Introduction to Artificial Intelligence

Course 16 :198 :440

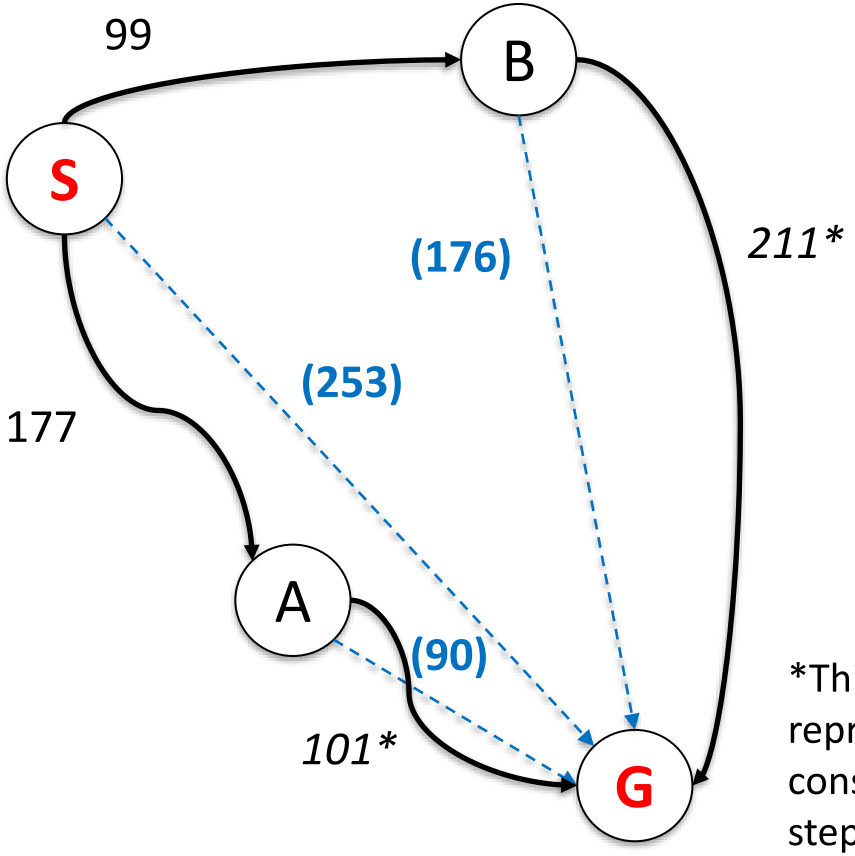
Recitation 3:

Informed Search

Additionally, imagine paths that point northwest from S. These should strike you as more likely to be suboptimal. **The Euclidean heuristic reflects this, and deprioritizes them in the queue.**

Consider going from S to G on this piece of a larger graph...

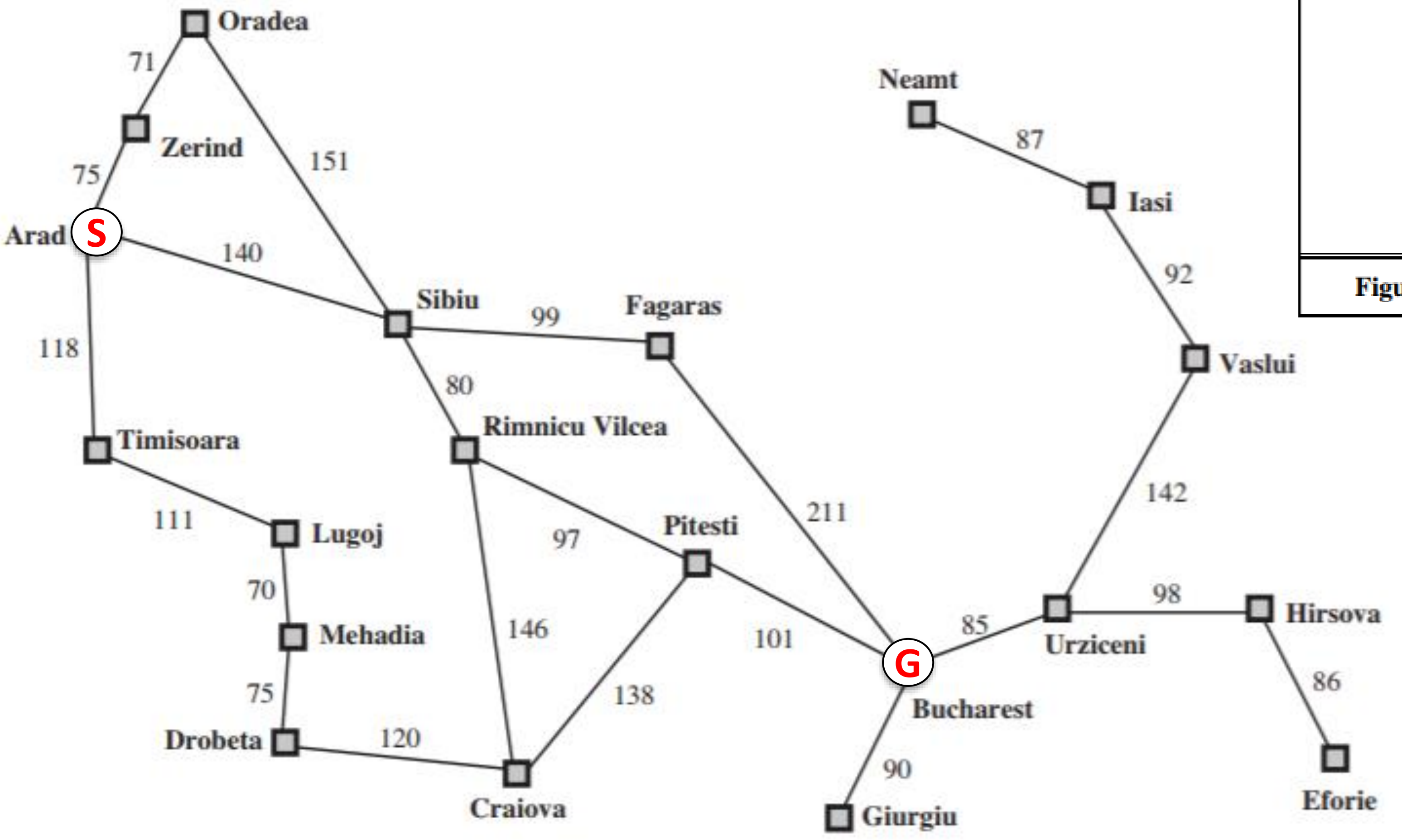
- Geometrically, the 'A' path seems shorter, as we are guided by the spatial proximity of A to G.
- What would uniform-cost expand first, A or B?
- How can an 'intelligent agent' be guided by this logic, such that it will consider A first?
  This is what brings us to *informed* search – and the A* algorithm.



*This cost may represent paths consisting of multiple steps

RUTGERS

A* in action



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

Figure 3.22 Values of h_{SLD}—straight-line distances to Bucharest.

Execute A*, using the straight line distance heuristic, to find the shortest path from Arad to Bucharest

Properties of A*

For Tree Search, admissibility is sufficient to achieve A optimality*

Definition

A heuristic function h is said to be **admissible** if it *never overestimates* the cost to reach the goal, i.e.

$$\forall n : h(n) \leq h^*(n),$$

where $h^*(n)$ is the true cost of the shortest path from n to the goal.

Theorem

If h is admissible then the tree search A^* is optimal.

Properties of A*

For graph search A^*, we need a stronger requirement on h because repeated states are not allowed.

Definition

A heuristic function h is said to be **consistent** if

$$\forall (n, a, n') : h(n) \leq c(n, a, n') + h(n').$$

where $c(n, a, n')$ is the step cost for going from n to n' using action a.

Theorem

If h is consistent then the graph search A^* is optimal.