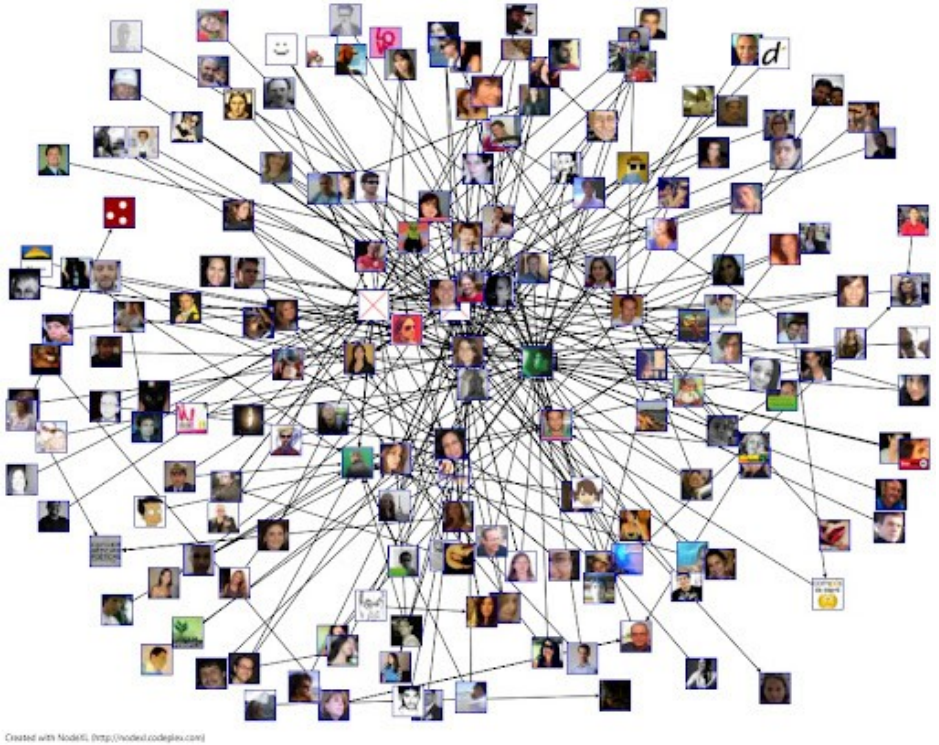
  - **Programação Orientada a Objetos (Classes)**

Grafos (Relacionamentos)



Grafos (Redes Sociais)

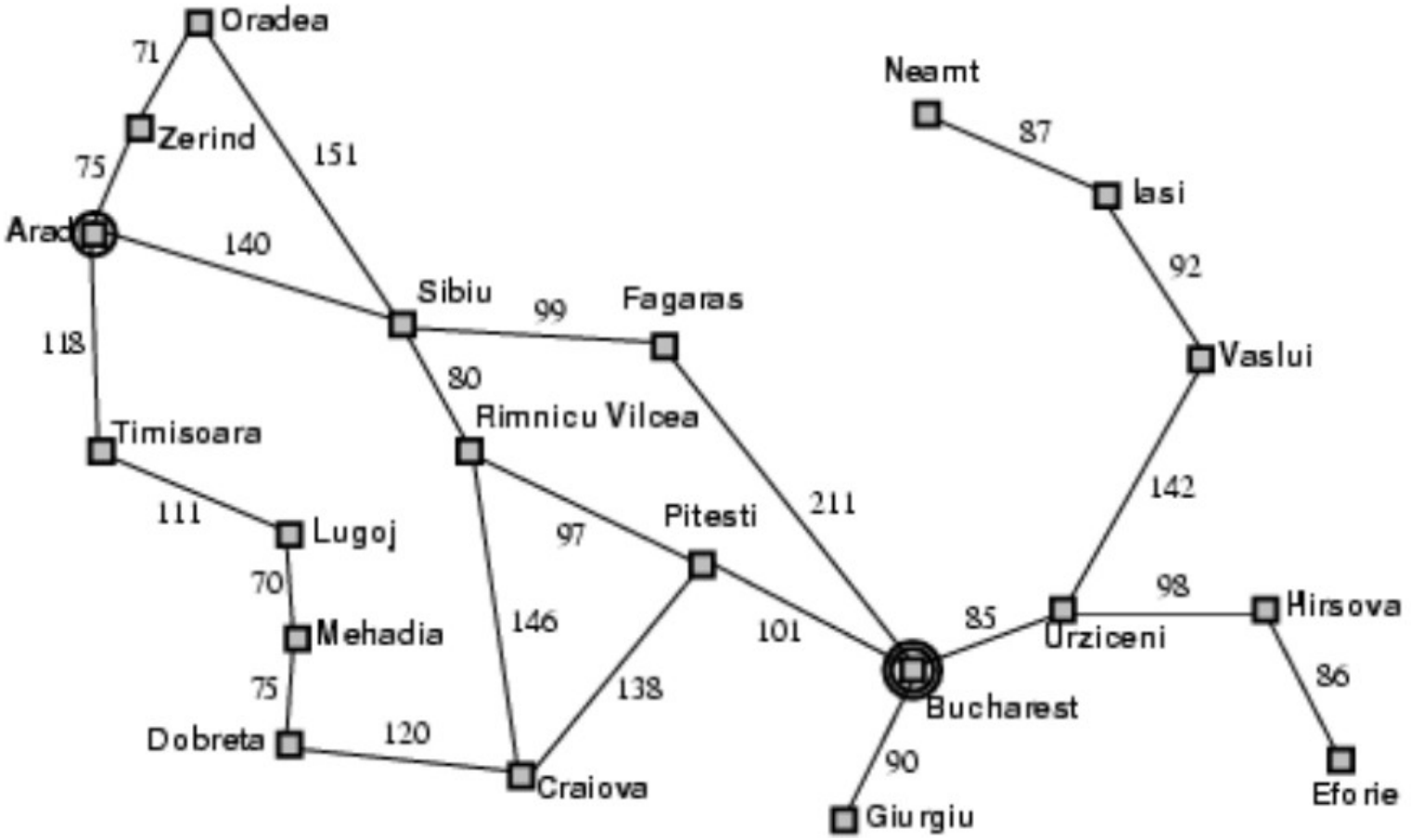




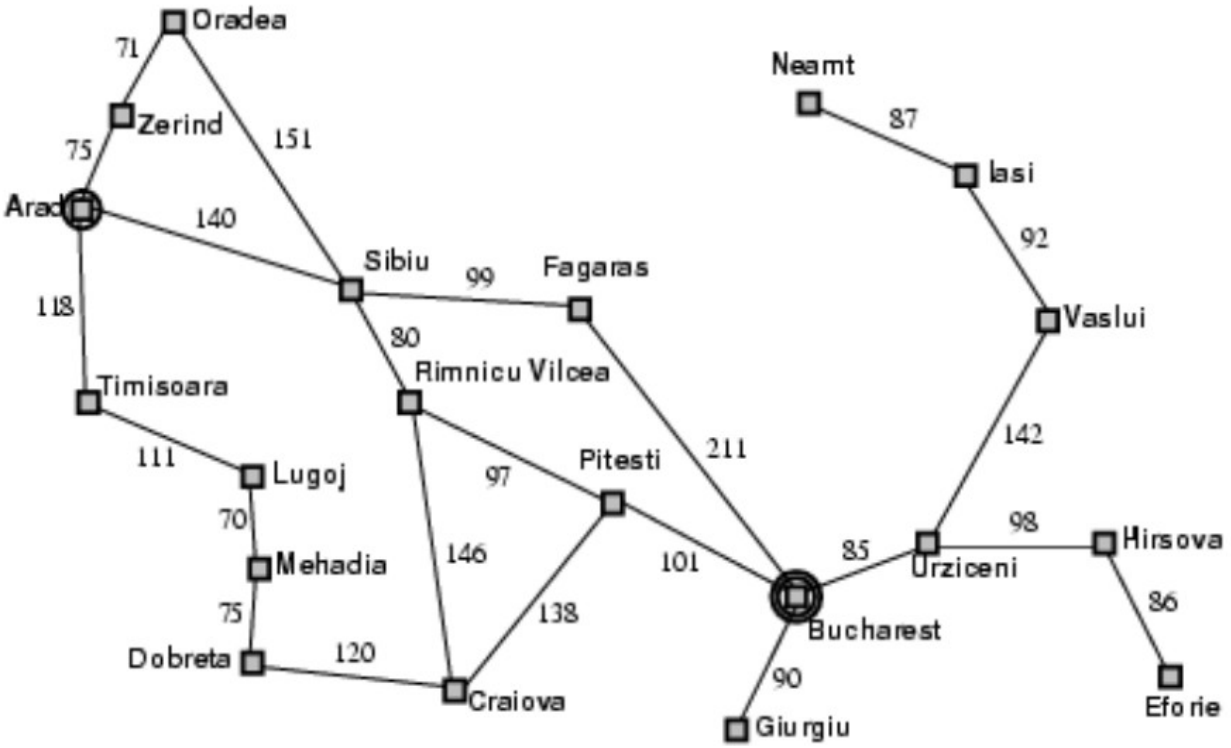
Grafos (Roteamento)

Busca Cegas (Sem Informação)

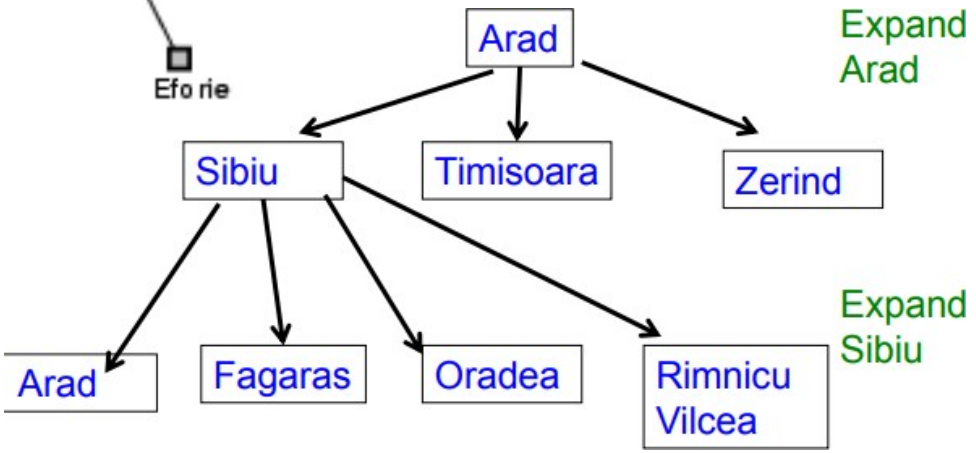
Problema: Arad → Bucharest



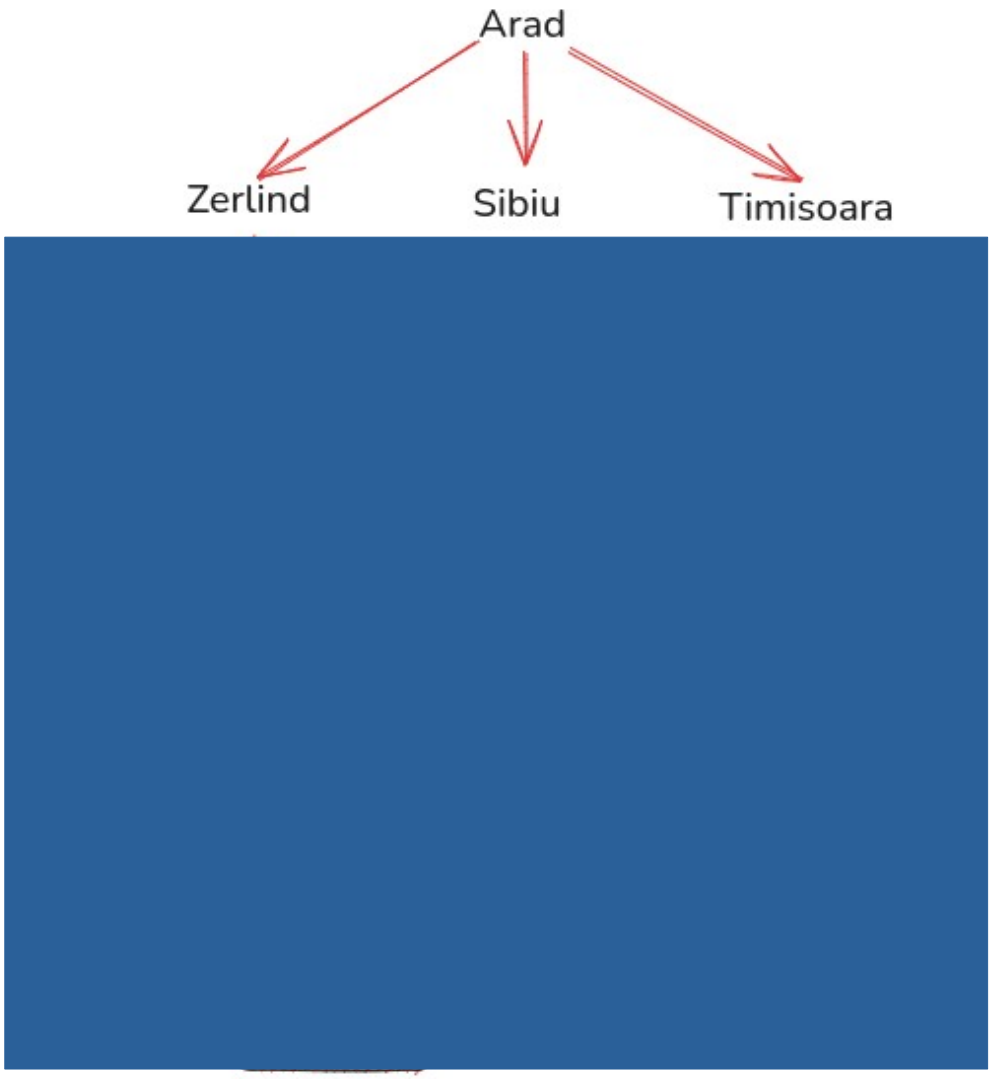
Busca Cegas (Sem Informação)

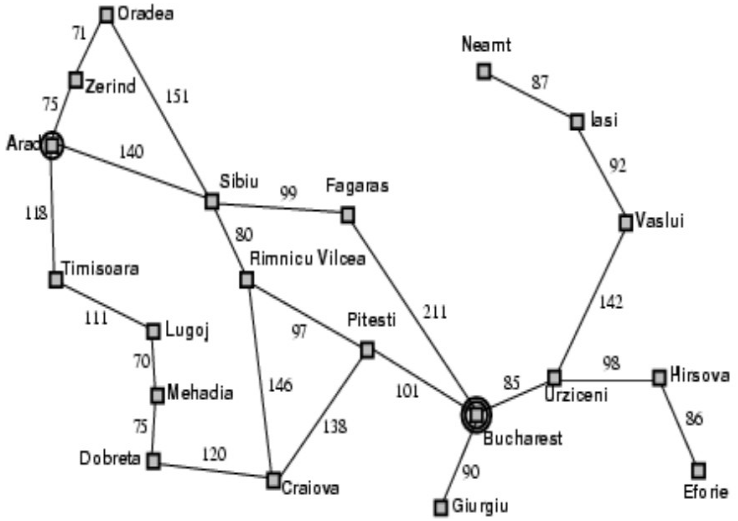


Problema: Qual nodo expandir?



Busca Cega: Profundidade





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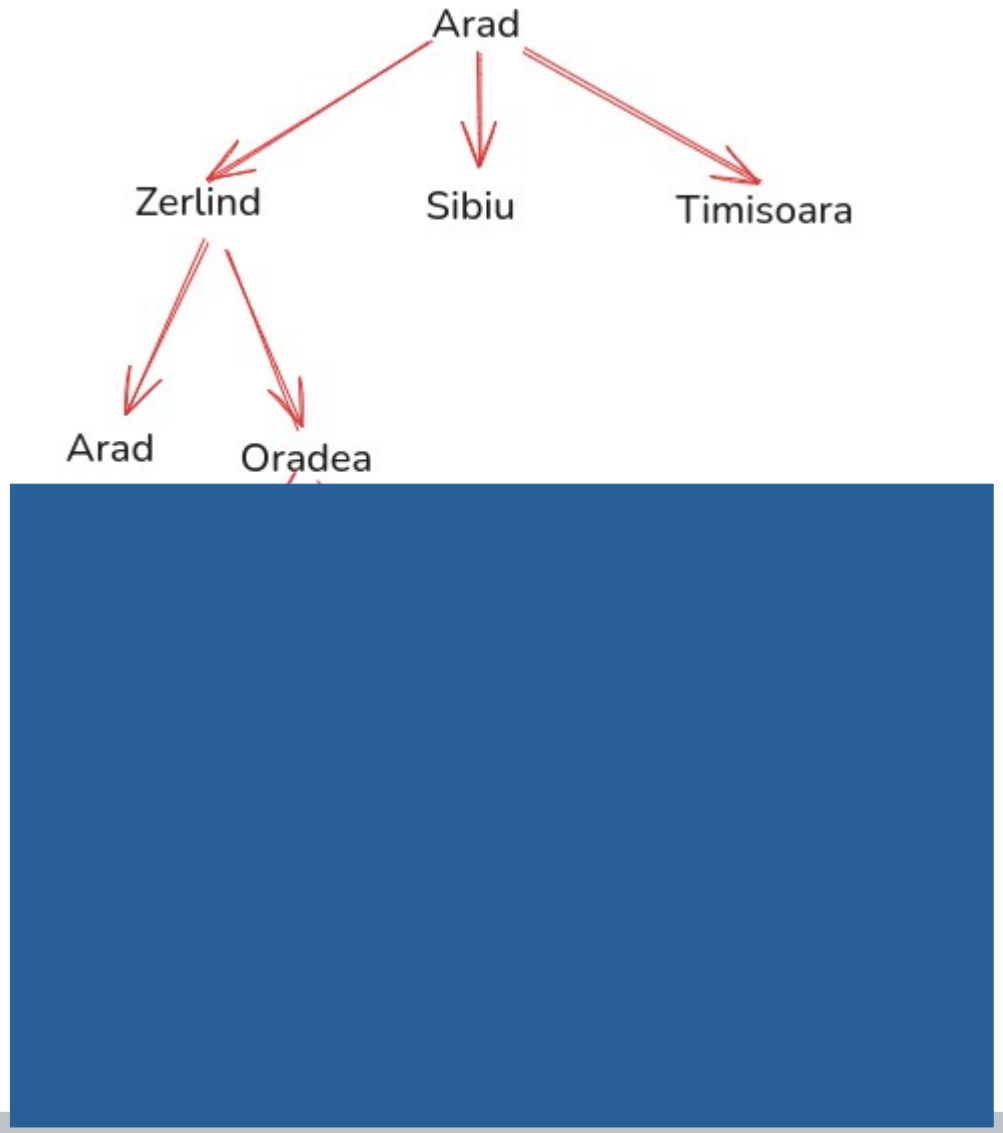

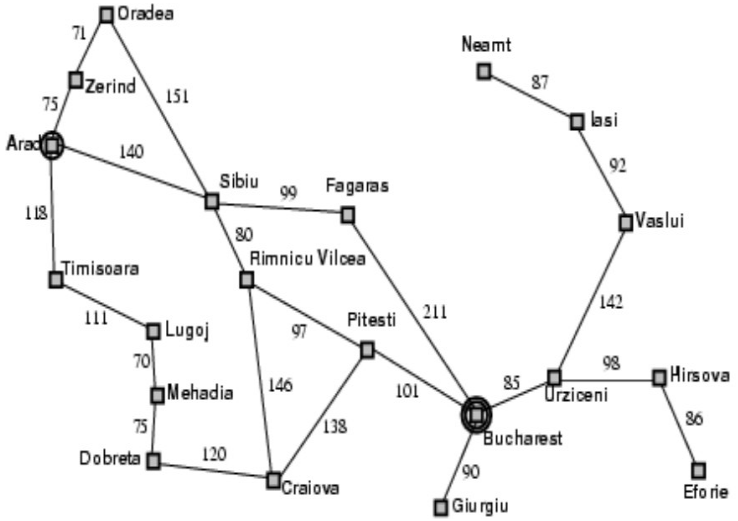

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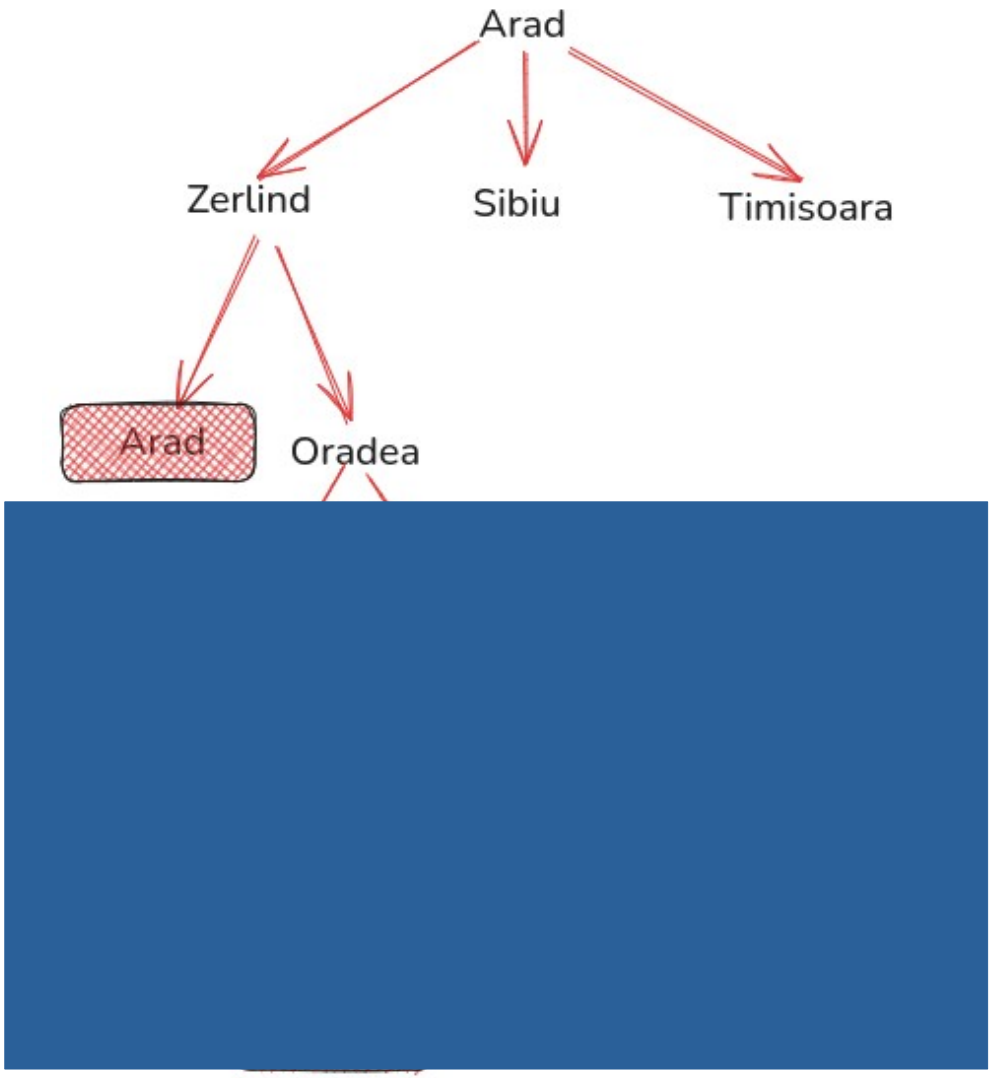

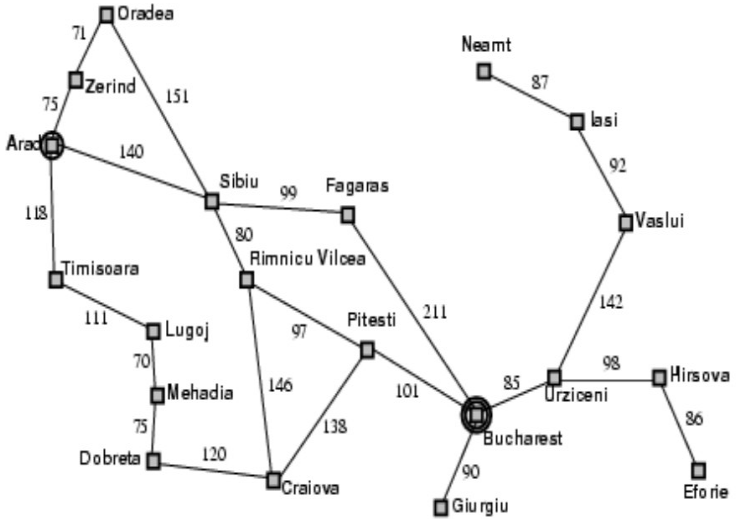

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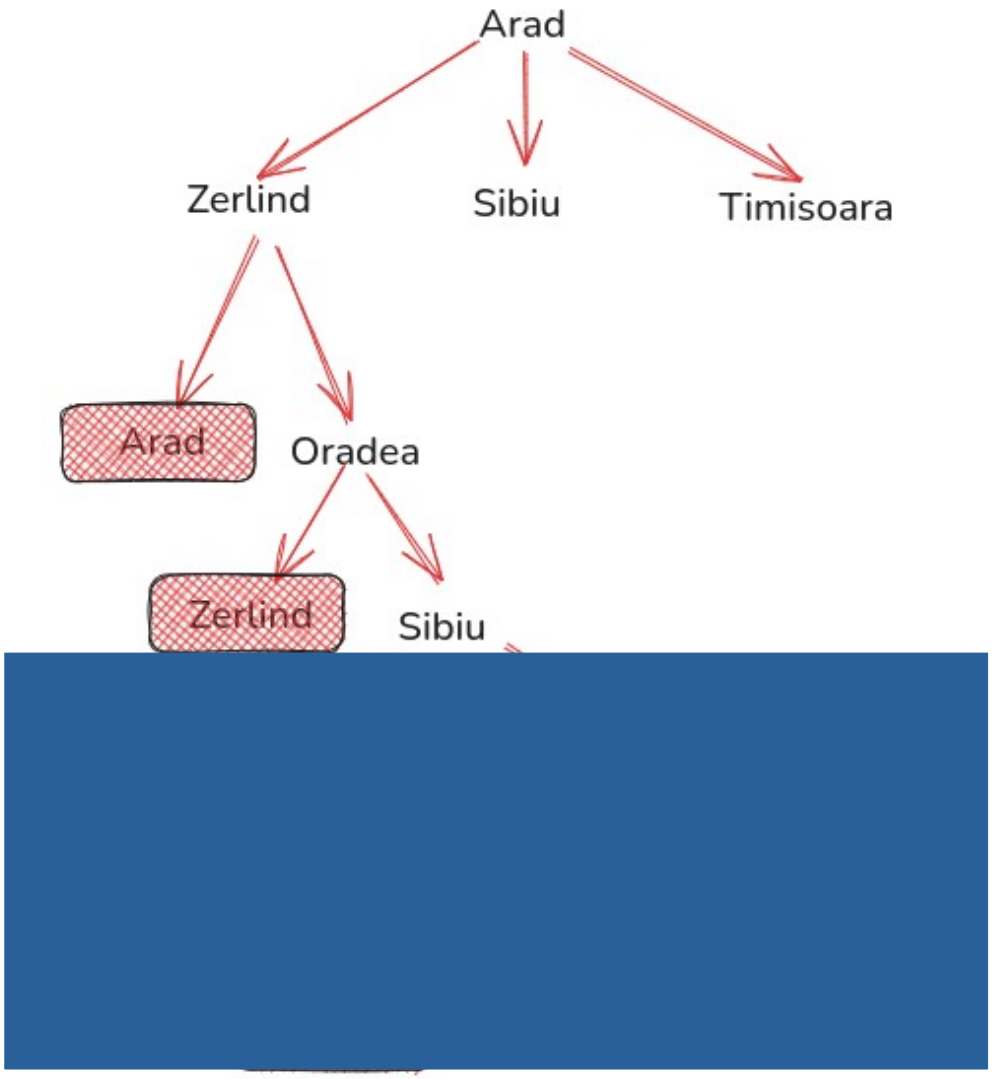

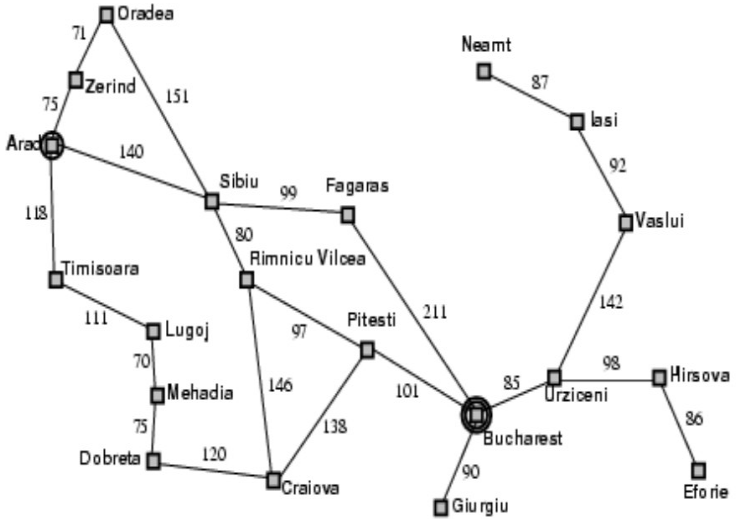

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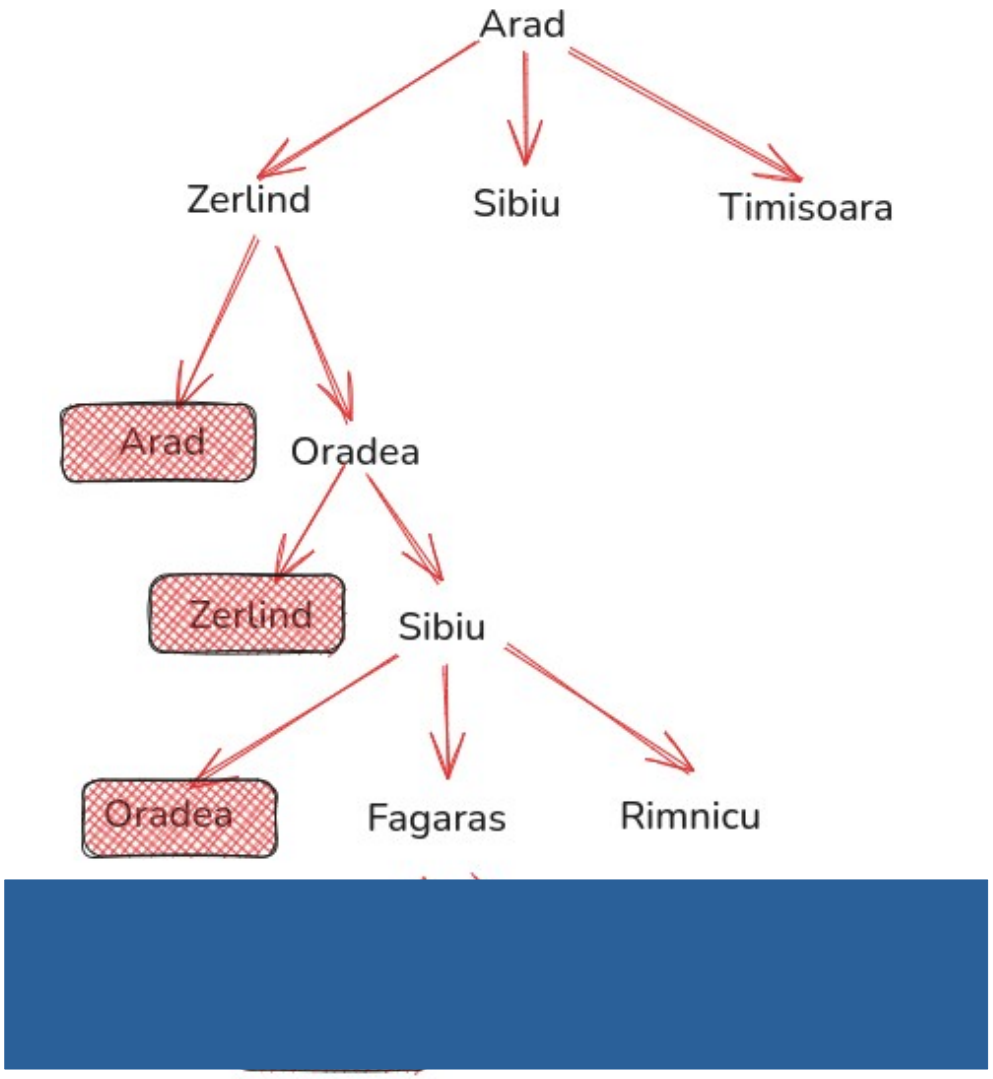

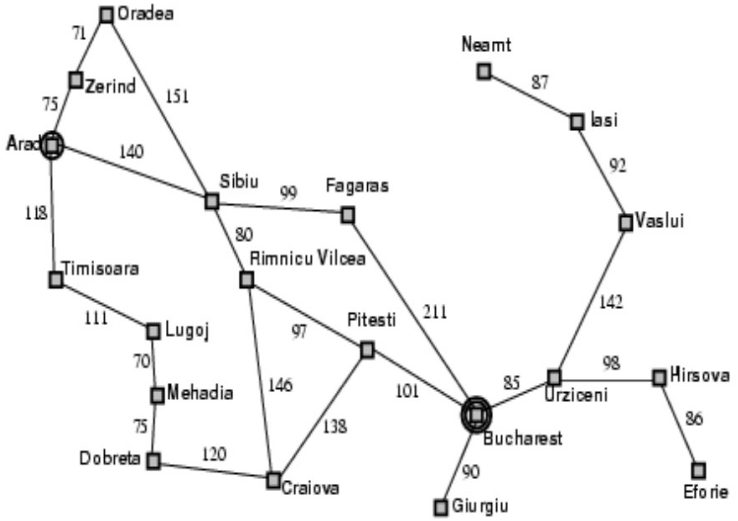

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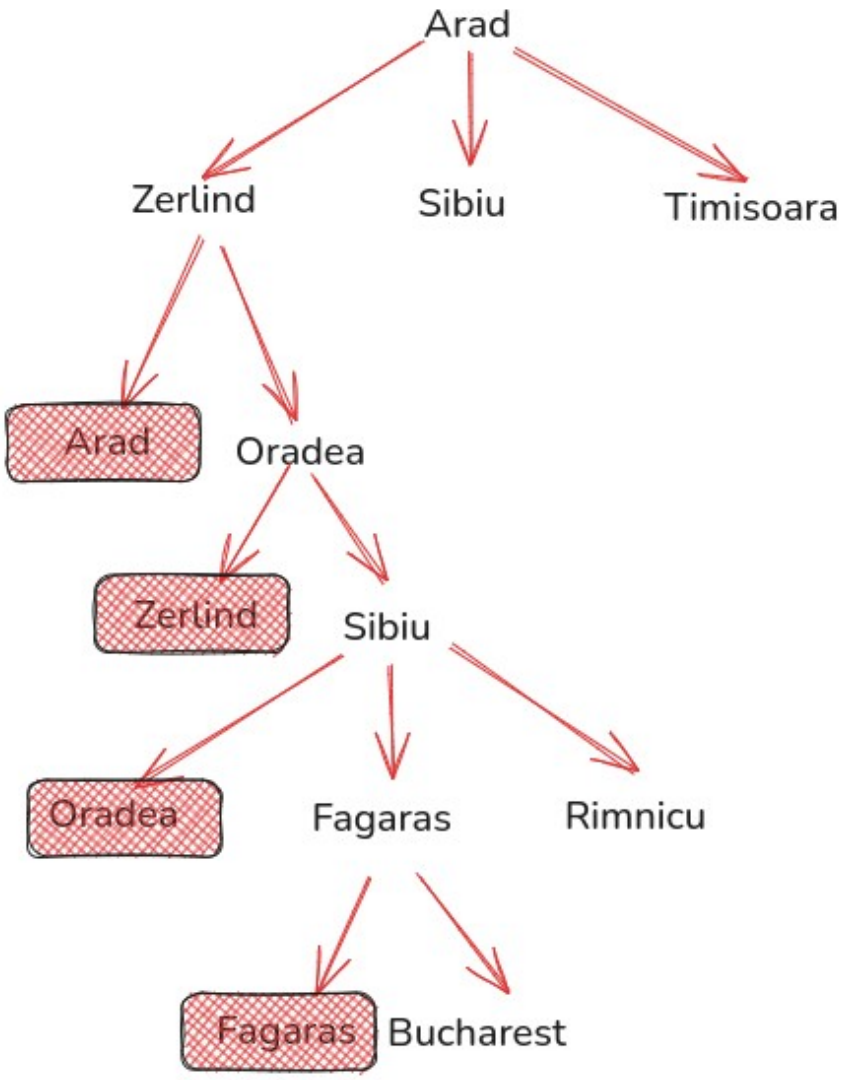
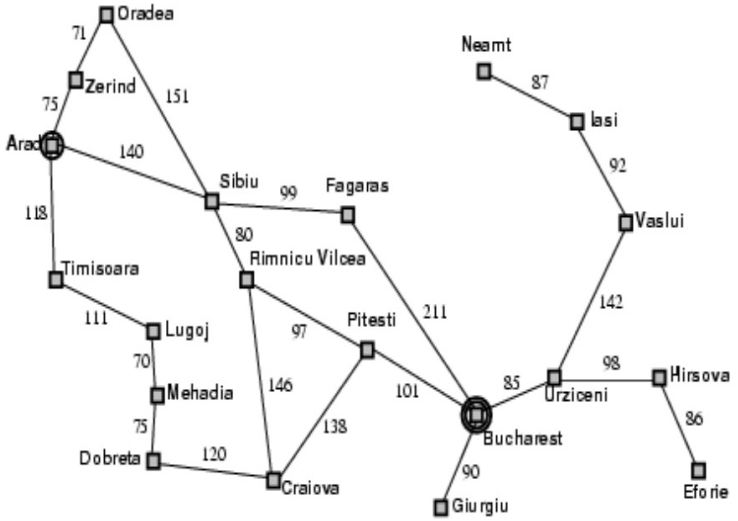
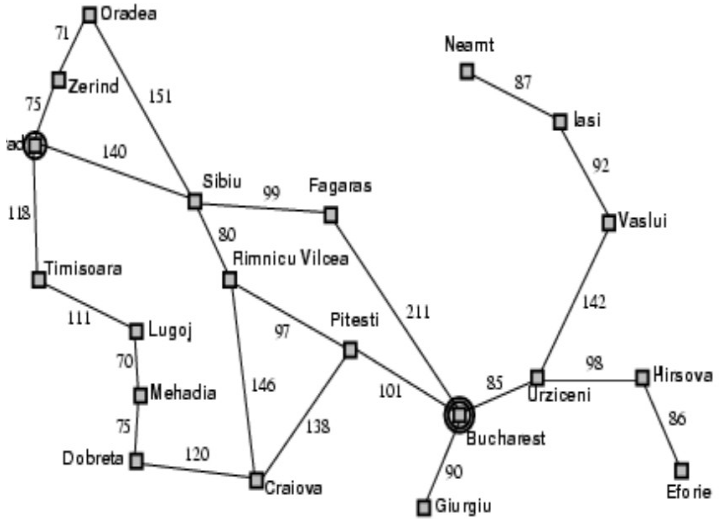




Não Garante a melhor solução!

Ciclos devem ser tratados!

Busca Cega: Largura



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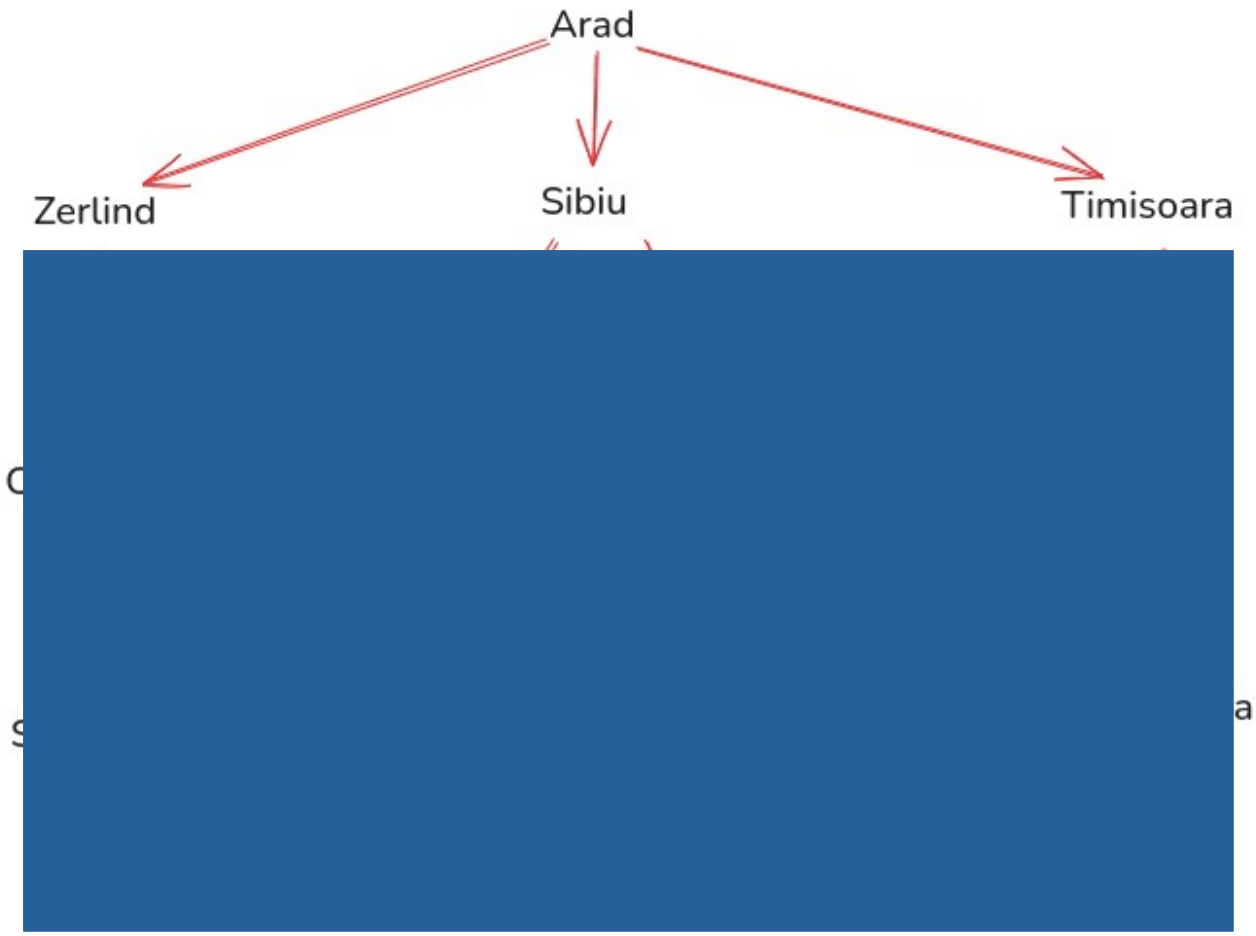

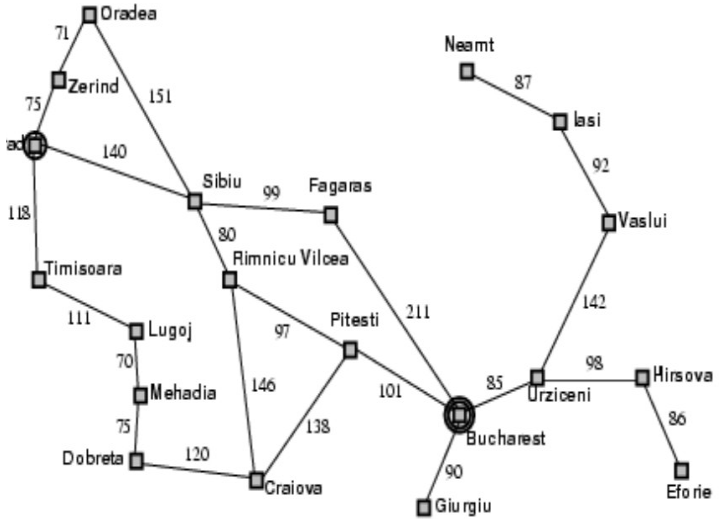

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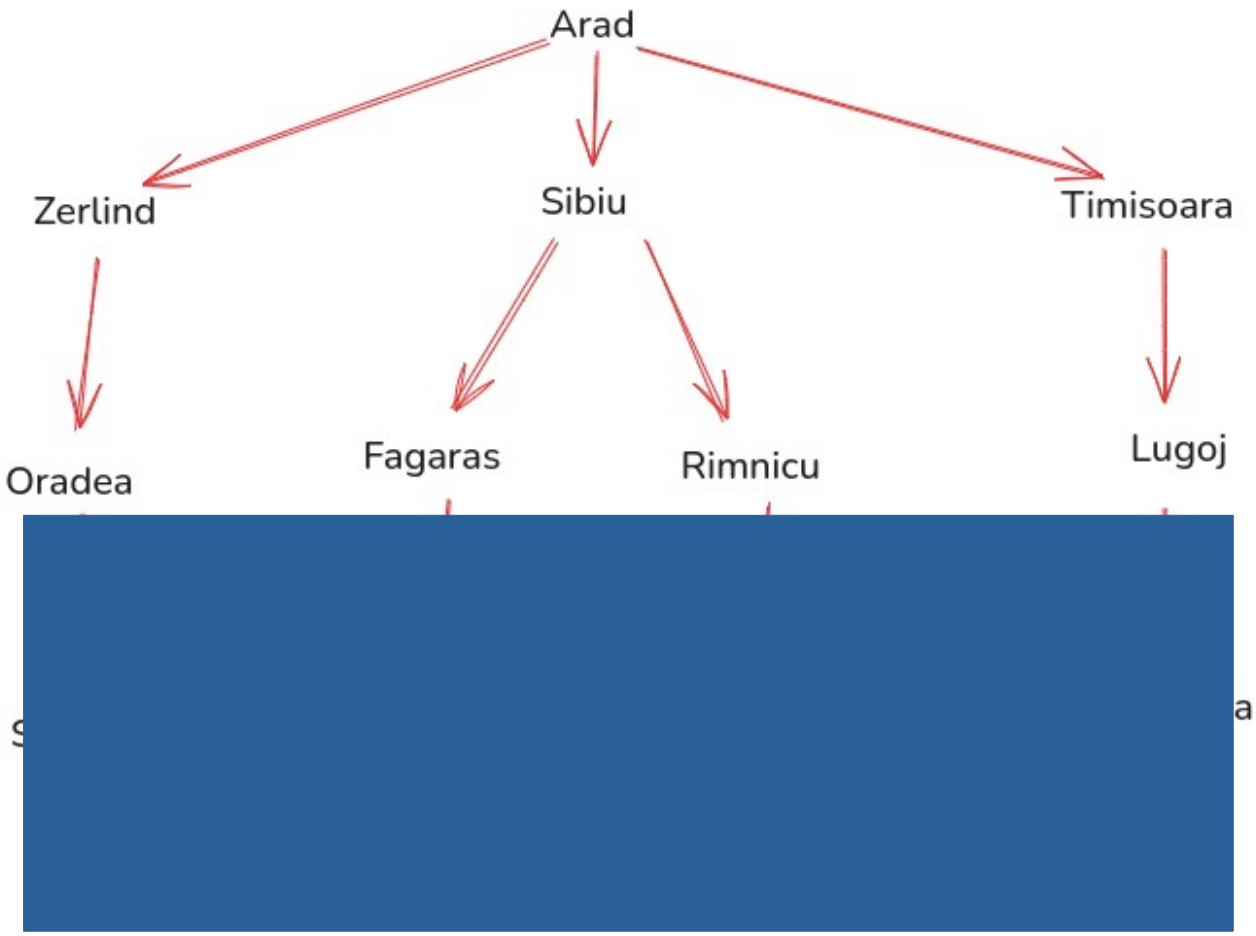

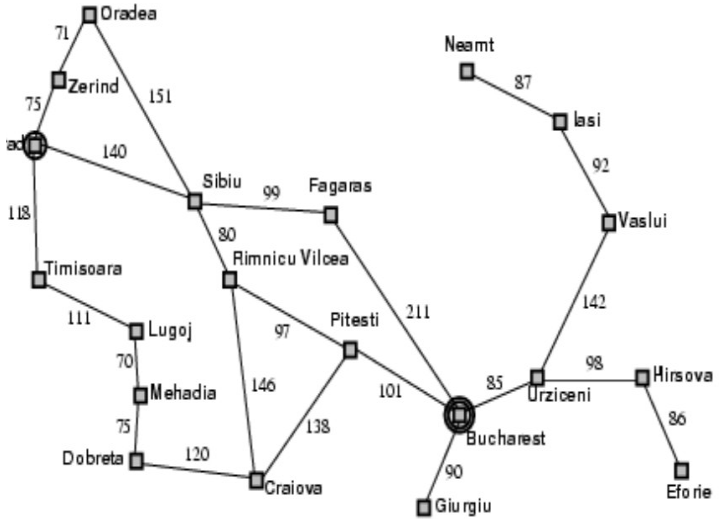

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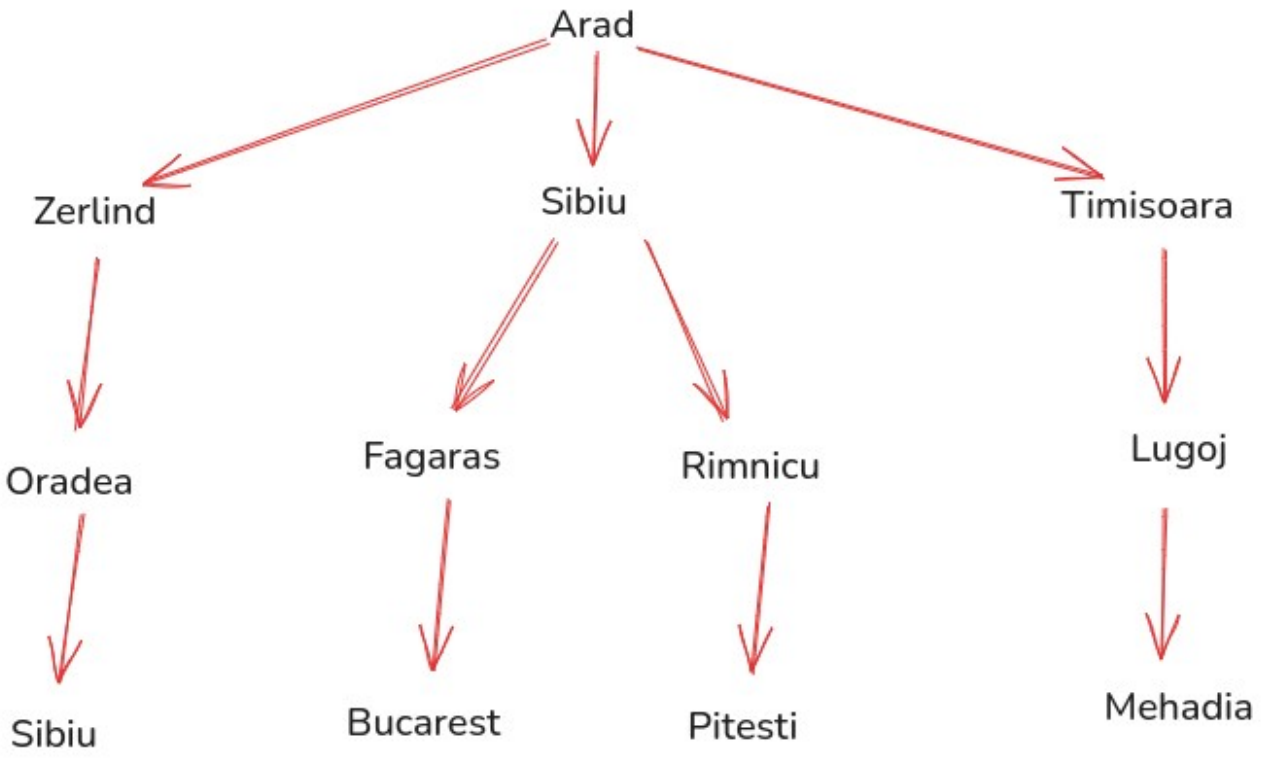
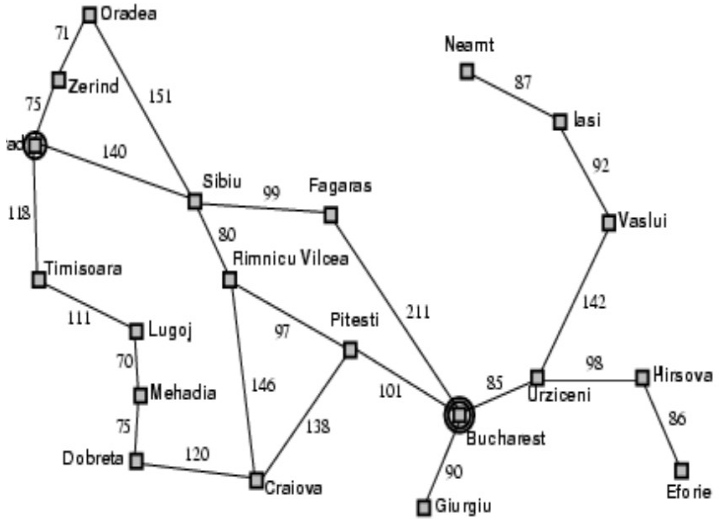




Garante a melhor solução!

Ciclos devem ser tratados!

Busca Cega: Largura

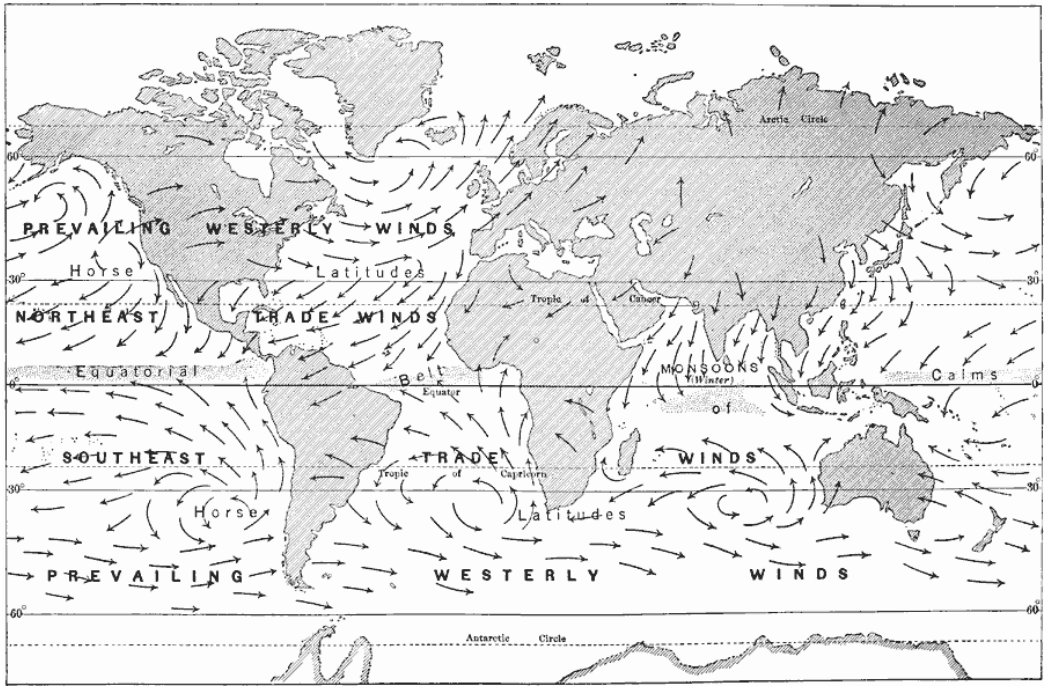
- **Bons resultados para arvores com pouca profundidade**
- **Caso contrário, o custo computacional é alto**
- **Exemplo**
  - **Ramificação b=10, 1 M nodos/seg , 1 KB por node**

$1+b^1+b^2+(b^3-b) = 1+10+100+(1000-10) = 1101$

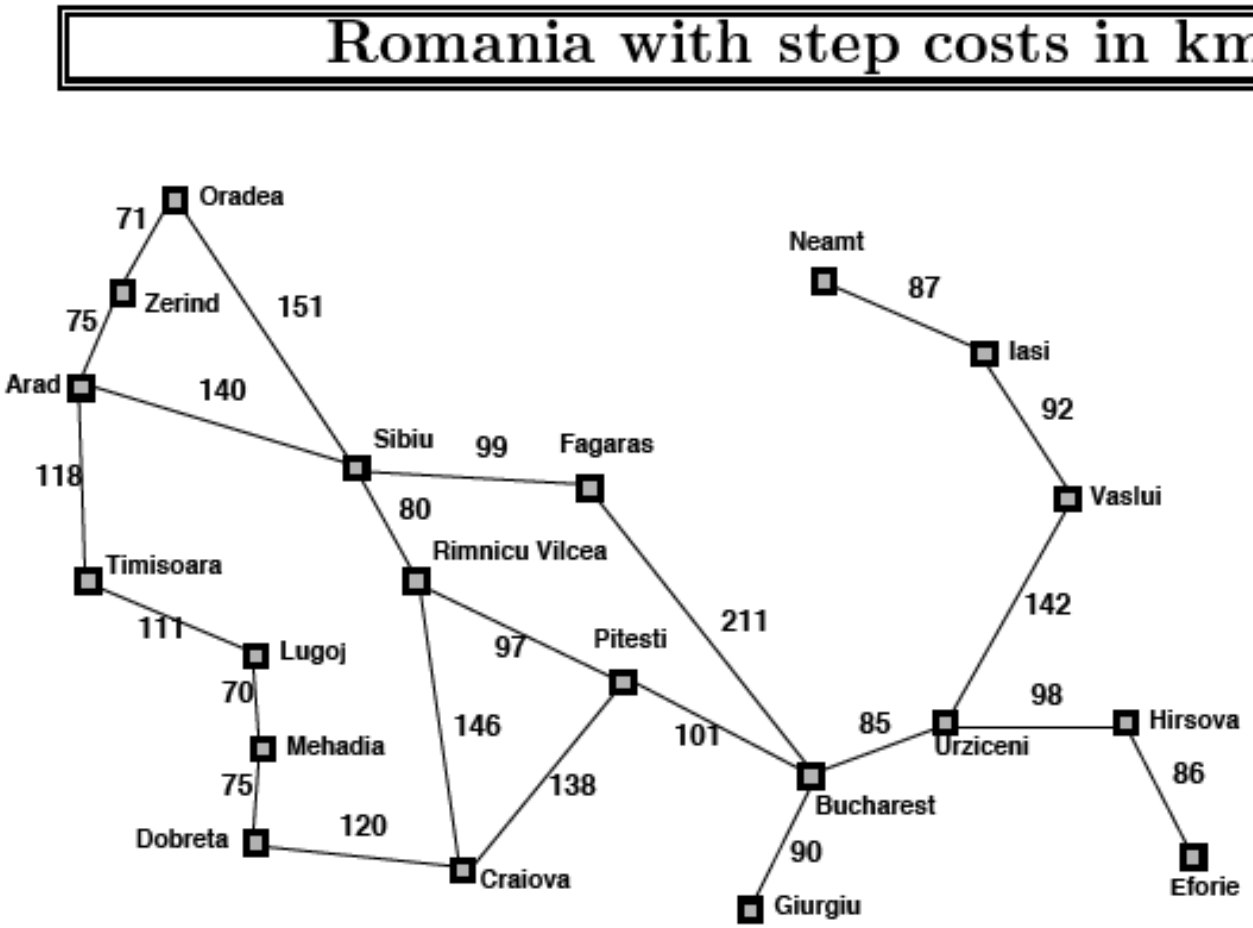
profundidade	nós	tempo	memória
2	1100	0,11 seg	1 MB
4	111.100	11 seg	106 MB
6	10^7	19 min	10 GB
8	10^9	31 horas	1 TeraB
10	10^{11}	129 dias	101 TeraB
12	10^{13}	35 anos	10 PentaB
14	10^{15}	3.523 anos	1 exaB

Busca Heuristica (Informada)

- **Utiliza uma função heurística para determinar a próxima expansão**
- **Problema: Procurar um barco no oceano**
  - **Cega: M2 por M2**
  - **Heurística: Corrente Marítima, Ventos, ...**



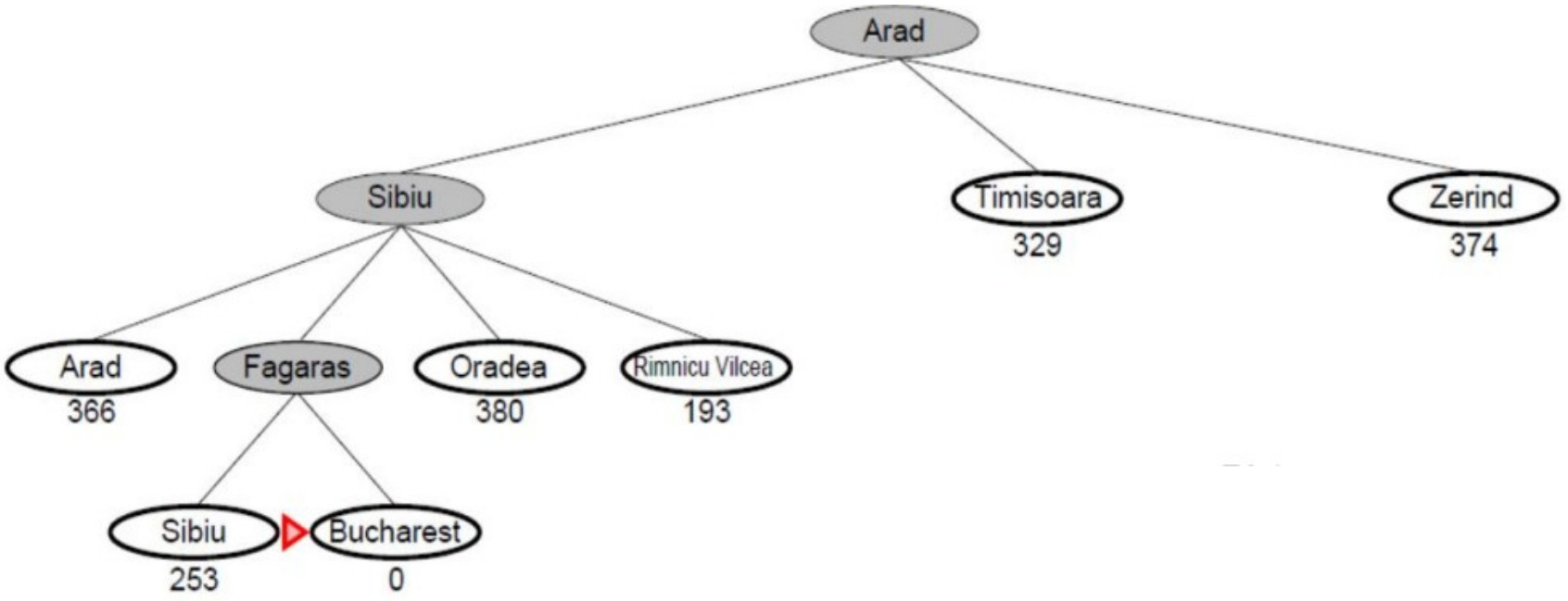
Busca Heurística



Straight–line distance to Bucharest	
Arad	366
Bucharest	0
Craiova	160
Dobreta	242
Eforie	161
Fagaras	178
Giurgiu	77
Hirsova	151
Iasi	226
Lugoj	244
Mehadia	241
Neamt	234
Oradea	380
Pitesti	98
Rimnicu Vilcea	193
Sibiu	253
Timisoara	329
Urziceni	80
Vaslui	199
Zerind	374

Busca Heurística: Ganânciosa (Greedy Search)

- **f(n) = h(n)**
  - **h(n): Custo de n até folha (n→destino)**



straight-line distances to Bucharest

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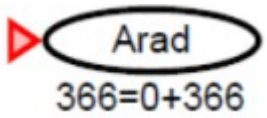
Busca Heurística: A*

- **f(n) = g(n) + h(n)**



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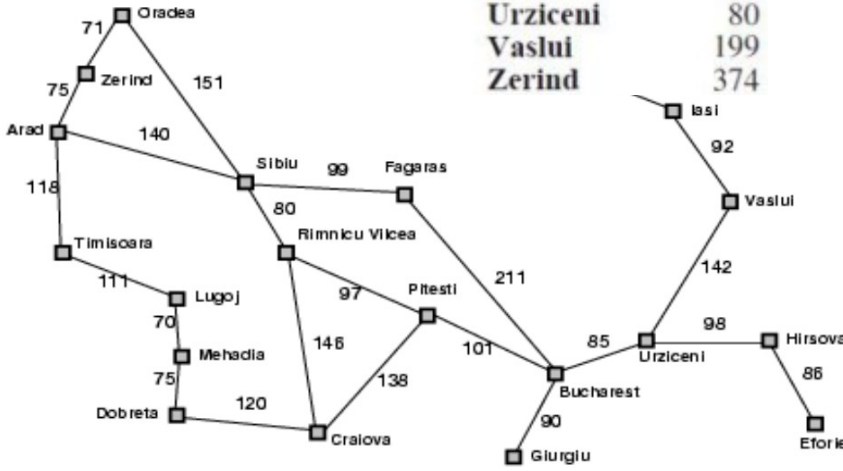

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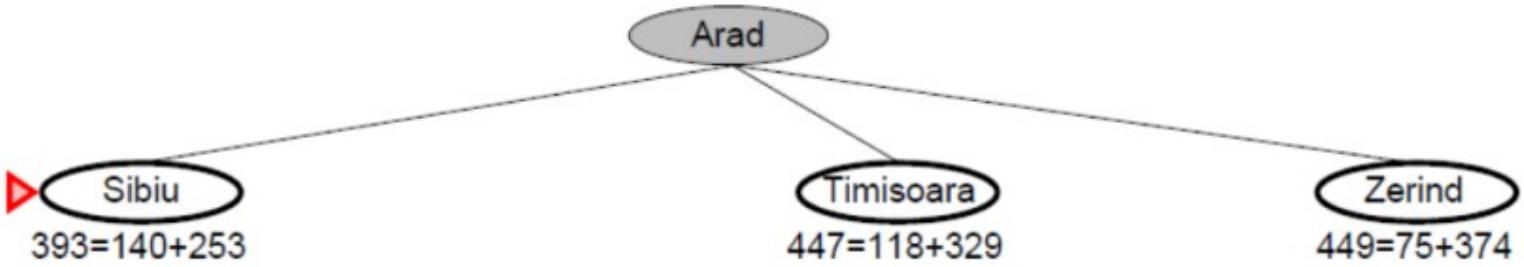

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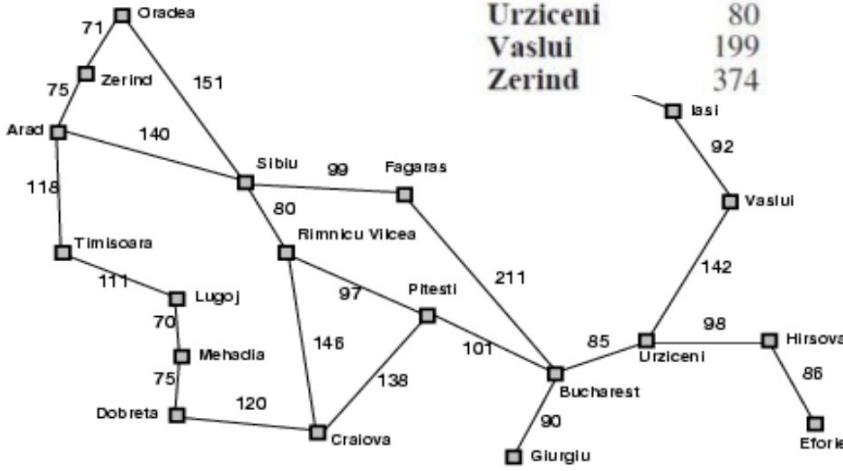
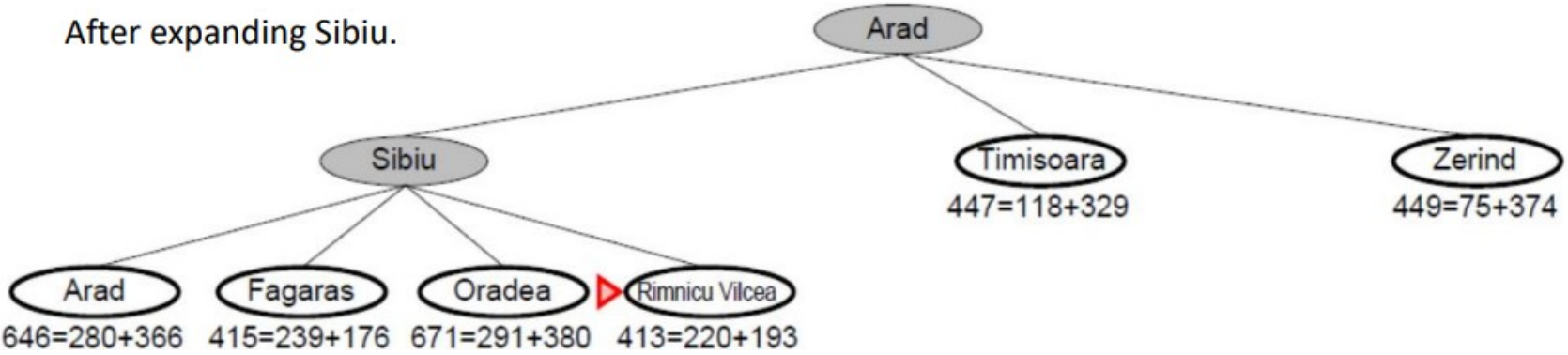


Busca Heurística: A*

After expanding Sibiu.



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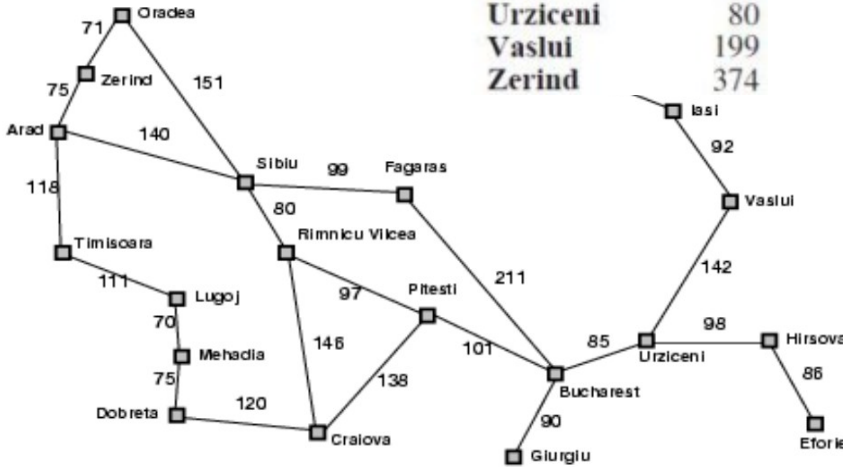
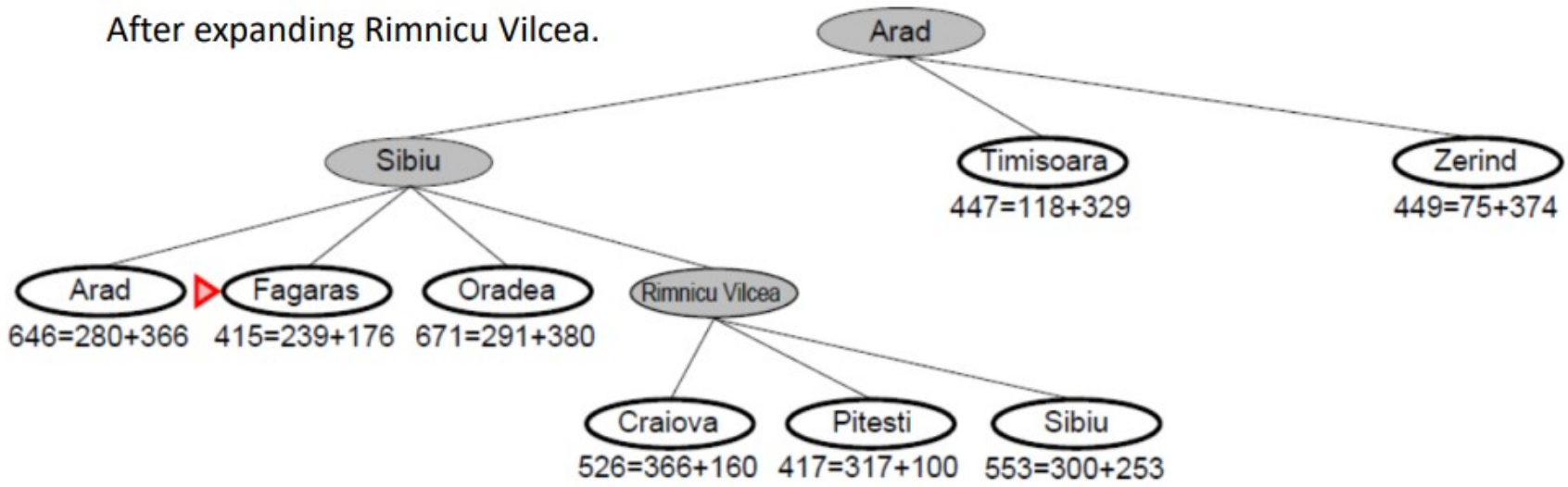


Busca Heurística: A*



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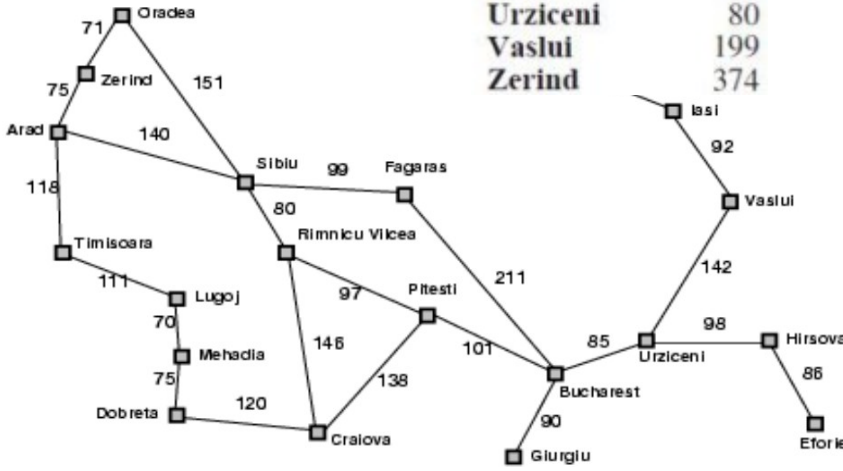
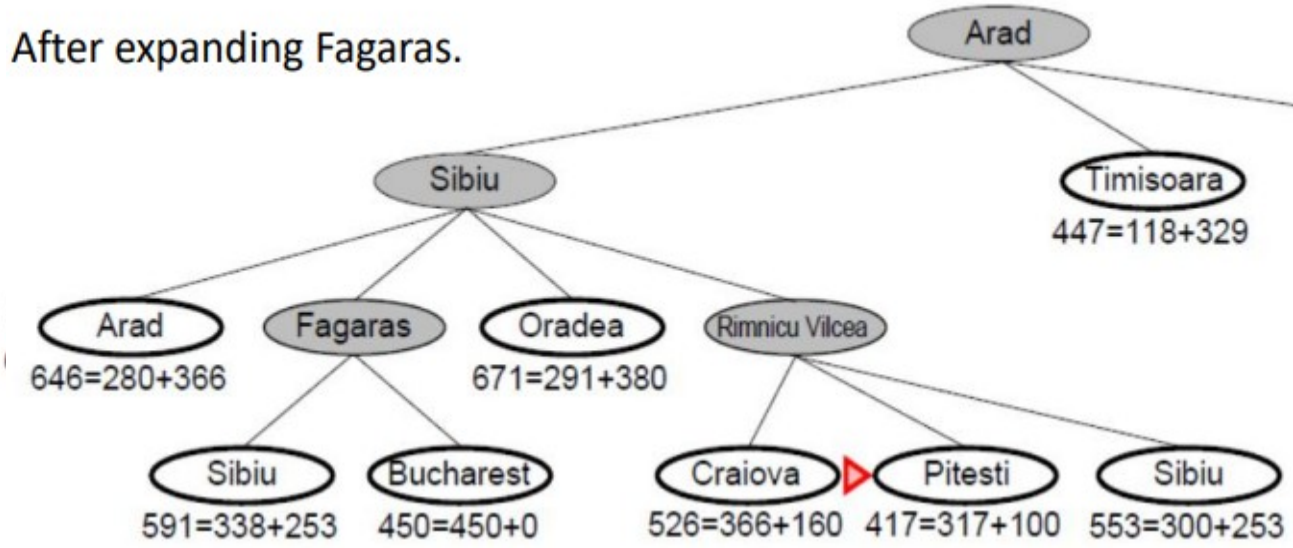


Busca Heurística: A*

After expanding Fagaras.



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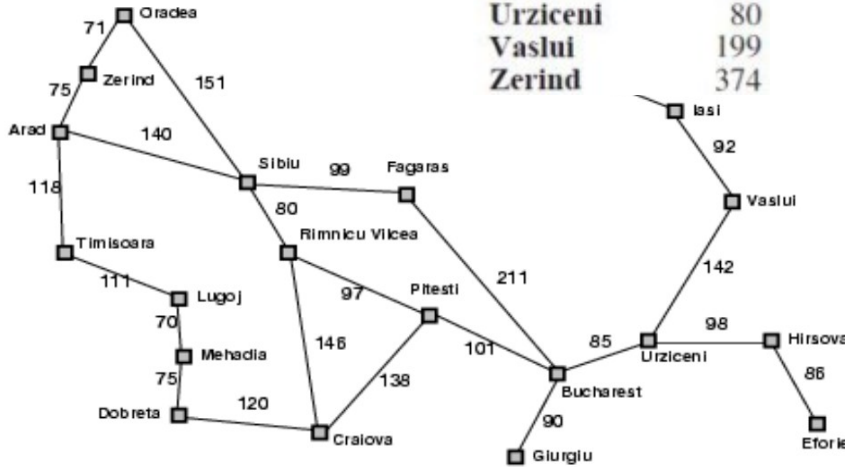
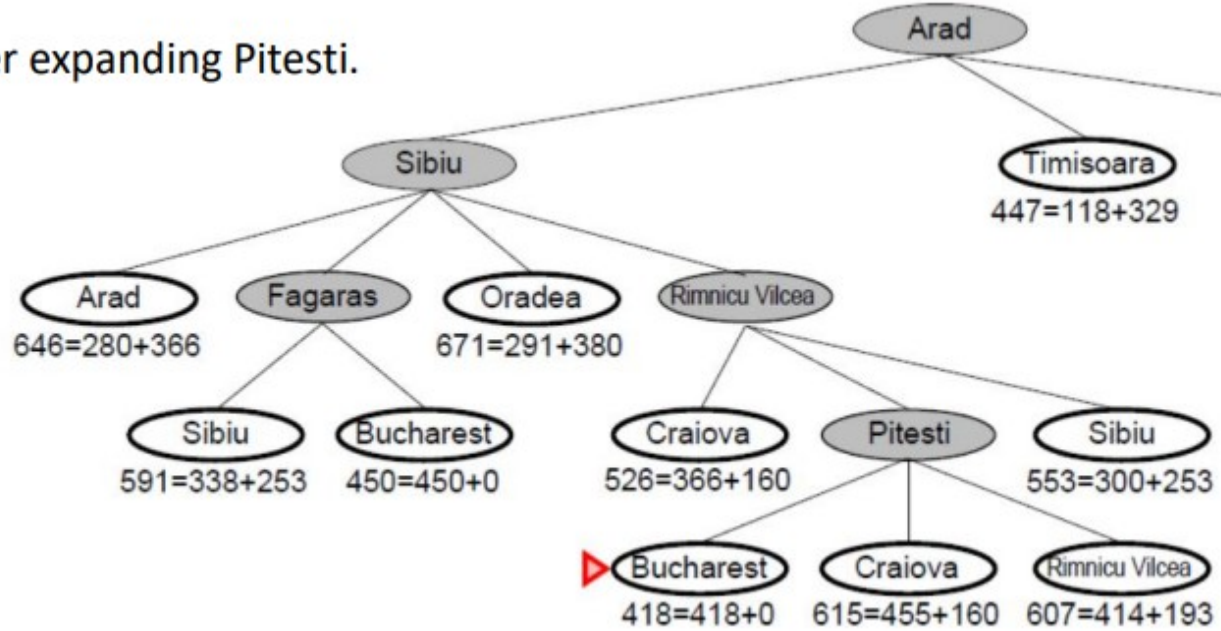
Vaslui	199
Zerind	374



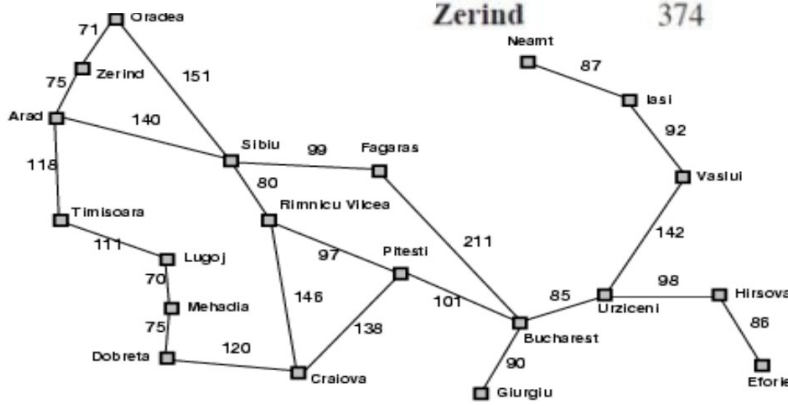
Busca Heurística: A*

After expanding Pitesti.



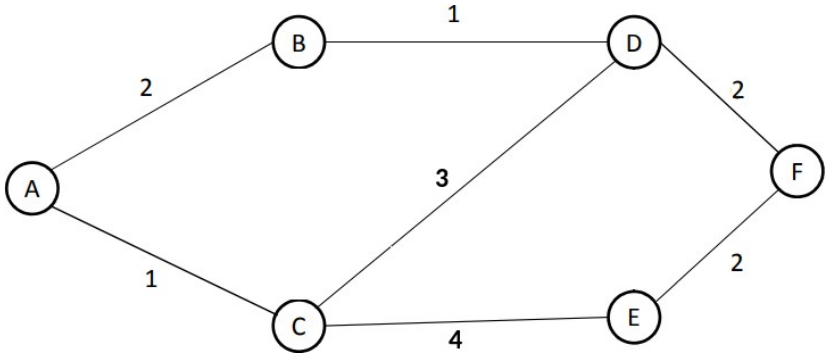
straight-line distances to Bucharest

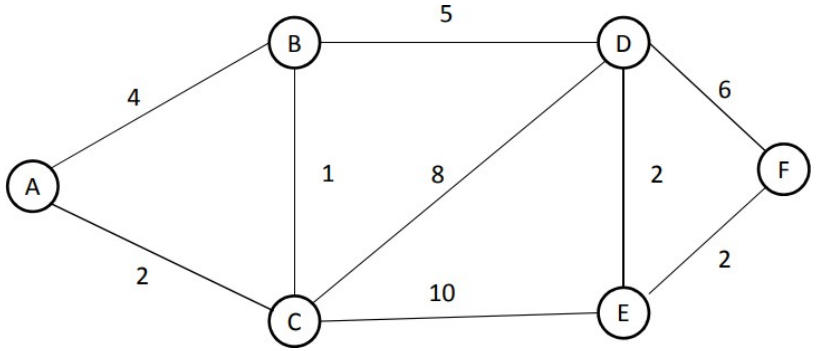
Arad	366
Bucharest	0
Craiova	160
Drobeta	242
Eforie	161
Fagaras	176
Giurgiu	77
Hirsova	151
Iasi	226
Lugoj	244
Mehadia	241
Neamt	234
Oradea	380
Pitesti	100
Rimnicu Vilcea	193
Sibiu	253
Timisoara	329
Urziceni	80
Vaslui	199
Zerind	374



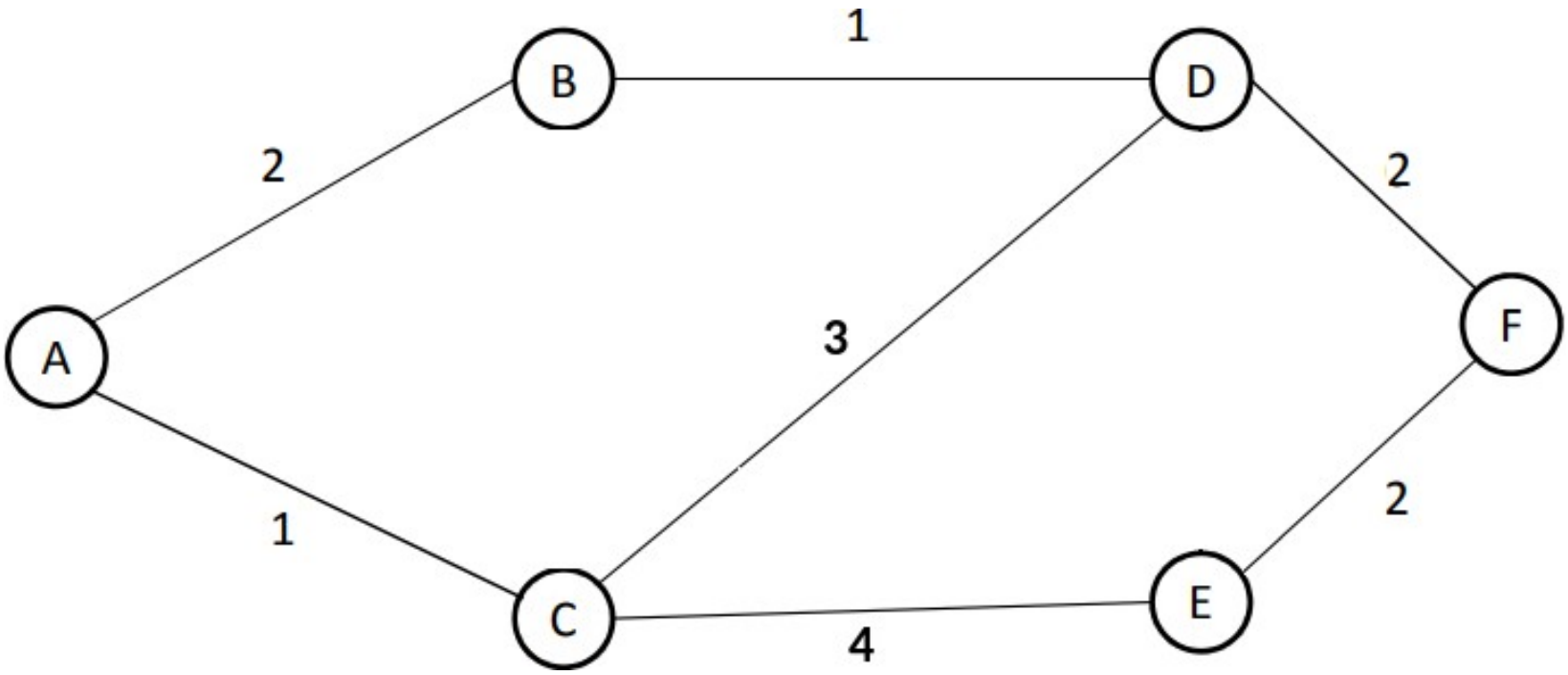
Algoritmo de Dijkstra

- **Edsger Dijskstra – 1959**
- **Caminho mais curto em grafo**
- **De A para F**

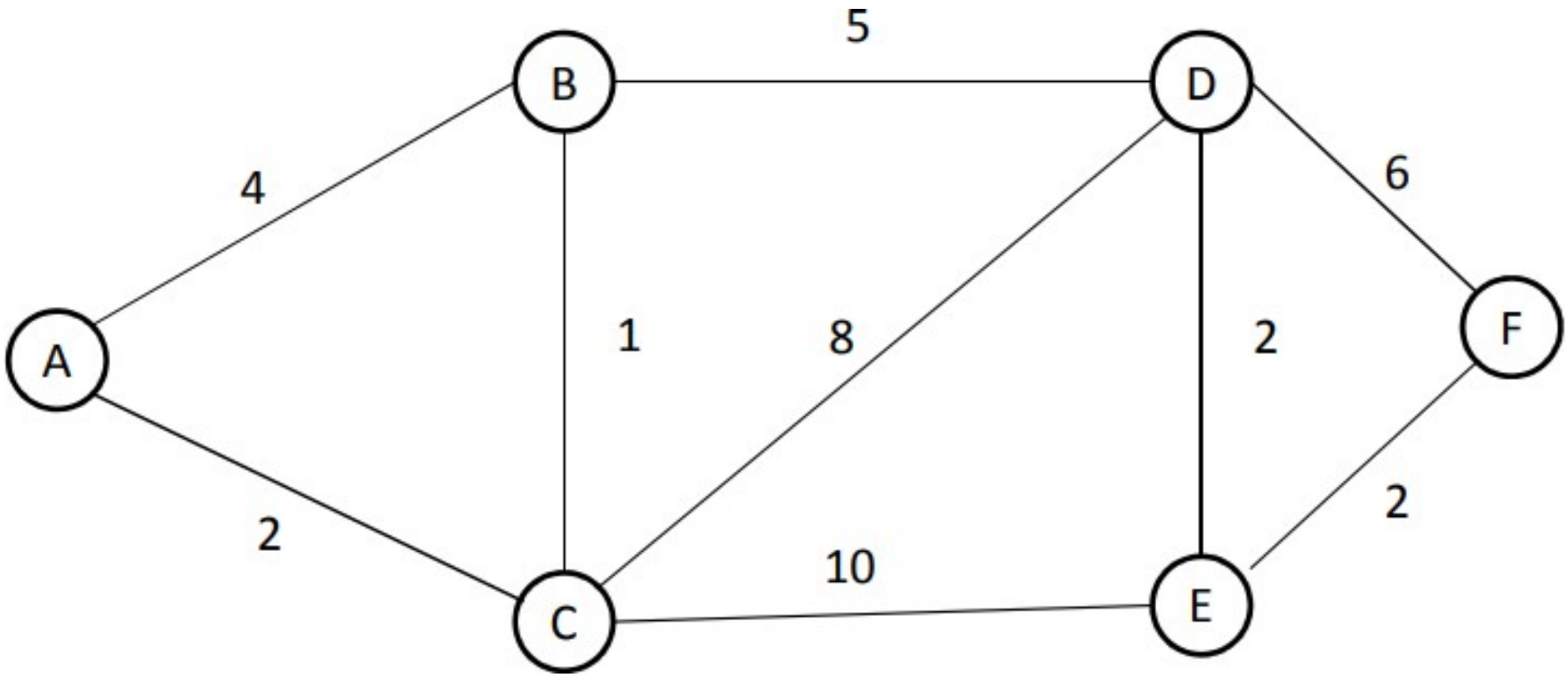




Algoritmo de Dijkstra



Algoritmo de Dijkstra



Codificando Grafos

- **LINK DEEPNOTE**

Trabalho

- **Implementação do algoritmo de Dijkstra**
- **Monte um grafo que represente um problema real**
- **Aplique o algoritmo de Dijkstra**
- **Utilize a biblioteca pyvis para ilustrar o grafo**

- **Entrega via AVA**

- **VERIFIQUE OS DETALHES NO AVA!!**