CSC340/AI320 - Artificial Intelligence
Fall 2022

Lab 6

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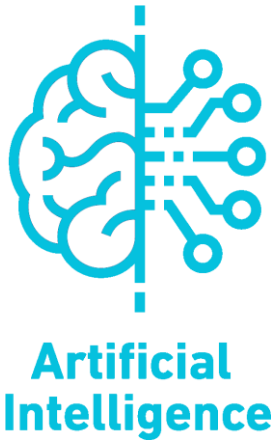


A* search: Minimizing the total estimated solution cost

The most widely known form of best-first search is called A* search.

It evaluates nodes by combining $\boldsymbol{g(n)}$, the cost to reach the node, and $\boldsymbol{h(n)}$, the cost to get from the node to the goal:

$$f(n) = g(n) + h(n)$$

Since $\boldsymbol{g(n)}$ gives the path cost from the start node to node n, and $\boldsymbol{h(n)}$ is the estimated cost of the cheapest path from n to the goal, we have

$$f(n) = \textit{estimated cost of the cheapest solution through } n$$

Thus, if we are trying to find the cheapest solution, a reasonable thing to try first is the node with the lowest value of $\boldsymbol{g(n) + h(n)}$.

It turns out that this strategy is more than just reasonable: provided that the heuristic function $h(n)$ satisfies certain conditions, A* search is both complete and optimal. The algorithm is identical to UNIFORM-COST-SEARCH except that A* uses $g + h$ instead of g.

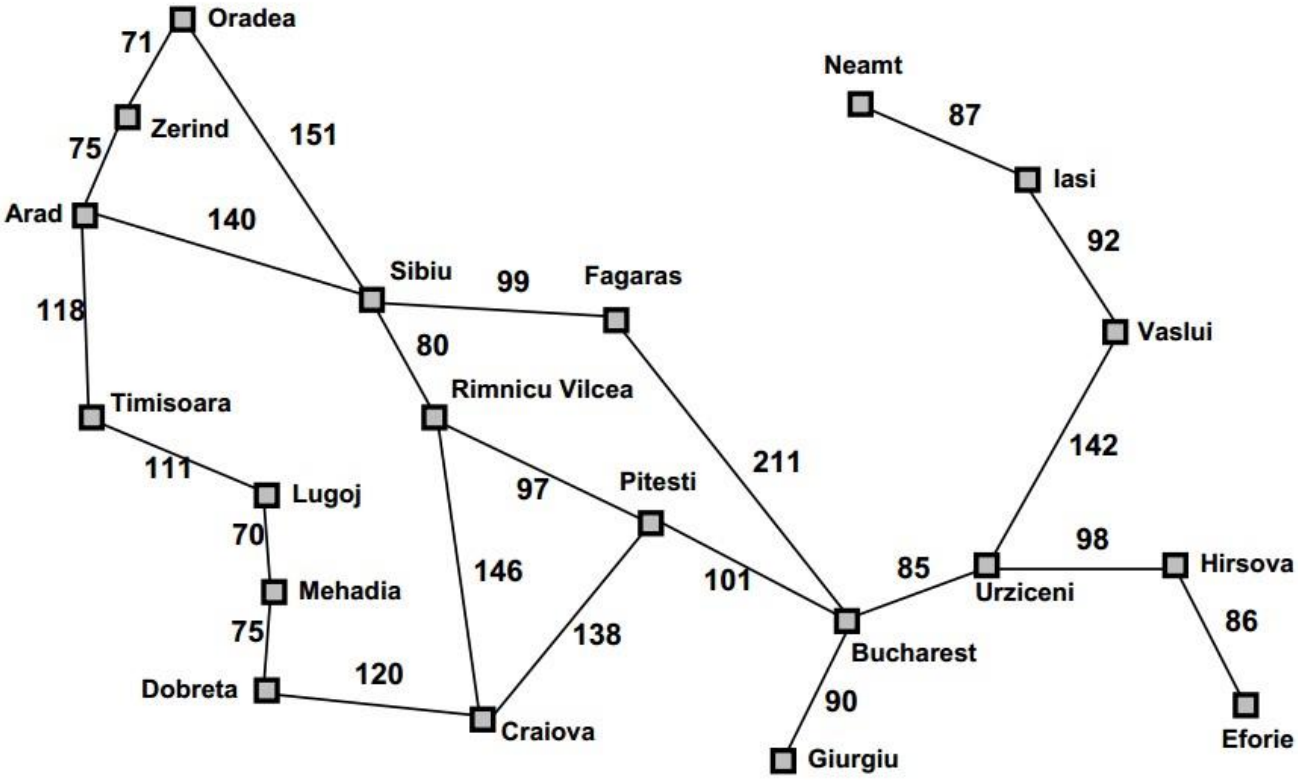
Conditions for optimality:

Admissibility: $\boldsymbol{h(n)}$ never overestimates the cost to reach the goal.

Consistency: A heuristic $\boldsymbol{h(n)}$ is consistent if, for every node $\boldsymbol{n}$ and every successor $\boldsymbol{n'}$ of $\boldsymbol{n}$ generated by any action $\boldsymbol{a}$, the estimated cost of reaching the goal from $\boldsymbol{n}$ is no greater than the step cost of getting to $\boldsymbol{n'}$ plus the estimated cost of reaching the goal from $\boldsymbol{n'}$:

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

Example 1:

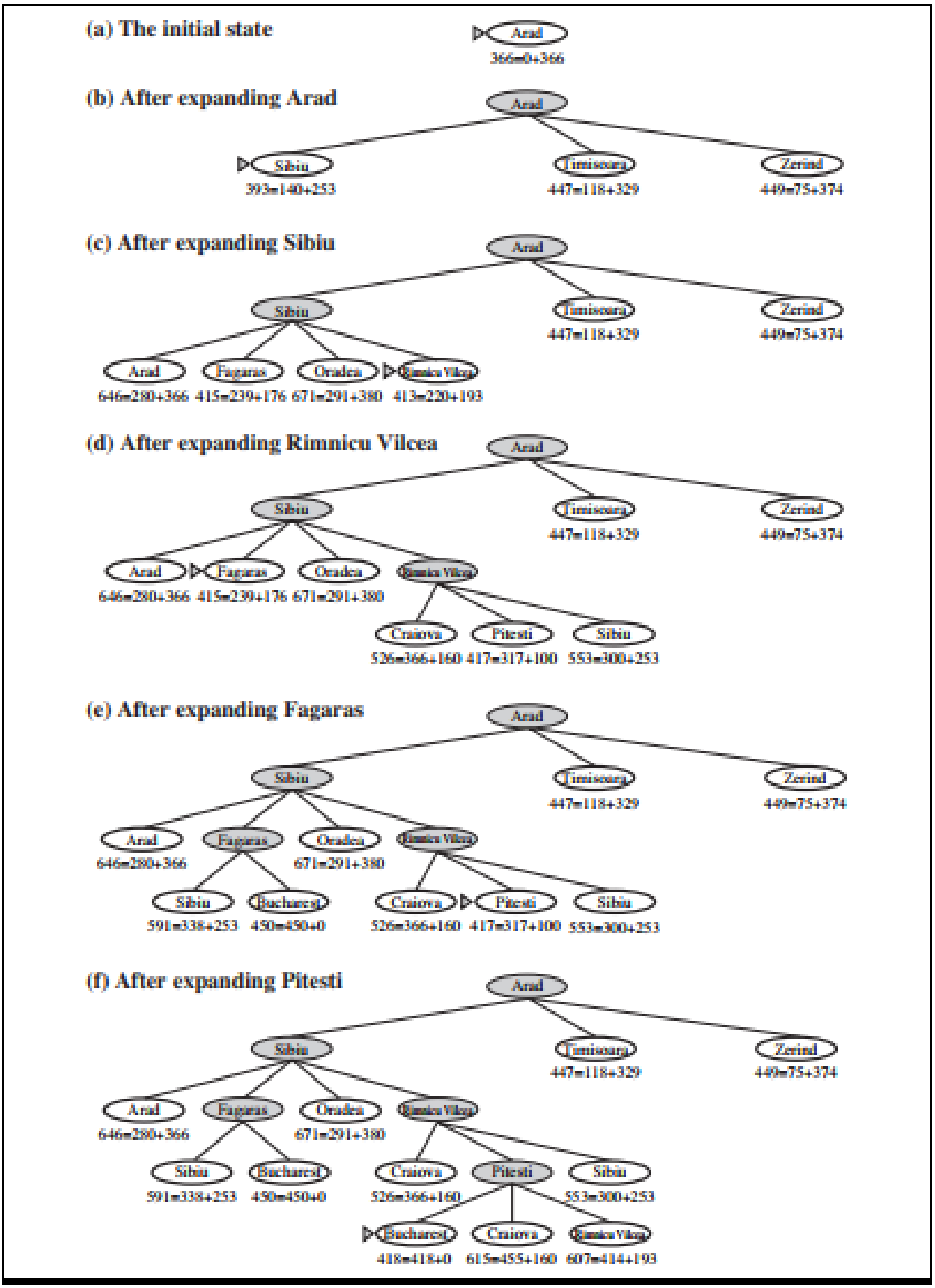


We use the straight-line distance heuristic, which we will call h_{SLD}.

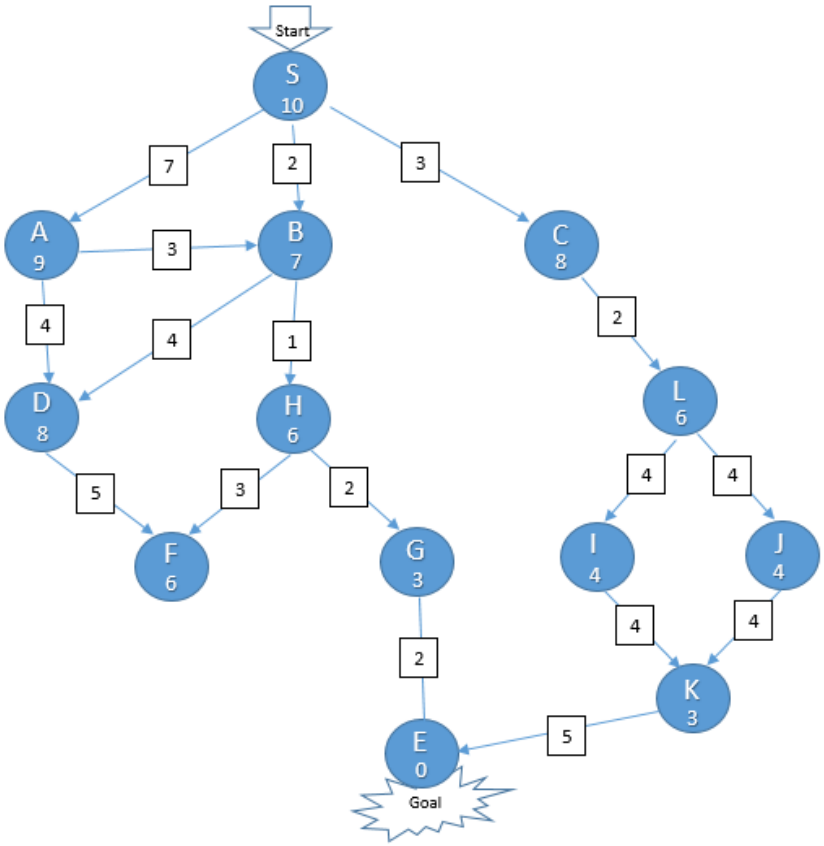
If the goal is Bucharest, the straight-line distances to Bucharest is shown below:

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

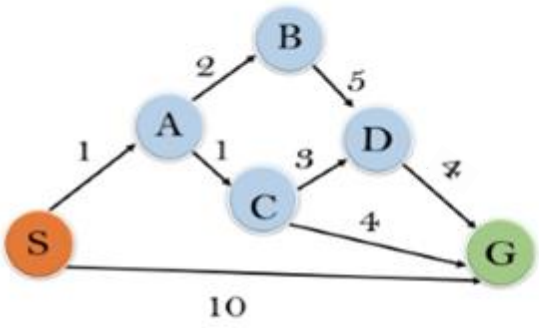
For this problem, A* search using h_{SLD} finds the optimal solution.



Example 2:



Example 3 (With code):



State	h(n)
S	5
A	3
B	4
C	3
D	6
G	0