



HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

Paper Code: MCS-PC 102

Paper Name: Advanced Data Structures

Time Allotted: 1 Hour 30 Minutes

Full Marks: 70

The figures in the margin indicate full marks

Candidates are required to give their answers in their own words as far as practicable

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives from the followings:

30 x 1 = 30

(i) What are splay trees?

a) Self adjusting binary search trees b) self adjusting binary trees c) a tree with strings d) a tree with probability distributions

(ii) Which of the following options is an application of splay trees?

a) Cache Implementation b) networks c) send values d) receive values

(iii) What is the special property of red-black trees and what root should always be?

- a) color which is either red or black and root should always be black color only
- b) height of the tree
- c) pointer to next node
- d) A color which is either red or black

(iv) When it would be optimal to prefer Red-black trees over AVL trees?

- a) when there are more insertions or deletions
- b) when tree must be balanced
- b) when more search is needed
- d) when $\log(\text{nodes})$ time complexity is needed

(v) What is the maximum height of an AVL tree with p nodes?

- a) p
- b) $\log(p)$
- c) $\log(p)/2$
- d) $p/2$

(vi) A mathematical-model with a collection of operations defined on that model is called

- a) Data Structure
- b) Abstract Data Type
- c) Primitive Data Type
- d) Algorithm

(vii) Which of the following abstract data types can be used to represent a many to many relation?

- a) Tree b) Plex c) Graph d) Both B and C

(viii) What is a hash table?

- a) A structure that maps values to keys b) A structure that maps keys to values
c) A structure used for storage d) A structure used to implement stack and queue

(ix) Which of the following is not a technique to avoid a collision?

- a) Make the hash function appear random b) Use the chaining method
c) Use uniform hashing d) Increasing hash table size

(x) In simple chaining, what data structure is appropriate?

- a) Singly linked list b) Doubly linked list c) Circular linked list d) Binary trees

(xi) Which of the following is identical to that of a separate chaining hash node?

- a) Linked List b) Array c) Stack d) Queue

(xii) On what value does the probe sequence depend on?

- a) c_1 b) k c) c_2 d) m

(xiii) Which of the following operations can be performed on an extendable hash structure?

- a) Lookup b) Insertion c) Deletion d) All of the above

(xiv) Skip lists are similar to which of the following data structure?

- a) Stack b) Heap c) Binary Search Tree d) Balanced Binary Search Tree

(xv) Trie is also known as _____

- a) Digital Tree b) Treap c) Binomial Tree d) 2-3Tree

(xvi) What is the pre-processing time of Rabin and Karp Algorithm?

- a) $\Theta(m^2)$ b) $\Theta(m \log n)$ c) $\Theta(m)$ d) $\text{Big-Oh}(n)$

(xvii) Which of the following is a sub string of "SANFOUNDRY"?

- a) SANO b) FOUND c) SAND d) FOND

(xviii) In Huffman coding, data in a tree always occur?

- a) Roots b) Leaves c) Left sub-trees d) Right sub-trees

(xix) Let T be a binary search tree with 15 nodes. The minimum and maximum possible heights of T are:

Note: The height of a tree with a single node is 0

a) 4 and 15 respectively b) 3 and 14 respectively c) 4 and 14 respectively d) 3 and 15

(xx) A B-tree of order 4 and of height 3 will have a maximum of _____ keys.

a) 255 b) 63 c) 127 d) 188

(xxi) Which of the following is true about the trie?

a) root is letter a b) path from root to the leaf yields the string c) children of nodes are randomly ordered d) each node stores the associated keys

(xxii) How do you move through a Huffman tree?

a) 0 = right 1 = left b) 1 = left 2 = right c) 0 = left 1 = right d) 0 = middle 1 = back

(xxiii) Which of the following is the simplest data structure that supports range searching?

a) Heaps b) binary search trees c) AA-trees d) K-d trees

(xxiv) What is the average retrieval time when n keys hash to the same slot?

a) $\Theta(n)$ b) $\Theta(n^2)$ c) $\Theta(n \log n)$ d) $\Theta(n^2)$

(xxv) Which type of traversal of binary search tree outputs the value in sorted order?

a) Pre-Order b) In-Order c) Post-Order d) None

(xxvi) What is a splay operation?

a) Moving parent node to down of child) b) moving a node to root c) moving root to leaf
d) removing leaf node

(xxvii) What are the operations that could be performed in $O(\log n)$ time complexity by red-black tree?

a) Insertion, deletion, finding predecessor, successor b) only insertion c) only finding predecessor, successor d) for sorting

(xxviii) Why we need to a binary tree which is height balanced?

a) to avoid formation of skew trees b) to save memory c) to attain faster memory access
d) to simplify storing

(xxix) Using division method, in a given hash table of size 157, the key of value 172 be placed at position _____

a) 19 b) 72 c) 15 d) 17

(xxx) What is the table size when the value of p is 7 in multiplication method of creating hash functions?

- a) 14 b) 128 c) 49 d) 127

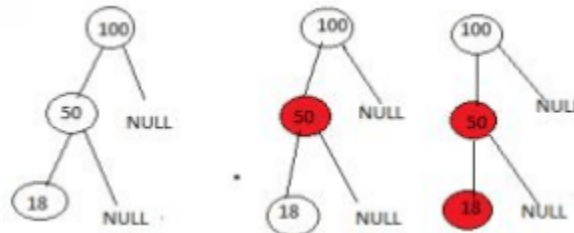
Group – B

(Multiple Choice Type Questions)

2. Choose the correct alternatives from the followings:

20 x 2 = 40

(i) Consider the below formations of red-black tree.



All the above formations are incorrect for it to be a redblack tree. then what may be the correct order?

- a) 50-black root, 18-red left subtree, 100-red right subtree b) 50-red root, 18-red left subtree, 100-red right subtree
c) 50-black root, 18-black left subtree, 100-red right subtree d) 50-black root, 18-red left subtree, 100-black right subtree
- (ii) The number of ways in which the numbers 1, 2, 3, 4, 5, 6, 7 can be inserted in an empty binary search tree, such that the resulting tree has height 6, is _____.
Note: The height of a tree with a single node is 0.

- a) 32 b) 128 c) 64 d) 16

(iii) Construct an AVL tree with the elements 7, 10, and 20. What will be the in-order traversal?

- a) 7, 20, 10 b) 20, 10, 7 c) 7, 10, 20 d) 10, 20, 7

(iv) Consider a hash table of size seven, with starting index zero, and a hash function $(3x + 4) \bmod 7$. Assuming the hash table is initially empty, which of the following is the contents of the table when the sequence 1, 3, 8, 10 is inserted into the table using closed hashing? Note that ‘_’ denotes an empty location in the table.

- a) 8, _, _, _, _, 10 b) 1, 8, 10, _, _, _, 3 c) 1, _, _, _, _, 3 d) 1, 10, 8, _, _, _, 3

(v) Calculate the Hash value of the key 5642 using division method. Consider $M=97$.

- a) 16 b) 18 c) 10 d) 31

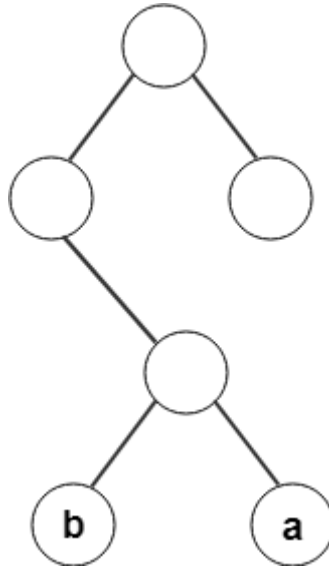
(vi) Huffman trees use the _____ of each character to work out their encoding.

- a) Frequency b) Order in ASCII c) Number value d) number of bits

(vii) Given a hash table T with 25 slots that stores 2000 elements, the load factor α for T is

- a) 80 b) 0.0125 c) 8000 d) 1.25

(viii) From the following given tree, what is the code word for the character 'a'?



- a) 011 b) 010 c) 100 d) 101

(ix) How many probes are required on average for insertion and successful search?

- a) 4 and 10 b) 2 and 6 c) 2.5 and 1.5 d) 3.5 and 1.5

(x) What output does the below pseudo code produces?

```

Tree_node function(Tree_node x)
{
    Tree_node y = x. left;
    x. left = y.right;
    y.right=x;
    return y;
}
  
```

- a) right rotation of subtree b) left rotation of subtree c) zig-zag operation d) zig-zig operation

(xi) Following code snippet is the function to insert a string in a trie. Find the missing line.

```

private void insert (String str)
{
    TrieNode node = root;
    for (int i = 0; i < length; i++)
    {
        int index = key.charAt(i) - 'a';
    }
}
  
```

```

    if (node.children[index] == null)
        node.children[index] = new TrieNode();

```

```

}

```

```

    node.isEndOfWord = true;

```

```

}

```

- a) node = node.children[index]; b) node = node.children[str.charAt(i + 1)];
 c) node = node.children[index++]; d) node = node.children[index++];

(xii) What is the depth of any tree if the union operation is performed by height?

- a) $O(N)$ b) $O(\log N)$ c) $O(N \log N)$ d) $O(M \log N)$

(xiii) Which of the following is not true?

- a) Trie requires less storage space than hashing
 b) Trie allows listing of all the words with same prefix
 c) Tries are collision free
 d) Trie is also known as prefix tree

(xiv) What can be the maximum depth of the trie with n strings and m as the maximum string length?

- a) $\log_2 n$ b) $\log_2 m$ c) n d) m

(xv) What traversal over trie gives the lexicographical sorting of the set of the strings?

- a) postorder b) preorder c) inorder d) level order

(xvi) What is the time complexity improvement of skip lists from linked lists in insertion and deletion?

- a) $O(n)$ to $O(\log n)$ where n is number of elements
 b) $O(n)$ to $O(1)$ where n is number of elements
 c) no change
 d) $O(n)$ to $O(n^2)$ where n is number of elements

(xvii) Which of the following strings is a palindromic subsequence of the string "ababcdabba"?

- a) abcba b) abba c) abbbba d) All of the mentioned

(xviii) What is a time complexity for inserting an alphabet in the tree using hash maps?

- a) $O(\log n!)$ b) $O(n!)$ c) $O(n^2)$ d) $O(1)$

(xix) How much space does construction of suffix tree takes?

a) $O(\log M)$ b) Exponential to Length of Tree c) $O(M!)$ d) Linear to Length of Tree

(xx) _____ is one of the earliest forms of a self-adjustment strategy used in splay trees, skew heaps.

a) Union by rank b) Equivalence function c) Dynamic function d) Path compression

Answer Key:

Group – A

1.

(i)	a	(ii)	a	(iii)	a	(iv)	a	(v)	b
(vi)	d	(vii)	d	(viii)	b	(ix)	d	(x)	b
(xi)	a	(xii)	b	(xiii)	d	(xiv)	d	(xv)	a
(xvi)	c	(xvii)	b	(xviii)	b	(xix)	b	(xx)	a
(xxi)	b	(xxii)	c	(xxiii)	d	(xxiv)	a	(xxv)	b
(xxvi)	b	(xxvii)	a	(xxviii)	a	(xxix)	c	(xxx)	b

Group – B

2.

(i)	a	(ii)	c	(iii)	c	(iv)	b	(v)	a
(vi)	a	(vii)	a	(viii)	a	(ix)	c	(x)	a
(xi)	a	(xii)	b	(xiii)	a	(xiv)	d	(xv)	c
(xvi)	a	(xvii)	d	(xviii)	d	(xix)	d	(xx)	d