COMP 282 - Midterm 1 (Fall, 2018) Name:

**Question 1** Provide a short answer to the following questions.

1. What is the benefit to using a binary tree over other data structures?
2. Give an example of when you would use a graph?
3. What is a clique?
4. What is one quality that *all* trees exhibit, that graphs, in general, do not?
5. What is the balance property all *AVL Trees* seek to maintain?

**Question 2** Build a proper *AVL Tree* given the following inputs. Show all steps. Include – at each step – the balance factor of each node.

3, 2, 1, 4, 5, 6

**Question 3** Provide all of the listed traversals for the following binary tree. Be sure to label them.

* Pre-order traversal.
* In-order traversal.
* Breadth-first traversal.



F

D

W

B

E

I

X

A

C

G

Z

H

**Question 4** Insert the value 5 into the following *Red-Black Tree*. Denote red nodes with a dashed outline, black nodes with a solid circle, and double-black nodes with a double-solid circle. Show all steps.



3

1

9

6

10

4

8

**Question 5** Build a proper *2-3-4 Tree* from the following input. Show all steps, including rotations.

insert 1,3,4,6

delete 3

insert 2, 7, 8, 9

delete 6

**Question 6** Delete the I node from the following *Red-Black Tree*. Denote red nodes with a dashed outline, black nodes with a solid circle, and double-black nodes with a double-solid circle. Show all steps.



I

D

K

B

F

J

L

A

C

E

H

**Question 7** Given the following adjacency matrix, draw the weighted, undirected graph with *V* =

*{v*0*, v*1*, v*2*, v*3*, v*4*, v*5*}*.

0 1 0 2 3 0

 

0 0 4 1 0 2

0 0 0 2 3 0

0 0 0 0 1 4

 

0 0 0 0 0 0

0 0 0 0 0 0

# No Illustrations

**Question 8** Given the following graph *G* = (*V, E*), list the vertices that form a connected component with *v*3.

*V* = *{v*0*, v*1*, v*2*, v*3*, v*4*, v*5*, v*6*, v*7*, v*8*, v*9*}*

*E* = *{{v*0*, v*1*}, {v*1*, v*3*}, {v*0*, v*3*}, {v*3*, v*4*}, {v*4*, v*6*}, {v*2*, v*5*}, {v*5*, v*7*}, {v*5*, v*8*}, {v*7*, v*8*}, {v*7*, v*9*}, {v*8*, v*9*}}*

# No Illustrations

**Question 9** Use Kruskal’s Algorithm to calculate the minimum spanning forest of the following graph

*G* = (*V, E, w*). Show all steps. List all vertices in a particular spanning tree, and give its final cost.

*V* = *{v*0*, v*1*, v*2*, v*3*, v*4*, v*5*, v*6*, v*7*, v*8*, v*9*}*

|  |  |
| --- | --- |
| E | w |
| *v*1*, v*2 | 1 |
| *v*1*, v*4 | 2.5 |
| *v*2*, v*3 | 1.5 |
| *v*5*, v*0 | 7 |
| *v*0*, v*7 | 0.2 |
| *v*6*, v*3 | 8.4 |
| *v*8*, v*9 | 2.6 |

# No Illustrations

**Question 10** Given the graph *G* = (*V, E, w*), below, find the shortest path between *v*2 and *v*6.

*V* = *{v*0*, v*1*, v*2*, v*3*, v*4*, v*5*, v*6*, v*7*}*

|  |  |
| --- | --- |
| E | w |
| *v*0*, v*1 | 0.5 |
| *v*0*, v*3 | 1.2 |
| *v*0*, v*4 | 0.3 |
| *v*1*, v*2 | 1.9 |
| *v*1*, v*3 | 2.2 |
| *v*1*, v*5 | 1.3 |
| *v*2*, v*3 | 4.7 |
| *v*2*, v*7 | 9.1 |
| *v*4*, v*6 | 2.7 |
| *v*5*, v*6 | 3.1 |
| *v*6*, v*7 | 2.8 |