CSE 2320 Name _____

Test 1

100 points UTA Student ID # _____

Short Answer - 5 points each

1. $H_n - H_{n-1} = ?$
2. Suppose the size of a table of integers in ascending order is increased from 100 to 800. How many ***additional*** probes are needed in the worst case for binary search?
3. Give the average case time for quicksort.
4. Give the averge case time for insertion sort.
5. For which sorts does the decision tree model NOT apply?
6. Which of the following include $f(n) = n^2 + n \lg n + n + \lg n$? ***Write*** your answer to the right.
   $\Theta(\lg n)$ $O(n)$ $\Omega(n \lg n)$ $\Theta(n^2)$
7. ***Write*** the true relationships to the right.
   $n \in \Theta(n/2)$
   $n \in O(\lg n)$
   $3^n \in \Omega(2^n)$
   $n^{1000} \in O(1.00001^n)$

Long Answer.

1. ***Trace*** the execution of PARTITION on the following array. Be sure to show all movements of the keys. (10 points)
   6 5 2 3 4 9 0 1 8 7
2. Suppose BUILD-MAX-HEAP has been used to construct the given array. ***Show the array*** after EXTRACT-MAX. 10 points

1	15
2	14
3	12
4	7
5	13
6	11
7	10
8	6
9	2
10	8
11	9
12	5
13	3
14	4
15	1

3. Use the recursion-tree method to show that $T(n) = 2T(n/2) + 1/n$ is in $\Theta(n)$. (15 points)
4. Use the substitution method to show that $T(n) = 3T(n/3) + n^2$ is in $\Theta(n^2)$. (15 points)
5. Suppose you have a table of n integers in ascending order with duplicates allowed. Give a O(log n) time algorithm (a C/C++ function is fine) that returns the lowest subscript with a key that is no smaller than a given key. If the array does not contain such an entry, then return n. (15 points)

CSE 2320 Name _____

Test 2

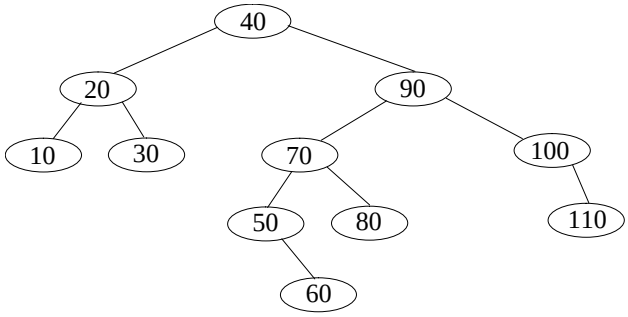
100 points UTA Student ID # _____

Short Answer - 5 points each

1. Suppose double hashing is used with a table size of 10,000. What difficulty arises?
2 A double hash table is 90% full. How many probes do you expect to use for an unsuccessful search?
3. Compare the difference in performance for finding the successor of an element in an unordered singly linked list and an unordered doubly linked list.
4. Compare the difference in performance for deleting an element of an ordered singly linked list and an element of an ordered doubly linked list.
5. Suppose each of the three binary tree traversal techniques are applied to a legal red-black tree. For which of the three techniques is it possible to process (e.g. print) two red nodes in succession?
6. Explain how deletion is performed when hashing is used.

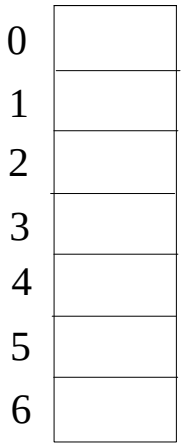
Long Answer. 10 points each

1. If possible, give a legal red-black coloring for the following tree by <u>listing</u> the keys of the black nodes.



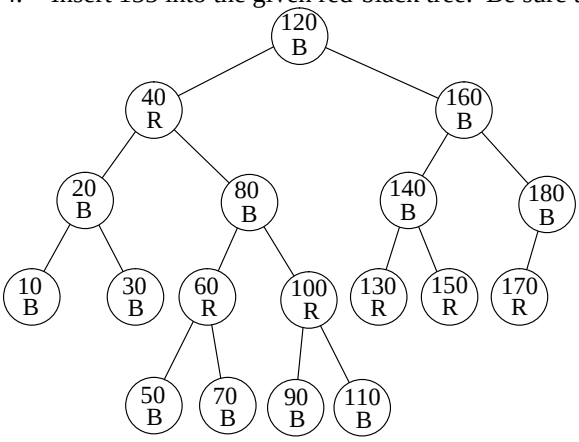
Black nodes:

2. Give implementations for the PUSH and POP operations for a stack, along with a COUNT operation that will indicate the number of stack entries currently available for the POP operation. It is not necessary to address error conditions.
3. Use double hashing to place numeric keys in a hash table.
   a. Indicate the h_1 and h_2 functions you are using.
   b. Insert these keys in this order. List the h_1 and h_2 values for each key, along with the elements of each probe sequence that were examined when inserting each key.

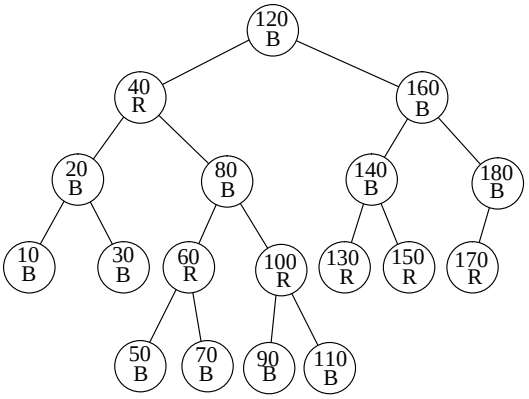


	h_1	h_2	Probe Sequence
86			
94			
87			
62			
122			
110			
20			

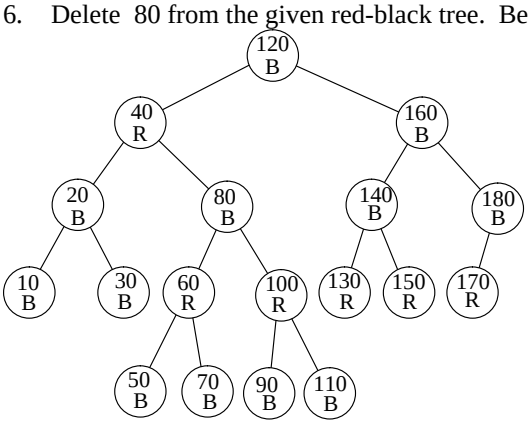
4. Insert 155 into the given red-black tree. Be sure to indicate the cases that you used. 10 points



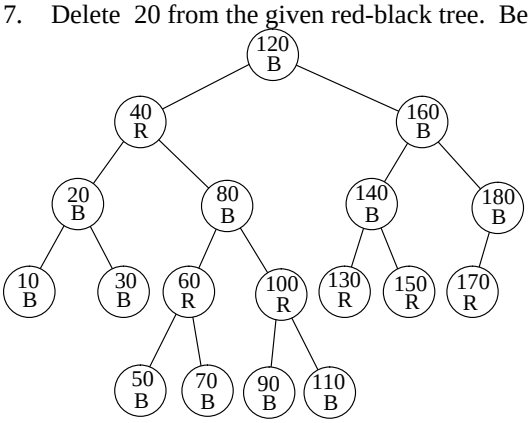
5. Insert 175 into the given red-black tree. Be sure to indicate the cases that you used. 10 points



6. Delete 80 from the given red-black tree. Be sure to indicate the cases that you used. 10 points



7. Delete 20 from the given red-black tree. Be sure to indicate the cases that you used. 10 points



CSE 2320 Name _____

Test 3

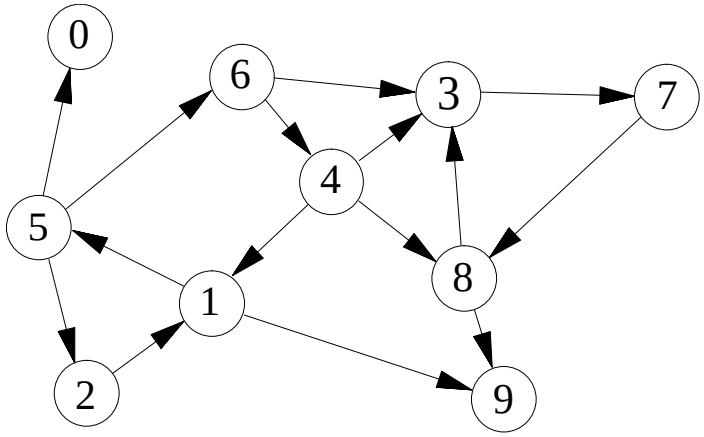
100 points UTA Student ID # _____

Short Answer - 5 points each

1. What is the advantage of using breadth-first search when finding augmenting paths?
2. For which problem(s) was the greedy solution only approximate, rather than being exact?
3. State the cost function for solving the matrix-chain multiplication problem by dynamic programming.
4. Give an asymptotic upper bound on the time for computing a Huffman code.
5. Give an asymptotic upper bound on the time for computing the optimal matrix multiplication order by dynamic programming.
6. Give an asymptotic upper bound on the time for Prim's algorithm.

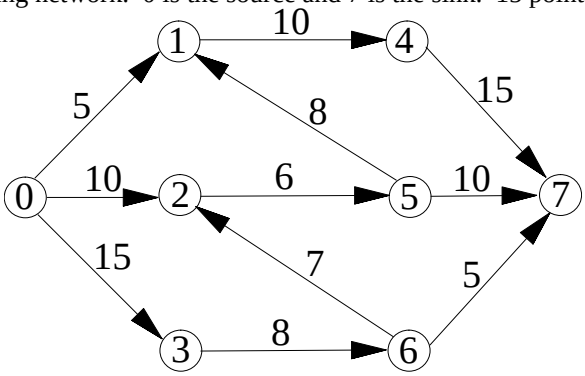
Long Answer.

1. Perform depth-first search on the following graph, including start/finish times and edge types (T=tree, B=back, C=cross, F=forward. Assume that the adjacency lists are ordered. Write your answer in the tables below. 15 points



Vertex	Start	Finish	Edge	Type	Edge	Type
0	_____	_____	1 → 5	_____	6 → 3	_____
1	_____	_____	1 → 9	_____	6 → 4	_____
2	_____	_____	2 → 1	_____	7 → 8	_____
3	_____	_____	3 → 7	_____	8 → 3	_____
4	_____	_____	4 → 1	_____	8 → 9	_____
5	_____	_____	4 → 3	_____		
6	_____	_____	4 → 8	_____		
7	_____	_____	5 → 0	_____		
8	_____	_____	5 → 2	_____		
9	_____	_____	5 → 6	_____		

2. Give a minimum cut for the following network. 0 is the source and 7 is the sink. 15 points.



S vertices: 0

T vertices: 7

3. Complete the following instance of KMP failure link table construction. 15 points

1	2
0	a
1	b
2	a

```
3       b
4       a
5       c
6       a
7       b
8       a
9       b
10      a
11      c
12      a
13      b
14      a
```

4. Use dynamic programming to find a longest common subsequence of `abcabc` and `cbaabc`. 10 points
5. In lab 4, Dijkstra's single-source shortest path algorithm was modified to find maximum capacity paths from the source to the sink in a network. Also, recall that the Floyd-Warshall algorithm may be used to determine all-pairs shortest paths.

a. Give code (or pseudocode) for the Floyd-Warshall algorithm. The input will be a matrix giving distances between vertices. In addition to modifying the input matrix to give shortest path distances, your answer must also produce the successor (or predecessor) matrix. YOU DO NOT NEED TO GIVE A COMPLETE PROGRAM, JUST THE FLOYD-WARSHALL ALGORITHM. 8 points

b. Modify your answer to part a. to compute a maximum capacity path between all pairs of vertices, not just the source and sink. 7 points