CSE 2320 Name ____________________________
Test 1
100 points UTA Student ID # ____________________________

Short Answer - 5 points each

1. Why is BUILD-MAX-HEAP better than using sorting?
2. Give the recurrence for the worst-case running time for merge sort.
3. Shellsort uses preprocessing to improve the performance of which sorting method?
4. Give the definition of H_n and an approximation of its value.
5. Give a function that is in both $\Omega(2^n)$ and $O(3^n)$, but is not in $\Theta(2^n)$ or $\Theta(3^n)$.
6. What is the worst-case running time for PARTITION?
7. Explain how the elements of a heap are mapped to an array.
8. Use integrals to bound, both above and below, the value of

$$\sum_{i=1}^{n} i$$

9. In the study of sorting, why is the fact that $\lg(n!) = \Omega(n \lg n)$ significant?
10. List the sorts that require only O(1) additional space besides the array to be sorted.

Long Answer.

1. Use the definitions of O and Ω to prove that if $f(n) \in O(g(n))$, then $g(n) \in \Omega(f(n))$. 10 points
2. Use the recursion tree method to show that $T(n) = T(n/2) + \lg n$ is in $\Theta(\lg^2 n)$. (Recall that $\lg^2 n=(\lg n)^2$.) 10 points.
3. Use the substitution method to show that $T(n) = T(n/2) + \lg n$ is in $\Theta(\lg^2 n)$. (Recall that $\lg^2 n=(\lg n)^2$.) 10 points.
4. Suppose an array stores 1000 distinct integers in descending order. Give code for a binary search to determine the subscript (if it exists) where a supplied number is stored in the table. 10 points
5. Demonstrate PARTITION on the following array. 10 points

8 0 4 9 1 2 3 6 7 5

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Test 2
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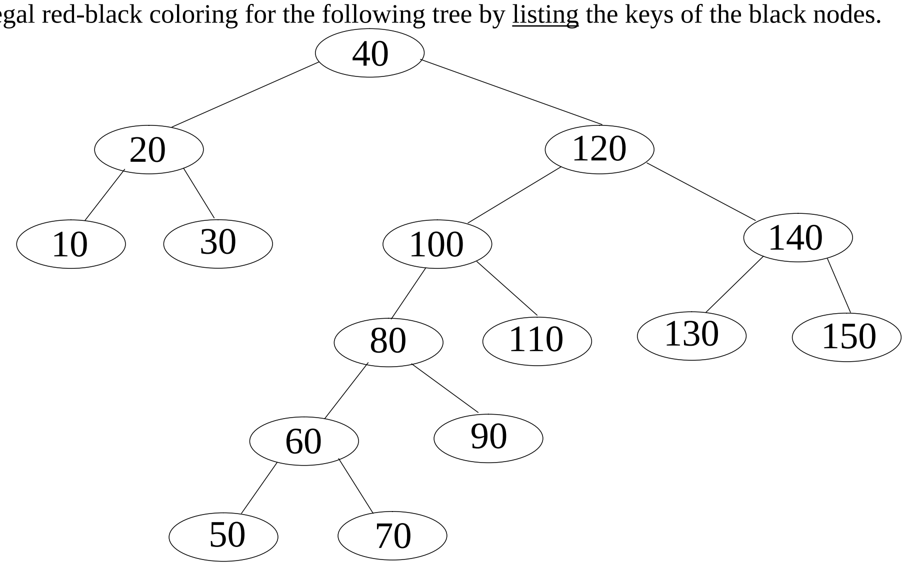
Short Answer - 5 points each

1. Give an example of an operation that is efficiently supported by red-black trees, but not by hashing.
2 When is a circular queue empty? When is a circular queue full?
3. When is it useful to find the successor of a key to be deleted from a binary search tree?
4. What do the stack entries contain when computing the value of a postfix expression?
5. Give the upper bound on the expected number of probes for successful search for open-address hashing.
6. Which binary tree traversal may be used to list the keys in a binary search tree in ascending order?

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.



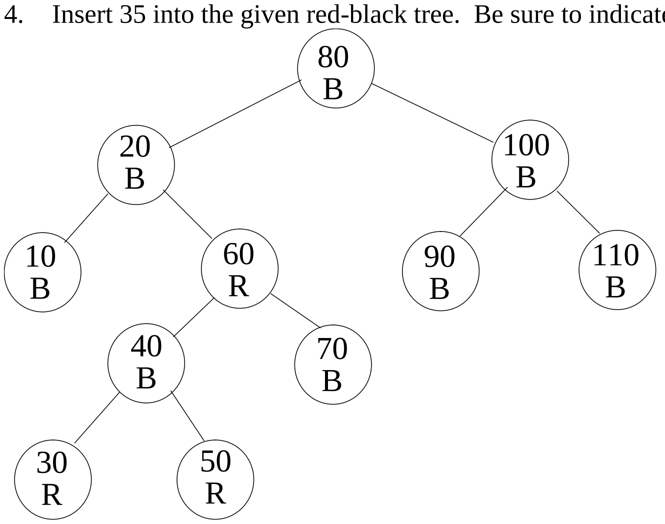
Black nodes:

2. Use linear probing with remaindering as the hash function to place the keys in the hash table. The insertions must be done in the order given:

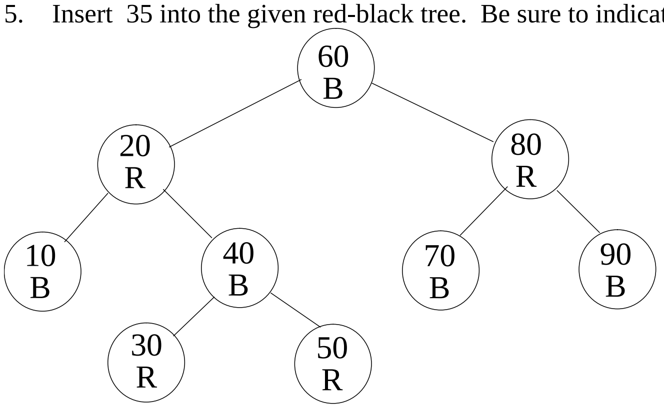
86 94 87 62 122 110 20 30 88

0	
1	
2	
3	
4	
5	
6	
7	
8	

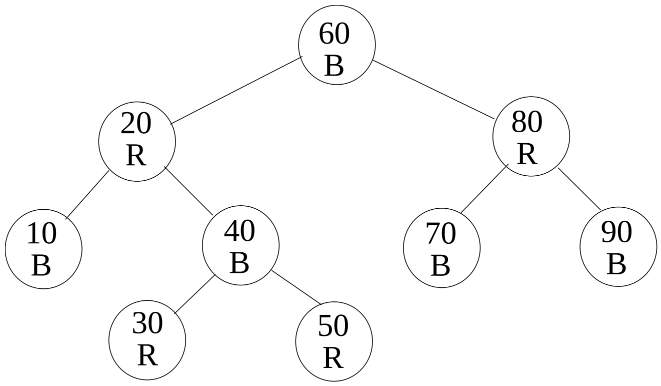
3. Describe each of the linked list variations that were studied and indicate why each is useful.
4. Insert 35 into the given red-black tree. Be sure to indicate the cases that you used. 10 points



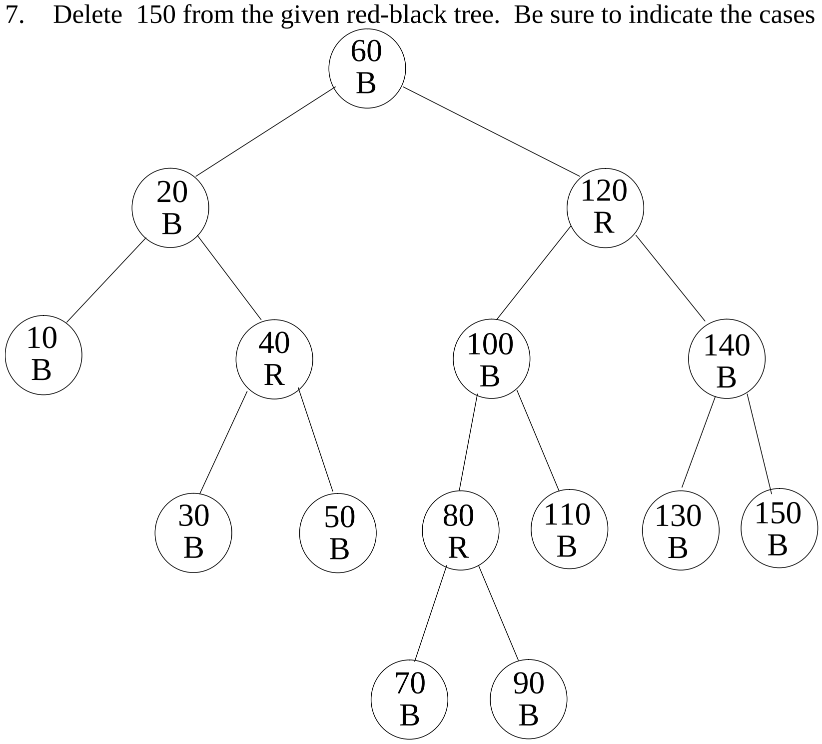
5. Insert 35 into the given red-black tree. Be sure to indicate the cases that you used. 10 points



6. Delete 60 from the given red-black tree. Be sure to indicate the cases that you used. 10 points



7. Delete 150 from the given red-black tree. Be sure to indicate the cases that you used. 10 points



CSE 2320
Test 3
100 points

Name ______________________________

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Short Answer - 5 points each

1. Give an instance of the network flow problem that could have an exponential number of augmenting paths if breadth-first search is not used.
2. What is the worst-case time for the algorithm that determines the strongly-connected components of a directed graph?
3. State the cost function for the longest common subsequence problem.
4. Explain the meaning of each of the ‘‘colors’’ used during breadth-first search.

Long Answer.

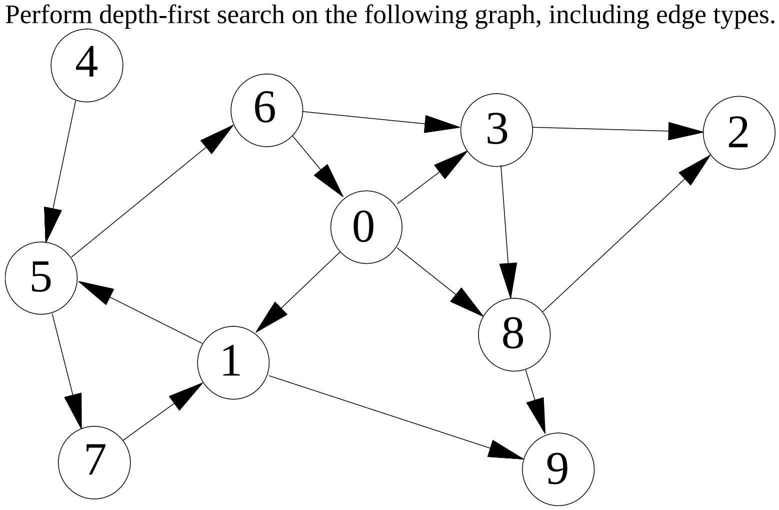
1. Complete the following instance of KMP failure link table construction. 15 points

<u>1</u> <u>2</u>

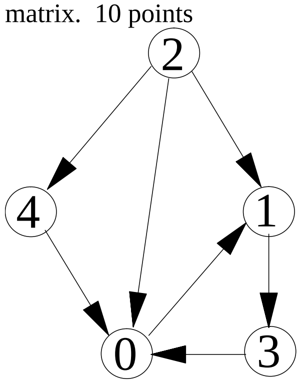
0	a
1	c
2	a
3	b
4	a
5	c

6	a
7	c
8	a
9	b
10	a
11	c
12	a
13	b
14	a

2. Perform depth-first search on the following graph, including edge types. Assume that the adjacency lists are ordered. 10 points



3. Demonstrate Warshall's algorithm on the following graph by giving either the final successor matrix or the final predecessor matrix. 10 points

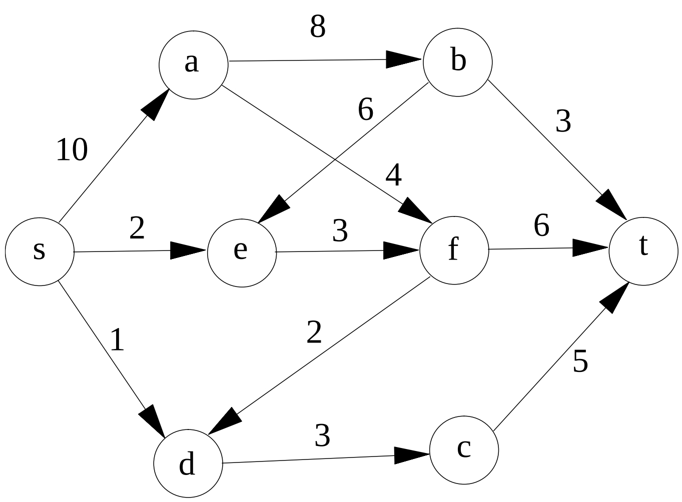


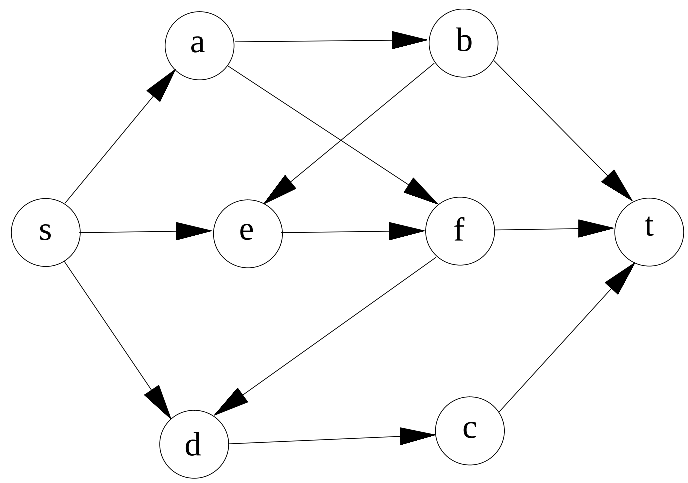
4. Complete the following instance of the optimal matrix multiplication ordering problem, including the tree showing the optimal ordering. 10 points

```
p[0]=5
p[1]=6
p[2]=4
p[3]=7
p[4]=8
p[5]=4
```

	1		2		3		4		5	
1	0	0	120	1	260	2	504	2	**???**	**?**
2	-------		0	0	168	2	416	2	432	2
3	-------		-------		0	0	224	3	336	3
4	-------		-------		-------		0	0	224	4
5	-------		-------		-------		-------		0	0

5. For the given network, determine a maximum flow and the minimum cut. Be sure to give each augmenting path, the amount of additional flow that it provides, and the residual graph after each augmenting path is recorded. You may choose the augmenting paths in any manner you wish. 15 points





Augmenting Path/Flow:
.
.
.
Minimum Cut:

6. Give an optimal Huffman code tree for the provided symbols and probabilities. In addition, compute the expected number of bits per symbol. 10 points

```
A  .15
B  .2
C  .15
D  .13
E  .2
F  .07
G  .1
```

7. What are the entries in the heap (for Prim's algorithm) before and after moving the next vertex and edge into the minimum spanning tree? DO NOT COMPLETE THE ENTIRE MST!!! Edges already in the MST are the thick ones. Edges currently not in the MST are the narrow ones. You do not need to show the binary tree for the heap ordering. 10 points