
ISAT 252 - ANALYTICAL METHODS

LAB #4: USING DECISION STRUCTURES

DUE DATE: MONDAY, FEBRUARY 24TH 2015

OBJECTIVES:

- Write code that uses decision structures If..elif..else
- Write code that use imports

DELIVERABLES: (40 POINTS)

1. Soft copies of:
 - a. Your planning documents (pseudo code **OR** flowchart)
 - b. Your working program
 - c. Your answers to the worksheet questions
2. Hard copies of:
 - a. Your planning documents (pseudo code OR flowchart)
 - b. Your source code
 - c. Your answers to the worksheet questions

THE SCENARIO:

Your little brother and sister need help with their math homework. They are studying quadratic equations and he's got some problems like these (from:

<http://www.purplemath.com/modules/quadprob.htm>) :

- An object is launched at 19.6 meters per second (m/s) from a 58.8-meter tall platform. The equation for the object's height s at time t seconds after launch is $s(t) = -4.9t^2 + 19.6t + 58.8$, where s is in meters. When does the object strike the ground? (RECALL from ISAT152: When the object smacks into the ground, its height is $s = 0$, so we can just set s equal to zero, and solve: $0 = -4.9t^2 + 19.6t + 58.8$ for the time t which gives **us the time of flight**)
- After the semester is over, you discover that the math department has changed textbooks (again) so the bookstore won't buy your book back. You and your friend Sheldon decide to get creative. You go to the roof of a twelve-story building and look over the edge to the reflecting pool 160 feet below. You drop your book over the edge at the same instant that Herman chucks his book straight down at 48 feet per second. By how many seconds does his book beat yours into the water?
- A garden measuring 12 meters by 16 meters is to have a pedestrian pathway installed all around it, increasing the total area to 285 square meters. What will be the width of the pathway?

To solve these and other problems, you might need to solve a quadratic equation. When you are done with this lab, you can visit that website and see if your SuDuQES (Super-Duper-Quadratic-Equation-Solver) will arrive at the correct answer.

YOUR TASK:

Write a program that can solve quadratic equations. It will need to determine the real roots of the quadratic equation $ax^2 + bx + c = 0$ (where $a \neq 0$) after requesting the values of a , b , and c . Check to ensure that a is nonzero. If a is zero, display a message to the user and do not let anything else happen. Your program should be robust and you are NOT to use the try..except exception handling structure with this lab.

FOR THOSE WHO HAVE FORGOTTEN HOW TO SOLVE QUADRATIC EQUATIONS:

The equation has 1 or 2 solutions, depending on whether the value of b^2-4ac is zero or positive. The solutions are given by the quadratic formula:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

If the value of b^2-4ac (this is called the discriminant) is negative, there is no **real** solution, but will have a solution with imaginary numbers solution. For this lab your program should solve for the quadratic equation for both real and imaginary number solutions. Your program should be robust and not crash, regardless of the values of the coefficients (but they should be numeric). You should check the value of the discriminant:

when < 0 : handle the case of no real roots
when $= 0$: handle the case of a double root
when > 0 : handle the case of two distinct roots

DESIGN

1. What are the inputs needed?
2. What is the necessary output from the application?
- 3.

PLAN AND CODE

1. **Develop an Algorithm (flowchart or pseudocode)**
2. **Define your inputs, process and outputs.** - Don't forget to use meaningful names for everything.
3. **Write code.** - Don't forget to use comments for each function in addition to your personal and program explanation and other places where they are needed. These structures are **required**:
 - Use if...elif...else to be sure a is not zero. Later we will use a better way to test input.
 - DO NOT use try...except to make the program robust. We will use that later (chapter 6)
 - YOU MUST precede your code with the statement **import math**

TEST YOUR PROGRAM

The output should include the specific quadratic equation with the coefficients on one line and its solution below. Test your program with a variety of inputs, including zero. Then test the program with the following sets of coefficients:

$a = 1$	$b = -11$	$c = 28$	Solutions are 4 and 7
$a = 1$	$b = -6$	$c = 9$	Solution is 3
$a = 1$	$b = 2$	$c = 1$	Solution is -1 and -1
$a = 1$	$b = 4$	$c = 5$	Solutions are $-2 + i$ and $-2 - i$

CODE TO GET YOU STARTED

```
# quadratic.py
# A program that computes the roots of a quadratic equation.

#import the math module (your first import of prewritten code!)
import math

#declare variables and initialize variables (done on one line!)
a ,b ,c = 0.0, 0.0, 0.0
discRoot = 0.0
print("This program finds the solutions to a quadratic equation.")
a = float (input("\nPlease enter the coefficient (a): "))
b = float(input("\nPlease enter the coefficients (b): "))
c = float(input("\nPlease enter the coefficients (c): "))

discRoot = math.sqrt(          )

print("\nThe solutions are:", root1, root2)
```

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Worksheet 4: Using Decision Structures

Name: _____ Section: _____

1. A chip manufacturer discounts the price of its product (usually \$87) according to the amount of units the customer buys. If the customer buys between 100 and 500 units, the discount is 5% of the price per unit, a purchase of more than 500 has a discount of 7% per unit. Write the if...elif...else statement for the code below that calculates and displays the total of a purchase.

```
UNIT_PRICE = 87.00

units = 0.0

PurchasePrice =0.0

TotalPurchase =0.0

units = float("Please enter the number of units.")
```

2. Determine the output displayed when the code below is executed.

```
change =0.0

dollars = 0

change = float("enter the change")

dollars = int(change / 100)

if change >= 100:

    print("Your change contains " + \

        format(dollars, '2.2f') + " dollars"

else:

    print("Your change contains no dollars.")
```

```
num =0.0

num = float("Number?")

if num < 0:

    print("Negative")

elif num = 0:

    print("Zero")

else:

    print("Positive")
```

Output for each value entered of num

456 _____

100 _____

45 _____

Output for each value entered of num

-2 _____

100 _____

0 _____