UNIVERSITY OF CALGARY

CPSC203 – Introduction to Problem Solving and Using Application Software

Fall 2009

Tutorial 25, Mehrdad Nurolahzade

Introduction

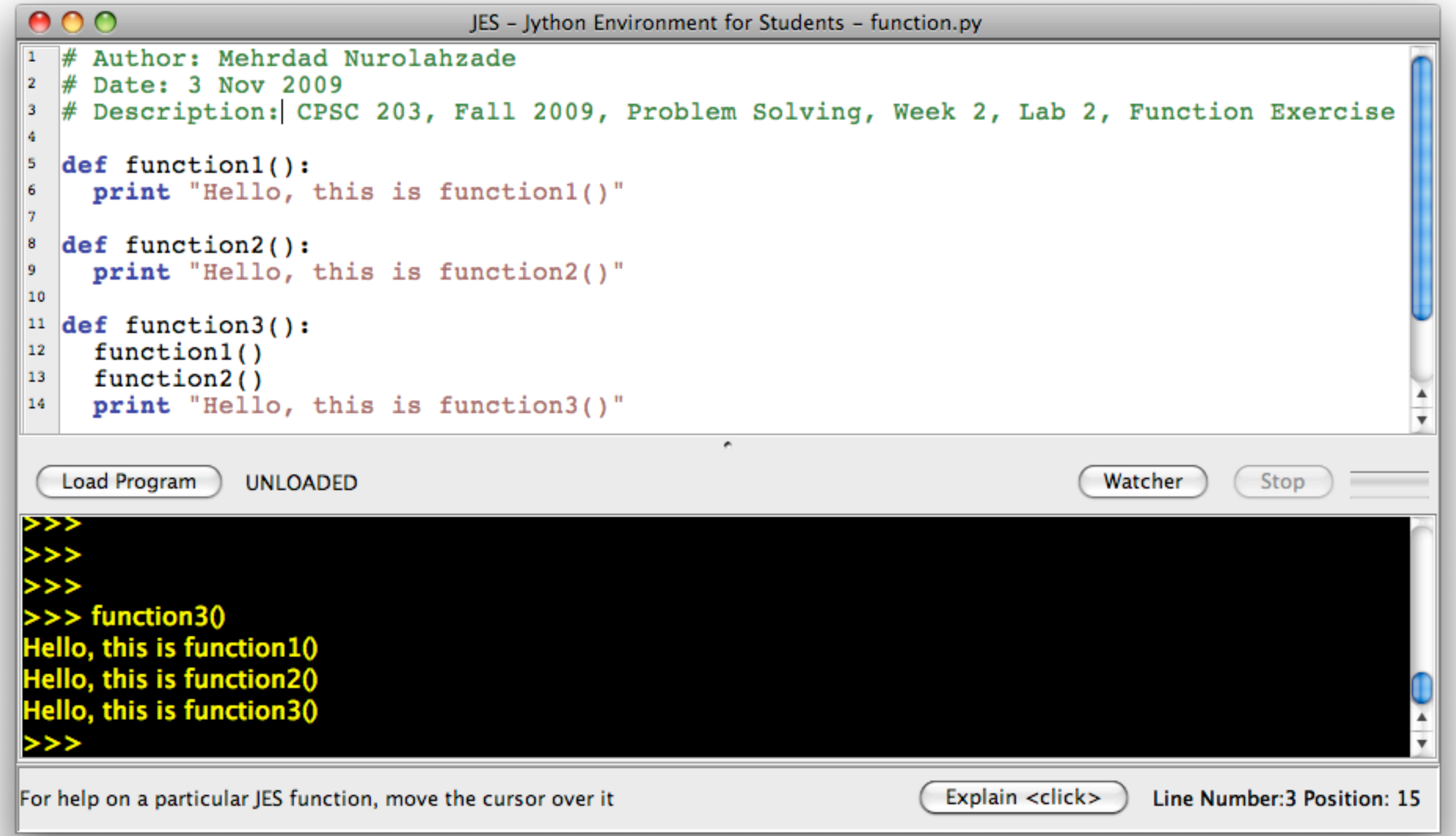
- Functions
- Graphics

Multiple Functions (1)

- Jython programs can have more than a function.
- A function can call (=invoke) other functions.

- When function A calls function B, all instructions in function B get executed first. Then, once function B returns (=exits) function A continues execution.

Multiple Functions (2)



```
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Function Exercise

def function1():
  print "Hello, this is function1()"

def function2():
  print "Hello, this is function2()"

def function3():
  function1()
  function2()
  print "Hello, this is function3()"
```

```
>>>
>>>
>>>
>>> function3()
Hello, this is function1()
Hello, this is function2()
Hello, this is function3()
>>>
```

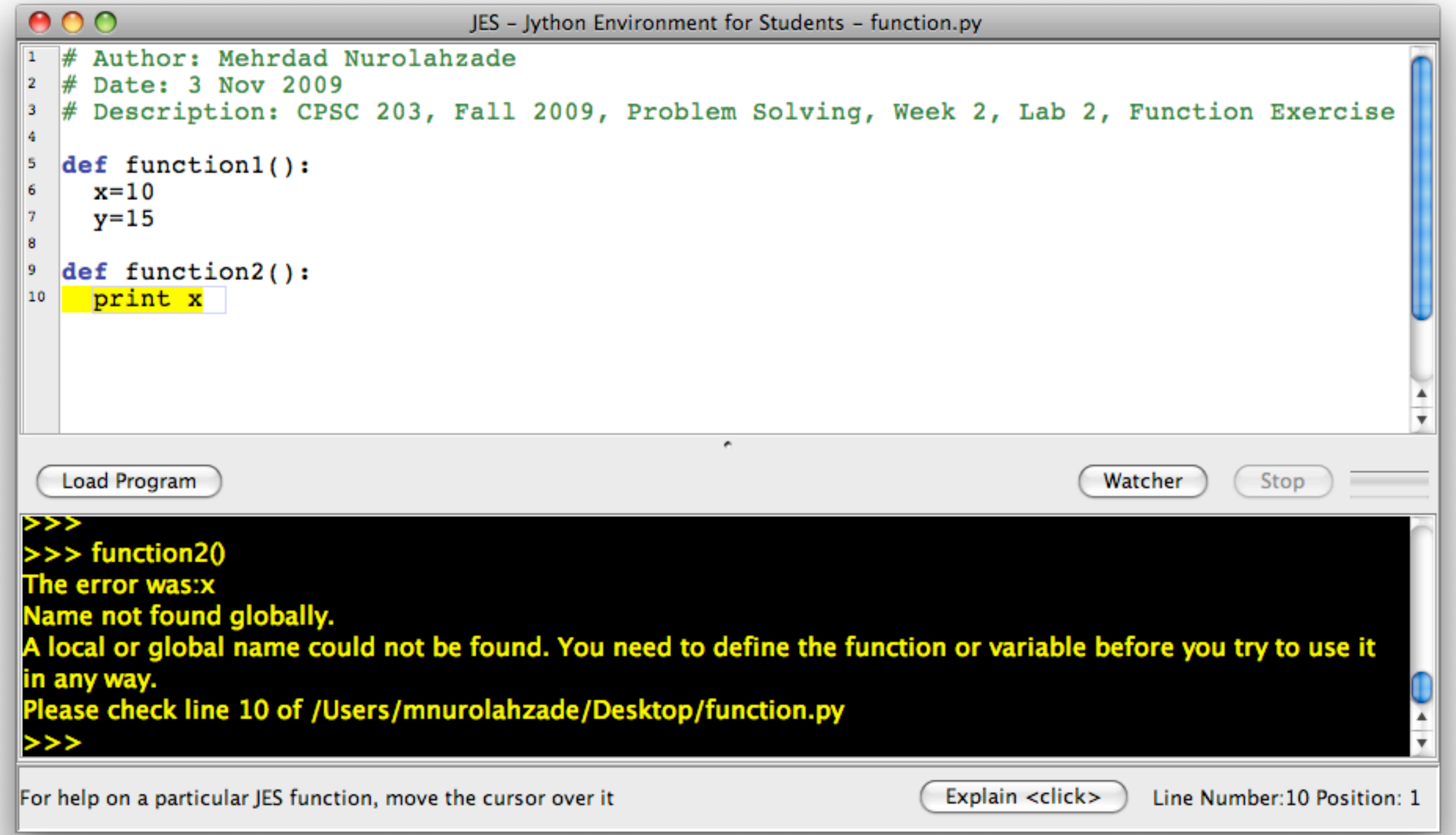
For help on a particular JES function, move the cursor over it

Line Number:3 Position: 15

Variable Scope (1)

- All variables defined inside the body of a function are local to that function, i.e. cannot be accessed in other functions.

Variable Scope (2)


JES – Jython Environment for Students – function.py
Load Program
Watcher
Stop
Explain <click>
For help on a particular JES function, move the cursor over it
Line Number:10 Position: 1

```
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Function Exercise

def function1():
  x=10
  y=15

def function2():
  print x
```

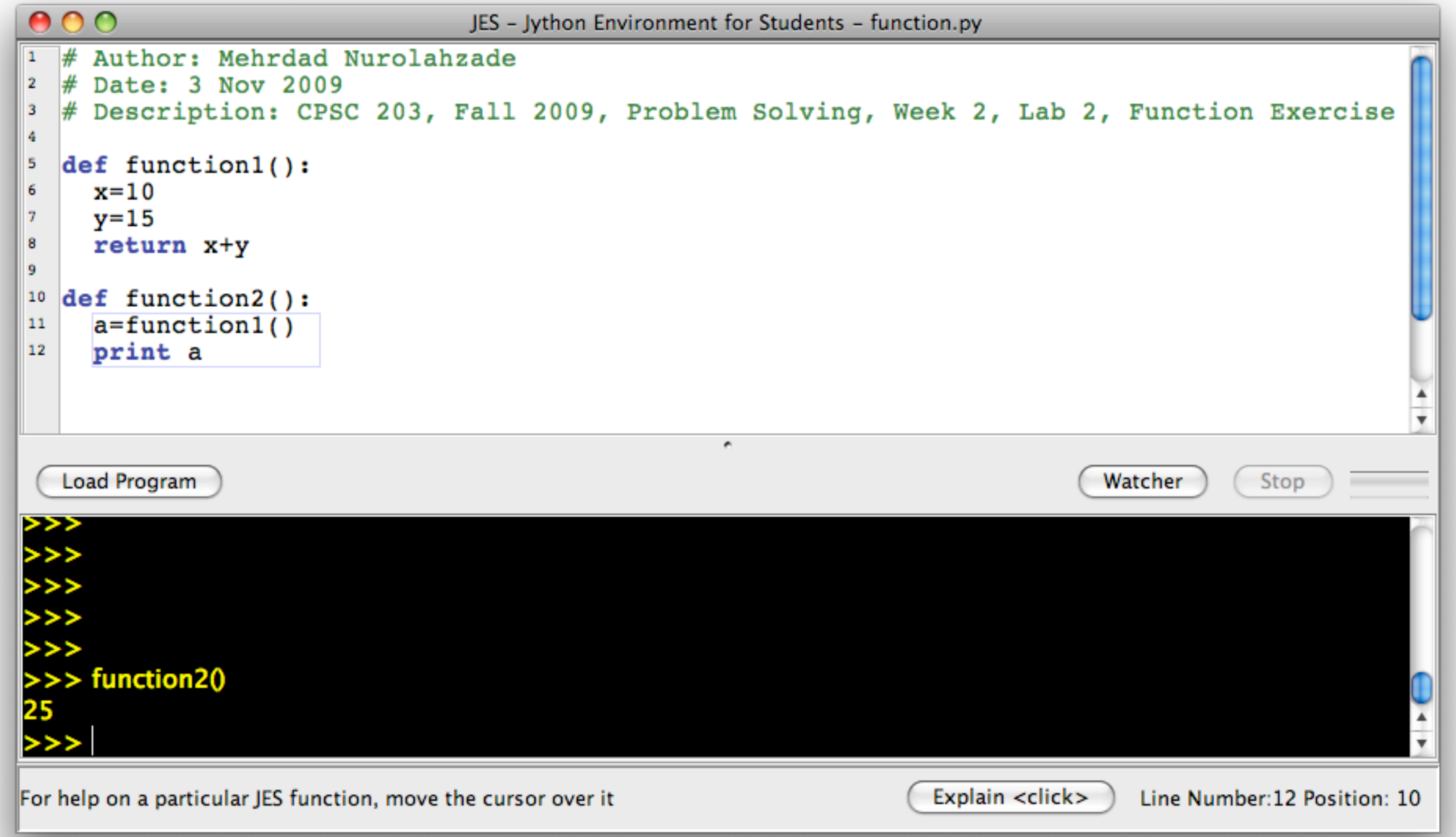
```
>>>
>>> function2()
The error was:x
Name not found globally.
A local or global name could not be found. You need to define the function or variable before you try to use it
in any way.
Please check line 10 of /Users/mnurolahzade/Desktop/function.py
>>>
```

Return Value (1)

- A function can return a value upon exit.
- Function A calling function B receives its return value.
- General syntax:

```
def function-name(zero or more arguments):
    statement1
    statement2
    …
    statementN
    return return-value
```

Return Value (2)



```
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Function Exercise

def function1():
  x=10
  y=15
  return x+y

def function2():
  a=function1()
  print a
```

```
>>>
>>>
>>>
>>>
>>>
>>> function2()
25
>>>
```

For help on a particular JES function, move the cursor over it

Line Number:12 Position: 10

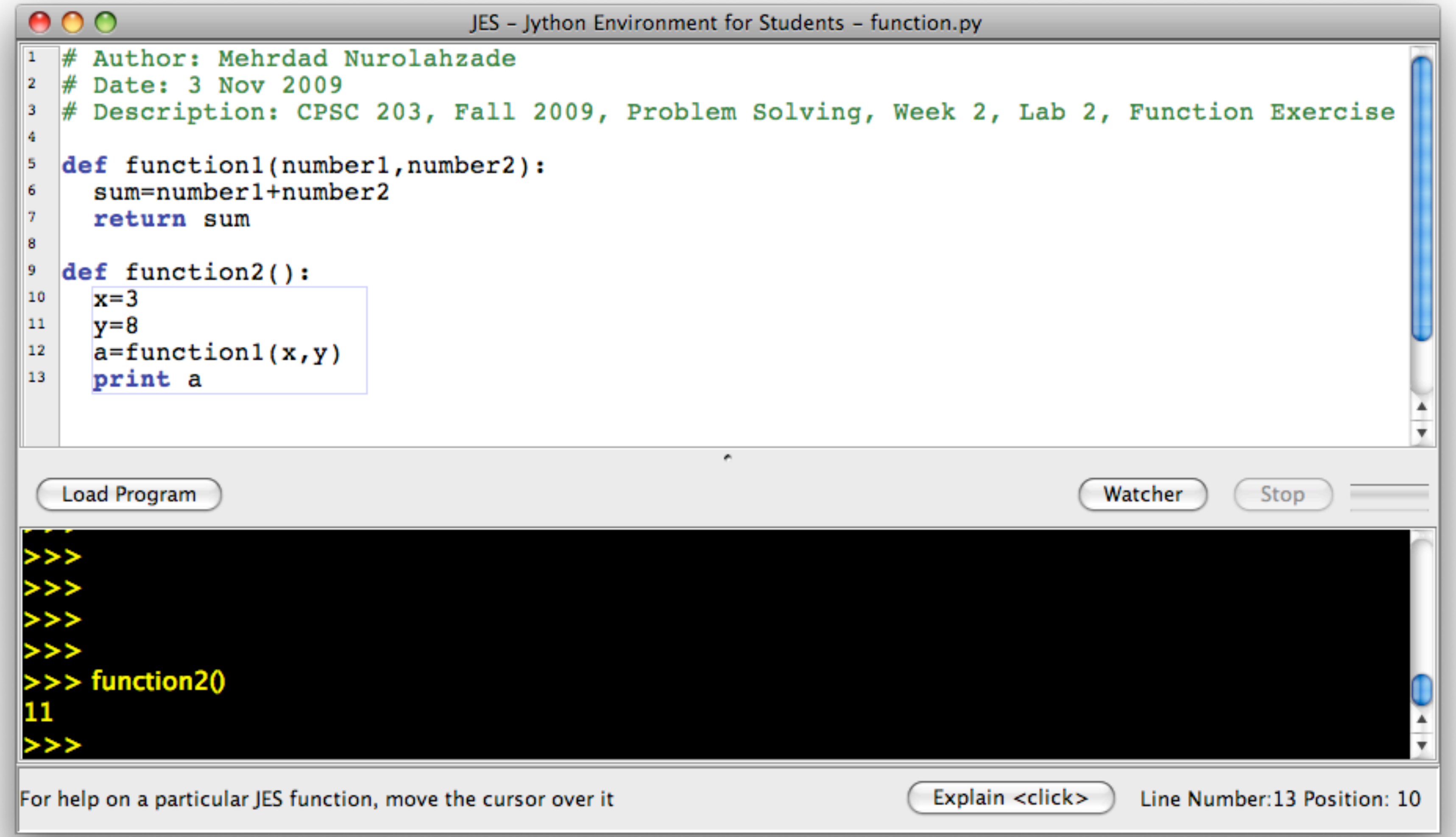
Function Arguments (1)

- Function arguments are a list of parameters that are passed to the function.
- A function can have zero or more arguments.

- General syntax:

```
def function-name(arg1, arg2, …, argN):
  statements
  return return-value
```

Function Arguments (2)


JES – Jython Environment for Students – function.py
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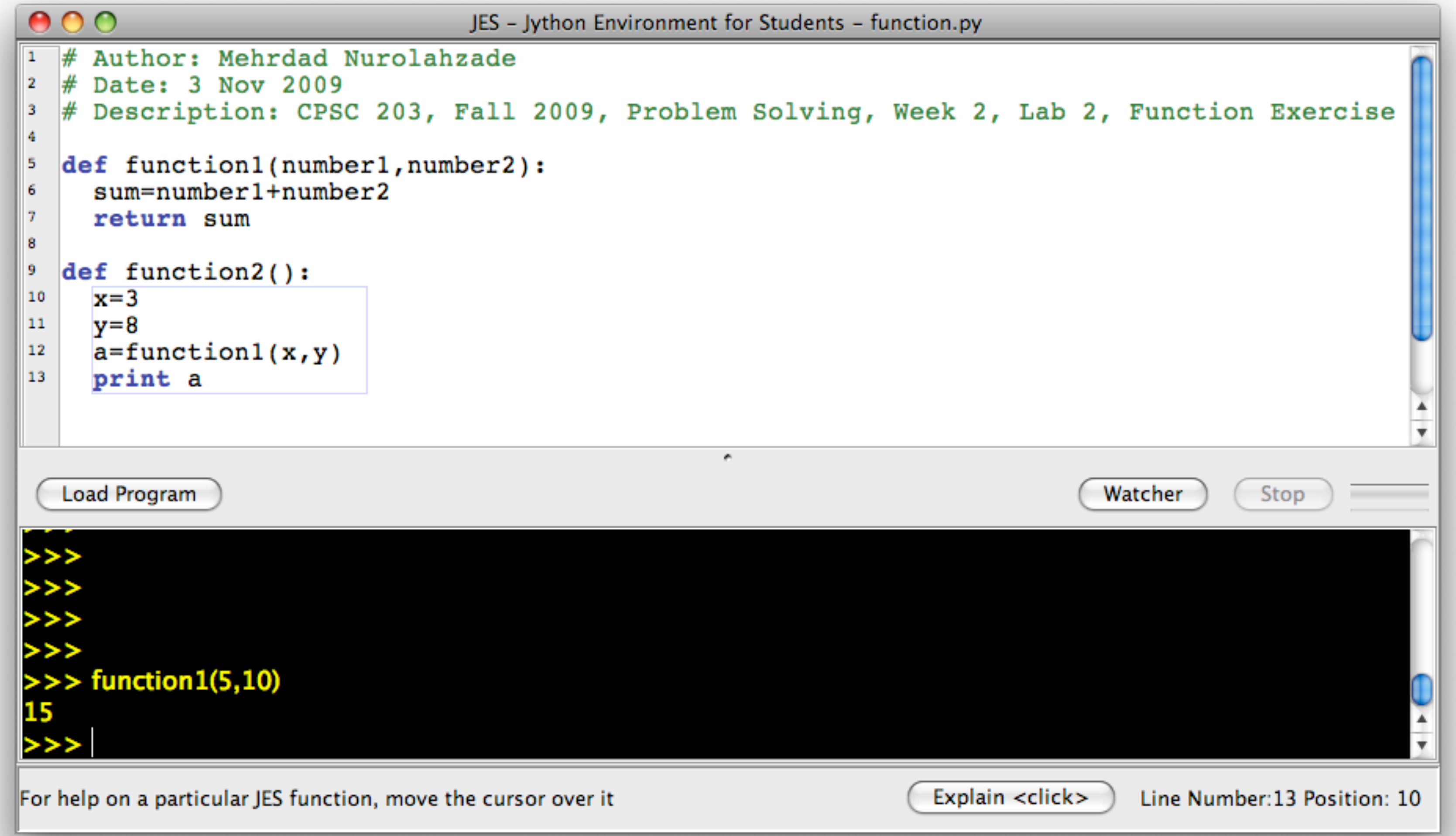
Line Number:13 Position: 10

```
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Function Exercise

def function1(number1,number2):
  sum=number1+number2
  return sum

def function2():
  x=3
  y=8
  a=function1(x,y)
  print a
```

```
>>>
>>>
>>>
>>>
>>> function2()
11
>>>
```

For help on a particular JES function, move the cursor over it

Function Arguments (3)


JES – Jython Environment for Students – function.py

```
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Function Exercise

def function1(number1,number2):
  sum=number1+number2
  return sum

def function2():
  x=3
  y=8
  a=function1(x,y)
  print a
```

```
>>>
>>>
>>>
>>>
>>> function1(5,10)
15
>>>
```

For help on a particular JES function, move the cursor over it

Line Number:13 Position: 10

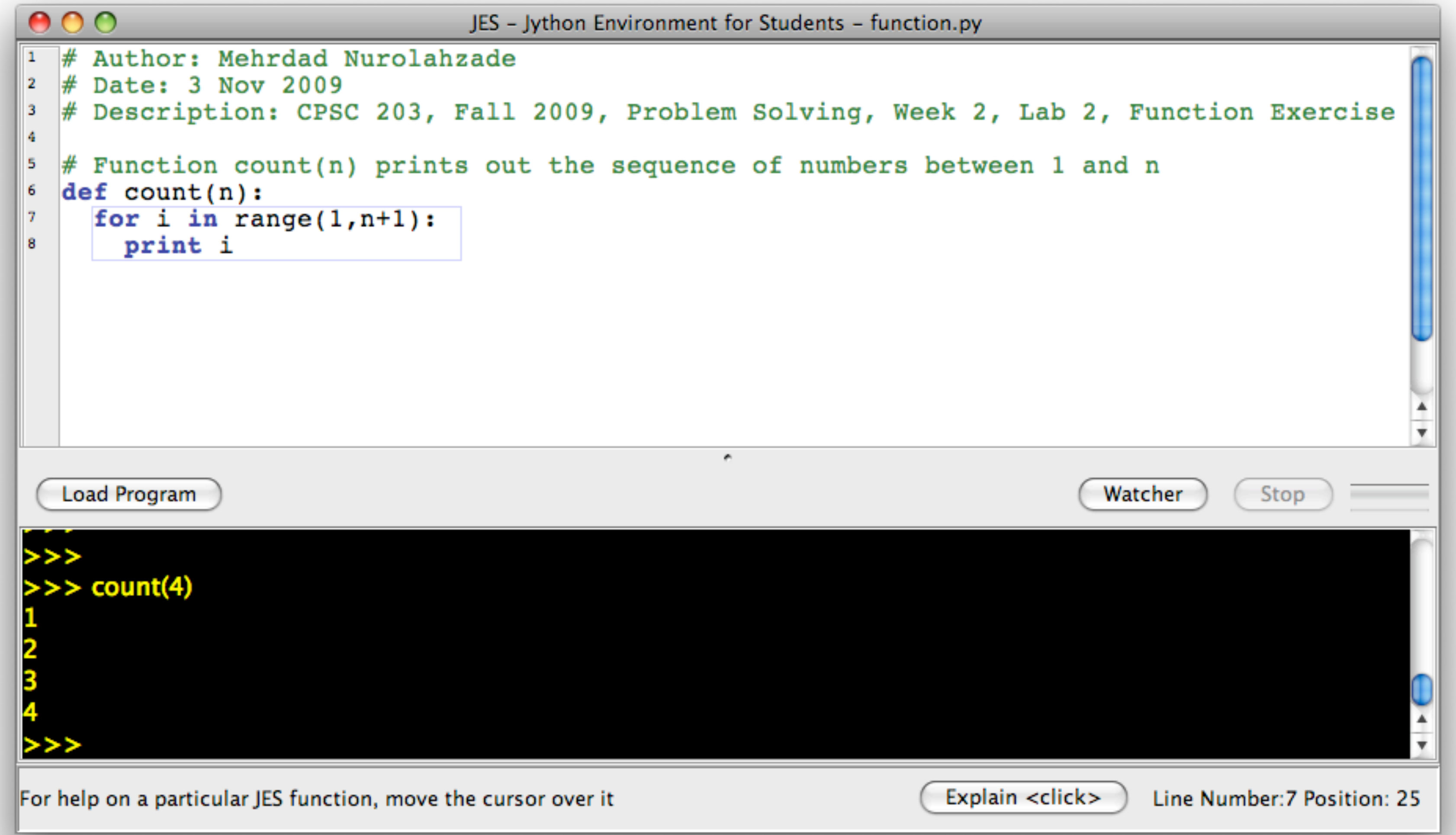
Function Exercise (1)

- Write the Jython function **count(n)** that given the argument **n** of type Integer prints out numbers from 1 to **n**.

- Example run:

```
count(4)
1
2
3
4
```

Function Exercise (2)



```
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Function Exercise

# Function count(n) prints out the sequence of numbers between 1 and n
def count(n):
  for i in range(1,n+1):
    print i
```

```
>>>
>>> count(4)
1
2
3
4
>>>
```

For help on a particular JES function, move the cursor over it

Line Number:7 Position: 25

Function Exercise (3)

- Write the Jython function **minimum(S)** that finds the minimum element in the given list **S** of Integers.
- Note: you are not allowed to use the **min()** function.

- Example run:

```
minimum([7, 3, 5, 6, 4, 2, 3])
2
```

Function Exercise (4)

```
def minimum(S):
   if len(S)==0:
        return 'undefined'
   else:
        min_so_far = S[0]
        for i in range(1,len(S)):
                if S[i] < min_so_far:
                        min_so_far = S[i]
   return min_so_far
```

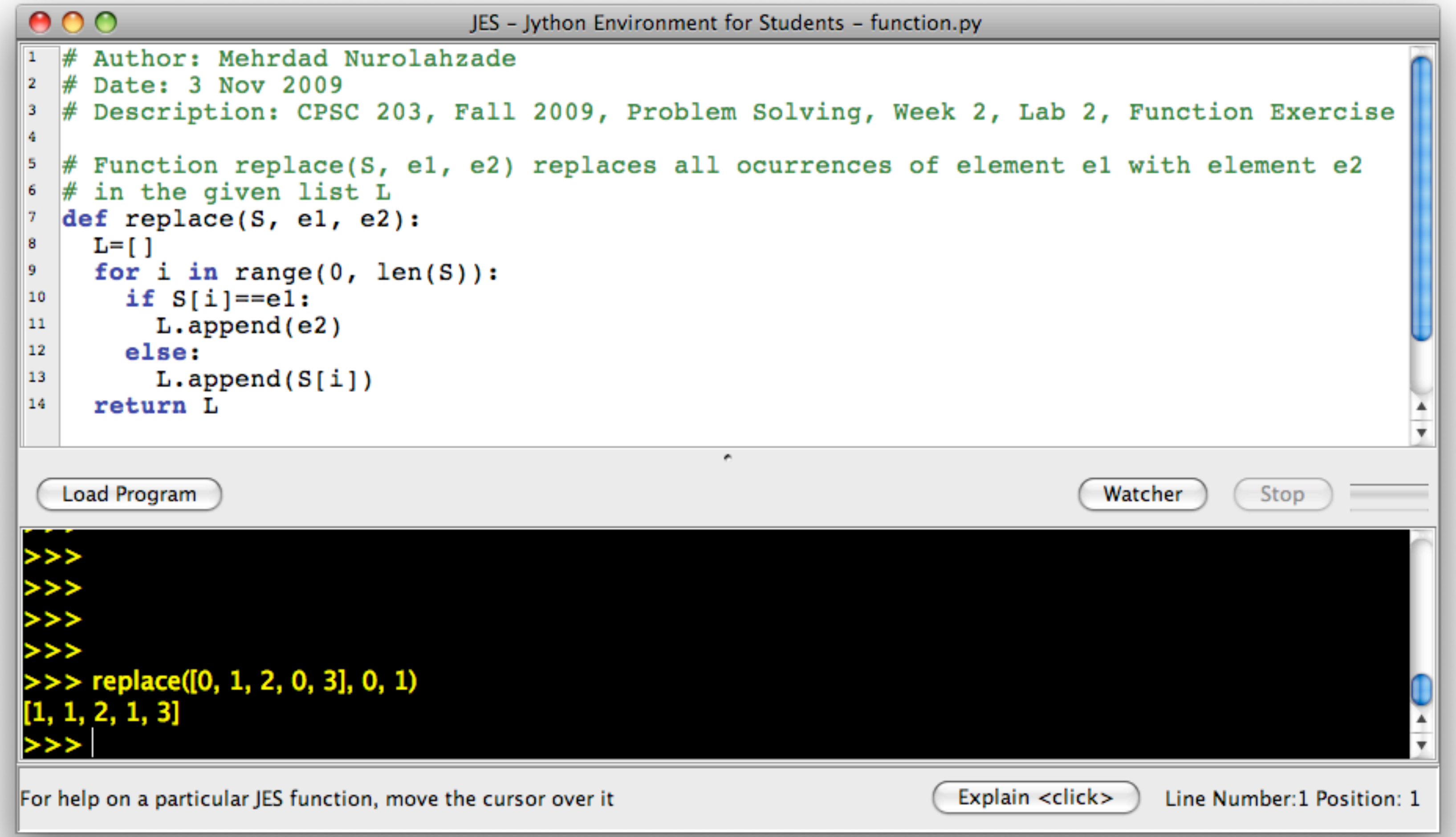
Function Exercise (5)

- Write the Jython function **replace(L, e1, e2)** that replaces all occurrences of element **e1** with element **e2** in the given list **L**.

- Example run:

```
replace([‘a’, ‘d’, ‘a’, ‘c’, ‘b’], ‘a’, ‘b’)
[‘b’, ‘d’, ‘b’, ‘c’, ‘b’]
```

Function Exercise (6)


JES – Jython Environment for Students – function.py
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Stop
Explain <click>
Line Number:1 Position: 1

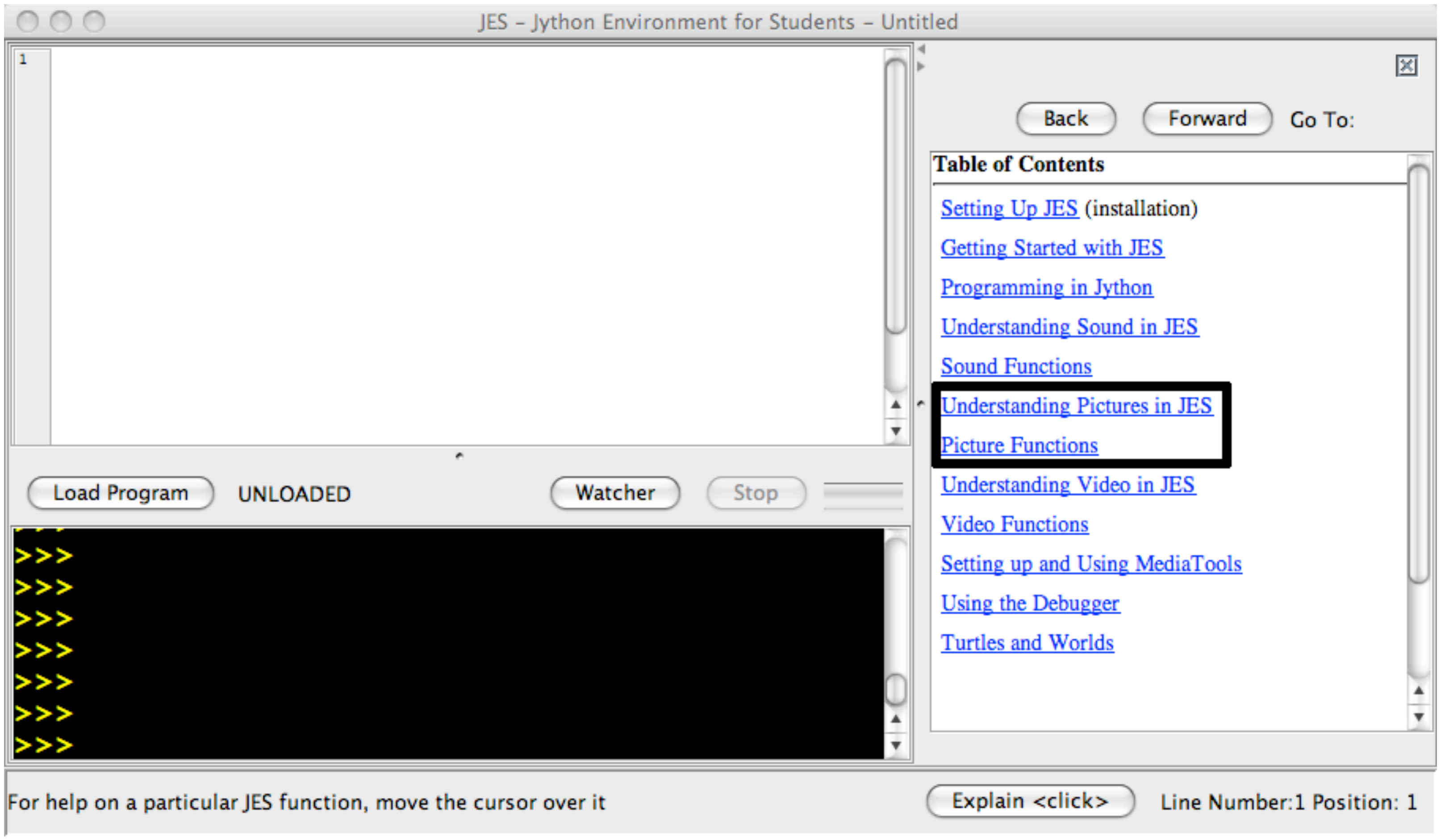
```python
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Function Exercise

# Function replace(S, e1, e2) replaces all ocurrences of element e1 with element e2
# in the given list L
def replace(S, e1, e2):
  L=[]
  for i in range(0, len(S)):
    if S[i]==e1:
      L.append(e2)
    else:
      L.append(S[i])
  return L
```

```
>>>
>>>
>>>
>>>
>>> replace([0, 1, 2, 0, 3], 0, 1)
[1, 1, 2, 1, 3]
>>>
```

For help on a particular JES function, move the cursor over it

Graphics in Jython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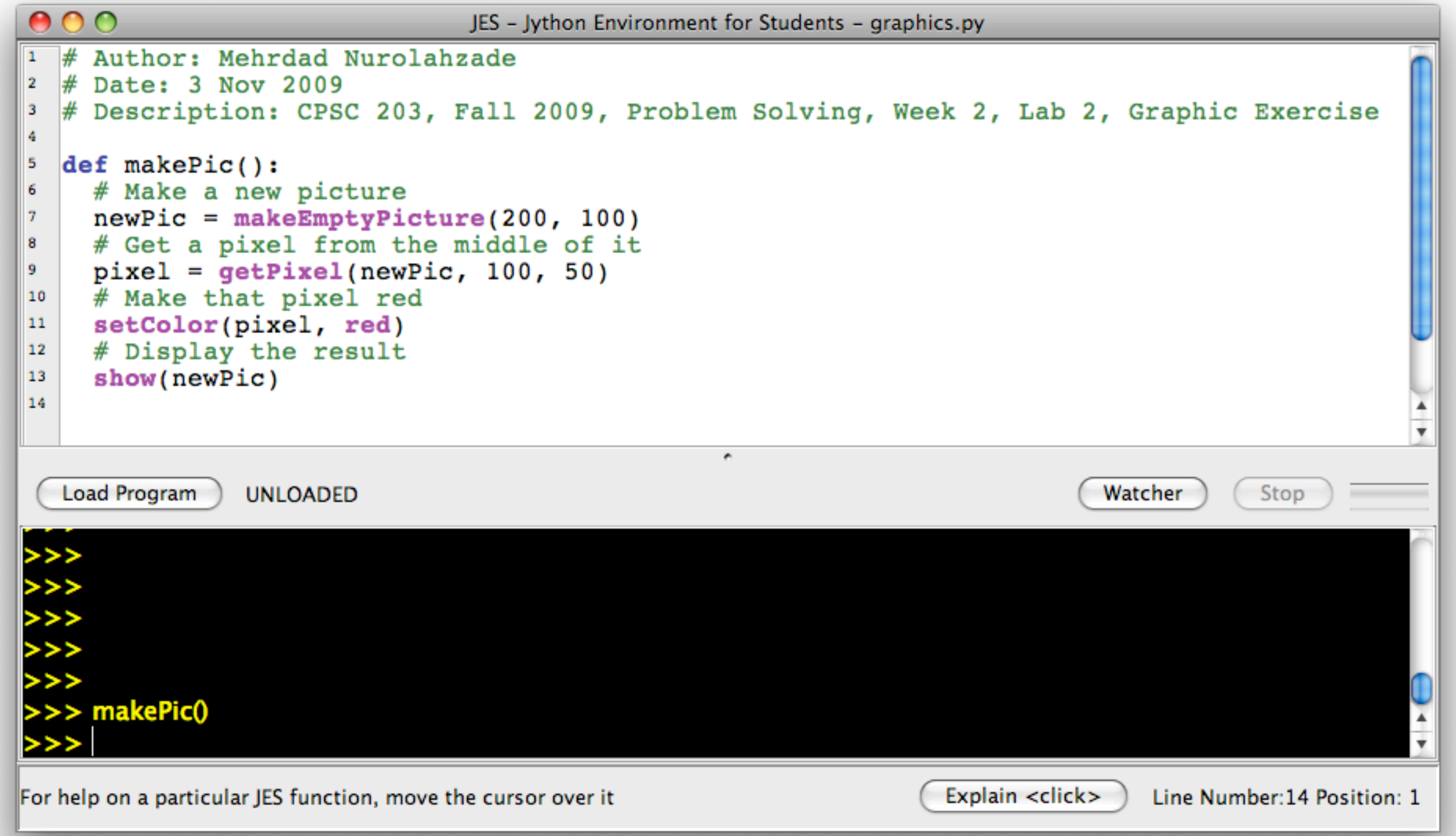
Using the Debugger
Turtles and Worlds

```
>>>
>>>
>>>
>>>
>>>
>>>
>>>
```

For help on a particular JES function, move the cursor over it

Making A Red Dot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Load Program
UNLOADED
Watcher
Stop
For help on a particular JES function, move the cursor over it
Explain <click>
Line Number:14 Position: 1

```
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Graphic Exercise

def makePic():
  # Make a new picture
  newPic = makeEmptyPicture(200, 100)
  # Get a pixel from the middle of it
  pixel = getPixel(newPic, 100, 50)
  # Make that pixel red
  setColor(pixel, red)
  # Display the result
  show(newPic)
```

```
>>>
>>>
>>>
>>>
>>>
>>> makePic()
>>>
```

makeEmptyPicture()

makeEmptyPicture(width, height[, color]):

width: the width of the empty picture

height: height of the empty picture

color: background color of the empty picture (optional)

returns: a new picture object with all the pixels set to the specified color

Makes a new "empty" picture and returns it to you. The width and height must be between 0 and 10000. Default color is white.

getPixel()

getPixel(picture, xpos, ypos):

picture: the picture you want to get the pixel from

xpos: the x-coordinate of the pixel you want

ypos: the y-coordinate of the pixel you want

Takes a picture, an x position and a y position (two numbers), and returns the Pixel object at that point in the picture.

setColor()

setColor(pixel, color):

pixel: the pixel you want to set the color of

color: the color you want to set the pixel to

Takes in a pixel and a color, and sets the pixel to the given color.

show()

show(picture):

picture: the picture you want to see

Shows the picture provided as input.

addLine()

addLine(picture, startX, startY, endX, endY[, color]):

picture: the picture you want to draw the line on

startX: the x position you want the line to start

startY: the y position you want the line to start

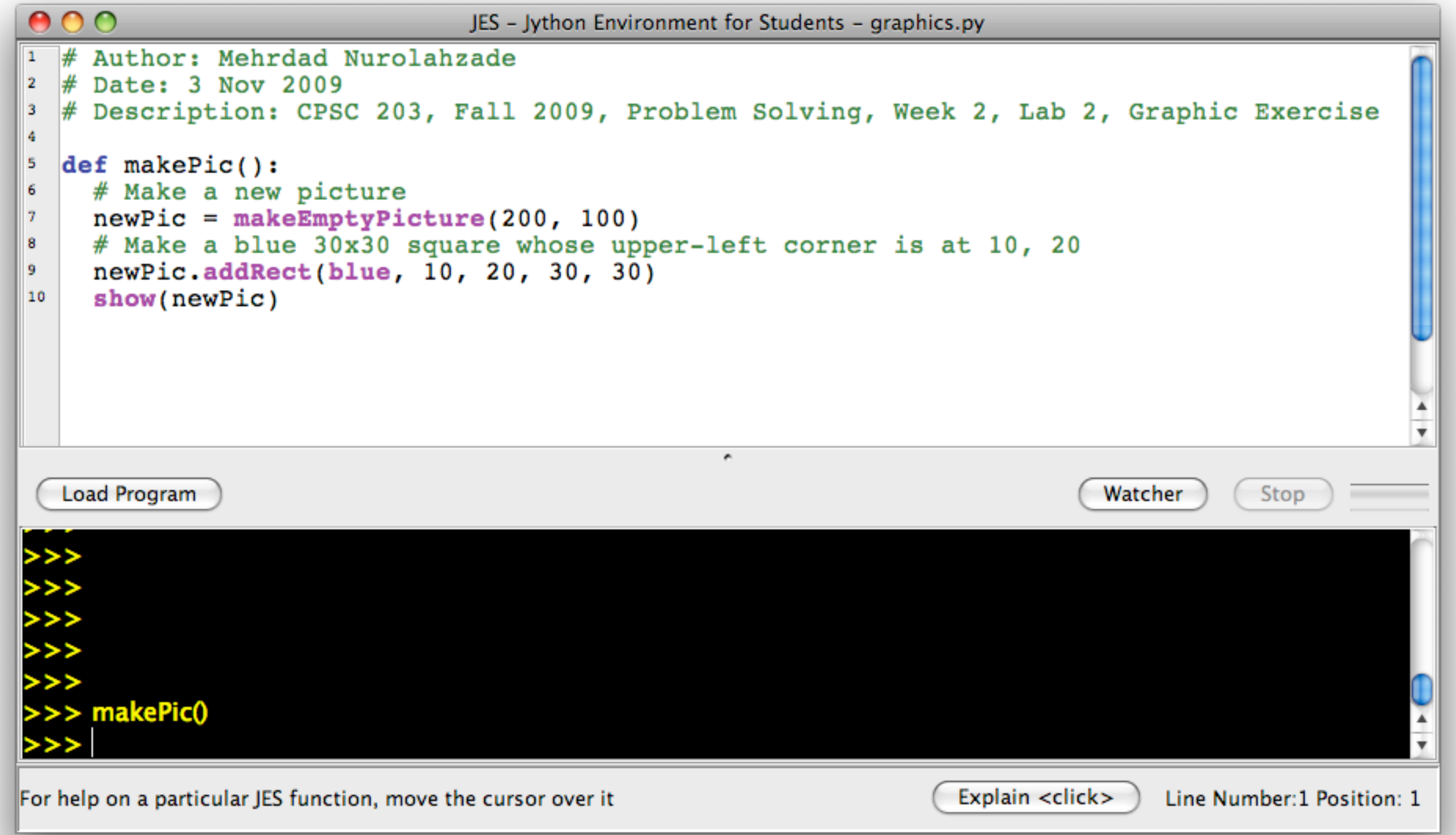
endX: the x position you want the line to end

endY: the y position you want the line to end

color: the color you want to draw in (optional)

Takes a picture, a starting (x, y) position (two numbers), and an ending (x, y) position (two more numbers, four total), and (optionally) a color as input. Adds a line from the starting point to the ending point in the picture. Default color is black.

Draw A Blue Rectangle


JES - Jython Environment for Students - graphics.py

```python
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Graphic Exercise

def makePic():
  # Make a new picture
  newPic = makeEmptyPicture(200, 100)
  # Make a blue 30x30 square whose upper-left corner is at 10, 20
  newPic.addRect(blue, 10, 20, 30, 30)
  show(newPic)
```

Load Program
Watcher
Stop

```
>>>
>>>
>>>
>>>
>>>
>>> makePic()
>>>
```

For help on a particular JES function, move the cursor over it
Explain <click>
Line Number:1 Position: 1

addRect()

addRect(picture, startX, startY, width, height[, color]):

picture: the picture you want to draw the rectangle on

startX: the x-coordinate of the upper left-hand corner of the rectangle

startY: the y-coordinate of the upper left-hand corner of the rectangle

width: the width of the rectangle

height: the height of the rectangle

color: the color you want to draw in (optional)

Takes a picture, a starting (x, y) position (two numbers), a width and height (two more numbers, four total), and (optionally) a color as input. Adds a rectangular outline of the specified dimensions using the (x,y) as the upper left corner. Default color is black.

addOval()

addOval(picture, startX, startY, width, height[, color]):

picture: the picture you want to draw the rectangle on

startX: the x-coordinate of the upper left-hand corner of the bounding rectangle of the oval

startY: the y-coordinate of the upper left-hand corner of the bounding rectangle of the oval

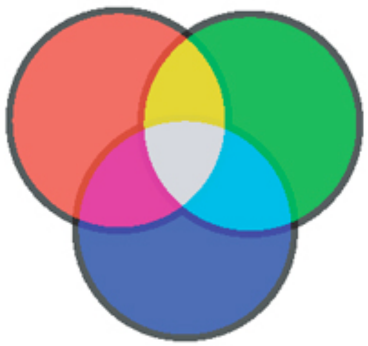
width: the width of the oval

height: the height of the oval

color: the color you want to draw in (optional)

Takes a picture, a starting (x, y) position (two numbers), a width and height (two more numbers, four total), and (optionally) a color as input. Adds an oval outline of the given dimensions using the (x,y) as the upper left corner of the bounding rectangle. Default color is black.

makeColor()



makeColor(red[, green, blue]):

red: the amount of red you want in the color (or a Color object you want to duplicate)

green: the amount of green you want in the color (optional)

blue: the amount of blue you want in the picture (optional)

returns: the color made from the inputs

Takes three integer inputs for the red, green, and blue components (in order) and returns a color object. If green and blue are omitted, the red value is used as the intensity of a gray color. Also it works with only a color as input and returns a new color object with the same RGB values as the original.

addText()

addText(picture, xpos, ypos, text[, color]):

picture: the picture you want to add the text to

xpos: the x-coordinate where you want to start writing the text

ypos: the y-coordinate where you want to start writing the text

text: string containing the text you want written

color: the color you want to draw in (optional)

Takes a picture, an x position and a y position (two numbers), and some text as a string, which will get drawn into the picture, in the specified color. Default is black.

writePictureTo()

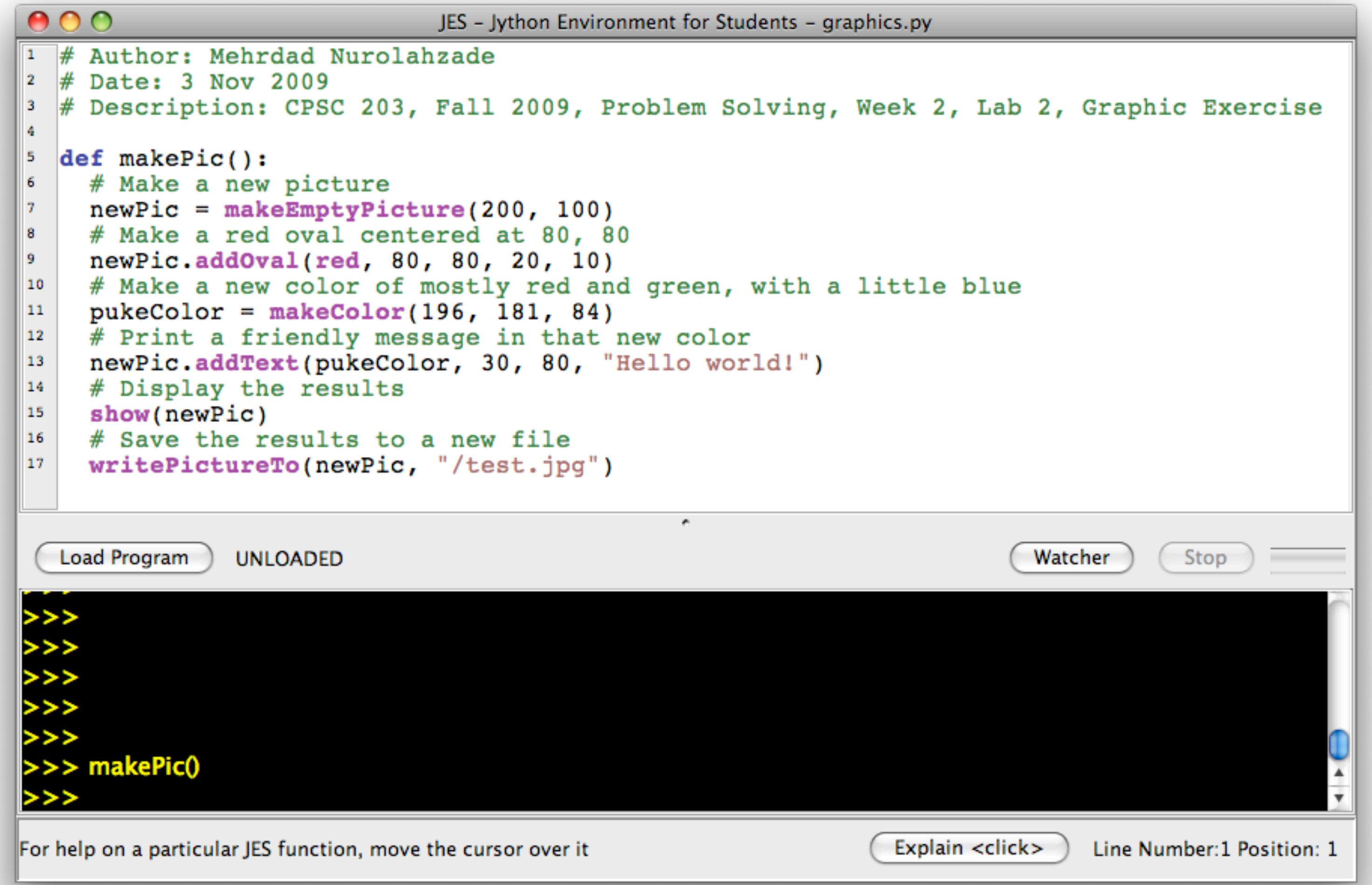
writePictureTo(picture, path):

picture: the picture you want to be written out to a file

path: the path to the file you want the picture written to

Takes a picture and a file name (string) as input, then writes the picture to the file as a JPEG, PNG, or BMP. (Be sure to end the filename in ".jpg" or ".png" or ".bmp" for the operating system to understand it well.)

Graphics Example



```python
# Author: Mehrdad Nurolahzade
# Date: 3 Nov 2009
# Description: CPSC 203, Fall 2009, Problem Solving, Week 2, Lab 2, Graphic Exercise

def makePic():
  # Make a new picture
  newPic = makeEmptyPicture(200, 100)
  # Make a red oval centered at 80, 80
  newPic.addOval(red, 80, 80, 20, 10)
  # Make a new color of mostly red and green, with a little blue
  pukeColor = makeColor(196, 181, 84)
  # Print a friendly message in that new color
  newPic.addText(pukeColor, 30, 80, "Hello world!")
  # Display the results
  show(newPic)
  # Save the results to a new file
  writePictureTo(newPic, "/test.jpg")
```

```
>>>
>>>
>>>
>>>
>>>
>>> makePic()
>>>
```

For help on a particular JES function, move the cursor over it
Explain <click>
Line Number:1 Position: 1