Indian Statistical Institute
Computer Science I
First Year Students
15Apr2021

Total Marks: 80

ANSWER Question 1 to 3 and either Question 4 or Question 5.

Q1: [Total Marks: 2+3+3+3+1x4=15]

Consider the following C program:

```
#include <stdio.h>
main()
{
    int i;
    float x=0.56,z;
    char ch='B'; // The constant character 'B' is represented by the number 66
    z=i=x+ch;
    printf("i=%4d\n",i);
    printf("z=%4.4f\n",z);
}
```

a. Explain the purpose of " #include <stdio.h> " in the above program. What kind of error message is likely to be generated if this line is not included. Is the error message likely to be generated during compile time or run time?

b. Explain carefully how the statement "z=i=x+ch; " is executed in C since the statement deals with variables of different data types

c. What will be the output of the above program?

d. What will be the output of the above program if we change the statement "z=i=x+ch;" to "i=z=x+ch;" ?

e. Evaluate the following (remember % has higher precedence than * / which have higher precedence than -+)

i) Value of x in x= 3 + 4 % 5 – 6;

ii) Value of x in x= -3 * 4 % – 6 / 5;

iii) If initially x = 1, then the value of y and x after evaluation of y = x++ -1;

iv) If initially x = 1, then the value of y and x after evaluation of y = ++x -1,

Q2. [Total Marks 5+15=20]

One way of factoring an integer n into primes is by trial division. This algorithm can be described by the following pseudo code:

```
Begin: given a positive integer n

  Set d = 2    // the trial divisor
  While n > 1,
    If d divides n,
    then
       write down the factor d
       replace n by n/d
    else
       replace d by d + 1

  go to Begin
```

a.) Describe how the algorithm works for n=60

b.) Implement the algorithm in a C function and write a complete C program which accepts an integer from the standard i/o and outputs to the standard i/o each prime factor with its exponent. For example, output for 45 is

3 to the power 2
5 to the power 1

Question 3 [Total Marks: 2+2+3+8+4+6=25]

a.) What is a pointer in C? Use a n example to explain what the data type of a pointer is and how a pointer is declared.

b.) If ptr is a pointer pointing to an integer variable i which has a current value of 100,
what is the value *ptr? If the current value of the variable i is 100, what will be the value of i right after the statement "*ptr +=50;" is executed.

c.) What will be output of the following program?

```c
#include <stdio.h>
int main()
{ int x=25;
int *ptr=&x;
int **temp=&ptr; //pointer to pointer
printf("%d\n",x);
printf("%d\n",*ptr);
printf("%d\n",**temp);
return 0;}
```

d.) Using pointers write two functions in C. The first function takes as input a string represented as an array of characters and returns its length. The second function takes as input as string of characters and reverses the string.

Q4. [Total Marks:3+5+15 20]

  a.) Define a Structure to represent a binary tree each of whose nodes contains an integer.
  b.) Write a C function that creates a single node (root node) of a binary tree of integers.
  c.) Write a C function that will take an array of integers and the number of integers in that array as imputs and create a binary tree from the array as shown in the example below. .

| 4 | 9 | 8 | 17 | 26 | 50 | 16 | 19 | 69 | 32 | 93 | 55 | | | |
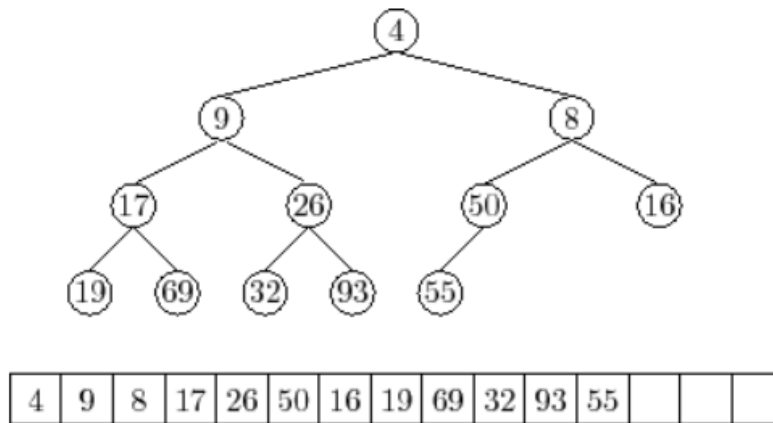
Q5. [Total Marks:5+5+6+4= 20]

  a.) Describe an algorithm/procedure to manage two contiguous sorted subarrays {A[p], .… , A[q]} and {A[q+1], … , A[r]} of a given array of integers A[i] (with obvious notation)

  b.) Implement the above algorithm in a C function "merge"

  void merge(int arr[], int p, int q, int r)

  c.) Using the above, write a C function that recursively merge sorts an array A[i]. (You can do this part even if you are not able to do part b.)

  d.) Illustrate you code in c.) using A[8]={40, 10, 60, 20,30, 80,50,70}