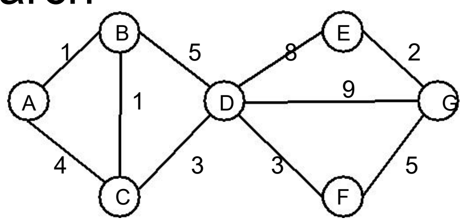
Homework 1 Due:23:59 May. 21th

Q1. Search



Node	h_1	h_2
A	9.5	10
B	9	12
C	8	10
D	7	8
E	1.5	1
F	4	4.5
G	0	0

Consider the state space graph shown above. A is the start state and G is the goal state. The costs for each edge are shown on the graph. Each edge can be traversed in both directions. Note that the heuristic h_1 is consistent but the heuristic h_2 is not consistent.

(a) Possible paths returned

For each of the following graph search strategies (do not answer for tree search), mark which, if any, of the listed paths it could return. Note that for some search strategies the speci c path returned might depend on tie-breaking behavior. In any such cases, make sure to mark all paths that could be returned under some tie-breaking scheme.

Search Algorithm	A-B-D-G	A-C-D-G	A-B-C-D-F-G
Depth rst search	✓	✓	✓
Breadth rst search	✓	✓	
Uniform cost search			✓
A* search with heuristic h_1			✓
A* search with heuristic h_2			✓

(b) Heuristic function properties

Suppose you are completing the new heuristic function h_3 shown below. All the values are xed except $h_3(B)$.

Node	A	B	C	D	E	F	G
h_3	10	?	9	7	1.5	4.5	0

For each of the following conditions, write the set of values that are possible for $h_3(B)$. For example, to denote all non-negative numbers, write [0, 1], to denote the empty set, write ?, and so on.

(i) What values of $h_3(B)$ make h_3 admissible?

$h^*(B) = \text{optimal cost} = 12$

$0 \le h_3(B) \le h^*(B)$

$h_3(B) \in [0, 12]$

(ii) What values of $h_3(B)$ make h_3 consistent?

$$\begin{cases} h_3(A) - h_3(B) \le \text{cost}(A \text{ to } B) \\ h_3(B) - h_3(C) \le \text{cost}(B \text{ to } C) \\ h_3(B) - h_3(D) \le \text{cost}(B \text{ to } D) \end{cases} \Rightarrow \begin{cases} h_3(B) \ge 9 \\ h_3(B) \le 10 \\ h_3(B) \le 12 \end{cases} \Rightarrow h_3(B) \in [9, 10]$$

(iii) What values of $h_3(B)$ will cause A* graph search to expand node A, then node C, then node B, then node D in order?

From A to C: $h_3(B) + 1 > h_3(C) + 4$

$\Rightarrow h_3(B) > 12$

From C to B: $h_3(B) + 5 < h_3(D) + 7$

$\Rightarrow h_3(B) < 9$

From A to B: $h_3(B) + 1 < h_3(D) + 7$

$\Rightarrow h_3(B) < 13$

$\Rightarrow h_3(B) \in (12, 13)$