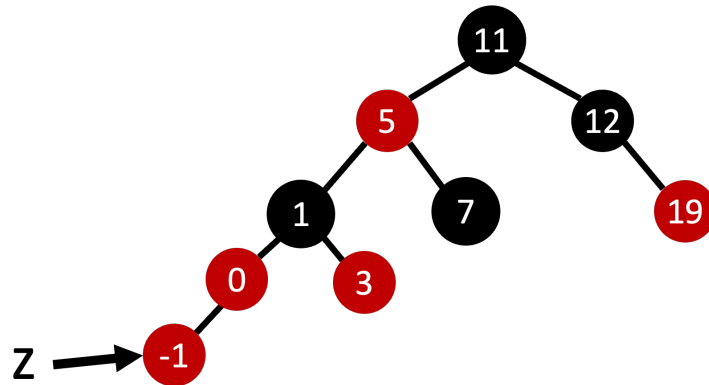
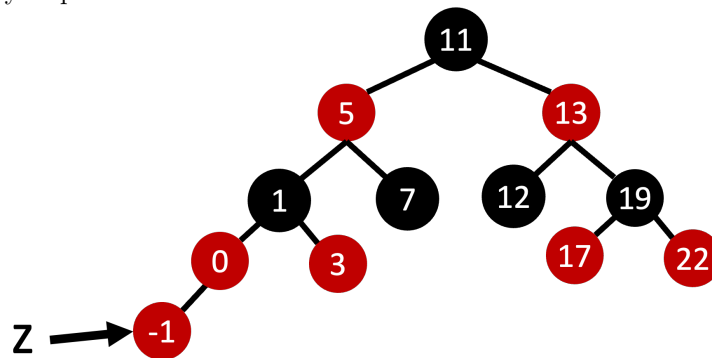


Theory Assignment 5

CS 452/652/752 Advanced Algorithms and Applications

Full points: 100 + 10 extra points

Question 1 - 20 points When inserting a node into a red-black tree, we may encounter three possible cases where at least one red-black property is violated. Given two red-black trees with a new node just inserted (marked as 'z'), (1) Identify which case each of the following trees encountered at node z. (2) Show step by step how to fix the red-black trees.



Question 2 - 50 points Given the following adjacency matrix for an undirected graph.

(1) - 5 points Draw the graph with edge weights.

(2) - 10 points Give the traversal order of BFS and DFS starting from node 's'. When enqueue or push unvisited neighbors into queue or stack, follow the alphabetical order.

(3) - 15 points Use Prim's algorithm to find a minimum spanning tree (MST) of the graph. You need to show step by step results and calculate the weight of the final MST.

(4) - 20 points Use Dijkstra's algorithm to find the shortest path from s to rest of the nodes in the graph. You need to show step by step results and the actual shortest paths from s to each node.

	s	a	b	c	d	e	f	g	i
s		2	4		2		1		
a	2				3	1			5
b	4					2	2	2	
c						3		2	6
d	2	3							1
e		1	2	3				6	1
f	1		2					3	
g			2	2		6	3		
i		5		6	1	1			

Question 3 - 40 points Given the following adjacency matrix for a directed graph. Assume matrix entry (i, j) is for edge $i \rightarrow j$.

(1) - 10 points Draw the graph with edge weights.

(2) - 10 points Give the traversal order of BFS and DFS starting from node 's'. When enqueue or push unvisited neighbors into queue or stack, follow the alphabetical order.

(3) - 20 points Use Bellman-Ford algorithm to find the shortest path from s to rest of the nodes in the graph. You need to show step by step results after each relaxation iteration. Identify if there is a negative cycle in the graph.

	s	a	b	c	d	e	f	g	i
s			4		-2		5		
a	2				3	1			
b								2	
c									6
d									1
e			2						-1
f			-2					3	
g				2		-6			
i		5							