Model Paper for Top-20 companies

Language Specific(C , C++ & Java)

Answer the following questions. Assume that integer and float type objects take 4 bytes, character type objects take 1 byte, double type objects take 8 bytes and any pointer variable take 4 bytes of memory. Also assume little-endian representation while storing data.

1. What would be the output of following program?

```
#include<stdio.h>
int main()
{
    int a[ ][3] = {
                    {-1,2,3},
                    {-4,5,6}
                  };
    printf("%d", *(*( a+1)-1)+2);
    return 0;
}
```

a) 5 b) -2 c) 4 d) -5 e) 7

2. What would be the output of following code snippet?

```
#include<stdio.h>
#define  MIN(a,b)   ((a)<(b)? (a): (b))
int main()
{
    int x=2, y=3, r;
    r = MIN(++x,++y);
    printf("%d", r);
    return 0;
}
```

a) 3 b) 4 c) 2 d) 5 e) garbage

3. Fill up the blank in the following program such that the contents of a[1][1] will become 8.

```
void f(char *a)
{
    [                    ]
}
int main()
{
     int a[2][3] = {
                    {1,2,3},
                    {4,5,6}
                   };
     f((char *)a);
     printf("%d", a[1][1]);
     return 0;
```

```
}
```

a) *((int*)a + 4) = 8 b) a[1][1] = 8
c) (int *)a) [1][1] = 8
d) only a and b
e) only a, b and c

4. Fill up the blank in the following program such that it prints 15 on the screen.

```
#include<stdio.h>
int sample(int i)
{
      static int s=0;
      if(i == 2)  return s;
      s+=5;
      i++;
      return sample(i);
}
int main( )
{
      printf("%d",sample(____));
      return 0;
}
```

a) -1 b) 0 c) 1 d) 2 e) 3

5. Does the following program compiles properly? If not, what might be the errors? If Yes, What would be the output of the following program after linking and execution?

f1.c

```
extern int i;
void test(void);
int main( )
{
    extern next(void);
    ++i;
    printf("%d ",i);
    test();
    return 0;
}
void test(void)
{
    next();
 }
```

f2.c

```
int i=10;
void next(void)
 {
   extern void prev(int);
   i++;
   printf("%d ",i);
   prev();
}
```

f3.c

```
extern int i;
void prev(int i)
{

    static int i=5;
    --i;
   printf("%d ",i);
   }
```

a) yes, output: 11 12 4
b) yes, output: 11 11 10
c) yes, output: 11 11 11
d) no, error: symbol i is undefined
e) no, error: symbol i and next are undefined

6. What would be the output of following program?

```
#include<stdio.h>
int main()
{
      char p[ ]="String";
      int x=0;
      if(p=="String")   {
         printf("Pass 1\n");
         if(p[sizeof(p)-2]=='g')
              printf("Pass 2\n");
          else
              printf("Fail 2\n");
       }
       else   {
          printf("Fail 1\n");
          if(p[sizeof(p)-2]=='g')
               printf("Pass 2\n");
          else
               printf("Fail 2\n");
        }
        return 0;
}
```

a) Pass 1
   Fail 2
b) Pass 1
   Pass 2
c) Fail 1
   Fail 2
d) Fail 1
   Pass 2
e) Pass 1
   Fail 1

7. What will be the output of following program?

```
 #include <iostream>
using namespace std;
class baseClass {
          public:
             void checkFunction() {  cout<<"baseclass";  }
};
class derivedClass:public baseClass {
          public:
             void checkFunction() {  cout<<"derived class";          }
};
int main(void)
{
```

```
        baseClass *ptr = new derivedClass();
        ptr->checkFunction();
        return 0;
}
```

a) baseclass b) derived class
c) Compile time error: cannot assign derived class object's address to a baseclass pointer
d) Compile time error: cannot resolve function checkFunction
e) none

8. What would be the output of following program?

```
#include <iostream>
using namespace std;
int m=6;
void foo(int *p)
{
    ++*p++;
    p=&m;
    ++*p++;
}
int main()
{
     int n=5;
     int *ptr=&n;
     foo(ptr);
     cout << m << n << endl;
     return 0;
}
```

a) 6 6 b) 7 5 c) 7 6 d) 6 5 e) 7 7

9. What would be the output of following program?

```
#include <iostream>
using namespace std;
int main()
{
   int foo = 3;
   int &bar = foo;
   bar = 5;
   cout << foo << " " << bar << " ";
   foo = 10;
   cout << foo << " " << bar << endl;
   return 0;
}
```

a) 5 5 10 10 b) 3 5 10 5 c) 5 5 5 10 d) 3 5 10 10 e) None

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10. What would be the output of following program?

```
#include <iostream>
using namespace std;
class Foo
{
   public:
     void g()
     {
         cout << "Foo::g()";
         cout << endl;
      }
}
class Bar : public Foo
{
   public:
     virtual void g()
     {
        cout << "Bar::g()";
        cout << endl;
     }
}
int main()
{
    Foo foo;
    Bar bar;
    Foo *baz = &bar;
    Bar *quux = &bar;
    baz->g();
    quux->g();
    return 0;
}
```

a) Foo::g()
   Bar::g()

b) Bar::g()
   Bar::g()

c) Foo::g()
   Foo::g()

d) Bar::g()
   Foo:g()

e) none

11. Consider the following java code:

```
public class MyClass
{
        private final int UNIQUE_ID = 1729;
        public static void main(String[] args)
        {
                System.out.println ("MyId is " + UNIQUE_ID);
        }
}
```

Which of the following is true about the above piece of Java code?

a. UNIQUE_ID cannot be initialized during declaration. It has to be done inside the constructor.
b. Every public class should have a default constructor.
c. UNIQUE_ID is not a static member of the class and cannot be referred from main although it is final.
d. None of these

12. What is the output of following java program?

```
class MyInteger
{
        private int myInt;
        public MyInteger(int val)  { myInt = val; }
        public void setMyInt(int val) { myInt = val; }
        public int getMyInt() { return myInt; }
        public String toString() { return myInt + ""; }
}
public class Argument
{
        public void firstAdd(MyInteger int1, MyInteger int2)
        {
                int1 = new MyInteger(int1.getMyInt() + int2.getMyInt());
        }
        public void secondAdd(MyInteger int1, MyInteger int2)
        {
                int1.setMyInt(int1.getMyInt() + int2.getMyInt());
        }
        public static void main(String[] args)
        {
                MyInteger int1 = new MyInteger(10);
                MyInteger int2 = new MyInteger(20);
                Argument arg = new Argument();
                arg.firstAdd(int1, int2);
                System.out.println(int1 + ",");
                arg.secondAdd(int2, int1);
                System.out.println(int2);
        }
}
```

a. 10, 30
b. 30, 50
c. 30, 30
d. 10, 50
e. None

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13. What is the output of following java code snippet?

```
public class javatest
{
        public static void main(String args[])
        {
                String s1 = "Hello", s2 = "Hello";
                if(s1 == s2)   System.out.println("True");
                else    System.out.println("False");
                s2 = s2.replaceAll("H","K");
                s2 = s2.replaceAll("K","H");
                if(s1 == s2)  System.out.println("True");
                else    System.out.println("False");
        }
}
```

a. True True
b. False False
c. True False
d. False True
e. None

14. What is the output of following code snippet?

```
public class Foo
{
        int m_a = 0, m_b = 0;
        public Foo(int a, int b)
        {
                m_a = a;
                m_b = b;
        }
        int Sum() {     return m_a+m_b;  }
}
public static  void main(String args[])
{
        System.out.println(new Foo().sum());
}
```

a. 0
b. Runtime Error
c. Compiler error: Variables can't be initialized outside the constructor
d. Compiler error: No default constructor
e. None

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15. What is the output of following java program?

```
public class test
{
        public static void main(String args[])
        {
                String s1 = "Hello";
                String s2 = "Hello";

                s1.replace('l','k');
                s2.replace('l','s');
                System.out.printn( s1 + s2 );
        }
}
```

a. HekkoHesso
b. HekkoHekko
c. HelloHello
d. HessoHesso
e. none

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Efficient Programming

Write the code for the following programs in your favourite programming language(C/C++/Java).

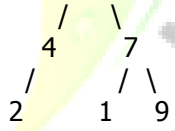
1. Given a linked list, where each node contains one more extra field called as random pointer (other than the normal "next" pointer) which could point to any other node or itself i.e., there could be loops. Write an efficient function to duplicate this linked list. What are the time and space complexities of your solution?
Function Prototype:
List DuplicateList(List l)

Assume the following declarations for a node and list:

```
struct ListNode {
    int element;
    struct ListNode* next;
    struct ListNode* random;
};
typedef struct ListNode* List;
```

2. Given an array of n elements in which each element lies in the range from 1 to n-1, write a function to find out which element is repeating maximum number of times in O(n) time and O(1) space. In case of a tie, report the one with the lower value.
Function Prototype:
int MaxRepeated(int a[], int n)

3. Given a binary tree, write an efficient function "struct treenode* DeepLeaf(struct treenode* t)" that returns a pointer to the farthest leaf from the root, i.e., the deepest leaf in the tree. In case of a tie, your function should return the rightmost leaf node. What are the time and space complexities of your solution?
Input:



Output: ADDR(9)

Assume the following declarations for a tree node:

```
struct treenode {
    int element;
    struct treenode* left;
    struct treenode* right;
};
```

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4. Given an array of N integers, write an efficient function to find a largest number Z such that there exists any two distinct integers X, Y such that X+Y=Z. Your function should return -1 if there is no such Z in the array. What are the time and space complexities of your solution?
Function Prototype:
```
int FindLargest(int a[], int n)
```

5. During the execution of a program, a temporary variable exists for only a part of the time. The register-allocation problem is the problem of assigning variables to hardware registers available in the system. One register may hold atmost one variable at any time. Also, a variable may be allocated to exactly one register for its entire lifespan. Given a number of variables n and their existence periods, write an efficient function that returns the number of registers needed to successfully run the program. What are the time and space complexities of your solution?
Function Prototype:
```
int FindMinReg(int start[], int end[], int n)
```
Input: start[] = {1, 3, 4, 7}
end[] = {5, 4, 9, 8}
Output: 2

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Code Analysis

Answer the following questions.

1. Consider the following program:

```
int count = 0;
void foo(int n, int k, int sum)
{
        if(n < 0)
                return;
        if(isSolution(n, sum))
                count++;
        for(i=1;i<=k;i++)
                foo(n-1, sum+i);
        return;
}
```

What is the time complexity of the above code assuming that time complexity of *isSolution* is O(1)?

a. O(n + k)
b. O(nk)
c. O(n^k)
d. O(k^n)
e. none

2. Assume that A is a two dimensional array m rows and m columns initialized to –1 in the following program:

```
 f (A, n, k)
{

        if((n<=k)||(k<=1))
                return 1;
        if(A(n,k) == -1)
                A(n,k) = f(A, n-1, k) + f(A, n-1, k-1);
        return A(n,k);
}
```

What is the time complexity of the function *f (A, m, m)* in terms of Big-Oh?

a. m
b. m^2
c. 2^m
d. 1
e. m log m

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3. Following is the code for Simulating a QUEUE with two STACKS

```
class QUEUE
{
        private stack in,out;
          //in and out are prioperly initialized and are empty on instantiation of QUEUE
        ……
};
 public void enqueue(int n)
{
      in.push(n);
 }
 public int dequeue()
// does not take into account the boundary case of dequeuing from an empty queue
{
       if( ! out.isEmpty())     return out.pop;
      for(  ; ! in.isEmpty(); out.push(in.pop()) );
      return out.pop();
}
```

What is the time taken for enqueuing and dequeuing n numbers?

a. O(n)
b. O(n^2)
c. Depends on the order of interleaving of enqueues and dequeues
d. O(n log n)
e. None of above

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Understanding Code/Expected Output

Answer the following questions.

1. Consider the following code:

```
Function f (X,n):
Input: X (an array of size n)
Begin
        G=0;
        S=0;
        For j=1 to n do
                If  X[j] + S > G then
                        S = G + X[j];
                        G = S;
                Else if X[j] + S > 0 then
                        S=X[j] + S;
                Else
                        S=0;
        Return G;
End
```

What does the function return:

a. Sum of all positive elements of the array X.
b. Sum of the maximum consecutive prefix of X.
c. Sum of the maximum consecutive subsequence of X.
d. Sum of the maximum consecutive suffix of X.
e. None

2. Given that 'k' is the maximum number in the array A, what does B contain after the function returns?

```
logicFunction(A[], B[], k)
{
        C ← array of size k
        for i = 1 to k do
                C[i] = 0
        for j = 1 to length(A) do
                C[A[j]] = C[A[j]] + 1
        for i = 1 to k do
                C[i] = C[i] + C[i-1]
        for j = 1 to length(A) do
        begin
                B[C[A[j]]] = A[j]
                C[A[j]] = C[A[j]] – 1
        end
        return;
```

}

a. All the integers of A in sorted order
b. All the integers of A in some random order
c. Contains the count of the number corresponding to its index occurring in A
d. Some random numbers
e. None

3. Return value of the following function is:

```
unsigned bits(unsigned x) {
        x = (x & 0x55555555) <<  1 | (x & 0xAAAAAAAA) >>  1;
        x = (x & 0x33333333) <<  2 | (x & 0xCCCCCCCC) >>  2;
        x = (x & 0x0F0F0F0F) <<  4 | (x & 0xF0F0F0F0) >>  4;
        x = (x & 0x00FF00FF) <<  8 | (x & 0xFF00FF00) >>  8;
        x = (x & 0x0000FFFF) << 16 | (x & 0xFFFF0000) >> 16;
        return x;
}
```

a) number of bits set in x
b) big endian equivalent of x
c) reverses the bit stream of x
d) number of pair of bits(sequence of 2) set
e) none

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Debugging

Answer the following questions.

1. The following code sorts a linked list. Only replacing one of the statements will make it work. Identify the statement.

```
1 void sortList(Node *header)
2 {
3       Node *traversal, *first;
4       if(header->next == NULL) return;
5       sortList(header->next);
6       first = header;
7       traversal = header->next;
8       for( ; traversal != NULL ; traversal = traversal->next )
9       {
10              if(traversal->value < first->value)
11              {
12                      swap(&(traversal->value), &(first->value));
13                      traversal = first;
14              }
15              else
16                      break;
17      }
18 }
```

a. Line No 4 if(header == NULL) return;
b. Line No 5 sortList(header)
c. Line No 13 first = traversal
d. Line No 16 continue
e. Line No 10

2. The following code is supposed to check if a given array of integers is sorted or not. Point out the line that has the error, if there is one.

```
1       int isSorted(int data[], int n)
2       {
3               if(n == 1)
4                       return 1;
5               else
6               {
7                       int temp = isSorted(data, n-1);
8
9                       return (temp) && (data[n-1] <= data[n]);
10              }
11      }
```

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Line Nos.
a. 3
b. 7
c. 9
d. both a and b
e. There is no error

3. This function should return the index of the first zero in the input array. If there are no zeros it returns –1.

```
public int indexOfZero(int [] array)
{
        for( int i=0;array[i] != 0 && i < array.length; i++ );
        if( i == array.length )
                return -1;
        return i;
}
```

This function will fail when
a. The input array has two 0s.
b. The input array has all 0s.
c. The input array has no 0s.
d. The input array has all 1s.
e. Won't fail in any case.

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Fundamental Reasoning

Answer the following questions.

1. A room has 100 light switches, numbered by the positive integers 1 through 100. There are also 100 children, numbered by the positive integers 1 through 100. Initially, the switches are all off. Each child k enters the room and changes the position of every light switch n such that n is a multiple of k. That is, child 1 changes all the switches, child 2 changes switches 2, 4, 6, 8, …, child 3 changes switches 3, 6, 9, 12, …, etc., and child 100 changes only light switch 100. When all the children have gone through the room, how many of the light switches are on?
a) 1 b) 5 c) 7 d) 10 e) 15

2. There are 128 soldiers with a no. on their T-shirts (1,2,3,.....63,64,.....,127,128) standing on a circular track. Man with no.1 has a sword on his hand. He kills man at no.2 and passes on sword to no.3. this goes on until we have only one soldier on the track. What will be the no. on his T-shirt?
a) 128 b) 120 c) 1 d) 2 e) 100

3. Your job is bowling ball tester. You have two identical bowling balls. Given a 100-story building, your challenge is to figure out from which floor a dropped bowling ball will shatter on the ground. You know nothing about the durability of the bowling balls; they may be very fragile and shatter when dropped from the first floor, or they may be so tough that they shatter from a drop from the one hundredth floor only. This is a bowling ball stress test. What is the most efficient way to determine the floor from which a dropped bowling ball will shatter? In other words, what is the minimum number of bowling ball drops you need to guarantee you can identify the floor from which they will surely shatter? You are allowed to destroy both bowling balls in the tests, provided that in doing so you uniquely identify the correct floor.
a) 1 to 14 b) 14 c) 9 d) 100 e) 50

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Other Areas(Applications of Data Structures)

Answer the following questions.

1. Which of the following is **least** suitable for implementing a set of integers, in terms of time complexity for the operations performed in it, given that main operation in the set is finding whether an element is present in it or not and assuming the maximum value that can be stored in the set is fixed?
a. Binary Tree
b. Heap
c. Bit Vector
d. Hash Table
e. Stack

2. Which of the following data structure can be used to represent stack, queue, binary tree, hash table, heap & graph?
a. Array
b. Singly Linked List
c. Double Linked List
d. Bit Vector
e. None of the above

3. You require a data structure that supports the following operations:
- Insert(x) : inserts element 'x' if it does not exist.
- Delete(x) : deletes the element 'x' if it exists
- FindNext(x) : finds the smallest element greater than 'x' .

All operations should be bounded by O (logn).
The data structure you would use is:
a. Heap
b. Hash Table
c. Binary Search Tree
d. Array
e. Stack

4. For each week of the year, and for each day in the week, values have been kept of the number of cars using the Howrah Bridge (integer values) and the peak smog level (real values) in the central district. What is the most appropriate data structure for storing these data within a program that is written to analyse, for specific days of the week, the relationship between cars using the bridge and peak smog levels?
a. A file
b. A multidimensional array
c. A record of arrays
d. An array of records
e. Binary Search Tree