19CSE102 Computer Programming
Practice Problems

1. Write a C program to find whether a given year is a leap year or not. A leap year is exactly divisible by 4 except for century years (years ending with 00). The century year is a leap year only if it is perfectly divisible by 400.

2. Write a C program to find whether a given character is vowel or consonant. Use switch case.

3. Write a C program to print the total number of days in a month. Your program should accept the number of the month and print the days in the month.

4. Given the coeffecients of a quadratic equation write a C program to find the roots of the quadratic equation. (you have to include `math.h` library for finding the square root. `sqrt()` function computes the square root of a given number)

5. Write a C program to check whether an input character is an alphabet, digit or special character.

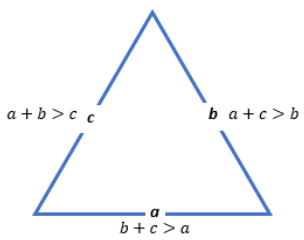
6. Write a C program that takes as input the number of seconds and converts it into equivalent hours, minutes and seconds.

   A typical output of the program is given below for your reference.

   ```
   45035
   45035 seconds is equal to 12 hours, 30 minutes, and 35 seconds
   ```

7. Write a C program that calculates the total amount of money earned by employee of an organization in `n` days given `n` and `rate` for each day. Your program should also categorize the given employee based on the following guidelines.
   a) If the number of days worked is <10 classify as under-worked
   b) If the number of days worked is 10-25 classify as satisfactory
   c) If the number of days worked is >25 classify as over-worked

8. Write a C program that accepts three sides of a triangle, checks whether those sides represent a valid triangle (use the following figure as a hint) and prints out the type of triangle. The following three triangles shall be considered. Equilateral Triangle has all three sides equal; Isosceles Triangle has (at least) two equal sides and Scalene Triangle does not have sides having equal length.



9. Admission to a professional course is subject to the following conditions:
   a) Marks in mathematics must be 60% or above
   b) Marks in physics must be 50% or above
   c) Marks in chemistry must be 40% or above
   d) Total of three subjects must be 200 or above or Total in mathematics and physics must be 150 or above

   Given the marks in three subjects, write a C program to find whether a candidate is eligible for the professional course or not.

10. Write a C program that will take as input a user's bank account type, level and balance he/she has. Based on this information and the below rate table, the program should determine the interest rate they are receiving and calculate and display the amount.

Type of account	Level	Minimum Balance	Interest Rate
Personal	Standard	$0	1.2%
Personal	Gold	$1000	1.9%
Personal	Gold	$5000	2.3%
Business	Standard	$1500	1.7%
Business	Platinum	$10000	2.5%

11. Collecting money becomes increasingly difficult during periods of recession, so companies may tighten their credit limits to prevent their accounts receivable (money owed to them) from becoming too large. In response to a prolonged recession, one company has cut its customers' credit limits in half. Thus, if a particular customer had a credit limit of Rs. 100000, it's now Rs. 50000. If a customer had a credit limit of Rs. 250000, it's now Rs. 125000. Write a C program that computess the credit status of a given customer of this company. For each of given customer you should provide:

    a) The customer's credit limit before the recession and
    b) The customer's current balance.

    Your program should calculate and print the new credit limit for each customer and should determine (and print) customer's current balance. Let your program prompt the above information and do the required computation forever as long as the users want to quit willingly.

    A typical input and computation is shown below for your reference.

    Before Recession

```
Enter customer's credit limit (old): 100000
Enter customer's balance           : 30000
```

    After Recession

```
Customer's new credit limit      : Rs. 50000
Customer's balance      : Rs. -20,000
```

    Customer has spent Rs. 70,000 So owes Rs. 20,000 to the company.

12. An online retailer sells five different products whose retail prices are shown in the following table.

S. No.	Product No.	RetailPrice (Rs.)
1	1122	149
2	2211	225
3	2121	499.5
4	1212	224.5
5	2112	343.5

Write a C program using functions that reads quantity sold one day of each product to print summary of a week's selling status. A sample session follows.

```
Quantity of 1122 sold in this week: 2
Quantity of 2211 sold in this week: 3
Quantity of 2121 sold in this week: 1
Quantity of 1212 sold in this week: 2
Quantity of 2112 sold in this week: 3

                        Weekly statement
product no   quantity    Unit price  amount
  1122          2           149.00      298.00
  2211          3           225.00      675.00
  2121          1           499.50      499.50
  1212          2           224.50      449.00
  2112          3           343.50     1030.50

                            Total     2952.00
```

13. The packing department of a television set manufacturer has to prepare a requisition note listing the number of different boxes required for different TV models that it has received from the production department. The list has to be forwarded to the stores department so that the required boxes are issued to the packing department. Write a C program that accepts as input the number of each television model (you can assume the type of boxes for each model) required and prints a list as follows (try to reproduce the table below as much as possible!!)

Model	Box Type	Numbers required
TV-LCD 17	1	98
TV-LCD 22	2	79

TV-LCD 26	3	65
TV-LCD 32	4	43
TV-LCD 37	5	17

14. In the *Indian Standard Soil Classification System (ISSC)* soils are classified into groups according to size and the groups are further divided into coarse, medium and fine sub-groups. The grain-size range is used as the basis for grouping soil particles into boulder, cobble, gravel, sand, silt or clay. The following table provides the classification based on grain-size.

Very coarse Soils	Boulder		> 300 mm
	Cobble		80 – 300 mm
Coarse Soils	Gravel	Coarse	20 – 79 mm
		Fine	4.75 – 19 mm
	Sand	Fine	0.075 – 0.424 mm
Fine Soils	Silt		0.002 – 0.74 mm
	Clay		< 0.002 mm

Write a C program to classify a *set of grain-size* values into soil groups.

A typical program session is as follows

```
Welcome to Indian Standard Soil Classification System
size of your grain-size data: 6
Enter the data (mm): 4.8 120 350 0.350 0.001 3

The results of soil classification
4.8mm  - Gravel Fine
120mm  - Cobble
50mm - Boulder
0.350mm - Sand Fine
0.001mm - Clay
3mm    - Sand Coarse
```

15. *Chatflow Wireless* offers customers 600 weekday minutes for a flat rate of Rs. 250 and 600 weekend minutes for a flat rate of Rs. 300. Additional weekday minutes and weekend minutes respectively cost Rs. 1.50 and Rs. 2.00 each. There are taxes of 5.25% on all charges. Write a program that prompts the user to enter the number of weekday minutes, weekend minutes and calculates the monthly bill. The program should display with labels the input data, the pretax bill, the tax, and the total bill.

Typical input output sessions follow.

```
        Weekday minutes for entire month: 1200
        Weekend minutes for entire month: 1440

        Chatflow Wireless Monthly Bill
        Weekday minutes: 1200
        Weekend minutes: 1440
        Weekday bill: Rs. 1150
        Weekend bill: Rs. 1980
        Pre-tax bill: Rs. 3130
        Tax (5.25%) : Rs. 164.325
Total bill  : Rs. 3294.325
```

16. Write C programs that print the following patterns.

17. A

```
(A)          (B)          (C)          (D)
*            **********    **********            *
**           *********      *********           **
***          ********        ********          ***
****         *******          *******         ****
*****        ******            ******        *****
******       *****              *****       ******
*******      ****                ****      *******
********     ***                  ***     ********
*********    **                    **    *********
**********   *                      *   **********
```

certain grade of steel is graded according to the following conditions:

a) Hardness must be greater than 50
b) Carbon content must be less than 0.7
c) Tensile strength must be greater than 5600

The grades of steel are as follows.

a) Grade is 10 if all three conditions are met.
b) Grade is 9 if conditions i and ii are met.
c) Grade is 8 if conditions ii and iii are met.
d) Grade is 7 if conditions i and iii are met.
e) Grade is 6 if only one condition is met.
f) Grade is 5 if none of the conditions are met.

Write a program to find the grade of a given a steel.

Sample Session follows.

```
        How many steels you want to grade: 2
        Enter data: 35 0.8 5700 60 0.5 6000
Grades:  8 7
```

18. Student's T test is a statistical test that compares two averages and tells if they are different from each other. T-test can be calculated using the formula

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

where $\overline{x_1}$ is the mean of the first data set, $\overline{x_2}$ is the mean of the second data set, S_1^2 is the standard deviation of the first data set, S_2^2 is the standard deviation of the second data set, N_1 is the number of elements in the first data set and N_2 is the number of elements in the second data set. Given two data sets in the form of arrays, write a program to calculate the t-test. Note that standard deviation can be calculated as given below.

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

```
Enter the size of the data: 5 5
Enter data: 10 20 30 40 50
1 29 46 78 99

T-test: -1.09789
```

```
Enter the size of the data: 6 5
Enter data: 5 20 40 80 100 120
1 29 46 78 99

T-test: 0.399518
```

19. Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ... By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.

    In fact the sum of even-valued terms such that the values in Fibonacci sequence whose values do not exceed four million is 4613732!!

20. Find below an algorithm to find the square root of a given number.

Algorithm to compute square root

1. Get m the positive integer whose square root has to be computed and the absolute difference e (error limit).
2. Set g1 to a random number less than m, say m/2.
3. Set the guess g2 to m/g1.
4. While absolute difference between g1 and g2 is greater than e, repeatedly do
   a) Set g1 = g2
   b) Set a better estimate g2 using the averaging formula; g2 = (g1 + (m/g1))/2
5. Display the estimated square root g2.

Write a C program to compute the square root of a given number. Once square root is implemented, cube root is a simpler extension. For improving the guess of cube root use

$$\frac{x/y^2 + 2y}{3}$$

where *y* is the cuberoot approximation (guess) of *x*. Write a C program to compute the cube root of given number too.

21. The Floyd's triangle is given as below. Given the input as 5 the following pattern results.

```
1
0 1
1 0 1
0 1 0 1
1 0 1 0 1
```

Write a C program that prints the Floyd's triangle for any given input *n*.

22. Write a C program to print the following pattern.

```
1
3 1
5 3 1
7 5 3 1
9 7 5 3 1
```

Once you have printed the pattern, can you print the inverse of the same?

```
9 7 5 3 1
7 5 3 1
5 3 1
3 1
1
```

The number of rows in the both cases are 5. Can you make it a variable where user inputs the row number and the program should print the pattern extended to as many rows as entered by the user?!!!

23. Write a C program to implement a number system converter which can convert a decimal number into its corresponding value in binary number system. The program must work for reverse conversion as well (from binary to decimal).

24. Write a program that prints the following patterns separately, one below the other. Use for loops to generate the patterns. All asterisks (*) should be printed by a single printf statement of the form printf("%s","*"); (this causes the asterisks to print side by side). [Hint: The last two patterns require that each line begin with an appropriate number of blanks.]

```
(A)          (B)          (C)          (D)
*            **********    **********            *
**           *********      *********           **
***          ********        ********          ***
****         *******          *******         ****
*****        ******            ******        *****
******       *****              *****       ******
*******      ****                ****      *******
********     ***                  ***     ********
*********    **                    **    *********
**********   *                      *   **********
```

25. A right triangle can have sides that are all integers. The set of three integer values (side1, side2 and hypotenuse) for the sides of a right triangle is called a *Pythagorean triple*. These three sides must satisfy the relationship that the sum of the squares of two of the sides (i.e. side1 and side2) is equal to the square of the hypotenuse. Write a program (use functions) that finds all *Pythagorean triples* for side1, side2, and the hypotenuse all no larger than 500.

Pythogorean Triples (all less than 500)

```
Side1 Side2 Hypotenuse
3     4     5
5     12    13
6     8     10
7     24    25
8     15    17
9     12    15
...
  300  315   435
  319  360   481
  320  336   464
  325  360   485
340   357   493
```

(beyond this hypotenuse exceeds 500!!)

26. Jamie is planning a buffet for the DirectiPlex inauguration party, and everyone is invited. On their way in, each guest picks up a sheet of paper containing a random number (this number may be repeated). The number is lucky if all digits of the number are different and the guest will be declared as winner of the lucky draw. Write a C program to find the lucky number using function

Examples:

```
Input: n = 983
Output: true
All digits are different

Input: n = 9838
Output: false
8 appears twice
```

27. Given a positive integer `n`, the task is to check if `n` is a *non-hypotenuse* number or not. If `n` is a non-hypotenuse number then print 'YES' else print 'NO'. In mathematics, a *non-hypotenuse number* is a natural number whose square can not be expressed as sum of two distinct non-zero squares. The number 1, 2, 3 and 4 are *non-hypotenuse numbers* while 5 is not.

```
Input: 5
Output: No Explanation: 5^2 can be expressed as 3^2 + 4^2
Input: 6
```

Output: YES Explanation: 6 can not be expressed as sum of two different squares.

10 (No because $8^2 + 6^2$)

13 (No because $12^2 + 5^2$)

28. You are provided with an array of `n` responses (whose values range from `1` to `9`) to a particular survey. Write a program to draw a histogram of the survey response results.

For example given the following array with 99 responses

```
{ 6, 7, 8, 9, 8, 7, 8, 9, 8, 9,
  7, 8, 9, 5, 9, 8, 7, 8, 7, 8,
  6, 7, 8, 9, 3, 9, 8, 7, 8, 7,
  7, 8, 9, 8, 9, 8, 9, 7, 8, 9,
  6, 7, 8, 7, 8, 7, 9, 8, 9, 2,
  7, 8, 9, 8, 9, 8, 9, 7, 5, 3,
  5, 6, 7, 2, 5, 3, 9, 4, 6, 4,
  7, 8, 9, 6, 8, 7, 8, 9, 7, 8,
  7, 4, 4, 2, 5, 3, 8, 7, 5, 6,
  4, 5, 6, 1, 6, 5, 7, 8, 7 }
```

your program should produce

```
Response     Frequency      Histogram
1               1           *
2               3           ***
3               4           ****
4               5           *****
5               8           ********
6               9           *********
7               23          ***********************
8               27          ***************************
9               19          *******************
```

You can check the correctness of your output by validating that the sum of frequencies should be equal to the size of the input survey response array.

29. Given an array of non-negative integers, write a program to find the minimum number of elements such that their sum should be greater than the sum of the rest of the elements of the array.

Given `{3, 1, 7, 1}` the output should be `1` element (i.e. `{7}`) since 7 is greater than the sum of the rest of the elements i.e `3+1+1 = 5`

Given {2, 1, 2} the output should be 2 elements (i.e. {2,1} or {1,2} and {2,2}) since 3 and 4 is greater than the sum of the rest of the elements i.e 2 and 1 respectively.

30. Given an array of n positive integers, write a program to count the number of pairs of integers in the array that have the sum divisible by 4.

    For example given the array {2, 2, 1, 7, 5} the pairs of integers whose sum is divisible by 4 are {2, 2}, {1, 7}, {7, 5}. So the output should be 3 pairs of integers.

    Given an array {2, 2, 3, 5, 6} the pairs of integers are {2, 2}, {3, 5}, {2, 6}, {2, 6}. So the output should be 4 pairs of integers.

31. Given a binary array and a number k, write a program to find the length of the longest sub-array of consecutive 1's by changing at most k 0's.

    For example given the array {1, 0, 0, 1, 1, 0, 1} and k = 1 the output should be 4 as changing 0 in position 5 to 1 gives the sub-array {1, 1, 1, 1}.

    Given the array {1, 0, 0, 1, 0, 1, 0, 1, 0, 1} and k = 2 , changing 0's in positions 5 and 7 or positions 7 and 9 gives the sub-array {1, 1, 1, 1, 1} so the length of longest sub-array is 5.

32. Given two arrays of integers of size m and n, write a program to find the minimum length sub-array in the first array that contains all the elements of the second array.

    For example given {2, 2, 4, 5, 8, 9} and {2, 5, 9} the output should be 5 since the sub-array is {2, 4, 5, 8, 9} of size 5.

    Given {5, 6, 5, 2, 7, 5, 6, 7, 5, 5, 7} and {5, 5, 7} the output should be 3 and the sub-array is {5, 5, 7}

33. Any drug (depending upon its composition) looses p% of its effectiveness every month in it's storage. When its effectiveness is below 50% it is considered expired and must be discarded. Write a program that determines how many months the drug can remain in storage.

    Sample Session follows. (Note since the values are rounded figures to some significant values, your results may/may not match the values given here!!)

```
Enter the name of the drug: vilaspen
Enter percentage: 4%

month: 0        effectiveness: 100.0
month: 1        effectiveness: 96.0
```

```
month: 2        effectiveness: 92.16
month: 3        effectiveness: 88.4735
month: 4        effectiveness: 84.9346
month: 5        effectiveness: 81.5372
month: 6        effectiveness: 78.2757
month: 7        effectiveness: 75.1447
month: 8        effectiveness: 72.1389
month: 9        effectiveness: 69.2533
month: 10       effectiveness: 66.4832
month: 11       effectiveness: 63.8239
month: 12       effectiveness: 61.2709
month: 13       effectiveness: 58.8201
month: 14       effectiveness: 56.4673
month: 15       effectiveness: 54.2086
month: 16       effectiveness: 52.0402
month: 17       effectiveness: 49.9586

Vilaspen can be kept in storage for 16 months. It should be
declared expired thereafter.
```

Do you want to continue (y/n): n

34. Given an array of sorted integers, write a program to find the closest array element to a given number.

    Given `{1, 2, 4, 5, 6, 6, 8, 9}` and the number as `11` the closest array element is `9`.

    Given `{2, 5, 6, 7, 8, 8, 9}` and the number as 4 the closest array element is `5`.

    If completed, can you make your program work for unsorted array of integers?

35. Given an array of `n` integers (duplicates allowed), write a program to find the contiguous (continuous) set of integers are present in the array.

    For example, given the array `{5, 2, 3, 6, 4, 4, 6, 6}` the contiguous set of integers are `{2, 3, 4, 5, 6}`.

    Given `{10, 14, 10, 12, 12, 13, 15}` the output should be `None` as there are no continuous set of integers in the given array.

36. Write a program to find intersection of two sorted arrays in C.

Given two arrays: `{21, 22, 34, 45, 41}` and `{11, 21, 34, 45, 61}`, the program should return `21` and `34` to be precise `{21, 34}`!!

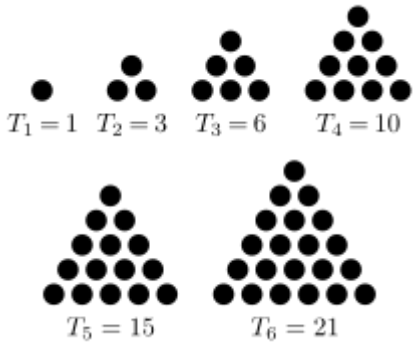
37. Given an array with every element repeated twice except one, write a program to find that element.
    Given `{1, 1, 2, 2, 3, 4, 4, 5, 5}` then your program should return `3`.

38. The sequence of *triangular numbers* is generated by adding the natural numbers. So the 7th *triangular number* would be 1 + 2 + 3 + 4 + 5 + 6 + 7 = 28. The first ten *triangular numbers* would be: 1, 3, 6, 10, 15, 21, 28, 36, 45 and 55
    Write a C program with functions to generate the first `n` *triangular numbers*.

    ```
    How many triangular numbers would you like to generate: 30
    1, 3, 6, 10, 15, 21, 28, 36, 45, 55, 66, 78, 91, 105, 120,
    136, 153, 171, 190, 210, 231, 253, 276, 300, 325, 351, 378,
    406, 435, 465
    ```

    Instead of straightforward additions to generate each triangular number, can you identify a pattern and use it to generate the numbers?

    Hint: First 6 triangular numbers

39. Given an array and a number `k` which is smaller than the size of the array, Write a program to find the `k`th smallest element in an array.

    Given array `{7, 10, 4, 3, 20, 15}` and `k = 3` the output should be `7`.
    Given `k = 4` the output should be `10`.

    If asked to find the `k`th largest element in an array, what changes in your program do you think you have to make?!

40. More to come....