CSC384H Tutorial 2

Informed Search

Summer 2025

A* & Heuristics

Below we showcase a tracing example of executing A* (without cycle-checking) on the problem highlighted in Figure 1.

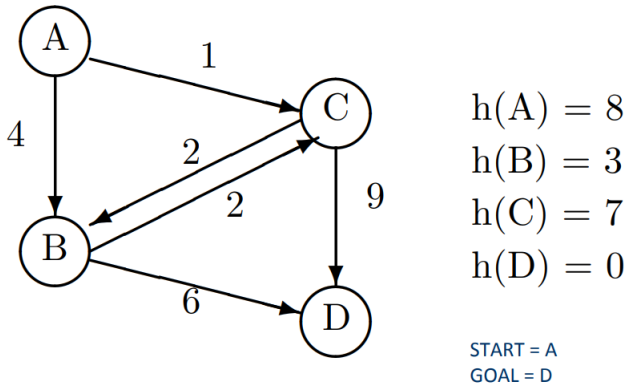

Figure 1: Another search problem.

Each cost is depicted as the cost to get to that node plus the heuristic cost at that node. The next node to be expanded is highlighted in blue. Here we maintain (Node, Path, Cost) as the tuple in the frontier.

Node Popped	Frontier
	{(A,A, 0+8=8)}
A	{(C,AC, 1+7=8), (B,AB, 4+3=7)}
AB	{(C,AC, 1+7=8), (C,ABC, 6+7=13), (D,ABD, 10+0=10)}
AC	{(B,ACB, 3+3=6), (D,ACD, 10+0=10), (C,ABC, 6+7=13), (D,ABD, 10+0=10)}
ACB	{(C,ACBC, 5+7=12), (D,ACBD, 9+0=9), (D,ACD, 10+0=10), (C,ABC, 6+7=13), (D,ABD, 10+0=10)}

Questions:

1. Execute A* with cycle-checking on the problem shown in Figure 1.

2. Prove that the A^* **Search** algorithm with cycle-checking is optimal when a consistent heuristic is utilized.

3. In the search problem below in Figure 2, we have listed 5 heuristics. Indicate whether each heuristic is admissible and/or consistent in the table below.

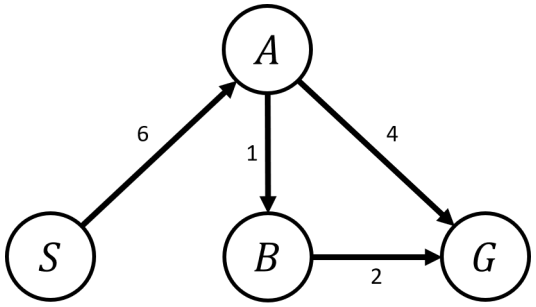

Figure 2: Graph for question 3.

	S	A	B	G	Admissible	Consistent
h_1	0	0	0	0		
h_2	8	1	1	0		
h_3	9	3	2	0		
h_4	6	3	1	0		
h_5	8	4	2	0		

4. (a) Provide a counter-example to show that the **Greedy Best-First Search** algorithm without cycle-checking is incomplete.

   (b) Provide a counter-example to show that **Greedy Best-First Search** (with or without cycle-checking) is not optimal.

5. Given that a heuristic h is such that $h(s_g) = 0$ where s_g is any goal state, prove that if h is consistent, then it must be admissible.