CSE 2320-004
Test 2
Fall 2019

Key 1
Your name as it appears on your UTA ID Card

Multiple Choice:

1. Write the letter of your answer on the line (_____) to the LEFT of each problem.
2. CIRCLED ANSWERS DO NOT COUNT.
3. 3 points each

1. Recently, we considered an abstraction supporting the operations *allocate*, *allocateAny*, and *freeup* in constant time. How does the *allocateAny* operation detect that all items have already been allocated?

D A. the header points at `(-1)` B. `next[n]!=0`
C. the recycling list is empty D. the header points at itself

2. Which of the following may be performed in $\Theta(1)$ worst-case time?

D A. SEARCH(L, k) on a sorted, singly linked list
B. SEARCH(L, k) on an unsorted, singly linked list
C. LOGICALPREDECESSOR(L, x) on a sorted, singly linked list
D. LOGICALPREDECESSOR(L, x) on a sorted, doubly linked list

3. Which binary tree traversal corresponds to the following recursive code?

```
void traverse(noderef x)
{
if (x==null)
  return;
traverse(x.left);
traverse(x.right);
// process x here
}
```

B A. inorder B. postorder C. preorder D. search for key `x`

4. Suppose that only numbers in 1 . . . 100 appear as keys in a binary search tree. While searching for 50, which of the following sequences of keys could not be examined?

A A. 10, 40, 70, 30, 50 B. 100, 20, 80, 30, 50
C. 10, 30, 70, 60, 50 D. 1, 100, 20, 70, 50

5. Which phase of counting sort uses this code?

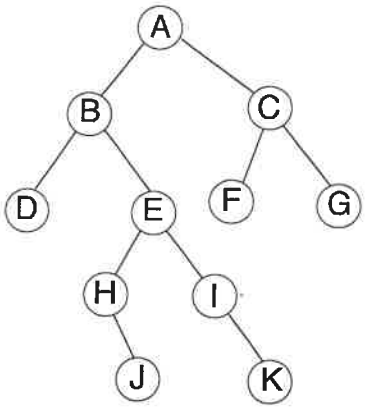
```
slot[0]=0;
for (i=1; i<k; i++)
  slot[i]=slot[i-1]+count[i-1];
```

C A. first B. second C. third D. fourth

6. In a binary search tree, which element does not have a predecessor?

C A. any one of the leaves B. the maximum C. the minimum D. the root

7. Suppose the tree below is a binary search tree whose keys and subtree sizes are not shown. Which node will contain the key with rank 10?



C

8. Why is it common for a circular queue implementation to waste one table element?

B A. To make sure the queue always has at least one element in use
B. To avoid confusing an empty queue with a full queue
C. To have a place to store the tail and head values
D. To perform some loops faster

9. Which of the following will not be true regarding the decision tree for QUICKSORT for sorting n input values?

C A. The height of the tree is $\Omega(n \log n)$.
B. There will be $n!$ leaves.
C. Every path from the root to a leaf will have $O(n \log n)$ decisions.
D. There will be a path from the root to a leaf with $\Omega(n^2)$ decisions.

10. The worst-case number of comparisons for finding the kth largest of n keys using PARTITION is in which asymptotic set?

D A. $\Theta(\log n)$ B. $\Theta(n)$ C. $\Theta(n \log n)$ D. $\Theta(n^2)$

11. If POP is implemented as return stack[--SP], then PUSH of element X is implemented as:

B A. return stack[SP++] B. stack[SP++] = X C. stack[--SP] = X D. stack[++SP] = X

12. Which of the following is a longest common subsequence for 0 1 2 0 1 2 and 0 0 1 2 1 2?

B A. 0 0 1 1 B. 0 1 2 1 2 C. 0 0 1 2 D. 0 1 2 0

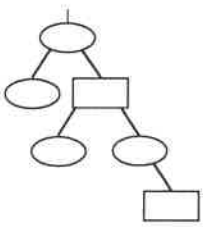
13. Suppose a value k appears for p entries in the cost function table (C) for an instance of the longest monotonically increasing subsequence problem. Going left-to-right across the corresponding input sequence values (y_i), which statement is true?
(Stated formally: For $i_1 < i_2 < \cdots < i_p$, suppose $C_{i_1} = C_{i_2} = \cdots = C_{i_p} = k$. Which statement is true regarding $y_{i_1}, y_{i_2}, \cdots, y_{i_p}$?)

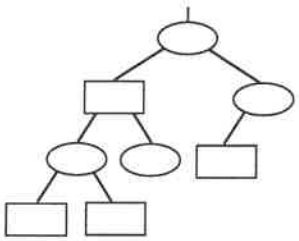
D

A. They are monotonically decreasing
B. They are strictly increasing
C. They are monotonically increasing
D. They are strictly decreasing

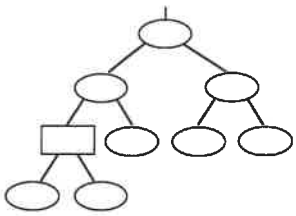
14. Which of the following binary trees has an illegal red-black tree coloring?

C

A. 

B. 

C. 

D. 

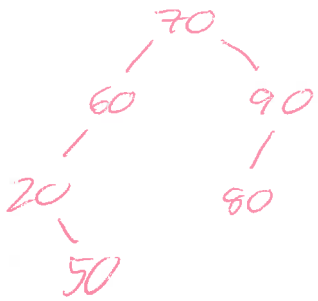
15. Based on dictionary search performance alone, the best justification for ordering a linked list is:

A

A. Many more misses than hits are expected
B. Sentinels are more effective in speeding up search
C. Many more hits than misses are expected
D. Less storage will be needed

Long Answer

1. Give the unbalanced binary search tree that results when the keys 70, 60, 90, 20, 80, 50 are inserted, ***in the given order***, into an initially empty tree. (5 points)



```
AB 8   2   5   3   6   1   9   0   7   4
A  8 B 2   5   3   6   1   9   0   7   4
   2 A 8 B 5   3   6   1   9   0   7   4
   2 A 8   5 B 3   6   1   9   0   7   4
   2   3 A 5   8 B 6   1   9   0   7   4
   2   3 A 5   8   6 B 1   9   0   7   4
   2   3   1 A 8   6   5 B 9   0   7   4
   2   3   1 A 8   6   5   9 B 0   7   4
   2   3   1   0 A 6   5   9   8 B 7   4
   2   3   1   0 A 6   5   9   8   7 B 4
   2   3   1   0 < 4 > 5   9   8   7   6
```

2. A billion integers in the range $0 \ldots 2^{32} - 1$ will be sorted by LSD radix sort. How much faster is this done using radix $0 \ldots 2^{8} - 1$ rather than $0 \ldots 2^{4} - 1$? Show your work. (10 points)

$0 \ldots 2^8 - 1$

$K = 2^8 = 256$

$d = 4$

$\Theta(d(n+k))$

$\Theta(4(1B + 256))$

↑

Twice as fast

$0 \ldots 2^4 - 1$

$K = 2^4 = 16$

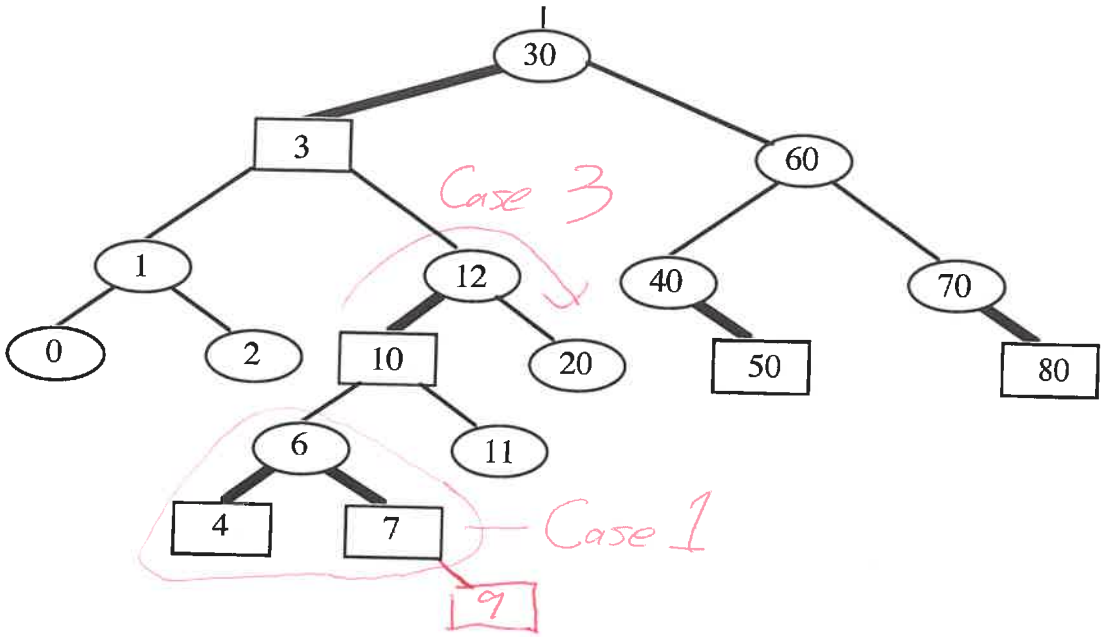
$d = 8$

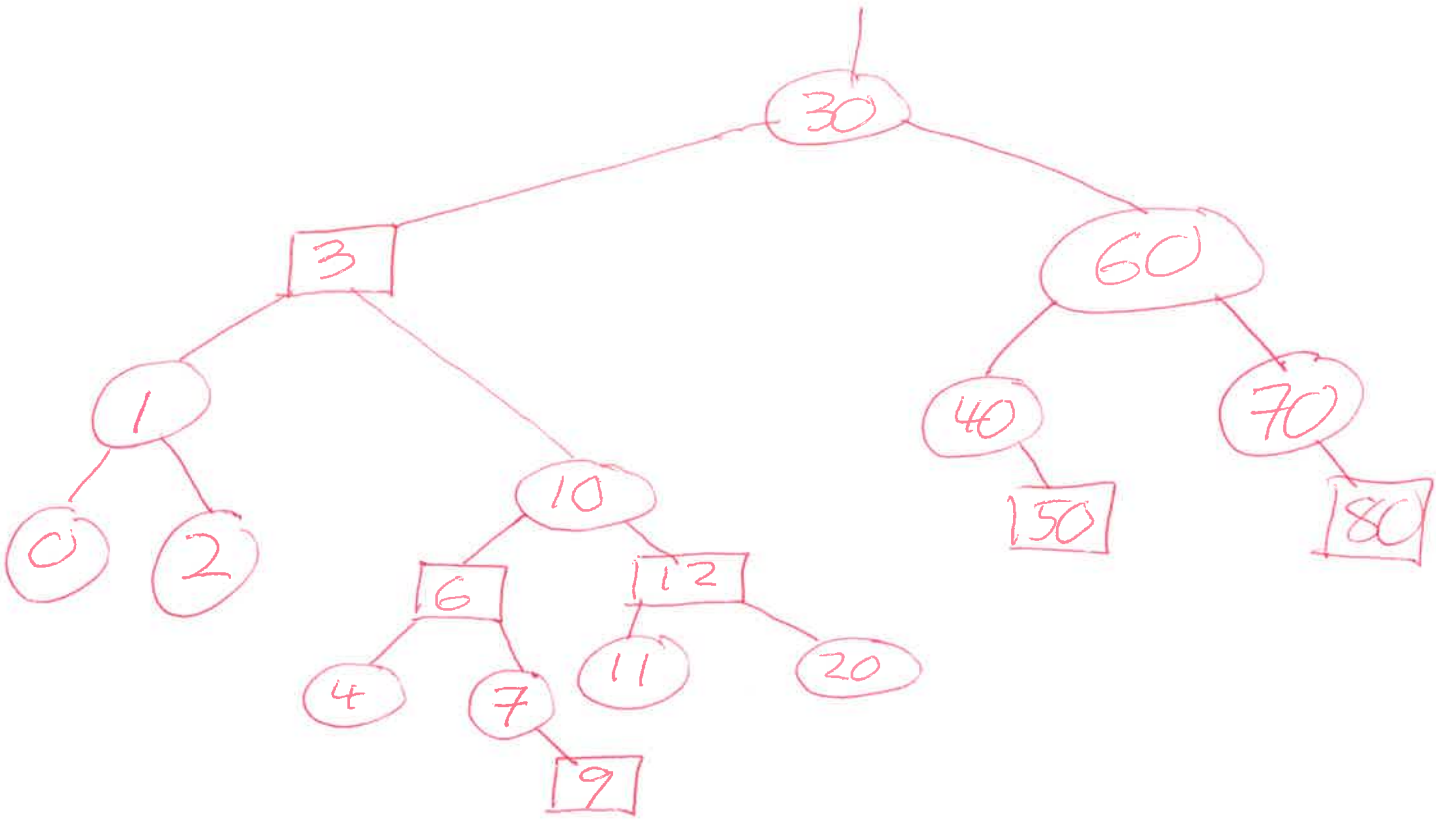
$\Theta(8(1B + 256))$

3. Show the result after PARTITION (Version 1) manipulates the following subarray. Recall that both pointers start at the left end of the subarray. (10 points)

8	2	5	3	6	1	9	0	7	4

4. Insert 9 into the given red-black tree. Be sure to indicate the cases that you used (10 points)





i	S
0	0
1	2
2	4
3	7
4	8
5	9

i	C
0	0
1	6
2	1
3	6
4	2
5	6
6	2
7	3
8	4
9	3
10	4
11	3
12	4
13	3
14	4
15	4
16	5
17	4

Solution

i	S
4	8
3	7
1	2

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

0 6 1 6 2 6 2 3 4 3 4 3 4 3 4 4 5 4

5. Use the dynamic programming solution for subset sums to determine a subset that sums to 17. Be sure to give the complete table that would be produced. (10 points, no points for solving by inspection)

i	0	1	2	3	4	5
S_i	0	2	4	7	8	9

6. Insert 55 into the given red-black tree. Be sure to indicate the cases that you used. (10 points)