COMP 282 - Midterm 1 (Spring, 2019) Name:

Question 1 (10 Points) Provide a short answer to the following questions.

a Give an example of when you might use a linked list.

b Give an example of when you would use a graph.

c What is the property that allows Binary Trees to be quickly searchable? What is an "easy" way of maintaining this property?

d We know that all trees are graphs. Why are not all graphs trees?

e Why do we have asyptotic analysis (Big-O notation)?

Question 2 (10 Points) Circle the appropriate choices for the following questions. There may be more than one correct answer.

a Which data structures are searchable in $O(\lg n)$ time. Assume any favorable arrangements of data necessary to achieve this property.

i Trees

ii Linked Lists

iii Arrays

iv Graphs

v Binary Trees

vi None of These

b Of these, which is the most appropriate data structure with which to construct a FIFO queue?

i Trees

ii Arrays

iii Primitive

iv Binary Trees

v Linked Lists

c Which of the following properties are relevant to binary trees?

i Balance

ii Mass Density

iii Edge Weight

iv Shortest Path

v Height

vi Half-Life

d Circle both the *minimum* and *maximum* height a binary tree containing 31 values may have.

i 0

ii 31

iii 6

iv 42

v 5

vi 4

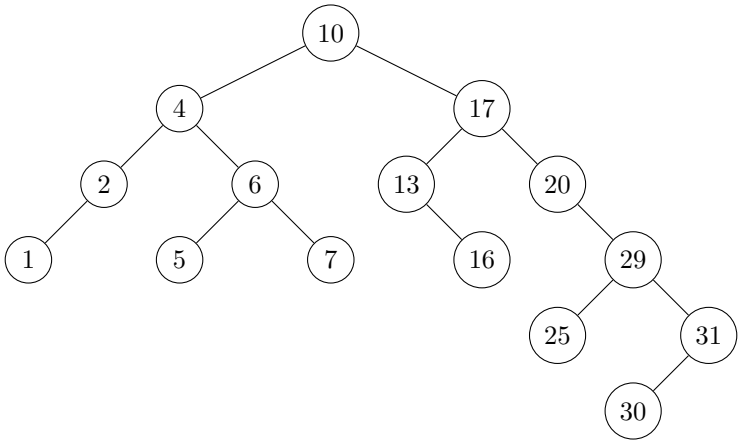
Question 3 (10 Points) Given the following scenarios, describe a data structure that would be most-appropriate. Justify each.

a You are building an e-commerce site which is expected to have a lot daily visitors. The problem is, your payment system is notoriously slow to process individual payments. You want a way to keep track of all customers currently waiting to check out their orders.

b You are writing a program for the campus library. The task is to organize all the Computer Science research papers currently in the archives. Each article has a list of references at the end that refer to other articles in the collection.

Question 4 (10 Points) 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.



Question 5 (20 Points) 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
$\{v_0, v_1\}$	3
$\{v_1, v_2\}$	2
$\{v_3, v_4\}$	3
$\{v_4, v_5\}$	1
$\{v_5, v_6\}$	2
$\{v_6, v_4\}$	2
$\{v_6, v_7\}$	4
$\{v_7, v_4\}$	3
$\{v_7, v_8\}$	2
$\{v_8, v_9\}$	1
$\{v_9, v_5\}$	4

Question 6 (20 Points) Given the following graph $G = (V, E)$, use any (appropriate) algorithm discussed in class to list the vertices that form a connected component with v_3. State the algorithm you are using, show all steps.

$$V = \{v_0, v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8, v_9\}$$

$$E = \{\{v_0, v_1\}, \{v_1, v_4\}, \{v_3, v_2\}, \{v_2, v_5\}, \{v_5, v_6\}, \{v_5, v_8\}, \{v_6, v_8\}, \{v_6, v_9\}, \{v_7, v_6\}, \{v_8, v_7\}, \{v_7, v_9\}, \{v_9, v_8\}\}$$

Question 7 (20 Points) Given the graph $G = (V, E, w)$, below, find the shortest path between v_2 and v_6. Show all steps.

$$V = \{v_0, v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8, v_9\}$$

E	w
$\{v_0, v_4\}$	1
$\{v_0, v_1\}$	7
$\{v_0, v_6\}$	2
$\{v_1, v_2\}$	4
$\{v_1, v_0\}$	7
$\{v_2, v_9\}$	3
$\{v_2, v_8\}$	6
$\{v_2, v_7\}$	4
$\{v_3, v_2\}$	1
$\{v_5, v_2\}$	3
$\{v_5, v_6\}$	4
$\{v_6, v_2\}$	10
$\{v_6, v_7\}$	2