AUBURN UNIVERSITY

SAMUEL GINN COLLEGE OF ENGINEERING

COMP 2210

Fundamentals of Computing II

Fall 2013 – Dr. Hendrix

Exam 3 – Answer Key

November 20, 2013

Name: _____

TigerMail: _____

Section: _____

Instructions: Make sure there is at least one empty seat between you and your nearest neighbor. Make sure your name (last name first) and Banner ID number are filled in on your Scantron sheet. Make sure your name, TigerMail ID, and course section are filled in above on this exam paper. Except where explicitly stated otherwise, you must record all your answers on your Scantron sheet. You must record all your answers in pencil. If you feel that a question is ambiguous, you may ask for clarification. Where appropriate, you may also document on this exam any assumptions that you make when answering a question. For each question, make sure that you select the choice that you feel *best* answers the question. You must turn in both this exam paper and your Scantron sheet no later than the end of this class period. If you have any questions during the exam, come down to the front and ask.

For each question, select the one choice A through D that you feel is the best match for what is being asked.

1. Assume the context of this problem is a node-based implementation of a binary tree. Which of the following methods returns the number of *right children* in the tree rooted at n? (For example, this method would return 4 for the tree shown in Figure 2.

A

```
private int numRightChild(Node n) {
   if (n == null)
      return 0;
   else
      return 1 + numRightChild(n.right);
}
```

B

```
private int numRightChild(Node n) {
   if (n == null)
      return 0;
   else
      return numRightChild(n.left) + 1 +
             numRightChild(n.right);
}
```

C

```
private int numRightChild(Node n) {
   if (n == null)
      return 0;
   int leftDesc = 0;
   int rightDesc = 0;
   if (n.left != null)
      leftDesc = numRightChild(n.left);
   if (n.right != null)
      rightDesc = 1 +
                  numRightChild(n.right);
   return leftDesc + rightDesc;
}
```

D

```
private int numRightChild(Node n) {
   if (n == null)
      return 0;
   int leftDesc = 0;
   int rightDesc = 0;
   if (n.left != null)
      leftDesc = 1 +
                 numRightChild(n.left);
   if (n.right != null)
      rightDesc = 1 +
                  numRightChild(n.right);
   return leftDesc + rightDesc;
}
```

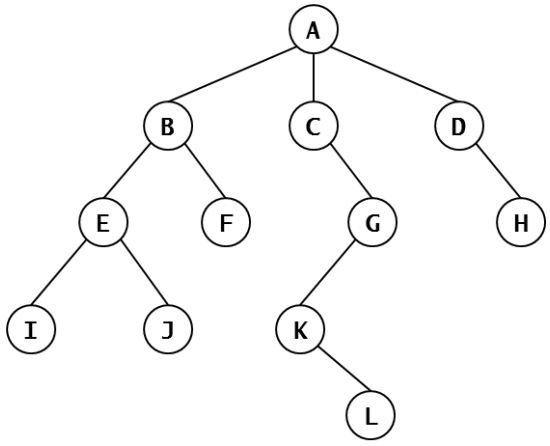


Figure 1.

2. In the tree shown in Figure 1, what is the length of the path from A to J?

   A. 3
   B. 5
   C. 4
   D. There is no such path.

3. In the tree shown in Figure 1, what is the length of the path from C to J?

   A. 3
   B. 5

C. 4
D. There is no such path.

4. In the tree shown in Figure 1, what is the length of the path from B to I?

A. 3
B. 5
C. 4
D. There is no such path.

5. In the tree shown in Figure 1, what is the height of A?

A. 5
B. 1
C. 4
D. 0

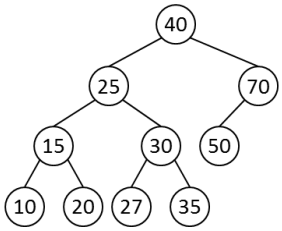
6. In the tree shown in Figure 1, what is the depth of A?

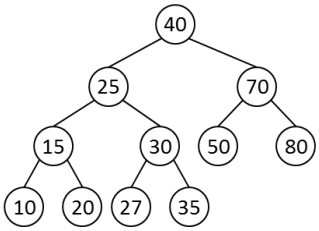
A. 1
B. 0
C. 4
D. 5

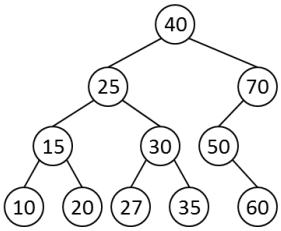
7. What is the minimum and maximum number of elements that can be in a binary tree of height 3?

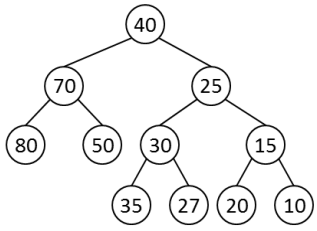
A. 2, 8
B. 3, 8
C. 3, 7
D. 4, 16

8. Which of the following trees is a complete binary tree?

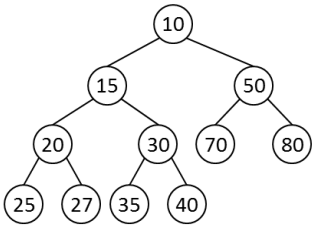
A


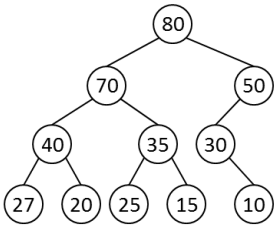
B


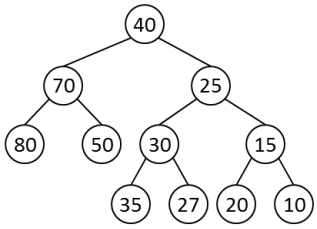
C


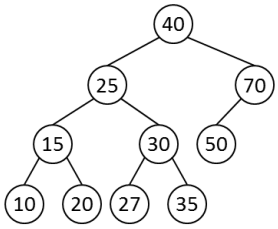
D


9. Which of the following trees is a binary search tree?

A


B


C


D


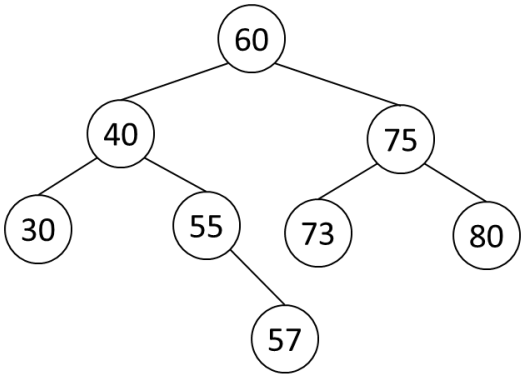


Figure 2.

10. If 79 is inserted into the tree shown in Figure 2, it will become

A. the left child of 80
B. the right child of 80
C. the right child of 73
D. the new right child of 75 and parent of 80

11. If 60 is deleted from the tree shown in Figure 2, what two values are the replacement candidates?

A. 40, 75
B. 57, 73
C. 55, 73
D. 57, 75

12. The values listed in the sequence that they would be visited in an inorder traversal of the tree shown in Figure 2 would be:

A. 30, 40, 55, 57, 60, 73, 75, 80
B. 60, 40, 75, 30, 55, 73, 80, 57
C. 60, 40, 30, 55, 57, 75, 73, 80
D. 30, 57, 55, 40, 73, 80, 75, 60

13. The values listed in the sequence that they would be visited in a preorder traversal of the tree shown in Figure 2 would be:

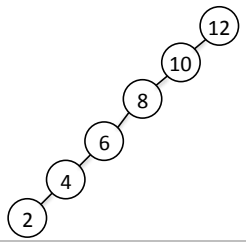
A. 30, 40, 55, 57, 60, 73, 75, 80
B. 60, 40, 75, 30, 55, 73, 80, 57
C. 60, 40, 30, 55, 57, 75, 73, 80
D. 30, 57, 55, 40, 73, 80, 75, 60

14. The values listed in the sequence that they would be visited in a postorder traversal of the tree shown in Figure 2 would be:

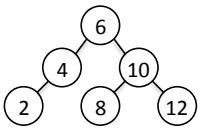
A. 30, 40, 55, 57, 60, 73, 75, 80
B. 60, 40, 75, 30, 55, 73, 80, 57
C. 60, 40, 30, 55, 57, 75, 73, 80
D. 30, 57, 55, 40, 73, 80, 75, 60

15. Which tree would result from inserting the following values in the order in which they are written into a binary search tree with no balance constraint? 2, 4, 6, 8, 10, 12

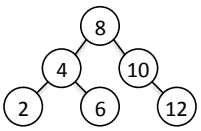
A



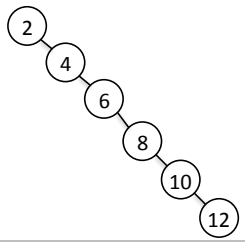
B



C

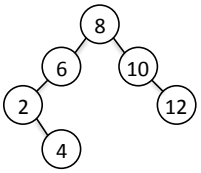


D

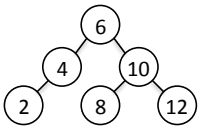


16. Which tree would result from inserting the following values in the order in which they are written into a binary search tree with no balance constraint? 8, 4, 10, 2, 6, 12

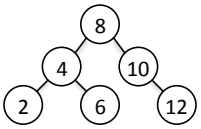
A



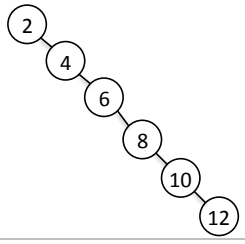
B



C

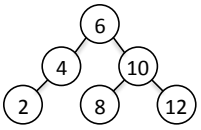


D

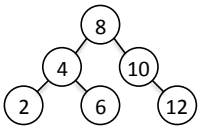


17. Which tree would result from inserting the following values in the order in which they are written into an AVL tree? 2, 4, 6, 8, 10, 12

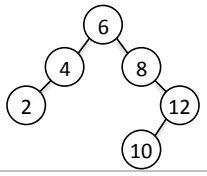
A



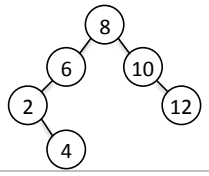
B



C

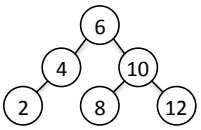


D

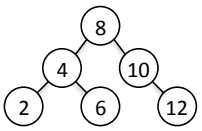


18. Which tree would result from inserting the following values in the order in which they are written into an AVL tree? 10, 12, 6, 8, 4, 2

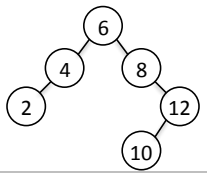
A



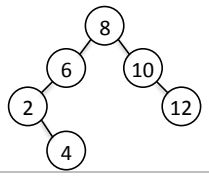
B



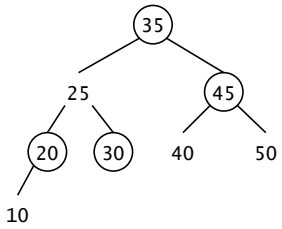
C



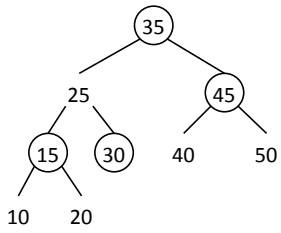
D



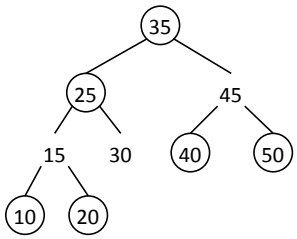
19. Which tree would result from inserting 15 into the following Red-Black tree? Black nodes are circled, red nodes are not.



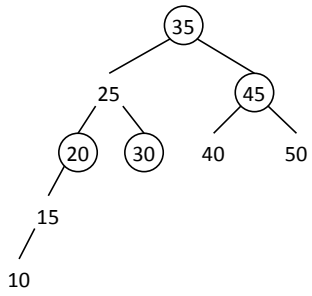
A



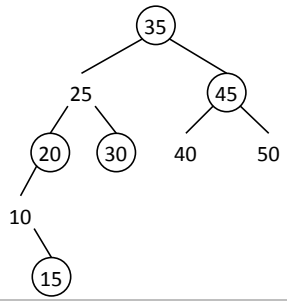
B



C

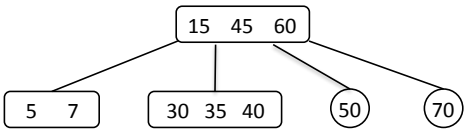


D

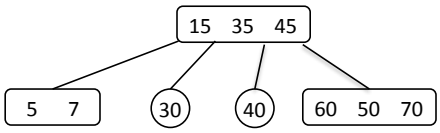


20. Which tree would result from inserting the following values in the order in which they are written into a 2-4 tree? 30, 60, 70, 40, 35, 45, 50, 5, 15, 7

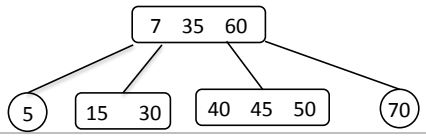
A



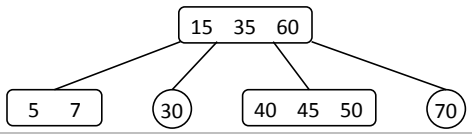
B



C



D



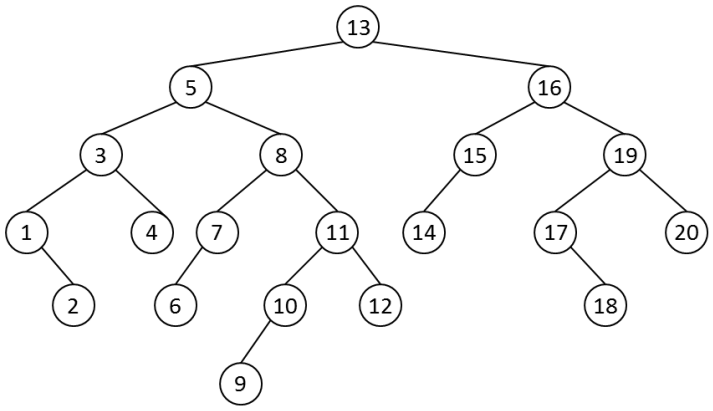


Figure 3.

21. In the tree shown in Figure 3, what is the balance factor of the node that contains 5?

A. 2
B. 1
C. -1
D. -2

22. In the tree shown in Figure 3, what is the balance factor of the node that contains 19?

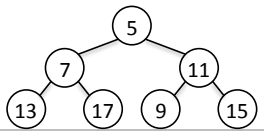
A. 2
B. 1
C. -1
D. -2

23. In the tree shown in Figure 3, what is the balance factor of the node that contains 13?

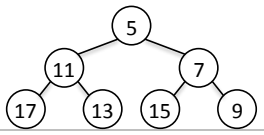
A. 2
B. 1
C. -1
D. -2

24. Which tree would result from inserting the following values in the order in which they are written into a min heap? 17, 15, 13, 11, 9, 7, 5

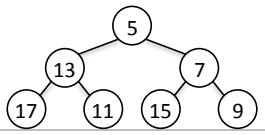
A



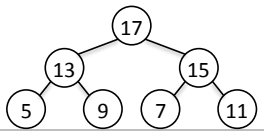
B



C



D



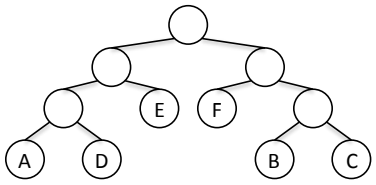
25. If the array a = [10, 2, 16, 12, 14, 6, 18, 8, 20, 4] is sorted with heapsort, which response below depicts a after the first phase of the heapsort algorithm discussed in class, when its elements have been arranged in partial order?

A. [2, 4, 6, 8, 10, 12, 14, 16, 18, 20]
B. [2, 8, 6, 10, 4, 16, 18, 12, 20, 14]
C. [20, 18, 14, 6, 16, 12, 10, 8, 2, 4]
D. [20, 14, 18, 12, 10, 6, 16, 8, 2, 4]

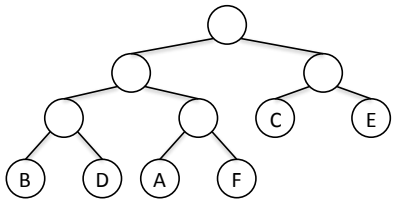
26. Which of the code trees below would Huffman's algorithm construct from the following text?

AAAABCCCCCDDEEEEEEFFFFFFF

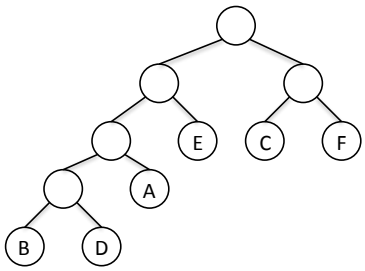
A



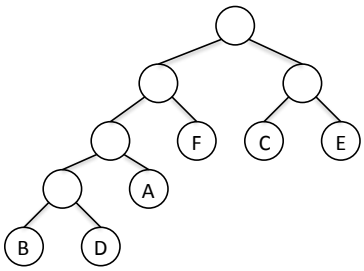
B



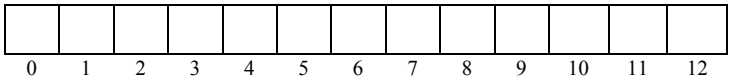
C



D



Use the following scenario to answer the following questions regarding inserting a sequence of values into a hash table.



Number of buckets: 13
Hash function: h(hashcode) = hashcode % 13
Load factor threshhold: 100% (no rehashing)
Addressing scheme: Open addressing

Hashcodes of elements to insert:

18, 24, 13, 27, 25, 50, 44, 17, 30, 69

27. The options below show the values in the hash table from left to right (i.e., from index 0 to index 12) where '*' indicates an empty bucket. Select the option that shows the hash table after all the elements have been inserted with linear probing used for collision resolution.

A. 13, 27, 50, *, 17, 18, 44, 69, 30, *, *, 24, 25
B. 13, 50, 27, *, 18, 17, 44, 30, 69, *, *, 24, 25
C. 13, 27, *, 17, 50, 18, 30, *, 69, *, 44, 24, 25
D. 13, 27, 50, *, 17, 18, 44, 30, 69, *, *, 24, 25

28. The options below show the values in the hash table from left to right (i.e., from index 0 to index 12) where '*' indicates an empty bucket. Select the option that shows the hash table after all the elements have been inserted with double hashing used for collision resolution. Use the following secondary hash function: h2(hashcode) = 1 + (hashcode % 12).

A. 13, 27, 50, *, 17, 18, 44, 69, 30, *, *, 24, 25
B. 13, 50, 27, *, 18, 17, 44, 30, 69, *, *, 24, 25
C. 13, 27, *, 17, 50, 18, 30, *, 69, *, 44, 24, 25
D. 13, 27, 50, *, 17, 18, 44, 30, 69, *, *, 24, 25

29. What load factor (λ) threshold would have to be maintained in an open addressed hash table with linear probing to guarantee no more than 4 probes on any operation?

A. $\lambda < 0.25$
B. $\lambda < 0.33$
C. $\lambda < 0.50$
D. $\lambda < 0.75$

30. What load factor (λ) threshold would have to be maintained in an open addressed hash table with double hashing to guarantee no more than 4 probes on any operation?

A. $\lambda < 0.25$
B. $\lambda < 0.33$
C. $\lambda < 0.50$
D. $\lambda < 0.75$

31. Given the following open addressed hash table below, assume that it uses linear probing for collision resolution. Assume also that it uses an immediate deletion strategy and that its hash function is h(hashcode) = hashcode % 13. Which option below shows the state of the hash table after 29 is deleted? (The options below show the values in the hash table from left to right (i.e., from index 0 to index 12) where '*' indicates an empty bucket.)

26			29	17	5	16	42			36		
0	1	2	3	4	5	6	7	8	9	10	11	12

A. 26, * *, 16, 17, 5, 42, *, *, *, 36, *, *
B. 26, *, *, *, 17, 5, 16, 42, *, *, 36, *, *
C. 26, *, *, 17, 5, 16, 42, *, *, *, 36, *, *
D. 26, 17, 5, 16, 42, 36, *, *, *, *, *, *