S.No: 8	Exp. Name: ***Write a C program to find all Roots of a Quadratic equation***	Date:2023-01-23

Aim:

Design and develop a flowchart or an algorithm that takes three coefficients (a, b, and c) of a **quadratic equation** ($ax^2+bx+c=0$) as input and computes all possible roots.

An equation is quadratic only if **a** is **non zero**.

If **a** is **zero** and **b** is **non zero** in the above equation then it becomes a **linear equation** (bx + c = 0).

If **a** and **b** are **zeros** then the it becomes a **constant equation**.

Implement a **C** program for the developed flowchart/algorithm and execute the same to output the possible roots for a given set of coefficients with appropriate messages.

At the time of execution, the program should print the message on the console as:

```
Enter coefficients a, b and c :
```

For example, if the user gives the **input** as:

```
Enter coefficients a, b and c : 2 6 4
```

then the program should **print** the result as:

```
The roots are real and distinct
root1 = -1.000000 and root2 = -2.000000
```

If the input is given as `0 0 0` then the result should be:

```
Invalid coefficients
Enter valid inputs
```

If the input is given as `0 2 8` then the result should be:

```
Linear equation
Root = -4.000000
```

If the input is given as `1 6 9` then the result should be:

```
The roots are real and equal
root1 = root2 = -3.000000
```

If the input is given as `1 4 7` then the result should be:

```
The roots are real and imaginary
root1 = -2.000000+i1.732051
root2 = -2.000000-i1.732051
```

Note - 1: Do use the **printf()** function with a **newline** character (`\n`) at the end.

Note - 2: Use `fabs()` funtion (**fabs(determinant)**) when the roots are real and imaginary.

Note - 3: Let us consider all the **coefficient** values as **float** values.

Source Code:

Program419.c

```
#include<stdio.h>
#include<math.h>
void main()
{
   float a,b,c,root1,root2,det;
   printf("Enter coefficients a, b and c : ");
   scanf("%f%f%f",&a,&b,&c);
   det=(pow(b,2)-4*a*c);
   if(a==0&&b==0&&c==0)
   {
      printf("Invalid coefficients\nEnter valid inputs\n");
 }
   else if(a==0&&b!=0)
   {
      printf("Linear equation\n");
      root1=-c/b;
      printf("Root = %f\n",root1);
  }
      else if(a!=0)
      {
         if(det==0)
         {
            printf("The roots are real and equal\n");
         root1=-b/(2*a);
         printf("root1 = root2 = %f\n",root1);
   }
         else if(det>0)
         {
            printf("The roots are real and distinct\n");
            root1=(-b+sqrt(det))/(2*a);
            root2=(-b-sqrt(det))/(2*a);
            printf("root1 = %f and root2 = %f\n",root1,root2);
   }
         else
         {
            printf("The roots are real and imaginary\n");
            root1=-((b)/(2*a));
            root2=(sqrt(-det))/(2*a);
            printf("root1 = %f+i%f\nroot2 = %f-i%f\n",root1,root2,root1,root2);
  }
  }
}
```

Execution Results - All test cases have succeeded!

Test Case - 1
User Output
Enter coefficients a, b and c : 2 6 4

The roots are real and distinct
root1 = -1.000000 and root2 = -2.000000

Test Case - 2
User Output
Enter coefficients a, b and c : 0 0 0
Invalid coefficients
Enter valid inputs

Test Case - 3
User Output
Enter coefficients a, b and c : 0 2 8
Linear equation
Root = -4.000000

Test Case - 4
User Output
Enter coefficients a, b and c : 1 6 9
The roots are real and equal
root1 = root2 = -3.000000

Test Case - 5
User Output
Enter coefficients a, b and c : 1 -5 3
The roots are real and distinct
root1 = 4.302776 and root2 = 0.697224

Test Case - 6
User Output
Enter coefficients a, b and c : 1 4 7
The roots are real and imaginary
root1 = -2.000000+i1.732051
root2 = -2.000000-i1.732051