

Question I (15 minutes – 20%): Choose the correct answer:

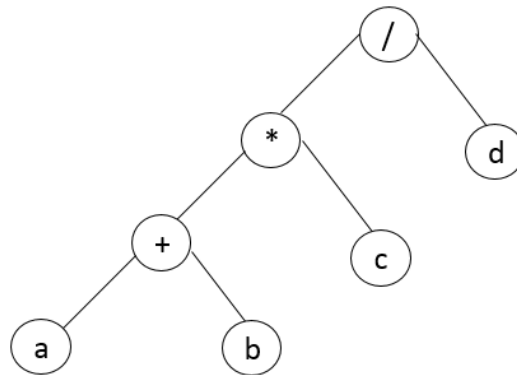
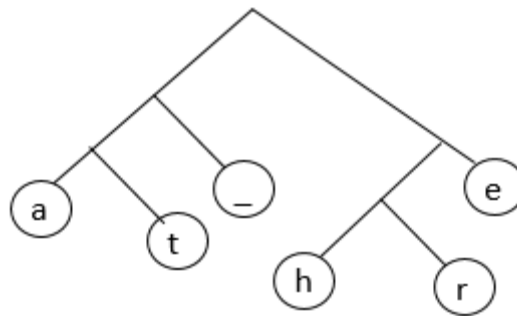


Figure 1

1. The postorder traversal of the tree in Figure 1
  - a.  $a\ b + c\ d\ /\ *$
  - b.  $ab + c\ *\ d\ /\$**
  - c.  $a + b\ c\ d\ /\ *$
  - d. None of the above.
2. The preorder traversal of the tree in Figure 1
  - a.  $\ /\ *\ + a\ b\ c\ d$**
  - b.  $\ *\ + a\ b\ /\ c\ d$
  - c.  $a + b\ c\ d\ /\ *$
  - d. None of the above.
3. The inorder traversal of the tree in Figure 1
  - a.  $((a + b) * d) / c$
  - b.  $\ /\ *\ + a\ b\ c\ d$
  - c.  $((a + b) * c) / d$**
  - d. None of the above.
4. The Big O of searching for an item in a binary search tree is:
  - a.  $O(\log n)$
  - b.  $O(n)$
  - c.  $O(h)$**
  - d.  $O(n/2)$
5. On removing an item with two children from a binary search tree, the replacement for the item can be:
  - a. The postorder predecessor.
  - b. The inorder successor.**

*This is the right answer*

- c.  $a + b$
  - d. **None of the above.**
6. How can we test whether a binary tree is a binary search tree?
- a. For each node, if the left child has a key that is less than the node's key, and the right child has a key is greater than the node's key.
  - b. Preorder traversal should can return a list ordered in ascending order.
  - c. Postorder traversal should can return a list ordered in descending order.
  - d. **None of the above.**
7. Which of the following statements is true about min heaps?
- a. Min heaps are special binary search trees.
  - b. Each node's key is greater than all of the node's children's keys.
  - c. **Min heaps are complete trees.**
  - d.  $b + c$
8. The most efficient data structure that is used to implement a heap is:
- a. **Vectors**
  - b. Hash tables
  - c. Hierarchal binary tree nodes.
  - d. None of the above.
9. What's the advantage of heap sort over merge sort?
- a. Heap sort is  $O(n)$  while merge sort is  $O(n \log n)$
  - b. **Less usage of memory.**
  - c. A stable sort.
  - d. None of the above.
10. Which of the following sentences is true about Huffman trees?
- a. It can model letters with the same frequency.
  - b. Letters with higher frequency tend to have shorter code.
  - c. It can be used to decode an English message.
  - d. **All of the above.**



**Figure 2**

11. Using the Huffman tree in Figure 2, the code of t is:
  - a. 111
  - b. 000
  - c. 010
  - d. **None of the above.**
12. A hash table is a useful data structure in the following situation(s):
  - a. We need to determine the element's position in the collection.
  - b. **We need to find the element fast.**
  - c. We need to determine the element's relative order in the collection.
  - d. All of the above.
13. The most efficient way to resolve collision in a hash table is to:
  - a. Linear open addressing.
  - b. Quadratic open addressing.
  - c. **Chaining.**
  - d. None of the above.
14. On average, the Big O of accessing an element based on its key in a hash-table based map is:
  - a.  $O(\log n)$
  - b.  $O(n)$
  - c.  **$O(1)$**
  - d. None of the above.
15. Which of the following statements is true about AVL trees?
  - a. Searching for an element is always  $O(\log n)$
  - b. An AVL tree can be out of balance by  $\pm 1$ .
  - c. An AVL tree is a self-balancing binary search tree.
  - d. **All of the above.**

16. In AVL trees, how many rotations do we need to balance a Right-Right tree?
- a. No rotation is needed.
  - b. Two rotations.
  - c. **One rotation.**
  - d. Three rotations.
17. Which of the following is true about red-black trees?
- a. The root is black.
  - b. A red node can't have red children.
  - c. The number of black nodes in any path from the root to a leaf is the same.
  - d. **All of the above.**
18. In the worst case scenario, the height of a an AVL tree is:
- a. **1.44 times the height of a complete binary tree.**
  - b.  $2 \log_2 n + 2$
  - c.  $1.002 \log_2 n$
  - d. None of the above.
19. Which of the following is true about 2-3 trees?
- a. A node can have four values.
  - b. **Leaf nodes have to be at the same depth.**
  - c. A node can have only up to four children.
  - d. All of the above.
20. Which of the following is true about B trees?
- a. They can be used as indexes to large databases stored on disk.
  - b. A B tree is a generalization of a 2-3-4 tree.
  - c. Nodes can store up to a defined number of items.
  - d. **All of the above.**