**Outline**

Develop an understanding of how images and graphics are drawn and stored in a computer. Learn about the RGB colour space. Apply Python concepts related to lists and loops.

**Objectives**

* tbd

**Materials**

* tbd

**Level 1: RGB Color Space**

1. Create a new Repl for Python with Turtle.
   1. Copy and paste “Sample Program #1” from the listing at the end of this module.
   2. Run the program and examine the Turtle output

* The program is drawing colored circles

1. Colours can be specified by using a combination of three numbers. These three numbers together define a “Pixel” point in a graphic image.
   1. What position is the number that controls the amount of red (r) in the pixel?

* 128,0,0
  1. What position is the number that controls the amount of green (g) in the pixel?
* 0,128,0
  1. What position is the number that controls the amount of blue (b) in the pixel?
* 0,0,128

1. Colour number values can range from 0 to 255.
   1. What happens when the colour value is less than 255?

* The color gets draker
  1. What happens when the colour value is close to 0?
* The circle turns black

1. Other shades of colours can be created using a combination of r,g,b number values.
   1. Create a pixel containing a shade of the colour orange.

* 237,102,0
  1. Create a pixel containing a shade of the colour yellow.
* 250,255,0
  1. Create a pixel containing a shade of your favorite colour.
* 32, 15, 219

1. Black, white, and shades of grey are created using combinations of equal r,g,b number values.
   1. Create a completely white pixel.

* (255,255,255)
  1. Create a completely black pixel.
* (0,0,0)
  1. Create a pixel containing a shade of middle grey.
* (68,68,68)

**Level 2: Resolution**

1. Download the image “Resoultion\_284x177.jpg” from Topic B folder in the class repository.
   1. Open the image in a program like Paint or Photoshop.
   2. What is the size of this image? How many pixels does it contain?

* Width:3.944
* Height:2.548
* Width:284 pixels
* Height:177 pixels
  1. Describe how the image looks (e.g. Can you see the pixels?)
* The image looks clear and easy to see
  1. Zoom in the view to enlarge the image
  2. Describe how the image looks (e.g. Can you see the pixels?)
* The image is blurry and I can see some pixels

1. Download the image “Resoultion\_16x16.jpg” from Topic B folder in the class repository.
   1. Open the image in a program like Paint or Photoshop.
   2. What is the size of this image? How many pixels does it contain?

* Width:0.111
* Height:0.111
* Width:8 pixels
* Height:8 pixels
  1. Describe how the image looks (e.g. Can you see the pixels?)
* It looks extremely small and I can’t see much
  1. Zoom in the view to enlarge the image
  2. Describe how the image looks (e.g. Can you see the pixels?)
* I can see all of the pixels in the picture

1. Create a new Repl for Python with Turtle.
2. Copy and paste “Sample Program #2” from the listing at the end of this module.
3. Run the program and examine the Turtle output

Compare the program output to the “Resoultion\_16x16.jpg” image in question #2 above.

* the resolution on the program is even worse quality than the 16x16 image

1. Explain how the program code in lines 52 to 58 works. (i.e. The main program code.)
2. How the program prints out pixels to produce and 8 by 8 resolution image.

* You tell the program to make 8 circles in a row
* You tell the program to make 8 circles in a column

1. How the program decides which colour information to use for each pixel.

* It uses pixel memory then it assigns the rgb to a single pixel

1. Explain the purpose of the code in lines 12 to 21
2. How this code is related to the pixels produced by the main program.

* It tells the value of rgb

1. The RGB value of the 19th pixel in the image

* (28,28,12)

1. The RGB value of the pixel in the 5th column on the 4th row.

* (154,140,22)

1. Modify the main program to print the image upside-down (i.e. pixels in reverse order).
2. Show your modified image to Mr. Nestor.
3. Explain your changes to the program code below.

* (49,102,29),(57,109,33),(92,125,53),(66,103,36),(29,66,13),(32,76,17),(48,91,26),(47,93,23),(35,86,13),(71,105,42),(223,208,144),(216,204,146),(100,134,82),(28,87,3),(39,83,12),(32,80,12),(50,95,13),(63,104,39),(224,213,156),(255,225,140),(120,153,92),(41,99,17),(58,103,28),(42,98,17),(42,88,15),(48,94,18),(98,120,49),(213,195,123),(109,134,66),(44,91,15),(52,86,22),(43,85,18),(34,59,10),(35,47,15),(24,35,12),(156,139,26),(154,140,22),(28,43,10),(9,12,1),(19,22,5),(25,19,5),(16,13,8),(28,28,12),(191,192,18),(205,202,21),(42,42,14),(11,11,4),(16,11,3),(21,19,17),(20,18,9),(7,7,6),(58,65,11),(42,47,7),(11,8,6),(24,25,8),(21,28,10),(15,15,5),(13,13,6),(8,10,3),(23,21,10),(32,33,16),(33,52,22),(32,54,21),(25,42,17)

You reverse the code to flip it

1. Modify the main program to print the image at a resolution of 12 by 4 pixels.
2. Show your modified image to Mr. Nestor.
3. Explain your changes to the program code below.

* for row in range (12) :

for column in range(4) :

**Level 3: your custom image**

1. Use and modify the sample pixel program code to create your own custom image.
   1. Create a larger resolution image than provided in the sample.
   2. Make sure the image is recognizable (or a clear pattern).
   3. Show your image to Mr. Nestor.
2. List and explain your modified image code below.

(89,244,65),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(89,244,65),

(0,0,0),(89,244,65),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(89,244,65),(0,0,0),

(0,0,0),(0,0,0),(89,244,65),(0,0,0),(0,0,0),(89,244,65),(0,0,0),(0,0,0),

(0,0,0),(0,0,0),(0,0,0),(89,244,65),(89,244,65),(0,0,0),(0,0,0),(0,0,0),

(0,0,0),(0,0,0),(0,0,0),(89,244,65),(89,244,65),(0,0,0),(0,0,0),(0,0,0),

(0,0,0),(0,0,0),(89,244,65),(0,0,0),(0,0,0),(89,244,65),(0,0,0),(0,0,0),

(0,0,0),(89,244,65),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(89,244,65),(0,0,0),

(89,244,65),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(8,244,65),

**SAMPLE PROGRAM #1**

import turtle

myPen = turtle.Turtle()

# These variables track the position of the turtle pen

posX = 0

posY = 0

# This user defined function draws a single image pixel

def drawPixel(rgb) :

global posX

myPen.down()

myPen.color(rgb)

myPen.begin\_fill()

myPen.circle(8)

myPen.end\_fill()

myPen.up()

myPen.forward(18)

posX = posX + 18

# THE MAIN PROGRAM CODE STARTS HERE

#

redColor = (255,0,0)

drawPixel(redColor)

drawPixel((128,0,0))

greenColor = (0,255,0)

drawPixel(greenColor)

drawPixel((0,128,0))

blueColor = (0,0,266)

drawPixel(blueColor)

drawPixel((0,0,128))

**SAMPLE PROGRAM #2**

import turtle

myPen = turtle.Turtle()

# These variables track the position of the turtle pen

posX = 0

posY = 0

# These variables define the image information.

# Each pixel in the image has a (r,g,b) value

# The complete image is simply a list of pixels

pixelAddress = 0

pixelMemory = [

(15,15,5),(13,13,6),(8,10,3),(23,21,10),(32,33,16),(33,52,22),(32,54,21),(25,42,17),

(21,19,17),(20,18,9),(7,7,6),(58,65,11),(42,47,7),(11,8,6),(24,25,8),(21,28,10),

(25,19,5),(16,13,8),(28,28,12),(191,192,18),(205,202,21),(42,42,14),(11,11,4),(16,11,3),

(34,59,10),(35,47,15),(24,35,12),(156,139,26),(154,140,22),(28,43,10),(9,12,1),(19,22,5),

(42,88,15),(48,94,18),(98,120,49),(213,195,123),(109,134,66),(44,91,15),(52,86,22),(43,85,18),

(50,95,13),(63,104,39),(224,213,156),(255,225,140),(120,153,92),(41,99,17),(58,103,28),(42,98,17),

(35,86,13),(71,105,42),(223,208,144),(216,204,146),(907,132,79),(28,87,3),(39,83,12),(32,80,12),

(49,102,29),(57,109,33),(92,125,53),(66,103,36),(29,66,13),(32,76,17),(48,91,26),(47,93,23)

]

# This user defined function draws a single image pixel

def drawPixel(rgb) :

global posX

myPen.down()

myPen.color(rgb)

myPen.begin\_fill()

myPen.circle(8)

myPen.end\_fill()

myPen.up()

myPen.forward(18)

posX = posX + 18

# This user defined function starts a new row of pixels

def newRow() :

global posX

global posY

myPen.up()

myPen.left(180)

myPen.forward(posX)

myPen.left(90)

myPen.forward(18)

myPen.left(90)

myPen.down()

posX = 0

posY = posY + 18

# THE MAIN PROGRAM CODE STARTS HERE

#

# Draw eight rows of the image.

# Each row contains eight pixels

for row in range (8) :

for column in range(8) :

drawPixel(pixelMemory[pixelAddress])

pixelAddress += 1

newRow()