CSC208_Lab: Algorithms Over Trees

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1 Problem 1

1. Come up with at least three spanning trees for this graph using the techniques discussed in the reading. Write down the collection of edges that compromises each tree.

A	0
B	1
C	2
D	1
E	2
F	3
G	2
H	3
I	4

2. In a sentence or two, translate what the triangle inequality says with respect to the domain of vertices and lengths of paths between them.
ANS: It says that adding the minimum distance between the first and second points and the second and third points will always either be the same or greater distance as the minimum distance between the first and the third

3. Table:

Destination	Path	Cost
A	A	0
B	AB	1
C	ABC	2
D	AD	1
E	ADE	2
F	ADEF	3
G	ADG	2
H	ADEH	3
I	ADEHI	4

The graph contains vertices where they are not all connected. For example given $|ab| + |bc| \geq |ac|$, we cannot compare $|ab| + |bc|$ to $|ac|$ because the edge BC does not exist.

4. First, the vertex v that minimizes the sum of the current best-known path from A to v and the straight line distance from v to I, v will be the vertex that has the length of 1 with the vertex I. Therefore, v will be either H or F. To calculate the shortest path from A to either H or F, we will first go from A to B, which has the weight of 1. From B we will move to E rather than C, because it has the shorter straight path compared than moving from C to I. Again, between H and F they have the same weight

5. Discuss why the heuristic function must now overestimate the actual cost of the shortest path. Specifically, what happens to Dijkstra's algorithm if the heuristic function has this bad property?
   ANS: Well, if it overestimated the cost instead of underestimating, we would be picking vertices that would lead to inefficient path finding.
   Havin ANS : If the heuristic function overestimates the cost to reach the goal, A* algorithm may explore unnecessary nodes, which increases the time complexity of the algorithm. This is because the algorithm assumes that the estimated cost is greater than or equal to the actual cost, so it explores all the nodes that are within the estimated cost. If the heuristic function overestimates the cost, the algorithm may miss the optimal solution.
   To avoid this issue, the heuristic function should always underestimate or precisely estimate the actual cost of reaching the goal. By doing so, A* algorithm can efficiently explore the graph and find the optimal solution in a reasonable amount of time.