Rational Quadratic Zeros

In this lesson, you will extend the code from **Integer Quadratic Zeros**. If you didn't complete the activity, complete that activity first or obtain the base code from your teacher.

In this lesson, you will create a game that lets you practice finding x-intercepts for equations in the form $y = ax^2 + bx + c$. These solutions will have one rational and one integer solution.

In the challenge, you will apply what you have learned to create a third game. This game will let you practice finding x-intercepts for equations in the form $y = ax^2 + bx + c$ where both x-intercepts are rational numbers.

Objectives:

Programming Objectives:

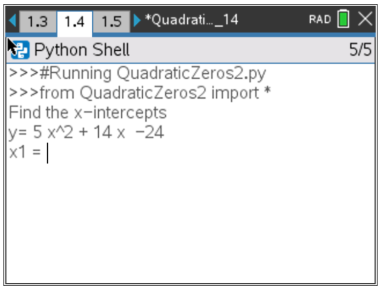
- Use the input function and a variable to collect and store data from a user
- Use the randint() function to generate random integers.
- Use a while loop to repeat code
- Use if..elif..else statements to make decisions.

Math Objectives:

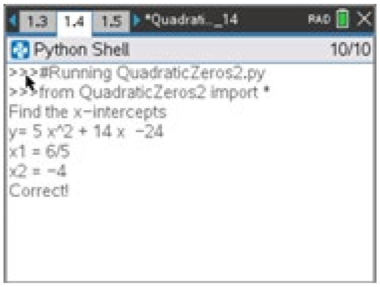
- Explore how x-intercepts are related to factored quadratic equations
- Explore how to factor equation in standard form
- Factor quadratic equations with rational solutions

Math Course Connections: Algebra 1 or Algebra 2

In this lesson, you will create a game that lets you practice finding x-intercepts for equations in the form $y = ax^2 + bx + c$. These solutions will have one rational and one integer solution.



```
>>>#Running QuadraticZeros2.py
>>>from QuadraticZeros2 import *
Find the x−intercepts
y= 5 x^2 + 14 x  −24
x1 = |
```



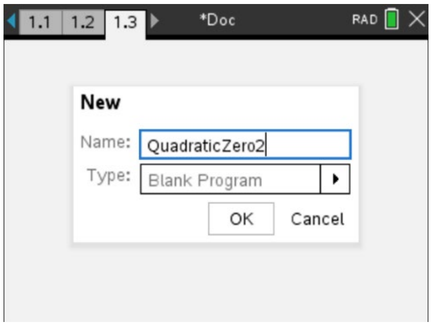
```
>>>#Running QuadraticZeros2.py
>>>from QuadraticZeros2 import *
Find the x−intercepts
y= 5 x^2 + 14 x  −24
x1 = 6/5
x2 = −4
Correct!
```

Teacher Tip:
To complete this project, students will need the base code from Integer Quadratic Zeros.

1. Insert a third page into the Integer Quadratic Zeros document.

   Add a python page.

   Name the project **QuadraticZero2**

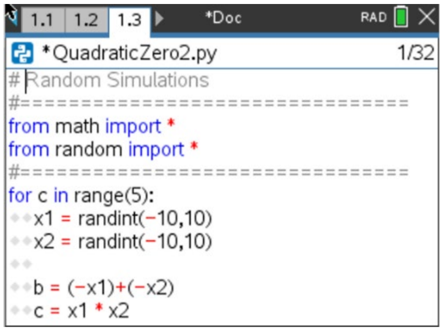


Name: QuadraticZero2
Type: Blank Program

2. This project will be a modification of QuadraticZero.

   Go back to page 1.1.
   Select all the code (ctrl -> a)
   Copy the code (ctrl -> c)

   Go to page 1.3, QuadraticZero2
   Paste the code (**ctrl -> v)**



*QuadraticZero2.py 1/32

```
# Random Simulations
#================================
from math import *
from random import *
#================================
for c in range(5):
    x1 = randint(-10,10)
    x2 = randint(-10,10)

    b = (-x1)+(-x2)
    c = x1 * x2
```

3. The factored equations in this problem will be of the type:

   y = (m*x – x1)(x – x2)

   In the first project, the line
   x2 = randint(-10,10)
   creates and stores random integer value from -10 to 10 in the variable x2

   Similarily, we will let m be an integer value from two to seven.

   Add a line of code after the x2 = randint(-10,10) to generate and store the value of m.

4. How does the addition of the cofficient m change the values of b and c in the code?

   Use distribution to solve and rewrite the equation in standard form.

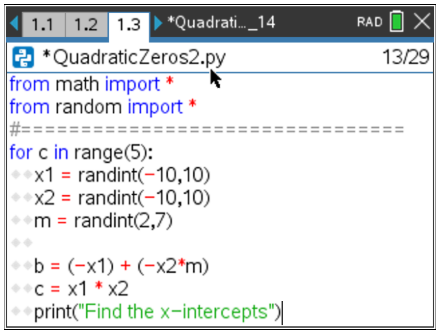
   y = (m*x – x1)(x – x2)

   b = ___________________

   c = ____________________

   Modify the values for b and c in the code if necessary.

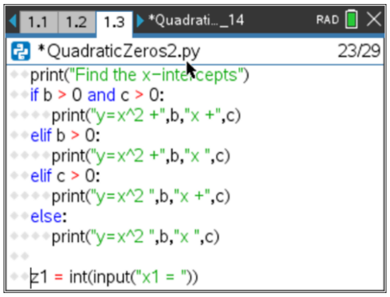
5. Does your code match the code to the right?



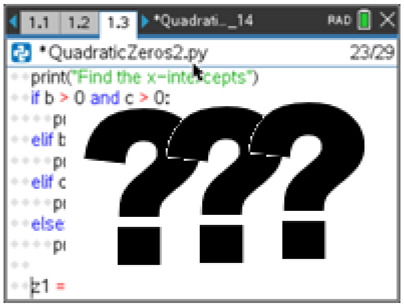
*QuadraticZeros2.py 13/29

```
from math import *
from random import *
#================================
for c in range(5):
    x1 = randint(-10,10)
    x2 = randint(-10,10)
    m = randint(2,7)

    b = (-x1) + (-x2*m)
    c = x1 * x2
    print("Find the x-intercepts")
```

6. When distributing m in step 4, your final equation started with mx^2 instead of x^2. How can you modify the print statements to show mx^2 instead of x^2? Be careful. You want the value of m to display not the letter m.



```
print("Find the x-intercepts")
if b > 0 and c > 0:
   print("y=x^2 +",b,"x +",c)
elif b > 0:
   print("y=x^2 +",b,"x ",c)
elif c > 0:
   print("y=x^2 ",b,"x +",c)
else:
   print("y=x^2 ",b,"x ",c)

z1 = int(input("x1 = "))
```

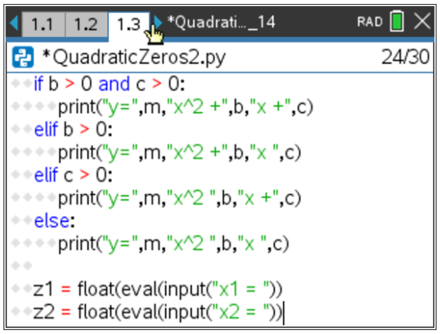


```
print("Find the x-intercepts")
if b > 0 and c > 0:
   pı
elif b
   pı
elif c
   pı
else
   pı

z1 =
```

Original

Modified

7. *How does the user input change?*



```
if b > 0 and c > 0:
   print("y=",m,"x^2 +",b,"x +",c)
elif b > 0:
   print("y=",m,"x^2 +",b,"x ",c)
elif c > 0:
   print("y=",m,"x^2 ",b,"x +",c)
else:
   print("y=",m,"x^2 ",b,"x ",c)

z1 = float(eval(input("x1 = "))
z2 = float(eval(input("x2 = "))
```

Let's look at a sample problem:

$4x^2 + 25x - 21 = 0$

$(4x – 3)(x + 7) = 0$

$4x – 3 = 0 \qquad x + 7 = 0$

$x = 3/4 \qquad x = -7$

Not all of the answers will be fractions, but some will be fractions.

The original code:

z1 = float(input(“x1 = “))

will not allow the user to enter the division sign.

To preform a calculation then store as a float, use the eval() function.

Modify the two input lines to:

z1 = float(eval(input(“x1 = “))

z2 = float(eval(input(“x2 = “))

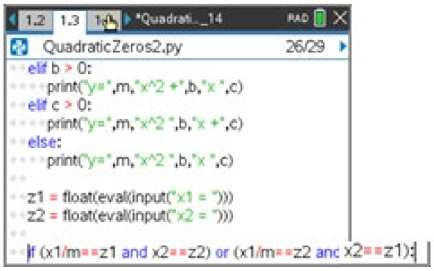
8. You have one more modification to make. The original project had the line:

if (x1 == z1 and x2== z2) or (x1 == z2 and z1== x2):

Modify the if statement so it include the new coefficient m.

Execute your program. Verify if statement works.

9. Did you change the code to:
   if (x1/m==z1 and x2==z2) or (x1/m==z2 and x2==z1):



QuadraticZeros2.py 26/29

```
  elif b > 0:
    print("y=",m,"x^2 +",b,"x ",c)
  elif c > 0:
    print("y=",m,"x^2 ",b,"x +",c)
  else:
    print("y=",m,"x^2 ",b,"x ",c)

  z1 = float(eval(input("x1 = ")))
  z2 = float(eval(input("x2 = ")))

  if (x1/m==z1 and x2==z2) or (x1/m==z2 anc x2==z1):
```

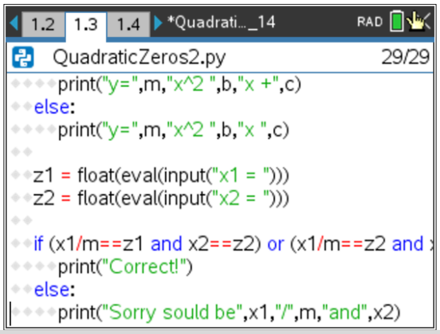
10. Lastly, modify your print statement if the user input is incorrect.

    Original:

    print("Sorry sould be",x1,"and",x2)

    Change To:

    print("Sorry sould be",x1,"/",m,"and",x2)



QuadraticZeros2.py 29/29

```
    print("y=",m,"x^2 ",b,"x +",c)
  else:
    print("y=",m,"x^2 ",b,"x ",c)

  z1 = float(eval(input("x1 = ")))
  z2 = float(eval(input("x2 = ")))

  if (x1/m==z1 and x2==z2) or (x1/m==z2 and
    print("Correct!")
  else:
    print("Sorry sould be",x1,"/",m,"and",x2)
```

Teacher Tip:

```
# Random Simulations
#================================
from math import *
from random import *
#================================
for c in range(5):
  x1 = randint(-10,10)
  x2 = randint(-10,10)
  m = randint(2,7)

  b = (-x1) + (-x2*m)
  c = x1 * x2
  print("Find the x-intercepts")
  if b > 0 and c > 0:
    print("y=",m,"x^2 +",b,"x +",c)
  elif b > 0:
    print("y=",m,"x^2 +",b,"x ",c)
  elif c > 0:
    print("y=",m,"x^2 ",b,"x +",c)
  else:
    print("y=",m,"x^2 ",b,"x ",c)

  z1 = float(eval(input("x1 = ")))
  z2 = float(eval(input("x2 = ")))

  if (x1/m==z1 and x2==z2) or (x1/m==z2 and x2==z1):
    print("Correct!")
  else:
```

```
  print("Sorry sould be",x1,"/",m,"and",x2)
```

Challenge:
Create a **QuadraticZero3** program that generates equations with two fractional x-intercepts.

For example, $6x^2 – 11x – 35 = 0$ factors to (3x + 5)(2x – 7) = 0.

The x-intercepts would be x = -5/3 and x = 7/2.

Teacher Tip:

```
# Random Simulations
#================================
from math import *
from random import *
#================================
for c in range(5):
  x1 = randint(-10,10)
  x2 = randint(-10,10)
  m = randint(2,7)
  n = randint(2,7)
  b = (-x1*n) + (-x2*m)
  c = x1 * x2
  print("Find the x-intercepts")
  if b > 0 and c > 0:
    print("y=",m*n,"x^2 +",b,"x +",c)
  elif b > 0:
    print("y=",m*n,"x^2 +",b,"x",c)
  elif c > 0:
    print("y=",m*n,"x^2",b,"x +",c)
  else:
    print("y=",m*n,"x^2",b,"x",c)

  z1 = float(eval(input("x1 = "))
  z2 = float(eval(input("x2 = "))
  if (x1/m == z1 and x2/n== z2) or (x1/m == z2 and z1== x2/n):
    print("Correct!")
  else:
    print("Sorry should be",x1,"/",m,"and",x2,"/",n)
  print("")
```