SET-2

Arrays, Tables and Set

1. A hash table with ten buckets with one slot per bucket is shown in **Figure 1**, with the symbols S1 to S7 entered into it using some hashing function with linear probing. The worst case number of comparison required when the symbol being searched is not in the table is ……………………….

0	S7
1	S1
2	
3	S4
4	S2
5	
6	S5
7	
8	S6
9	S3

Fig. 1

2. The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function $h(k) = k \bmod 10$ and linear probing. What is the resultant hash table?

3.

(A)		(B)		(C)		(d)	
0		0		0		0	
1		1		1		1	
2	2	2	12	2	12	2	12, 2
3	23	3	13	3	13	3	13, 3, 23
4		4		4	2	4	
5	15	5	5	5	3	5	5,15
6		6		6	23	6	
7		7		7	5	7	
8	18	8	18	8	18	8	18
9		9		9	15	9	

4. Consider a hash table of size 11 that uses open addressing with linear probing. Let $h(k) = k \bmod 11$ be a hash function used. A sequence of records with keys

43 36 92 87 11 4 71 13 14

is inserted into an initially empty hash table, the bins of which are indexed from zero to ten. What is the index of the bin into which the last record is inserted?

(A) 3
(B) 4
(C) 6
(D) 7

5. The minimum number of comparisons required to determine if an integer appears more than $n/2$ times in a sorted array of n integers is

(A) $\Theta(n)$
(B) $\Theta(\log n)$
(C) $\Theta(\log^* n)$
(D) $\Theta(1)$

6. Consider a hash function that distributes keys uniformly. The hash table size is 20. After hashing of how many keys will the probability that any new key hashed collides with an existing one exceed 0.5.

(A) 5   (B) 6   (C) 7 (D) 10

7. Consider a hash table of size seven, with starting index zero, and a hash function (3x + 4) mod 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

8. A hash table contains 10 buckets and uses linear probing to resolve collisions. The key values are integers and the hash function used is key % 10. if the values 43, 165, 62, 123, 142 are inserted in the table, in what location would the key value 142 be inserted?

(A) 2   (B) 3   (C) 4   (D) 6

9. A program P reads in 500 integers in the range [0, 100] representing the scores of 500 students. It then prints the frequency of each score above 50. what would be the best way for P to store the frequencies?

(A) An array of 50 numbers
(B) An array of 100 numbers
(C) An array of 500 numbers
(D) A dynamically allocated array of 550 numbers

10. Two matrices M_1 and M_2 are to be stored in arrays A and B respectively. Each array can be stored either in row-major or column-major order in contiguous memory locations. The time complexity of an algorithm to compute $M_1 \times M_2$ will be

(A) Best if A is in row-major, and B is in column-major order
(B) Best if both are in row-major order
(C) Best if both are in column-major order
(D) Independent of the storage scheme

11. An advantage of chained hash table (external hashing) over open addressing scheme is

(A) Worst case complexity of search operations is less
(B) Space used is less
(C) Deletion is easier
(D) None of the above

12. Consider a hash table with chaining scheme for overflow handling:

(i) What is the worst-case timing complexity of inserting n elements into such a table?

(ii) For what type of instances does this hashing scheme take the worst case time for insertion?

13. Let A be a n x n matrix such that the elements in each row and each column are arranged in ascending order. Draw a decision tree which finds 1st, 2nd and 3rd smallest elements in minimum number of comparisons

14. An array A contains n integers in locations A[0], A[1], ..., A[n-1]. It is required to shift the elements of the array cyclically to the left by K places, where $1 \leq K \leq n-1$. An incomplete algorithm for doing this in linear time, without using another array is given below. Complete the algorithm in the blanks. Assume all variables are suitably declared.

      min: = n;

      i: = 0;

      while _____ do

      begin

           temp: = A[i];

           j: = i;

           while _____ do

           begin

                A[j]: = _____;

                j: = (j+K) mod n;

                if j < min then

                    min: = j;

           end;

           A[n + i – K) mod n]: = _____;

           i: = ...;

    end;

15. An array A contains n integers in non-decreasing order, $A[1] \leq A[2] \leq ....\leq A[n]$. Describe, using Pascal-like pseudo code, a linear time algorithm to find i, j such that A[i] + A[j] = a given integer M, if such i, j exist.

16. A two dimensional array A[1..n][1..n] of integers is partially sorted if

    For all i, j ε [1...., n-1]   A[i][j] < A[i][j+1] and.

                                A[i][j] < A[i+1][j]

Fill in the blanks:

The smallest item in the array is at A[i][j] where 1 = [____] and j = [____].

The smallest item is deleted. Complete the following O(n) procedure to insert item x (which is guaranteed to be smaller than any item in the last row or column) still keeping A partially sorted.   (4)

procedure   insert(x: integer);

var   i, j: integer;

begin

    (1)   i:= 1; j:= 1; A[i][j]:= x;

    (2)   while ([x> ____]   [x> ____]

    (3)   if A[i+1][j] < A[i][j] then begin

    (4)   A[i][j]:= A[i+1][j]; i:= i+1;

    (5)   end

    (6)   else begin

(7)   [_____]

(8)   <u>end</u>

(9)   A[i][j]:=   [_____]

<u>end</u>

17.   Let A be a two dimensional array declared as follows:

         A: array [1 … 10] [1 … 15] of integer;

         Assuming that each integer takes one memory locations the array is stored in row-major order and the first element of the array is stored at location 100, what is the address of element A[i][j]?

             (a) 15i + j + 84   (b) 15j + i + 84

             (c) 10i + j 89   (d)10j+i+89

18.   Suppose you are given an array s[1 .. n] and a procedure *reverse*(s, i, j) which reverses the order of elements in s between positions i and j (both inclusive). What does the following sequence do, where $1 \le k < n$

19.   Consider the following declaration of a two dimensional array in C:
                 Char a[100][100];

         Assuming that the main memory is byte addressable and that the array is stored starting from address 0, the address of a[40][50] is

     A.   4040
     B.   4050
     C.   5040
     D.   5050