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

Short Answer. 5 points each

1. What is the purpose of the decision-tree model?
2. What is the h-sequence that we used for shellsort?
3. Is $\theta(2^n) = \theta(3^n)$?
4. When is counting sort inappropriate? Be precise.
5. Suppose that the subscript of a heap element is 10 in a heap with 20 elements. What are the subscripts of its children?
6. Suppose that a C program uses `qsort()` to sort a table, but is found to incorrectly sort the table in reverse order. Give a good way to fix the program. (Writing a function that reverses the table is not a good way!)
7. Give two functions, g(n) and h(n), such that f(n) = lg n is in $\Omega(g(n))$ and $O(h(n))$, but f(n) is not in either $\theta(g(n))$ or $\theta(h(n))$.

8. Evaluate the |sum: $$\sum_{k=1}^{10}\left(\frac{1}{k} - \frac{1}{k+1}\right)$$

9. How may an unstable sort be forced to behave in a stable fashion?
10. Give a recurrence that describes the worst-case behavior of quicksort.
11. What value of *q* does PARTITION return when all elements in the array *A*[*p*..*r*] have the same value?
12. Give C code to perform ordinary binary search to find an integer key in a table in ascending order. Each value in the table is unique. You may do this using `bsearch()` and the appropriate comparison function or you may hardcode the entire search.

Long Answer. 10 points each

1. Demonstrate LSD radix sort for the following binary strings.

   0101
   1110
   1010
   0001
   1001
   1101
   0111
   1011
   1100
   0000
   0010
2. Use the iteration method to show that T(n) = T(2n/3) + 3n/2 is in $\theta(n)$.
3. Use the substitution method to show that T(n) = T(2n/3) + 3n/2 is in $\theta(n)$.
4. Explain how you would use a <u>max</u>Heap with 15 nodes to determine, in linear time, the 15 <u>smallest</u> values in a table with n values. You do not need to give details of the heap algorithms. Instead, refer to the heap algorithms that you will use. The input table should not be altered.

CSE 2320   Name _____
Test 2
100 points   UTA Student ID # _____

Short Answer. 5 points each

1. Give a situation where circular lists are useful.
2. What is primary clustering?
3. Compare the number of probes for unsuccessful search in linear probing and double hashing when the hash table is nearly full.
4. How does a B-tree gain height?
5. What causes a red-black tree to increase the black-height at the root?
6. Describe the operations that are typically available for accessing a stack.
7. Why are doubly-linked lists useful?
8. What indicates that a circular queue is full?Long Answer.
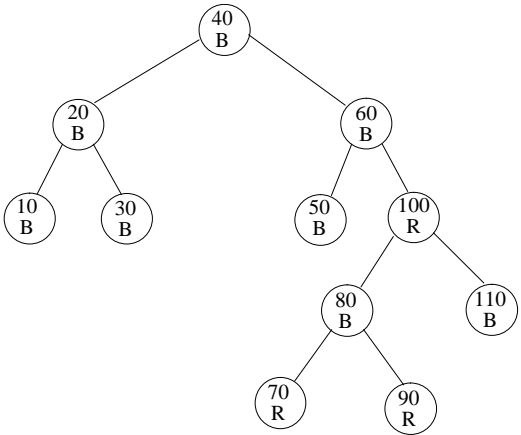
10 points each

1. Describe double hashing.
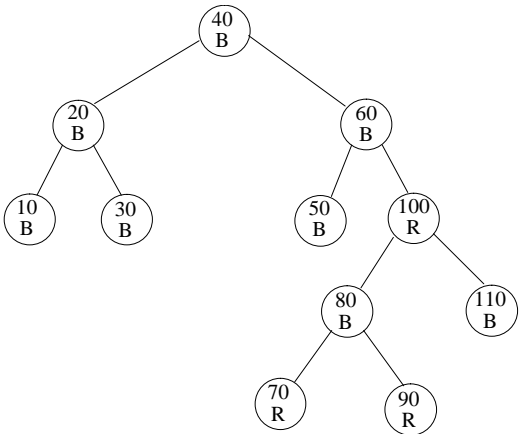2. Assign a legal coloring to the following red-black tree.
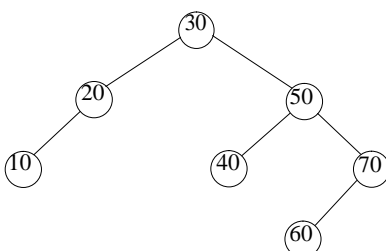
3. Insert 75 into the following red-black tree. Be sure to indicate the cases that are used.
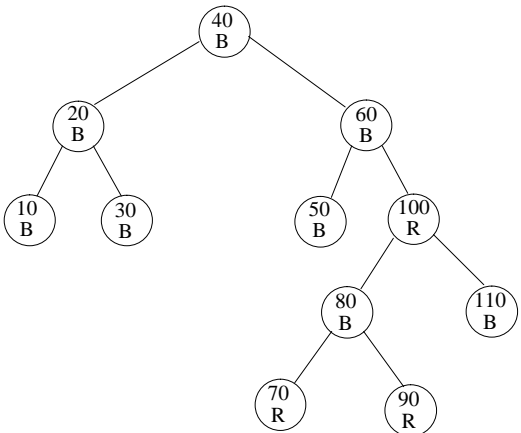
```
              50
              B
       25            70
       B             B
   10     30      60     80
   R      R       R      R
```
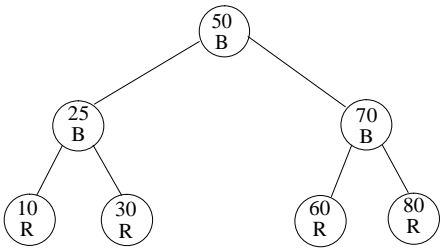
4. Insert 95 into the following red-black tree. Be sure to indicate the cases that are used.

```
                40
                B
       20                60
       B                 B
   10     30        50       100
   B      B         B        R
                         80      110
                         B       B
                      70     90
                      R      R
```

5. Delete 110 from the following red-black tree. Be sure to indicate the cases that are used.

```
                40
                B
       20                60
       B                 B
   10     30        50       100
   B      B         B        R
                         80      110
                         B       B
                      70     90
                      R      R
```

6. Delete 10 from the following red-black tree. Be sure to indicate the cases that are used.

```
                40
                B
       20                60
       B                 B
   10     30        50       100
   B      B         B        R
                         80      110
                         B       B
                      70     90
                      R      R
```

(For test 2 you will be supplied with a red-black cheat sheet.)

Short Answer. 5 points each

1. What does the Ford-Fulkerson algorithm compute?
2. What does the Floyd-Warshall algorithm compute?
3. What is the difference between the two types of fail links for the KMP method?
4. Suppose that a minimum spanning tree is found for an undirected, weighted graph G. Must the set of edges for the MST include a shortest path with respect to the original graph for every pair of vertices?
5. Give the asymptotic complexity for determining the optimal ordering for multiplying n matrices.
6. What is the input for the Huffman code algorithm?
7. What type(s) of edges may occur when performing a depth-first search on an undirected graph?
8. What is optimized in the unit-time task scheduling problem?

Long Answer.

1. Give both types of fail links for the pattern `aabaacaababa`. 15 points
2. Perform depth-first search on the following graph using the ''rule of choice'' (smaller labels first). Be sure to indicate the type of each edge. 15 points
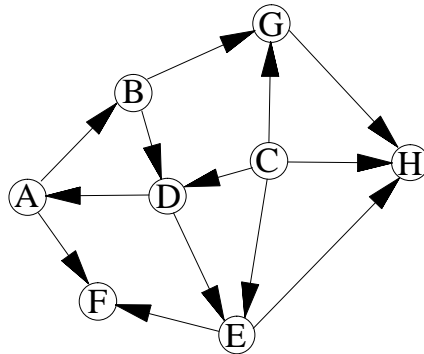
3. Determine the maximum achievable flow in the following network. Be sure to indicate the augmenting paths and the residual graphs used in obtaining your solution. 15 points
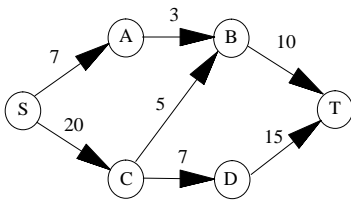
4. Determine a longest common subsequence for the sequences `010101` and `101010` using dynamic programming. 15 points