ICS 202 – Data Structures and Algorithms
Spring Semester 2024/2025 (242)
Assignment #3

Question 1 (30 points): For all parts below, show all intermediate steps. Redraw if there is a need to "erase".

a) (15 points): Draw the tree after inserting integers/keys: 15, 5, 30, 12, 40, 3, 18, 7, 20, 6, 22 into an initially empty
   i. Binary search tree.
   ii. AVL tree.
   iii. B-tree of order 3.

b) (7.5 points) Draw the tree after deleting
   i. 15 from the Binary search tree generated in part a) by copying.
   ii. 3 from the AVL tree generated in part a).
   iii. 3 from the B-tree generated in part a).

c) (7.5 points) Draw the tree after inserting 50 into
   i. Binary search tree generated in part a).
   ii. AVL tree generated in part a).
   iii. B-tree generated in part a).

Question 2 (20 points): Use the hash function $h(x) = x \; mod \; 11$ to load the following values 25, 14, 36, 47 using each of following to resolve collisions into the hash table. Make sure you show all your work:

index	0	1	2	3	4	5	6	7	8	9	10
	33										**21**

a) $c(i) = i$

index	0	1	2	3	4	5	6	7	8	9	10
	33										**21**

b) $c(i) = \pm i$

index	0	1	2	3	4	5	6	7	8	9	10
	33										**21**

c) $c(i) = i * h_p(x)$ where $h_p(x) = 1 + x \bmod 10$

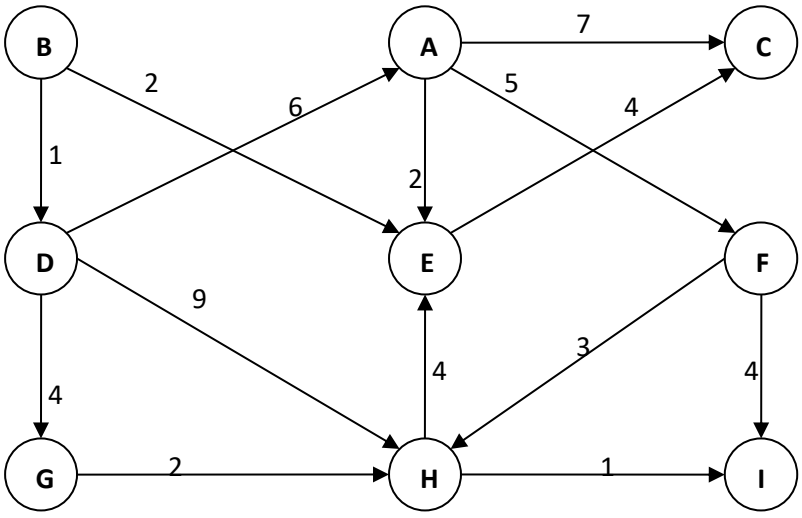
Question 3 (20 points): Given the following search pattern: ABXABYABXZ

a) (5 points) Create the KMP lps array.

b) (15 points) Using that search pattern and the array you created, perform a search on the following block of text by filling the following table: ABXABYABXABYABXZABC

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	#comparisons
A	B	X	A	B	Y	A	B	X	A	B	Y	A	B	X	Z	A	B	C	

Question 4 (60 points): Given the following graph, answer the following questions. Make sure to process vertices or adjacent vertices in alphabetical order.



a) (9 points) List the vertices in the order they are visited using pre-order depth-first traversal starting from **vertex A**.

b) (9 points) List the vertices in the order they are visited using post-order depth-first traversal starting from **vertex A**.

c) (9 points) List the vertices in the order they are visited using breadth-first traversal starting from **vertex A**.

d) (9 points) List the vertices in the order they are visited using Topological order traversal.

e) (24 points) Trace the execution of Dijkstra's algorithm, filling the table below, as it solves the shortest path problem starting from **vertex B**. Draw the resulting vertex-weighted graph.

Pass	initially	1	2	3	4	5	6	7	8	9	weight	Predecessor
Active Vertex												
A												
B												
C												
D												
E												
F												
G												
H												
I												

IMPORTANT NOTE REGARDING THIS HOMEWORK SUBMISSION

This part will be submitted to GRADESCOPE. It must be a single pdf file. If you do not type your homework and just solve by hand, make sure you clearly scan the pages (using a scanner or a mobile scanning software like Office Lens or Cam Scanner) of your homework and convert them into **A SINGLE pdf file** or using the GRADESCOPE app directly on iOS/Android. Make sure to map each answer to the corresponding question. *Failure to do the mapping will result in losing 5 points.*