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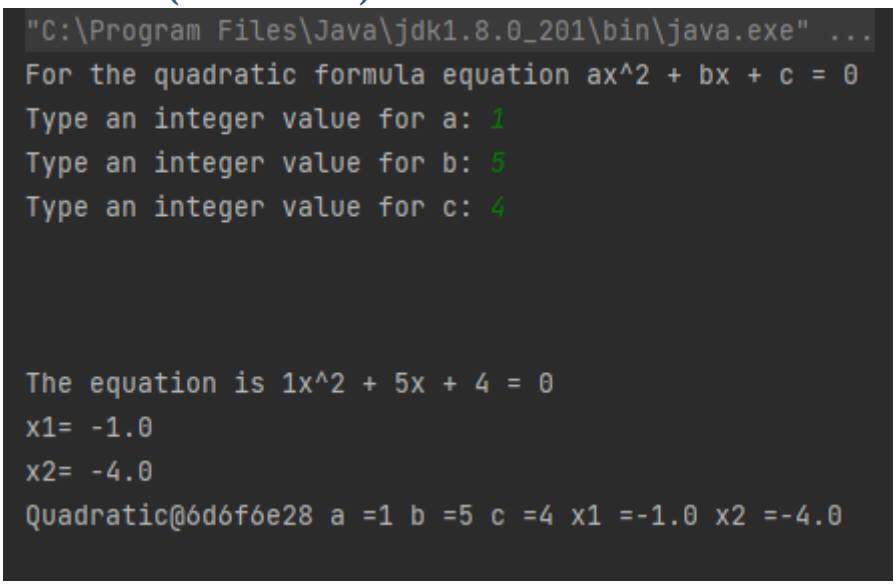
Black-box Testing

Testing for real roots (small values):



Input for a, b and c are as follows:

- A: 1
- B: 5
- C: 4

Output for x1 and x2 are as follows:

- X1 = -1.0
- X2 = -4.0

Expected output for x1 and x2:

- X1 = -1.0
- X2 = -4.0
- A message stating what type of root it is

From testing, it was observed that the program did not tell me if the result of the calculation is a real/complex/no real root (despite the answer being real roots). What can be done to rectify the issue is to let the user know that it is real roots (output). **There were no difference with the answers between the large and small values inputted.**

Testing for real roots (large values):

```
For the quadratic formula equation ax^2 + bx + c = 0
Enter a value of a: 1000
Enter a value of b: 5000
Enter a value of c: 4000

The equation is 1000x^2 + 5000x + 4000 = 0
x1= -1.0
x2= -4.0
Quadratic@6d6f6e28 a =1000 b =5000 c =4000 x1 =-1.0 x2 =-4.0
```

Input for a, b and c are as follows:

- A: 1000
- B: 5000
- C: 4000

Output for x1 and x2 are as follows:

- X1 = -1.0
- X2 = -4.0

Expected output for x1 and x2:

- X1 = -1.0
- X2 = -4.0
- A message stating what type of root it is

From testing, it was observed that the program did not tell me if the result of the calculation is a real/complex/no real root (despite the answer being real roots). What can be done to rectify the issue is to let the user know that it is real roots (output). **There were no difference with the answers between the large and small values inputted.**

Testing for complex/imaginary roots (small values):

```
For the quadratic formula equation ax^2 + bx + c = 0
Enter a value of a: 2
Enter a value of b: 6
Enter a value of c: 5

The equation is 2x^2 + 6x + 5 = 0
Error -999999.0. There are no real roots.
Quadratic@6d6f6e28 a =2 b =6 c =5 There are no real roots for x1 and x2
```

Input for a, b and c are as follows:

- A: 2
- B: 6
- C: 5

Expected output for x1 and x2:

- There are imaginary roots.

The program is able to plug the values into the equation but is unable to calculate the problem and return an error with a value of -999999.0. It also pointed out that there are no real roots (Which is true but there shouldn't be an error message). **There were no difference with the answers between the large and small values inputted.**

Testing for complex/imaginary roots (large values):

```
For the quadratic formula equation ax^2 + bx + c = 0
Enter a value of a: 2000
Enter a value of b: 6000
Enter a value of c: 5000

The equation is 2000x^2 + 6000x + 5000 = 0
Error -999999.0. There are no real roots.
Quadratic@6d6f6e28 a =2000 b =6000 c =5000 There are no real roots for x1 and x2
```

Input for a, b and c are as follows:

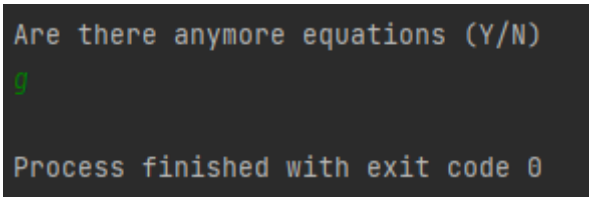
- A: 2000
- B: 6000
- C: 5000

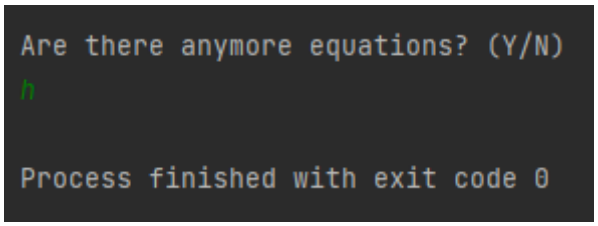
Expected output for x1 and x2:

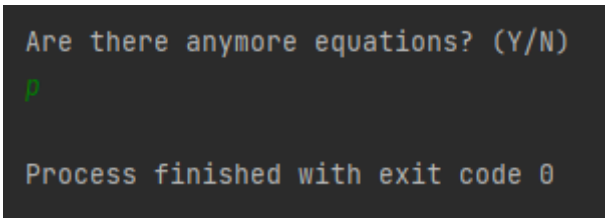
- There are imaginary roots.

The program is able to plug the values into the equation but is unable to calculate the problem and return an error with a value of -999999.0. It also pointed out that there are no real roots (Which is true but there shouldn't be an error message). **There were no difference with the answers between the large and small values inputted.**

If a person inputs a value that isn't y or n when asked if they want to do another question:







Input: g, h, p

From observations made, it seems as though if the user inputs a letter except the letter y, it will close the application.

Whitebox testing

Testing for real roots:

```
public double formulaX1()
{
    if (pow(b,2)>=4*a*c)
        return (-b+(pow((pow(b,2)-(4*a*c)),0.5)))/(2*a);
    else
    {
        return -999999;
    }
}

public double formulaX2()
{
    if (pow(b,2)>=4*a*c)
        return (-b-(pow((pow(b,2)-(4*a*c)),0.5)))/(2*a);
    else
    {
        return -9999999;
    }
}
```

The code above is the only set of calculations that take place and while it is not wrong, it doesn't outline if they are real roots or not.

```
"C:\Program Files\Java\jdk1.8.0_201\bin\java.exe" ...
For the quadratic formula equation ax^2 + bx + c = 0
Type an integer value for a: 1
Type an integer value for b: 5
Type an integer value for c: 4



The equation is 1x^2 + 5x + 4 = 0
x1= -1.0
x2= -4.0
Quadratic@ódóföe28 a =1 b =5 c =4 x1 =-1.0 x2 =-4.0
```

There is no output stating if it's real roots or not.

Once change that can be made is to put an output statement stating that it have real roots. It would help if there were else if statements to cycle the values and determine if it have roots/no roots/imaginary.

Testing for complex/imaginary roots

Input was given with an expected outcome of both x1 and x2 being imaginary. The resulting output was:

```
For the quadratic formula equation ax^2 + bx + c = 0
Type an integer value for a: 2
Type an integer value for b: 6
Type an integer value for c: 5



The equation is 2x^2 + 6x + 5 = 0
Error -999999.0. There are no real roots.
Quadratic@6d6f6e28 a =2 b =6 c =5 There are no real roots for x1 and x2
```

The expected answers for x1 and x2 are:

- X1 = imaginary
- X2 = imaginary

The output gives me a value -999999.0.

The following code below details the problem that occurs.

```
public double formulaX1()
{
    if (pow(b,2)>=4*a*c)
        return (-b+(pow((pow(b,2)-(4*a*c)),0.5)))/(2*a);
    else
    {
        return -999999;
    }
}

public double formulaX2()
{
    if (pow(b,2)>=4*a*c)
        return (-b-(pow((pow(b,2)-(4*a*c)),0.5)))/(2*a);
    else
    {
        return -9999999;
    }
}
```

The code does not have the functionality to determine if the values for x1 and x2 are imaginary. Instead it prints an error which is not the desired output. It is unable to calculate when (b^2 -4ac) is negative.

```
if (pow(b,2)>=4*a*c)
{
    if (test.formulaX1()==test.formulaX2())
        System.out.println("The quadratic is a perfect square and the value of x= "+test.formulaX1());
    else
    {
        System.out.println("x1= "+test.formulaX1());
        System.out.println("x2= "+test.formulaX2());
    }
}
else
    System.out.println("Error "+test.formulaX1()+". There are no real roots.");
```

One other problem which occurs is that it prints there are no real roots when it should print that it’s imaginary. So there are two problems within the class file and the main.

If a person inputs a value that isn't y or n when asked if they want to do another question:

The code only checks for the char value = y (Yes). It does not check for n (no) or any other value entered.

```
    System.out.println("Error "+test.formulaX1()+". There are no real roots.");
System.out.println(test);
System.out.println("\nAre there anymore equations? (Y/N)");
char answer=console.next().charAt(0);
while(answer=='Y' || answer=='y')
{
```

If a user enters a value besides y, it closes the program as if they entered n