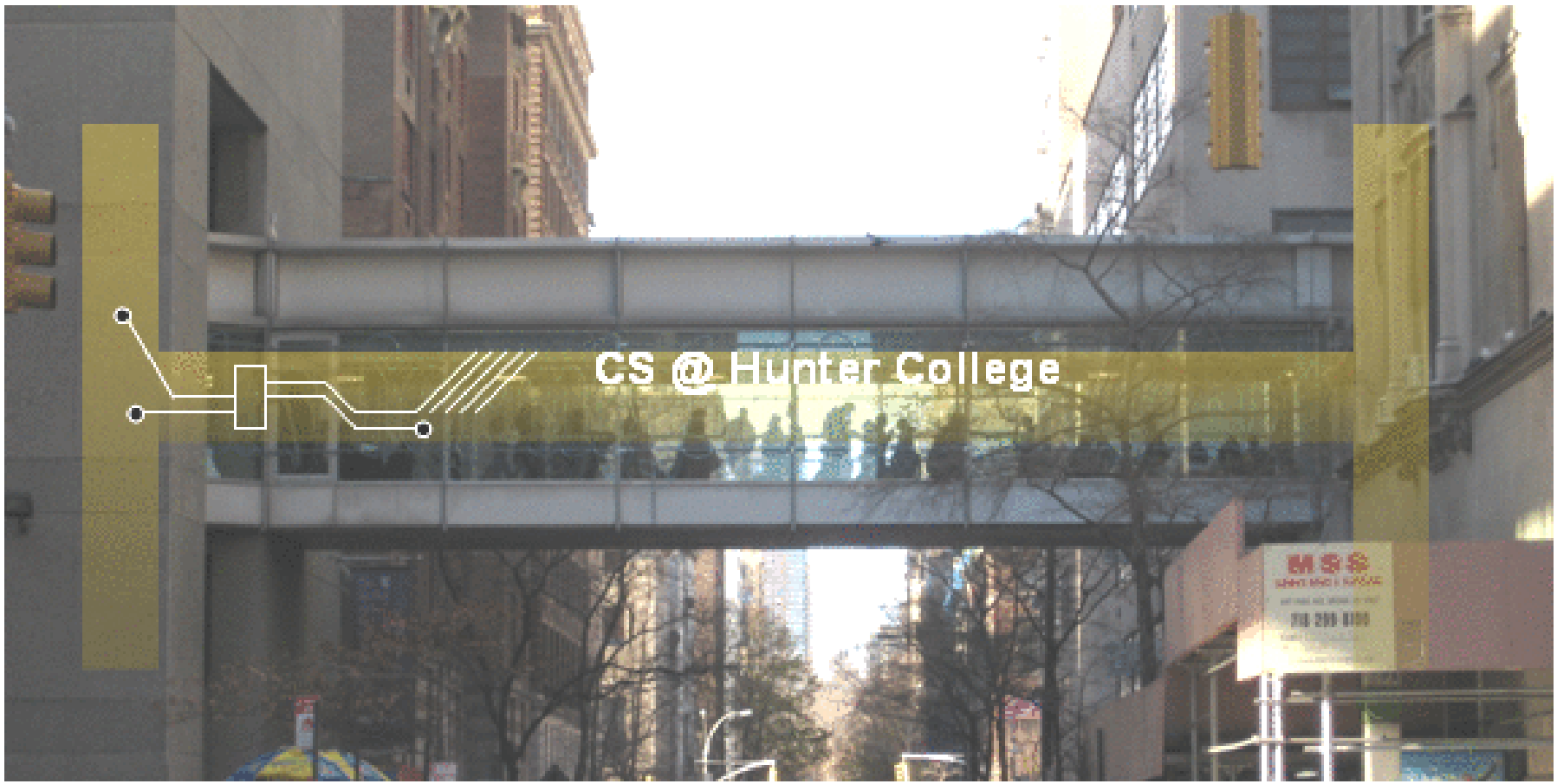
Announcement

Tutoring, code review, and quizzes are **appointments ONLY.**

CSci 127: Introduction to Computer Science



Finished the lecture preview?

hunter.cuny.edu/csci

Why Code Review?

Career Readiness

- National Association of Colleges and Employers (NACE) on Career Readiness

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Today's Topics

- Recap: Colors
- 2D Arrays & Image Files
- Design Challenge: Airplanes
- Decisions

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- 2D Arrays & Image Files
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Challenge (Group Work)

EmpID: CSci 127 Mock Final, S19

2. (a) Fill in the boxes with the appropriate hexcode to change the color to match the comments:

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import turtle
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i. `#Change thomasH to be the color black:`

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- Gray: `4 2 4 2 4 2`

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- Purple: `F F 0 0 F F`
- Gray: `4 2 4 2 4 2` (any choice where RR = GG = BB).

Recap: Colors

Color Name	HEX	Color
Black	#000000	
Navy	#000080	
DarkBlue	#00008B	
MediumBlue	#0000CD	
Blue	#0000FF	

- Can specify by name.

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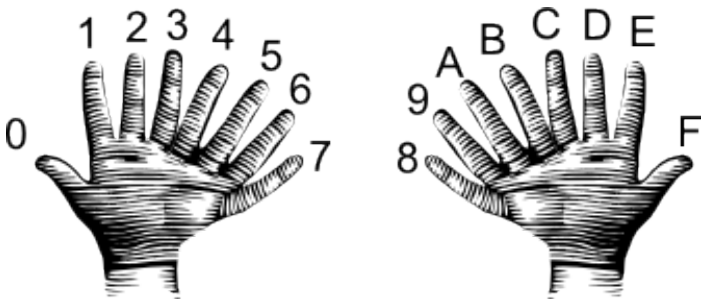
  - Hexcodes (base-16 numbers)...

Recap: Hexadecimal




```
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F
30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F
40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F
50 51 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F
60 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F
70 71 72 73 74 75 76 77 78 79 7A 7B 7C 7D 7E 7F
80 81 82 83 84 85 86 87 88 89 8A 8B 8C 8D 8E 8F
90 91 92 93 94 95 96 97 98 99 9A 9B 9C 9D 9E 9F
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 AA AB AC AD AE AF
B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF
C0 C1 C2 C3 C4 C5 C6 C7 C8 C9 CA CB CC CD CE CF
D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB DC DD DE DF
E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB FC FD FE FF
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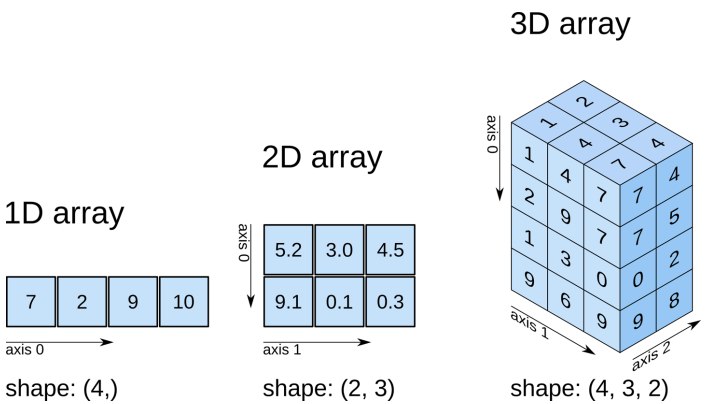
  - Hexcodes (base-16 numbers):
    e.g. `#0000FF` is no red, no green, and 100% blue.

Today's Topics

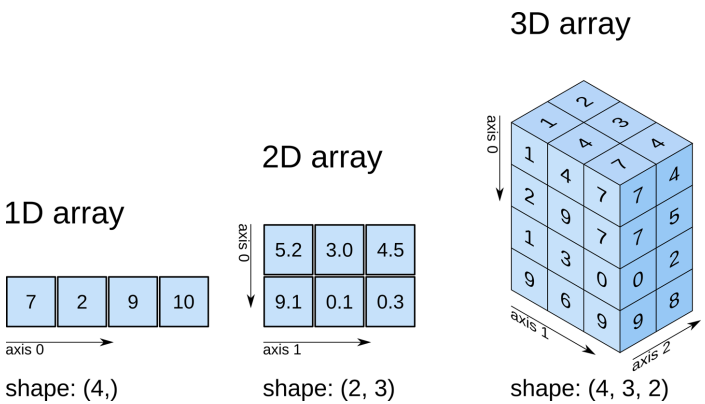
- Recap: Colors
- **2D Arrays & Image Files**
- Design Challenge: Airplanes
- Decisions

Arrays



- An **array** is a sequence of elements, much like a list.

Arrays



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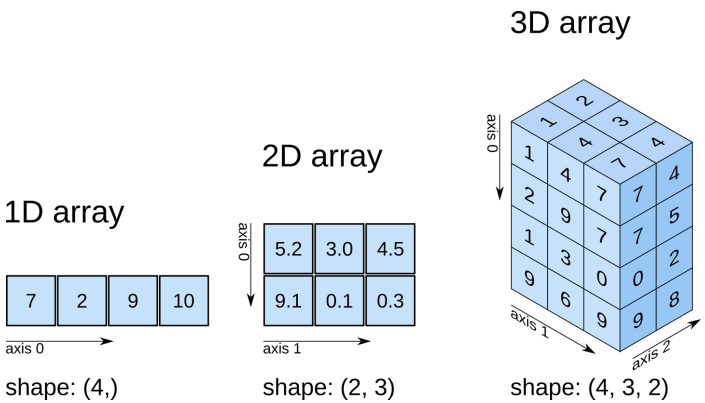
Arrays



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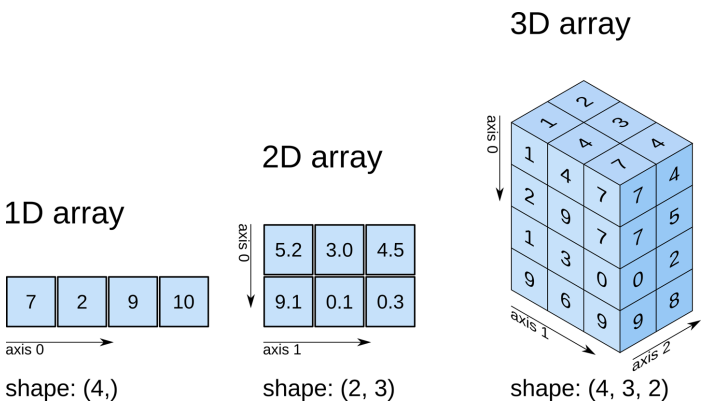
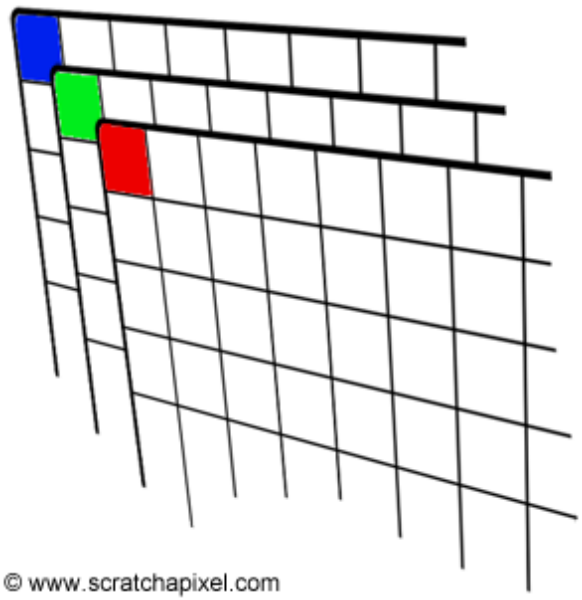


- An **array** is a sequence of elements, much like a list.
- A **2D array** is like a grid of elements, think a list of lists.
- Can keep on adding dimensions (3D, etc.)
- Can access pieces/slices as we do with strings and lists

Images



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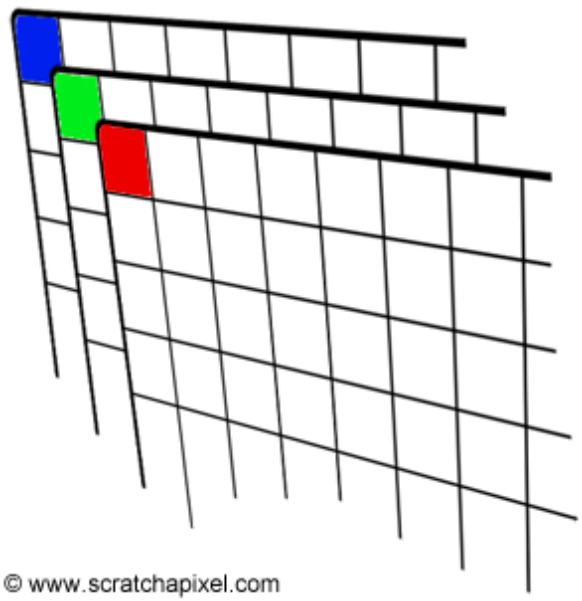

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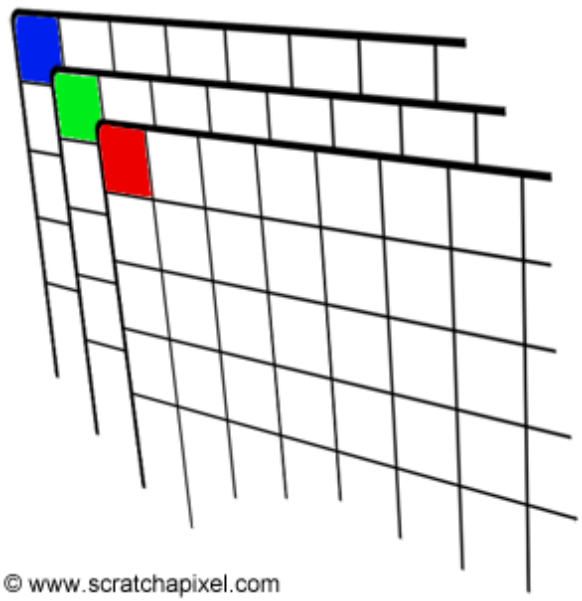

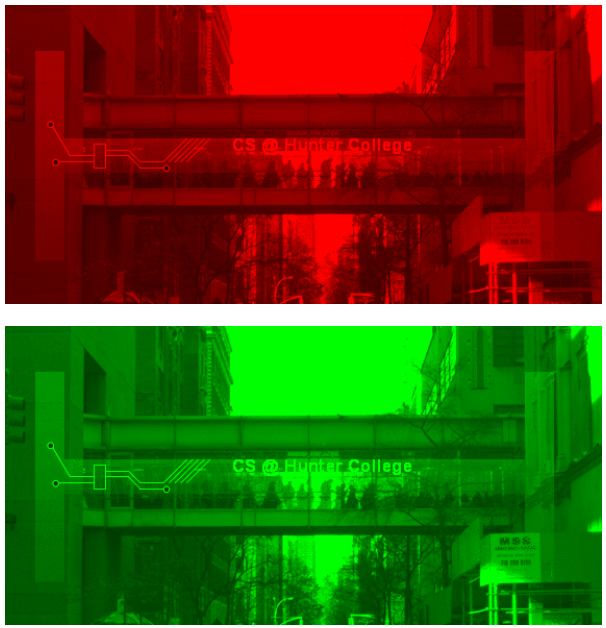

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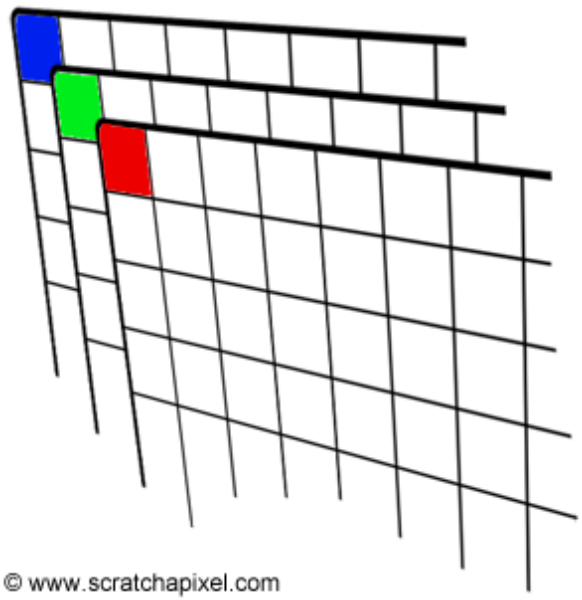
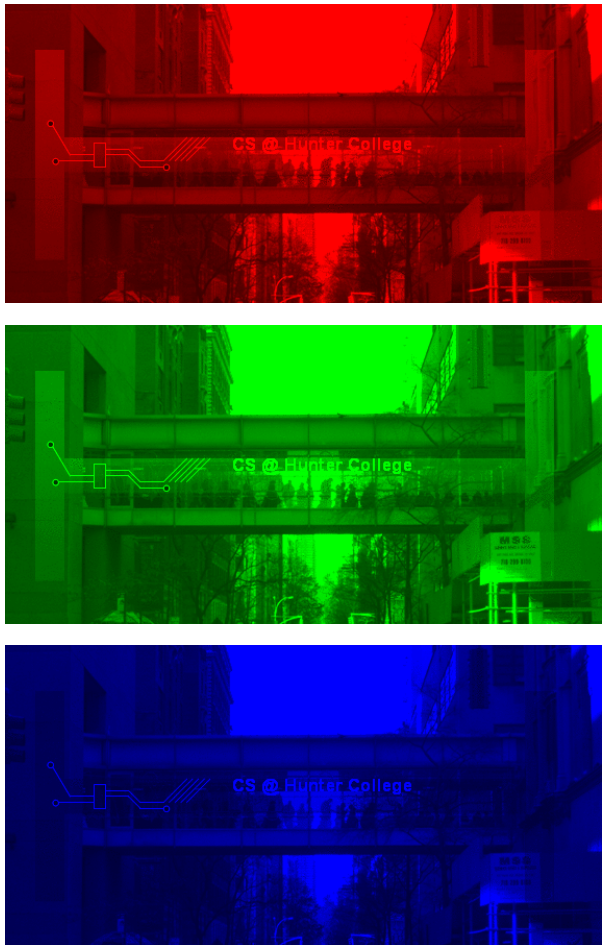

© www.scratchapixel.com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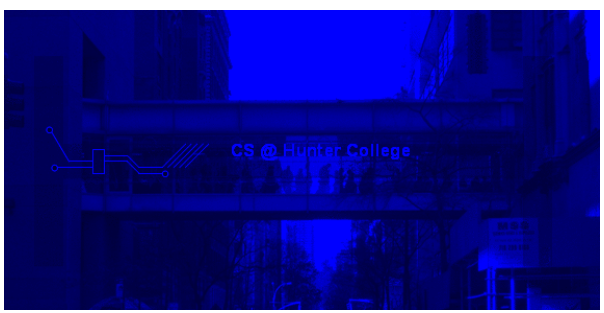
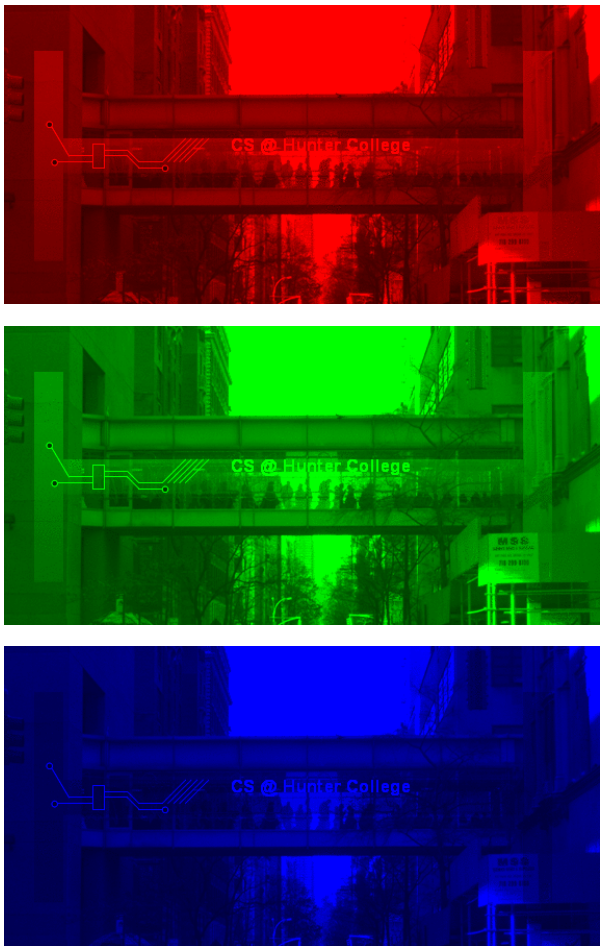
Useful Packages



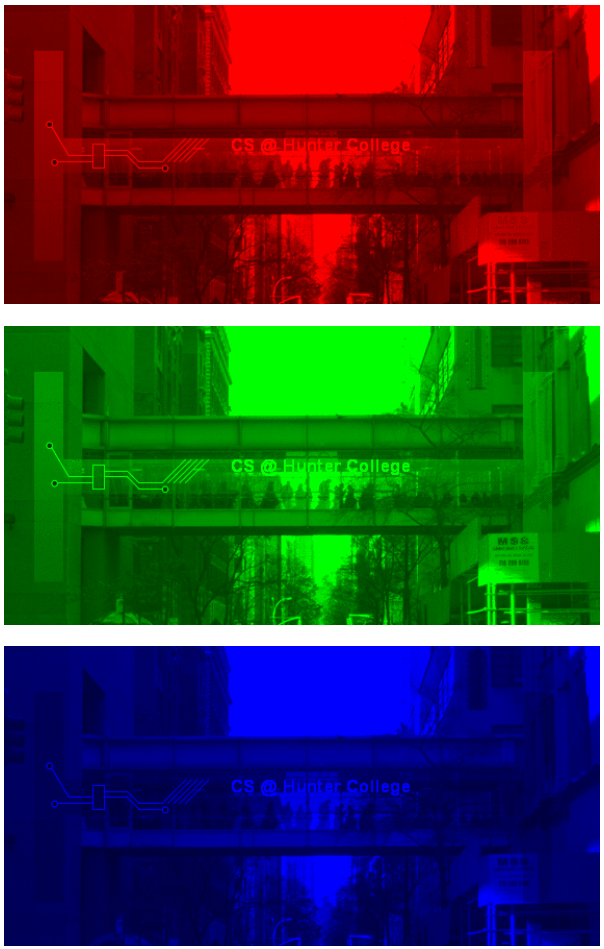
- We will use 2 useful packages for images:

Useful Packages



- We will use 2 useful packages for images:
  - `numpy`: numerical analysis package

Useful Packages



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  - `numpy`: numerical analysis package
  - `pyplot`: part of `matplotlib` for making graphs and plots

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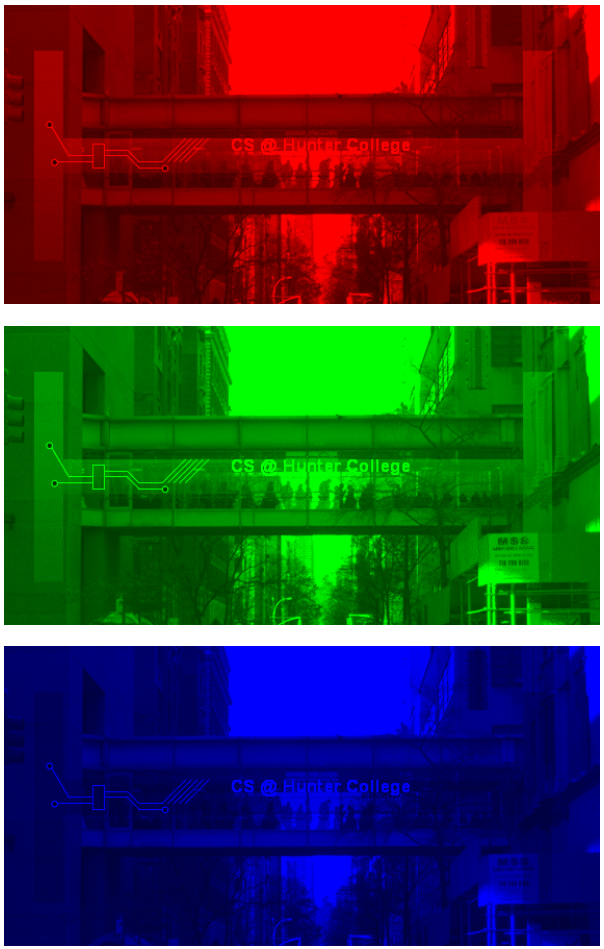
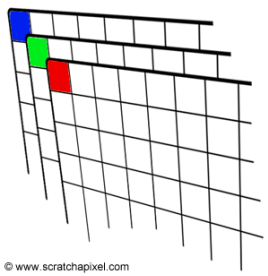


- We will use 2 useful packages for images:
  - `numpy`: numerical analysis package
  - `pyplot`: part of `matplotlib` for making graphs and plots
- See lab notes for installing on your home machine.

Images with pyplot and numpy




```
#Import the packages for images and arrays:
import matplotlib.pyplot as plt
import numpy as np


img = plt.imread('csBridge.png')    #Read in image from csBridge.png
plt.imshow(img)                      #Load image into pyplot
plt.show()                           #Show the image (waits until close

img2 = img.copy()          #make a copy of our image
img2[:,:,1] = 0            #Set the green channel to 0
img2[:,:,2] = 0            #Set the blue channel to 0

plt.imshow(img2)           #Load our new image into pyplot
plt.show()                 #Show the image (waits until closed to conti

plt.imsave('reds.png', img2)  #Save the image we created to the file:
```

Images with pyplot and numpy

```
#Import the packages for images and arrays:
import matplotlib.pyplot as plt
import numpy as np


img = plt.imread('csBridge.png')    #Read in image from csBridge.png
plt.imshow(img)                      #Load image into pyplot
plt.show()                           #Show the image (waits until close

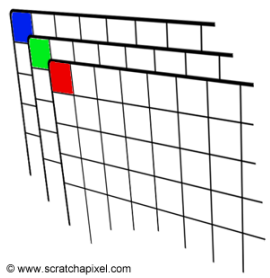
img2 = img.copy()          #make a copy of our image
img2[:,:,1] = 0            #Set the green channel to 0
img2[:,:,2] = 0            #Set the blue channel to 0

plt.imshow(img2)           #Load our new image into pyplot
plt.show()                 #Show the image (waits until closed to conti

plt.imsave('reds.png', img2)  #Save the image we created to the file:
```

Creating Images

To create an image from scratch:



Creating Images

To create an image from scratch:

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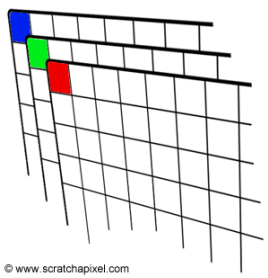

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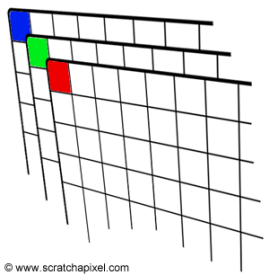


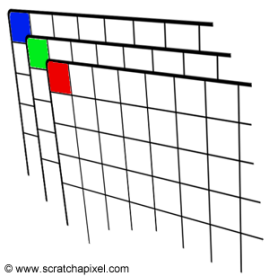
Creating Images

To create an image from scratch:

1. Import the libraries.

```
import matplotlib.pyplot as plt
import numpy as np
```

2. Create the image– easy to set all color



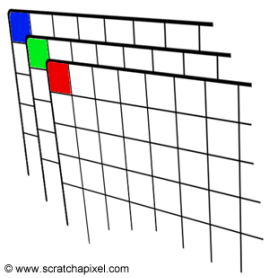
Creating Images

To create an image from scratch:

1. Import the libraries.

```
import matplotlib.pyplot as plt
import numpy as np
```

2. Create the image– easy to set all color
   1. to 0% (black):



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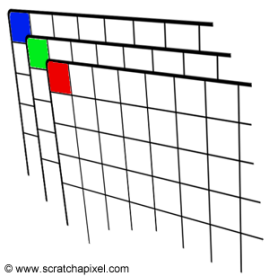
```
img = np.zeros( (num,num,3) )
```



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```
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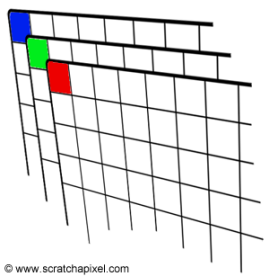
   2. to 100% (white):



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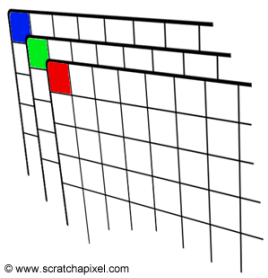

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   1. to 0% (black):
      `img = np.zeros( (num,num,3) )`
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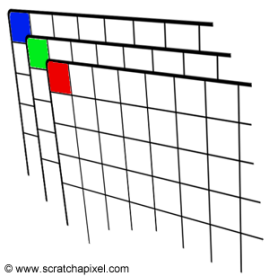
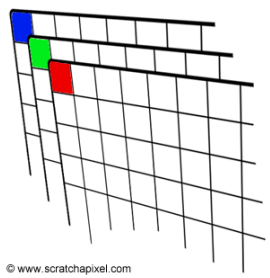
3. *Do stuff to the pixels to make your image*



Creating Images



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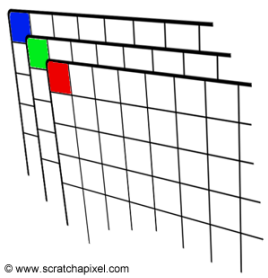
3. *Do stuff to the pixels to make your image*
4. You can display your image:

```
plt.imshow(img)
plt.show()
```



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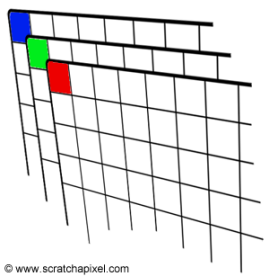
plt.show()
```

5. And save your image:



Creating Images

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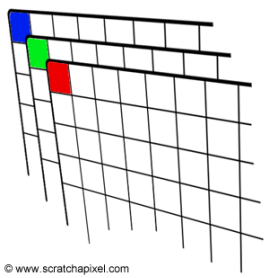
      `img = np.ones( (num,num,3) )`
3. *Do stuff to the pixels to make your image*
4. You can display your image:

```
plt.imshow(img)
plt.show()
```

5. And save your image:

```
plt.imsave('myImage.png', img)
```



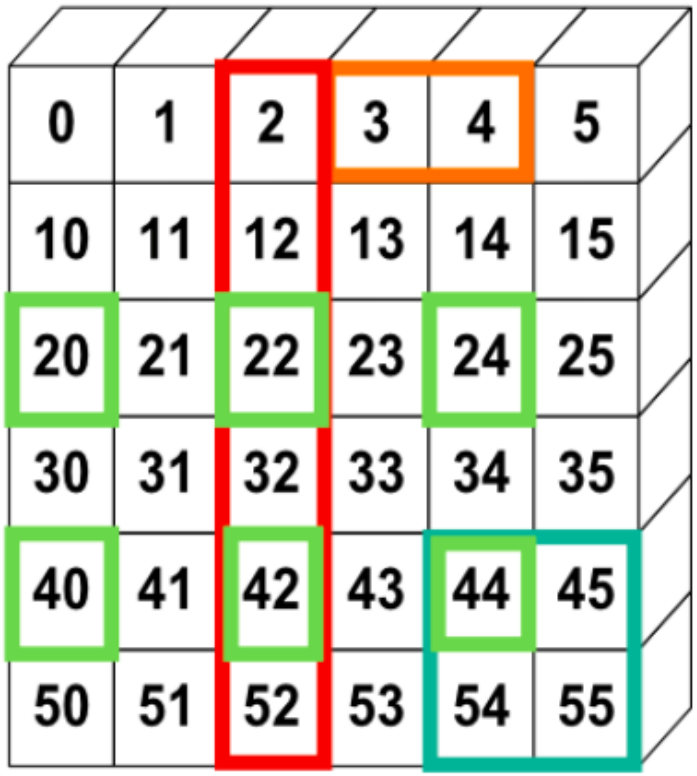
More on numpy arrays

```
>>> a[0,3:5]
array([3,4])

>>> a[4:,4:]
array([[44, 45],
       [54, 55]])

>>> a[:,2]
array([2,12,22,32,42,52])

>>> a[2::2,::2]
array([[20,22,24]
       [40,42,44]])
```



numpy tutorial

Slicing & Image Examples

- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.

Slicing & Image Examples

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- Assuming the libraries are imported, what do the following code fragments produce:
  - ```
    img = np.zeros( (10,10,3) )
    img[0:10,0:5,0:1] = 1
    ```
    ```

Slicing & Image Examples

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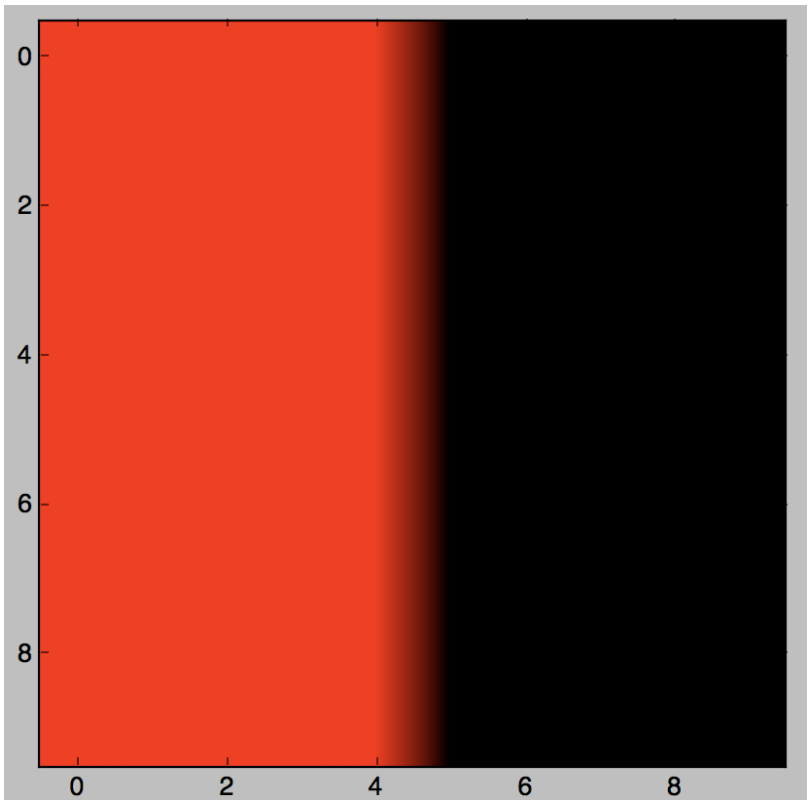
    ```

Slicing & Image Examples

- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
- Assuming the libraries are imported, what do the following code fragments produce:
  - ```
    num = 10
    img = np.zeros( (num,num,3) )
    img[0:2,:,2:3] = 1.0
    ```
    ```

Slicing & Image Examples

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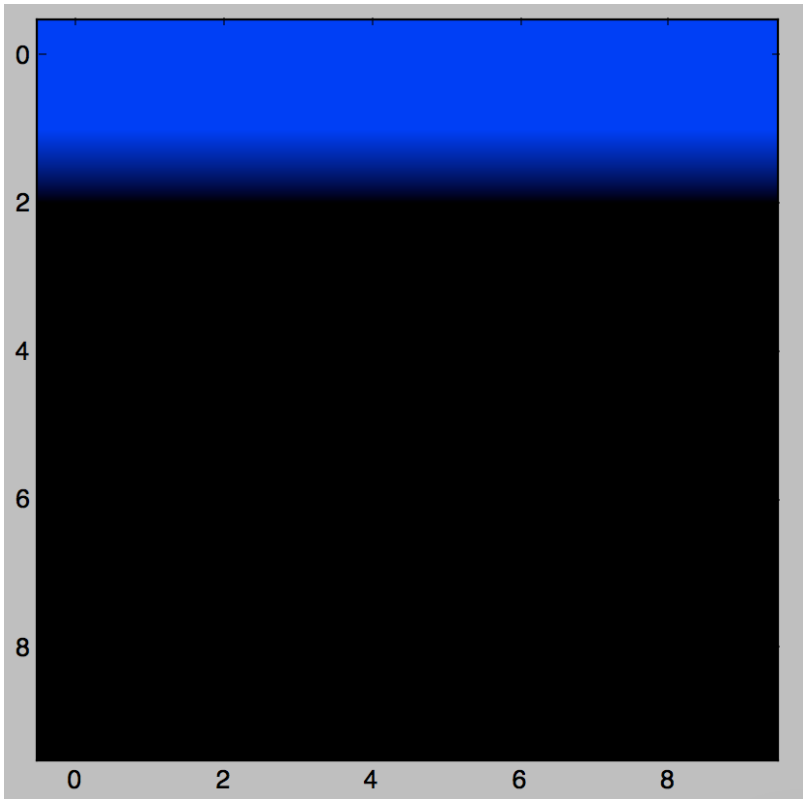
- Assuming the libraries are imported, what do the following code fragments produce:
  - ```
    num = 10
    img = np.zeros( (num,num,3) )
    img[0:2,:,2:3] = 1.0
    ```


    ```

Slicing & Image Examples

- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
- Assuming the libraries are imported, what do the following code fragments produce:
  - ```
    num = int(input('Enter size'))
    img = np.zeros( (num,num,3) )
    img[:,::2,1] = 1.0
    ```
    ```

Slicing & Image Examples

- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
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  - ```
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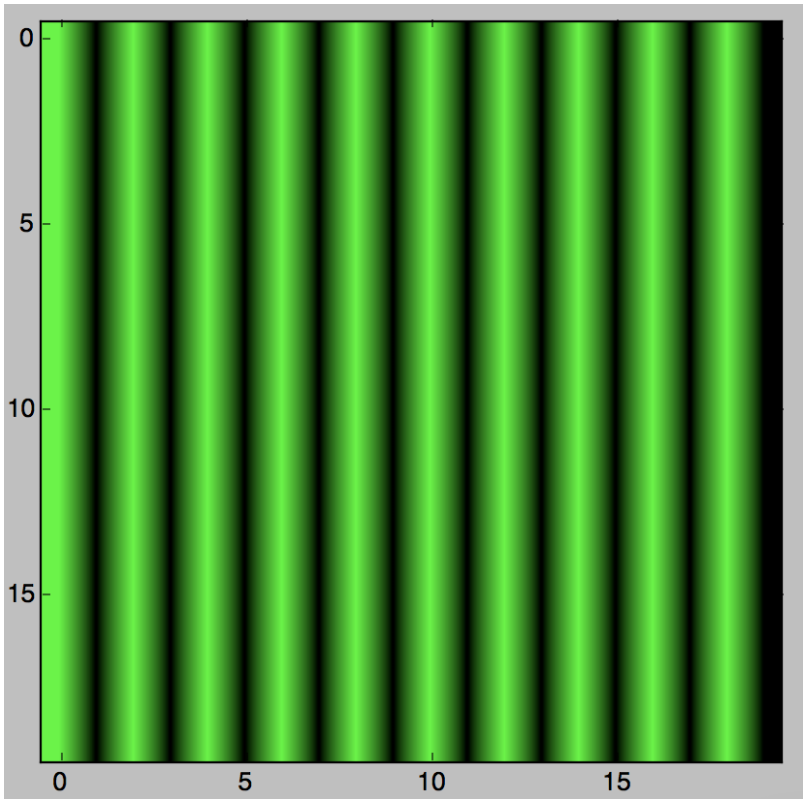
    ```

Challenge (Group Work)

- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
- Assuming the libraries are imported, what do the following code fragments produce:

  - ```
    img = np.ones( (10,10,3) )
    img[0:10,0:5,0:2] = 0
    ```
    ```

Challenge (Group Work)

- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
- Assuming the libraries are imported, what do the following code fragments produce:

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    img = np.ones( (10,10,3) )
    img[0:10,0:5,0:2] = 0
    ```

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    num = int(input('Enter size '))
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  - ```
    num = int(input('Enter size '))
    img = np.ones( (num,num,3) )
    img[::2,:,1:]  = 0
    ```

  - ```
    img = np.zeros( (8,8,3) )
    img[::2,::2,0] = 1
    ```
    ```

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- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
- Assuming the libraries are imported, what do the following code fragments produce:

  - ```
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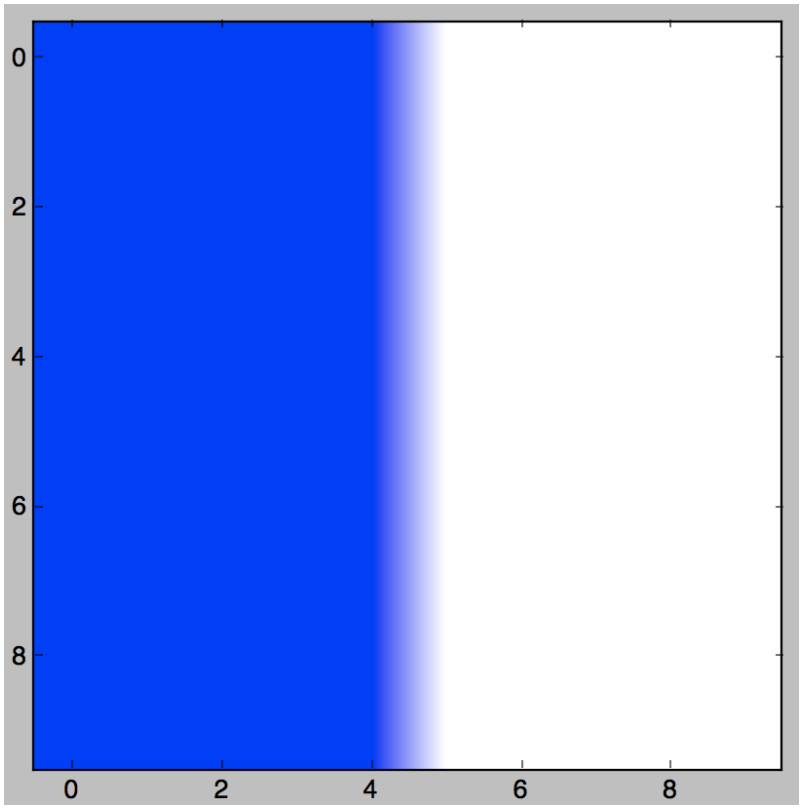
    ```

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  - ```
    num = int(input('Enter size '))
    img = np.ones( (num,num,3) )
    img[::2,:,1:]  = 0
    ```
    ```

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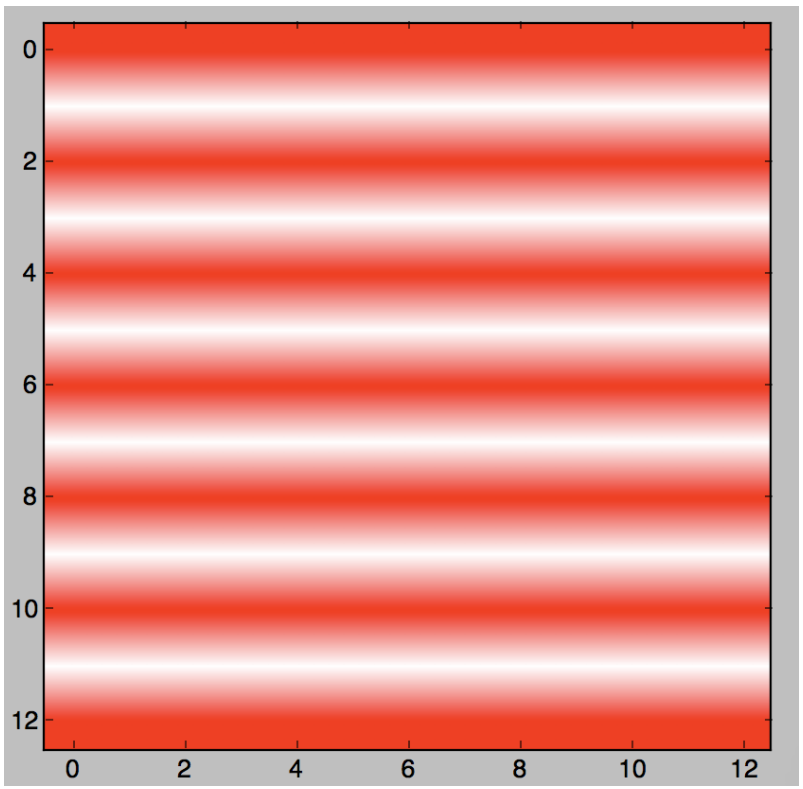
- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
- Assuming the libraries are imported, what do the following code fragments produce:

  - ```
    num = int(input('Enter size '))
    img = np.ones( (num,num,3) )
    img[::2,:,1:]  = 0
    ```


    ```

Challenge (Group Work)

- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
- Assuming the libraries are imported, what do the following code fragments produce:

  - ```
    img = np.zeros( (8,8,3) )
    img[::2,1::2,0] = 1
    ```
    ```

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- Basic pattern: *img[rows, columns, channels]* with: *start:stop:step*.
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    img[::2,1::2,0] = 1
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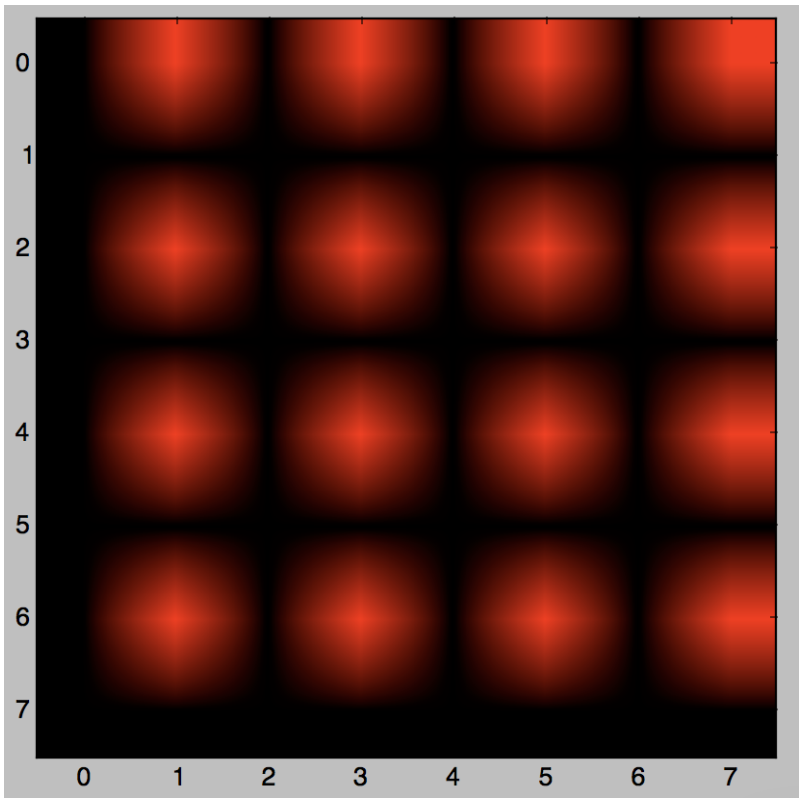
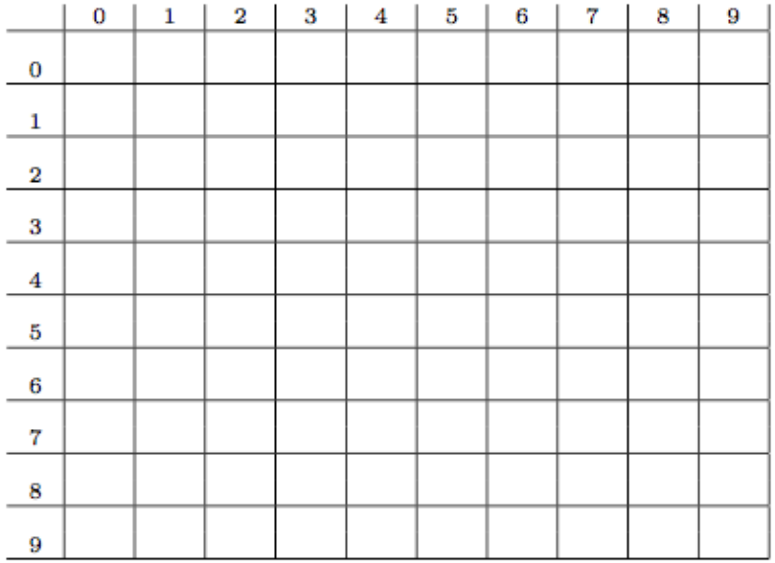
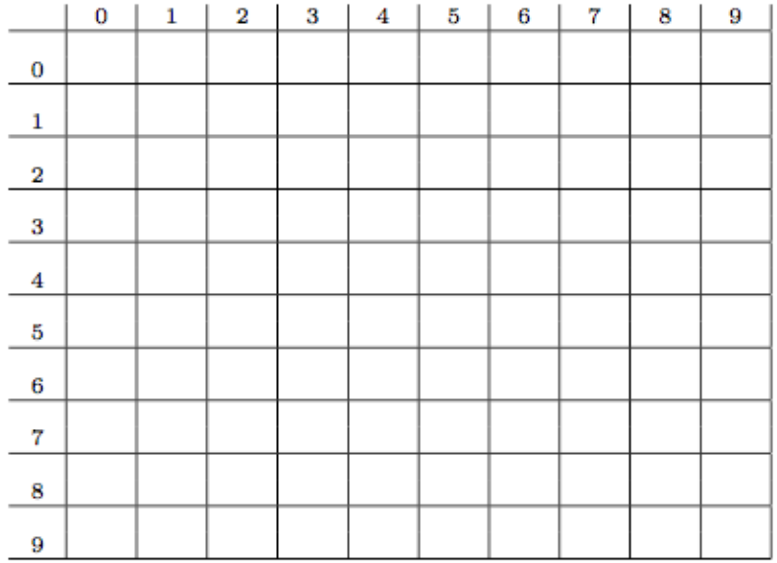

    ```

Challenge (Group Work)



1. Design a 10 by 10 logo for Hunter College that contains a purple 'H'.

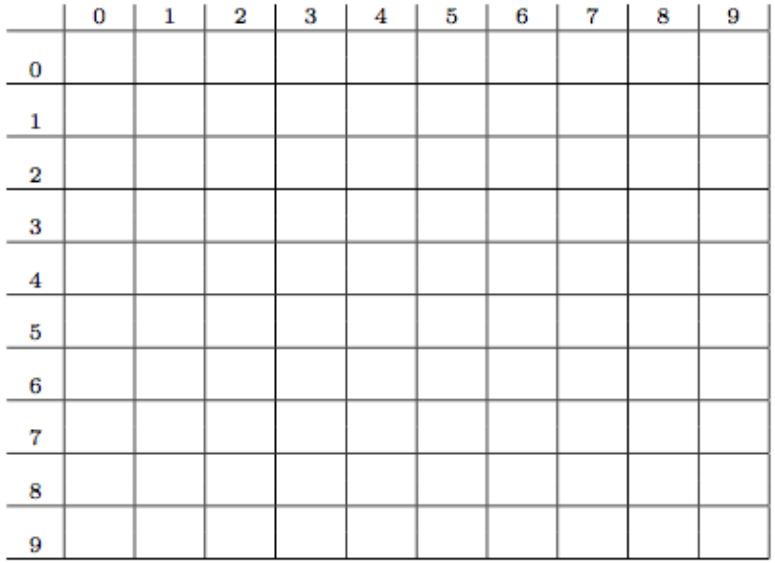
Challenge (Group Work)



	0	1	2	3	4	5	6	7	8	9
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										

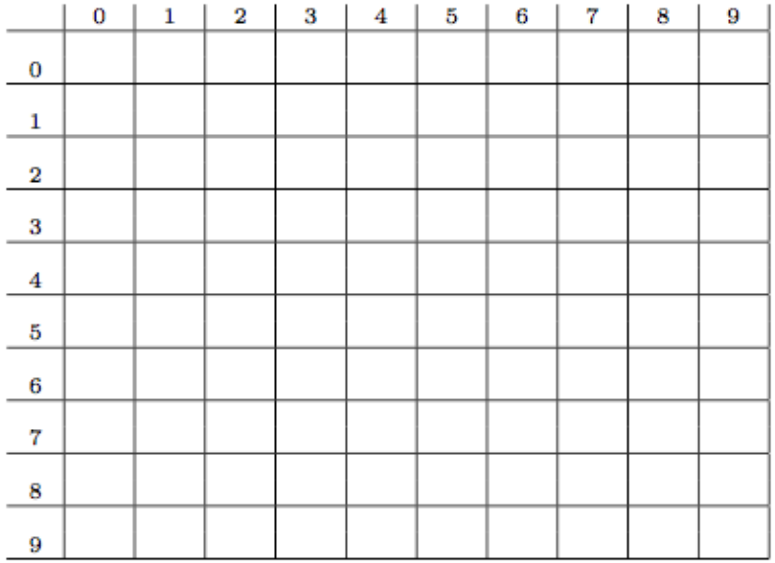
1. Design a 10 by 10 logo for Hunter College that contains a purple 'H'.
2. Your logo should only contain the colors purple and white.

Challenge (Group Work)



1. Design a 10 by 10 logo for Hunter College that contains a purple 'H'.
2. Your logo should only contain the colors purple and white.
3. How can you make Python draw the logo?
   Write down a "To Do" list of things you need to do.

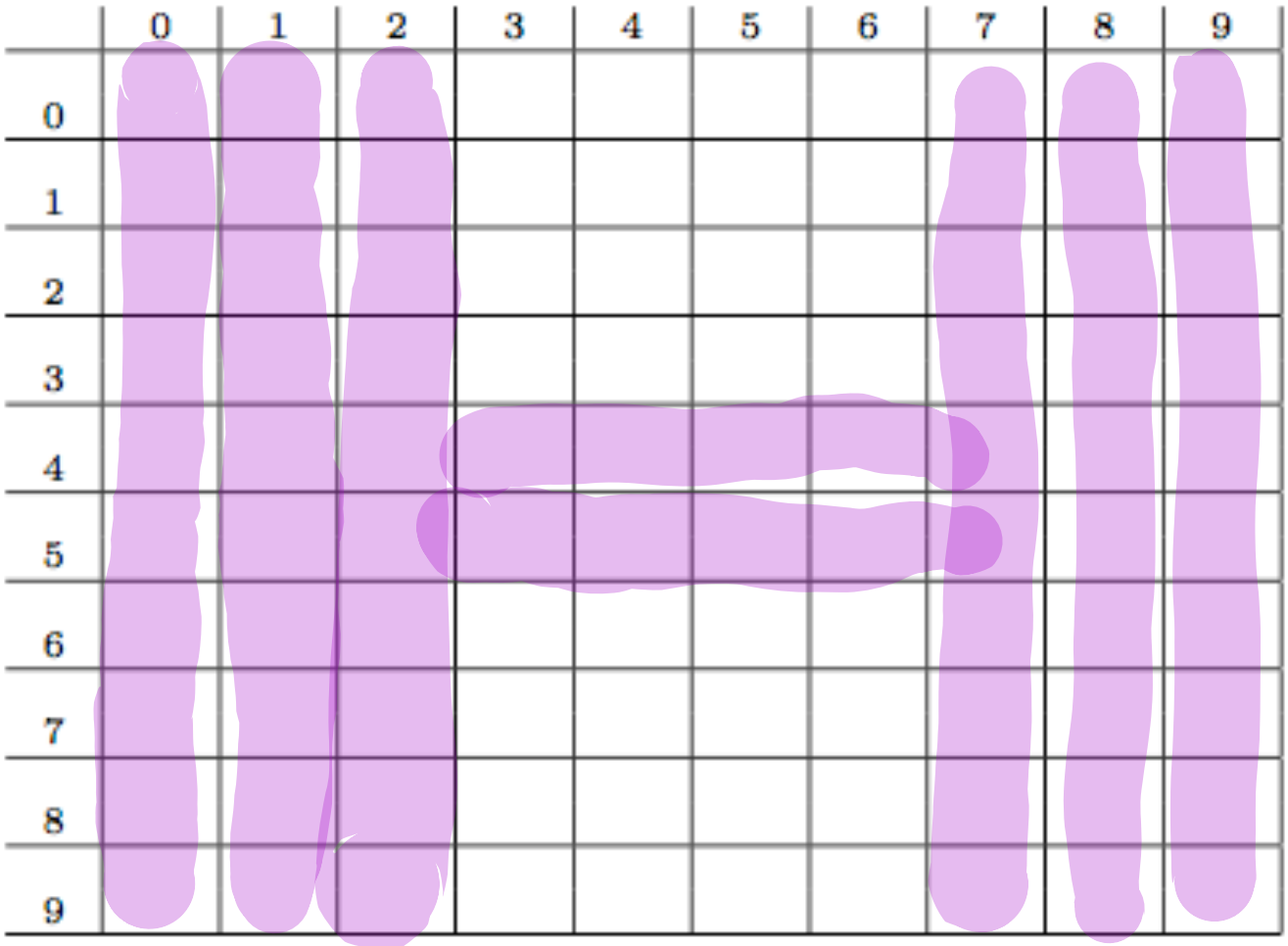
Challenge (Group Work)



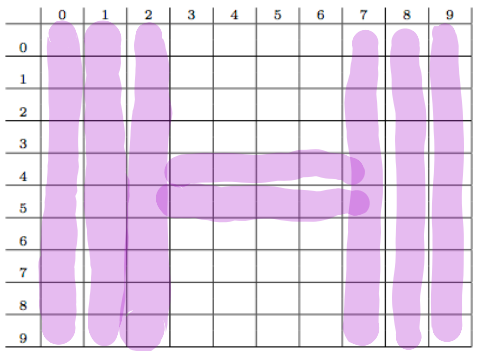
1. Design a 10 by 10 logo for Hunter College that contains a purple 'H'.
2. Your logo should only contain the colors purple and white.
3. How can you make Python draw the logo?
   Write down a "To Do" list of things you need to do.
4. If time, refine your steps above into a Python program.

Design a Hunter Logo

One possible solution:

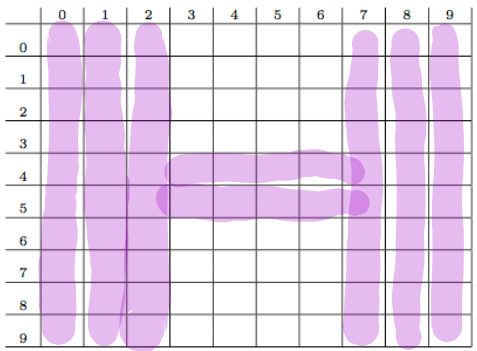


Design a Hunter Logo



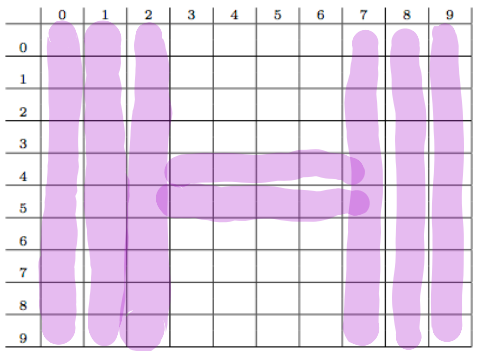
1. Create a 10 by 10 array, `logo`, that starts out as all white pixels.

Design a Hunter Logo



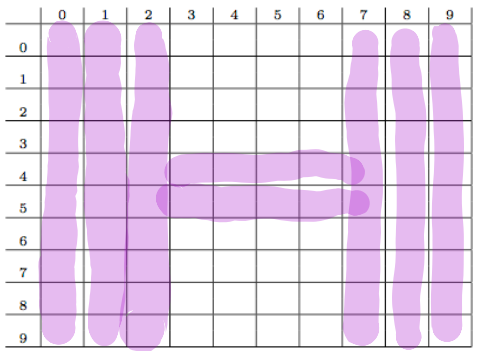
1. Create a 10 by 10 array, `logo`, that starts out as all white pixels.
2. Set the 3 left columns to be purple.

Design a Hunter Logo



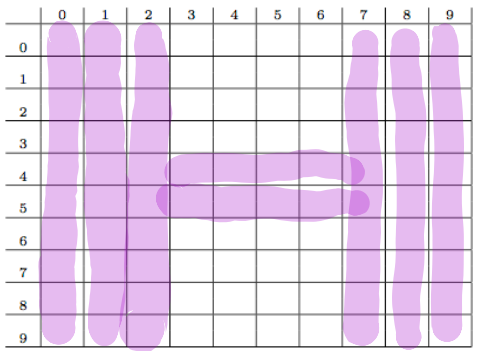
1. Create a 10 by 10 array, `logo`, that starts out as all white pixels.
2. Set the 3 left columns to be purple.
3. Set the 3 right columns to be purple.

Design a Hunter Logo



1. Create a 10 by 10 array, `logo`, that starts out as all white pixels.
2. Set the 3 left columns to be purple.
3. Set the 3 right columns to be purple.
4. Set the middle 2 rows to be purple.

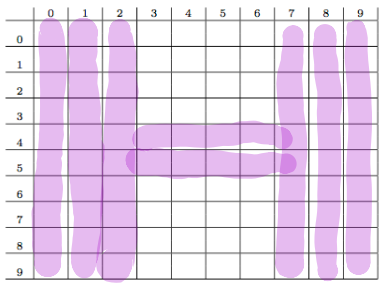
Design a Hunter Logo



1. Create a 10 by 10 array, `logo`, that starts out as all white pixels.
2. Set the 3 left columns to be purple.
3. Set the 3 right columns to be purple.
4. Set the middle 2 rows to be purple.
5. Save `logo` array to a file.

Translating the Design to Code

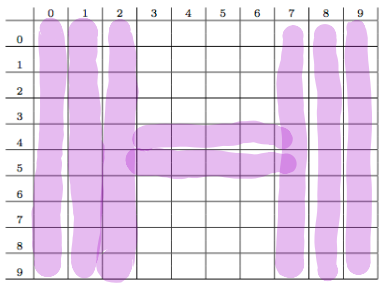
1. Create a 10 by 10 array, `logo`, that starts out as all white pixels.



Translating the Design to Code

1. Create a 10 by 10 array, `logo`, that starts out as all white pixels.

```
import matplotlib.pyplot as plt #import libraries for plotting
import numpy as np              #and for arrays (to hold images)
logoImg = np.ones((10,10,3))    #10x10 array with 3 sheets of 1's
```



Translating the Design to Code

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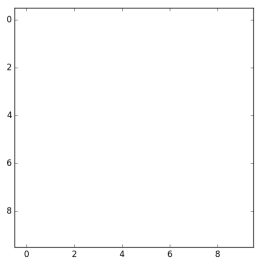

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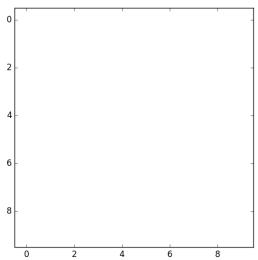

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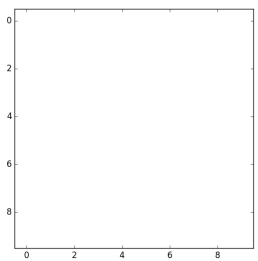

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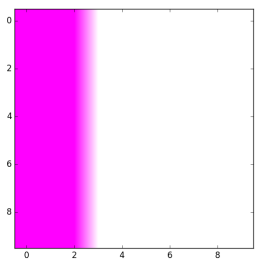

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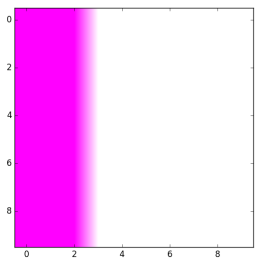

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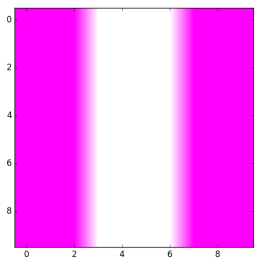

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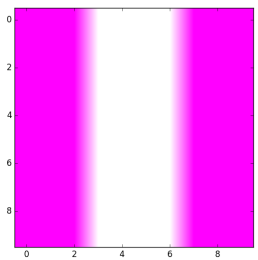

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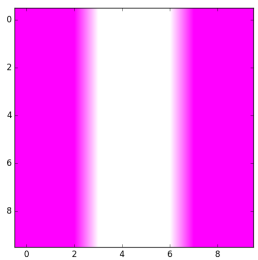

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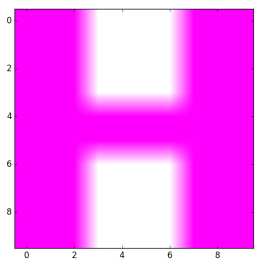

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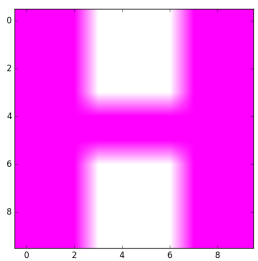

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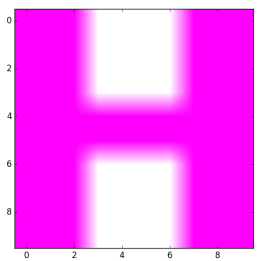

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```
plt.imsave("logo.png", logoImg) #Save the image to logo.png
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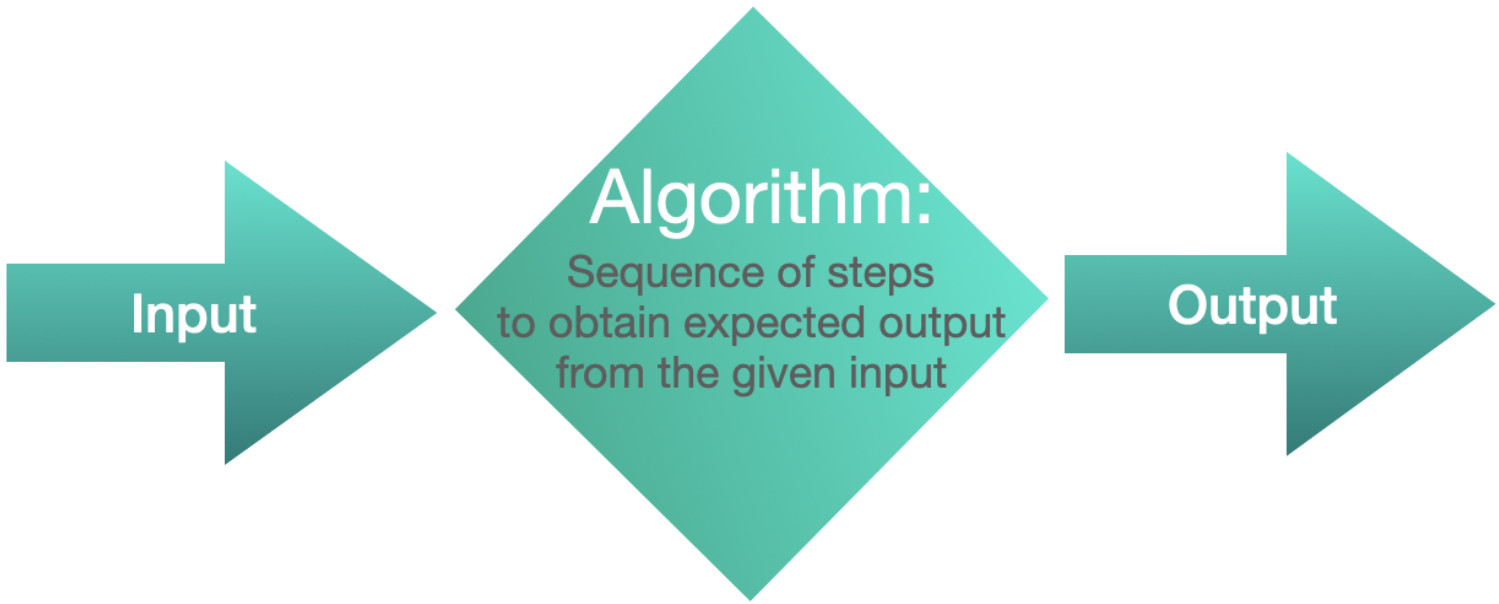
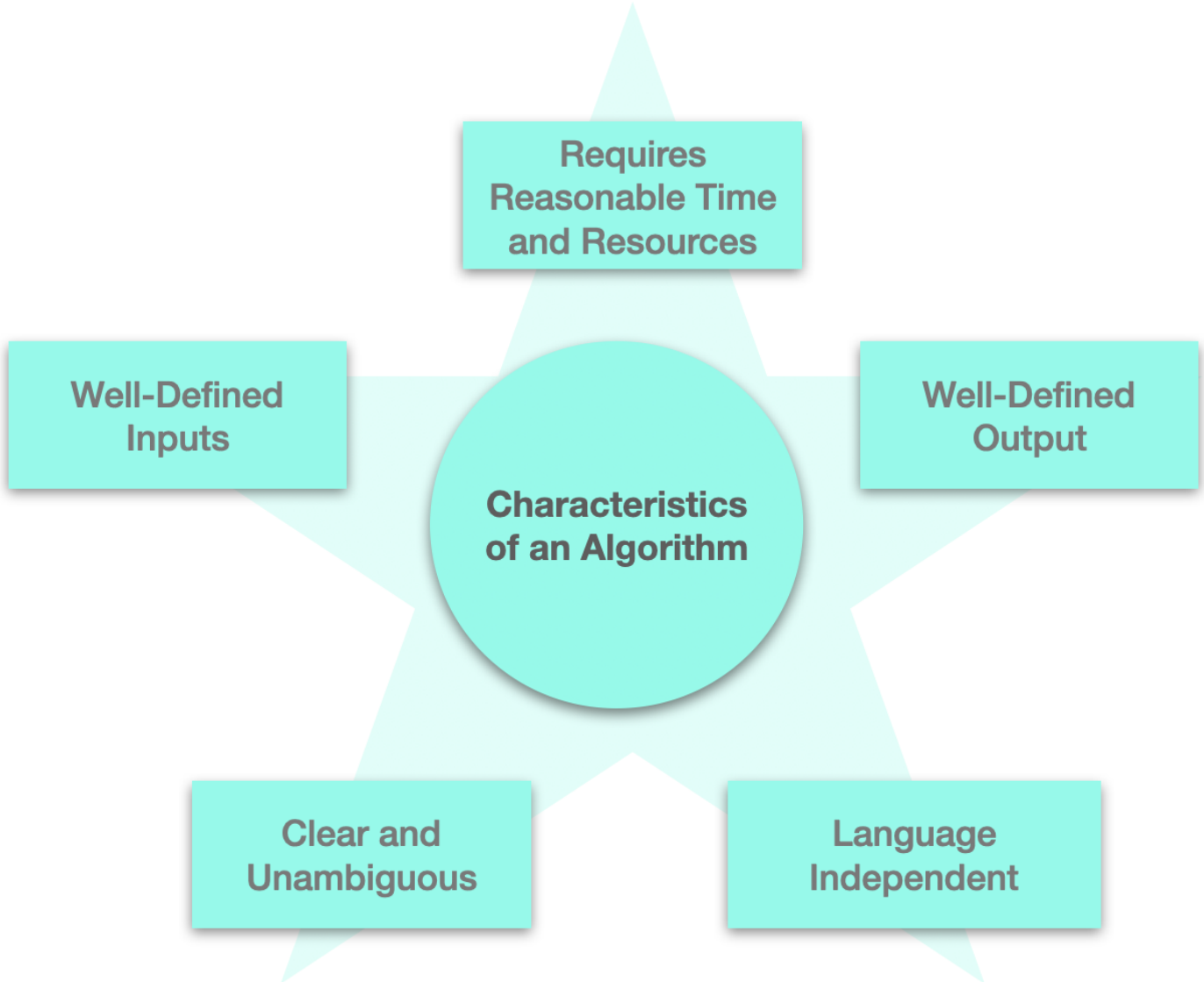
Today's Topics

- Recap: Colors
- 2D Arrays & Image Files
- **Design Challenge: Airplanes**
- Decisions

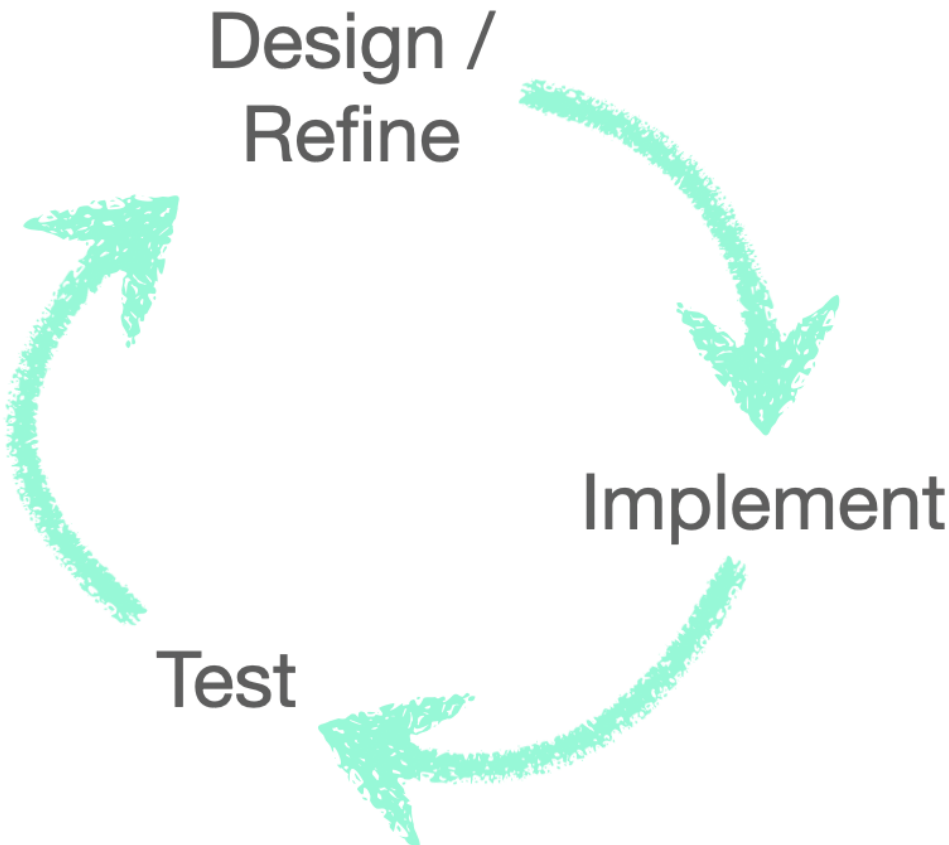
What is an Algorithm?



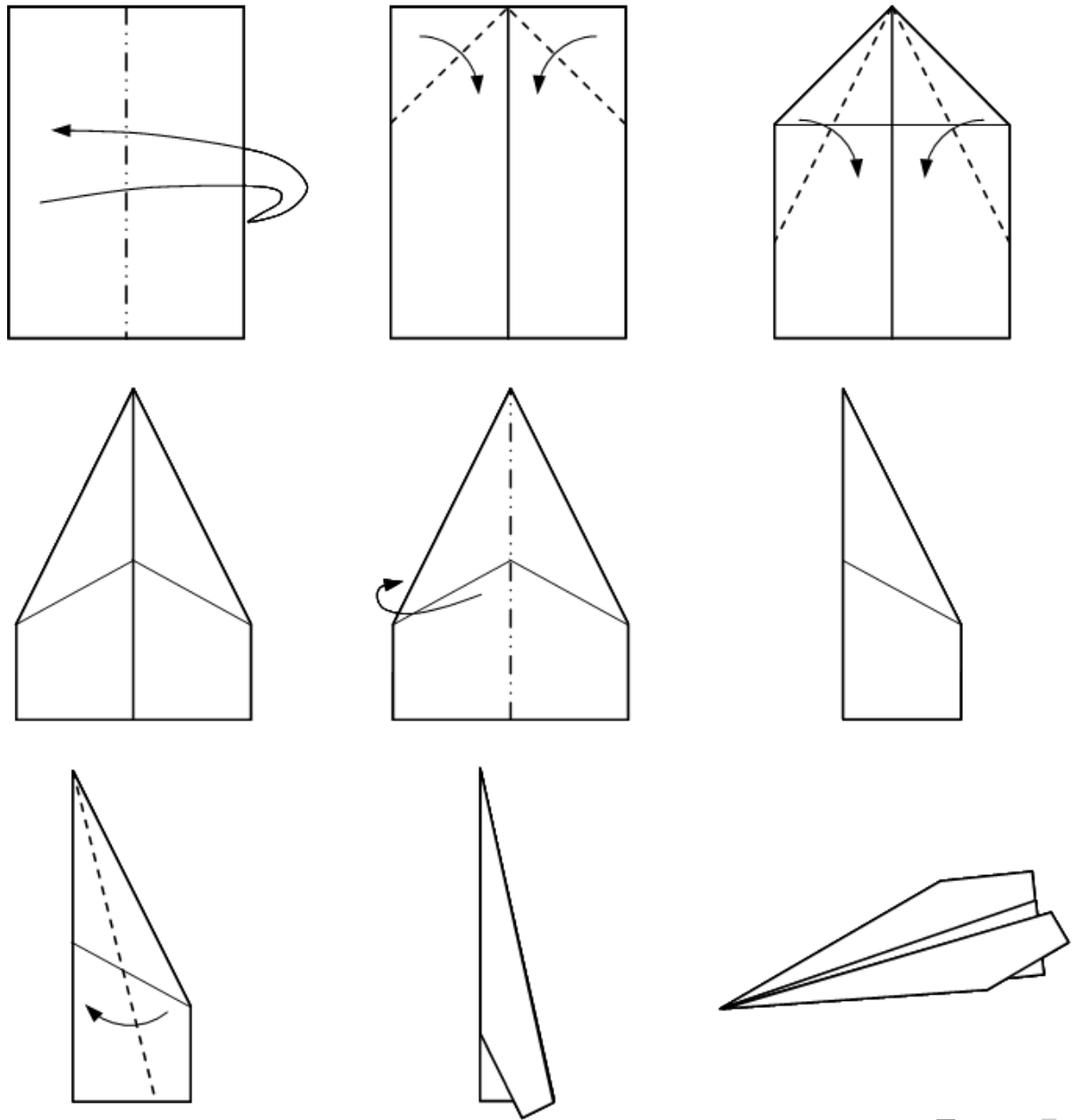
Characteristics of an Algorithm



Algorithm Design Cycle



Design Challenge: Planes



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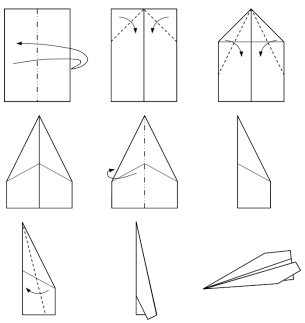

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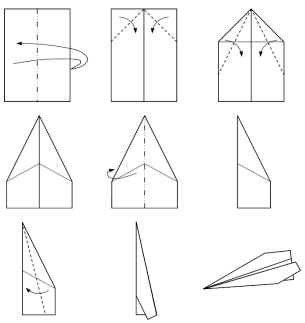

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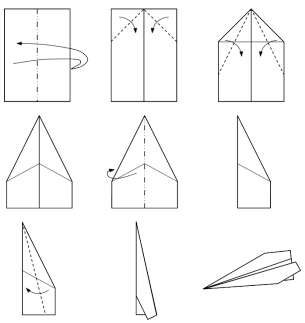

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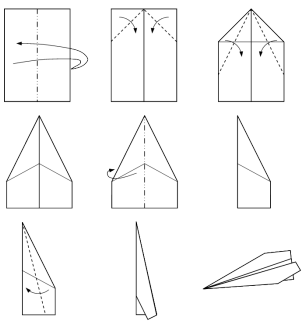

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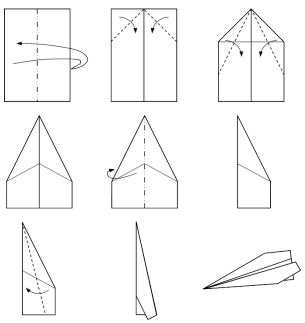

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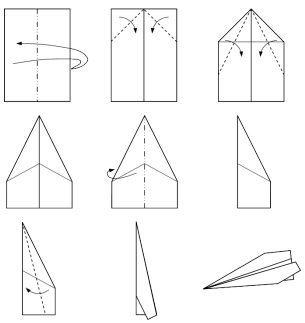

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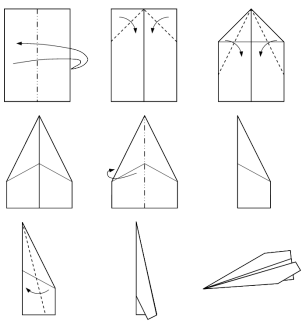

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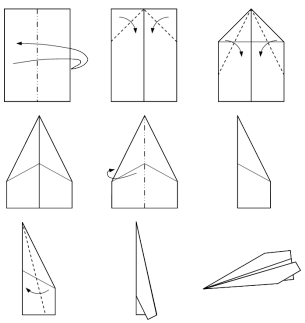

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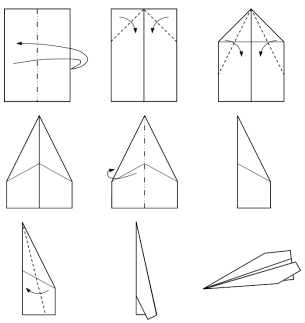

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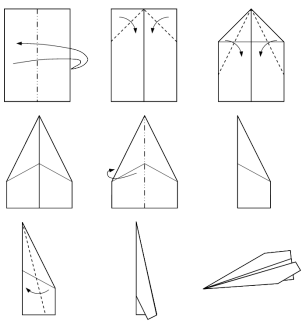

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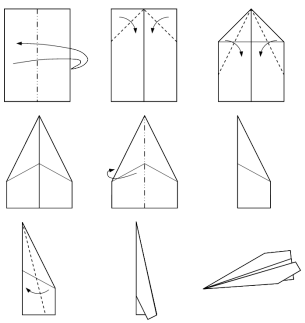

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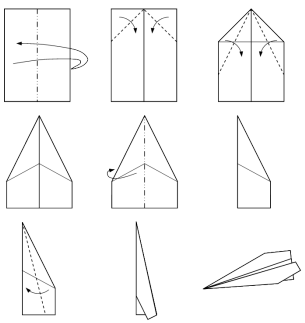

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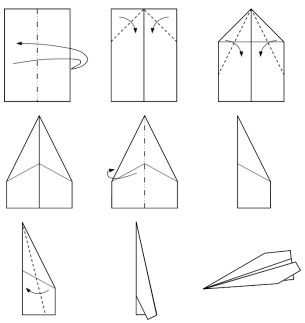
Design Challenge: Initial Design **(2 Minutes)**



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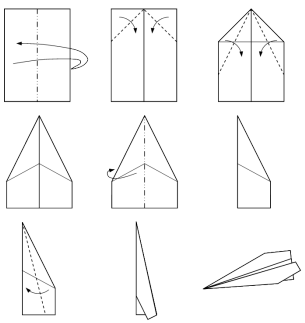
Design Challenge: Test Build **(2 Minutes)**



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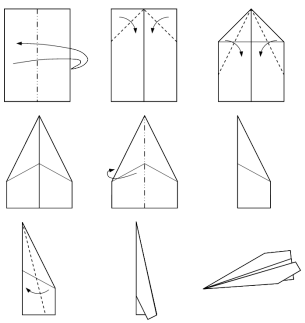
Design Challenge: Revise Design **(3 Minutes)**



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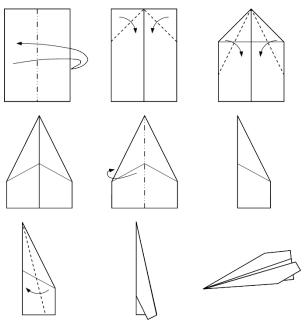
Design Challenge: Build Final Planes **(2 Minutes)**



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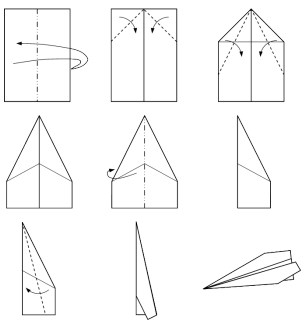
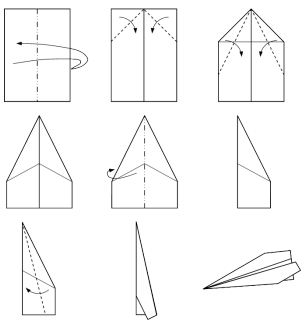
Design Challenge: Test Planes **(3 Minutes)**



- A classic write-an-algorithm challenge for introductory programming.
- With a slight twist: refining designs
  - As a team, write down your design.
  - Exchange with another team.
  - They build an airplane to your design (TEST FLIGHT) without consulting you.
  - You exchange test planes, and revise your algorithm.
  - The build team makes a copy of your revised paper airplane (FINAL FLIGHT) **and flies it from the balcony (must be behind first row of seats)**.
  - Will be judged on closeness to the stage.
  - Winning design/build team gets chocolate.
- Remember to pick up all your airplanes!

Design Challenge: Retrieve Planes **(2 Minutes)**



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Today's Topics

- Recap: Colors
- 2D Arrays & Image Files
- Design Challenge: Airplanes
- **Decisions**

Challenge (Group Work)

Predict what these will do (novel concepts):

```
yearBorn = int(input('Enter year born: '))
if yearBorn < 1946:
    print("Greatest Generation")
elif yearBorn <= 1964:
    print("Baby Boomer")
elif yearBorn <= 1984:
    print("Generation X")
elif yearBorn <= 2004:
    print("Millennial")
else:
    print("TBD")

x = int(input('Enter number: '))
if x % 2 == 0:
    print('Even number')
else:
    print('Odd number')
```

```
import turtle

tess = turtle.Turtle()
myWin = turtle.Screen()     #The graphics window
commands = input("Please enter a command string: ")

for ch in commands:
    #perform action indicated by the character
    if ch == 'F':           #move forward
        tess.forward(50)
    elif ch == 'L':         #turn left
        tess.left(90)
    elif ch == 'R':         #turn right
        tess.right(90)
    elif ch == '^':         #lift pen
        tess.penup()
    elif ch == 'v':         #lower pen
        tess.pendown()
    elif ch == 'B':         #go backwards
        tess.backward(50)
    elif ch == 'r':         #turn red
        tess.color("red")
    elif ch == 'g':         #turn green
        tess.color("green")
    elif ch == 'b':         #turn blue
        tess.color("blue")
    else:                   #for any other character
        print("Error: do not know the command:", c)
```

Python Tutor

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(Demo with pythonTutor)

IDLE

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(Demo with IDLE)

Decisions

```
if x < y:
    print("x is less than y")
elif x > y:
    print("x is greater than y")
else:
    print("x and y must be equal")
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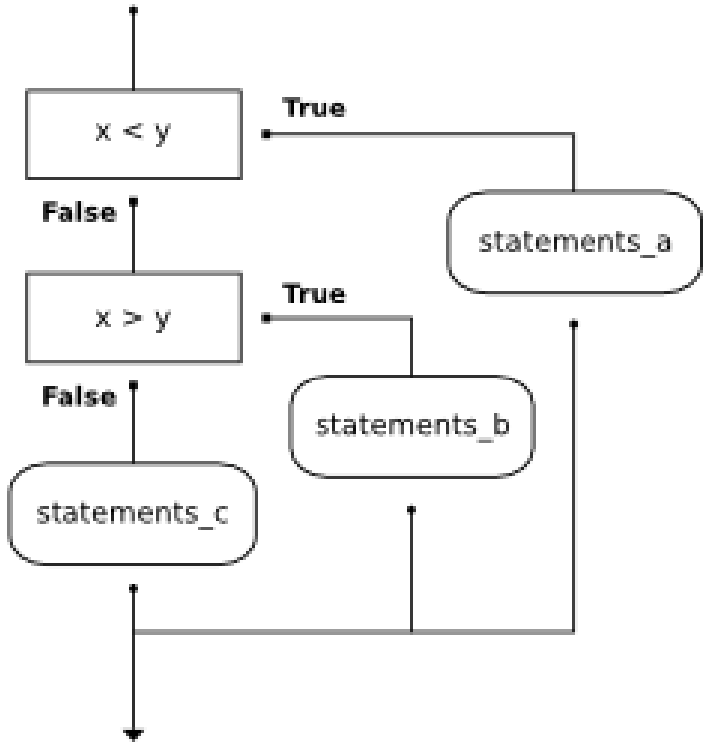

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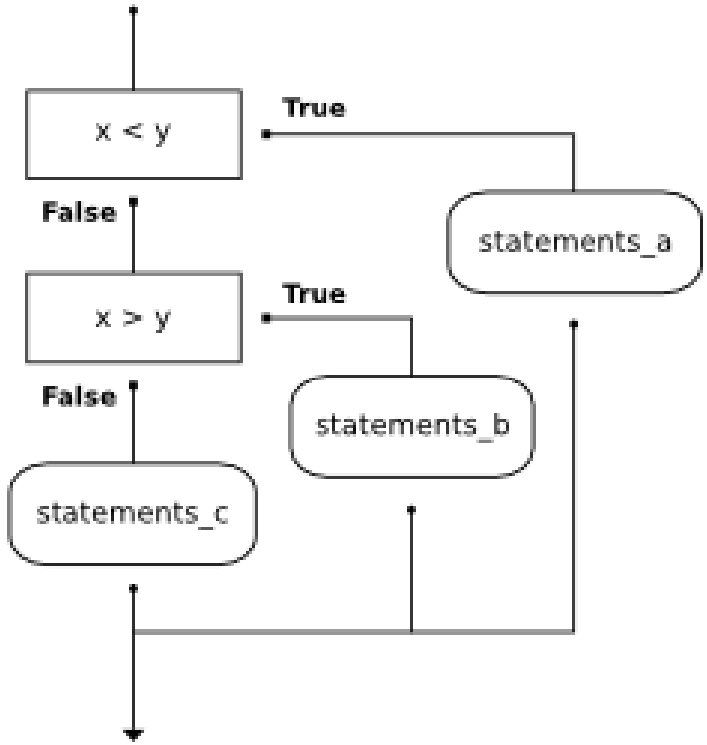

(This was just a first glance, will do much more on decisions over the next several weeks.)

Recap

- In Python, we introduced:

Recap

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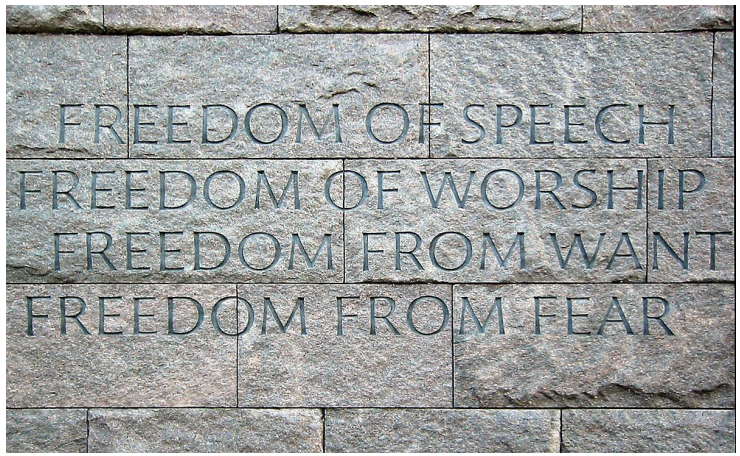
  - Recap: Colors
  - 2D Array & Image Files
  - Decisions

Practice Quiz & Final Questions

(NYTimes)

(Hunter College)



(FDR 4 FP)

- Since you must pass the final exam to pass the course, we end every lecture with final exam review.
- Pull out something to write on (not to be turned in).

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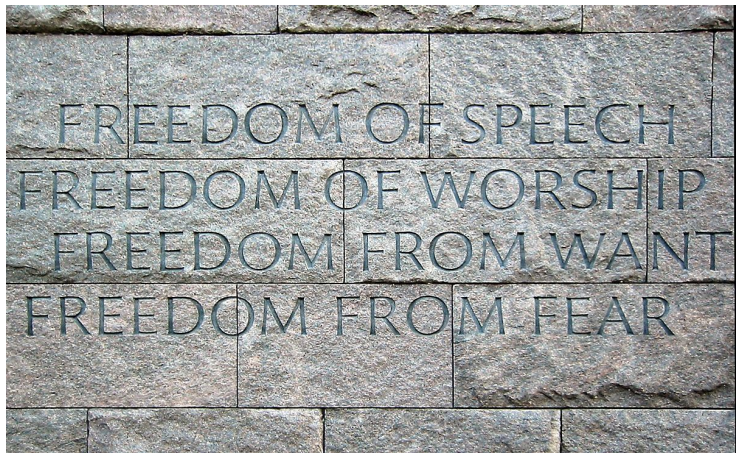

(FDR 4 FP)

- Since you must pass the final exam to pass the course, we end every lecture with final exam review.
- Pull out something to write on (not to be turned in).
- Lightning rounds:
  - write as much you can for 60 seconds;
  - followed by answer; and
  - repeat.
- Past exams are on the webpage (under Final Exam Information).
- We are starting with Fall 2019, Version 1.

Weekly Reminders!

Before next lecture, don't forget to:

- Work on this week's Online Lab

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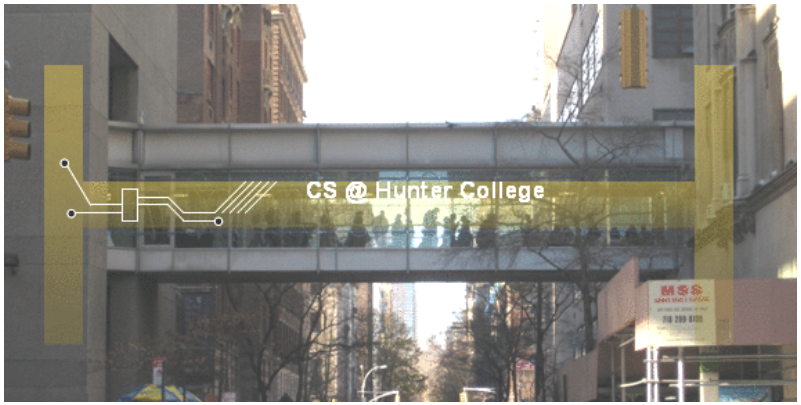

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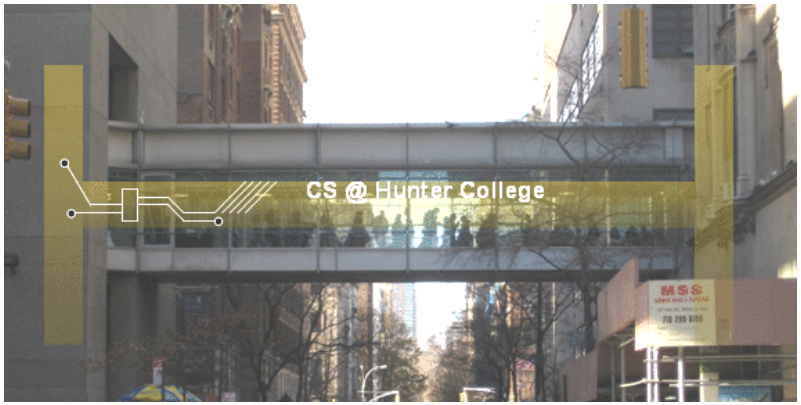

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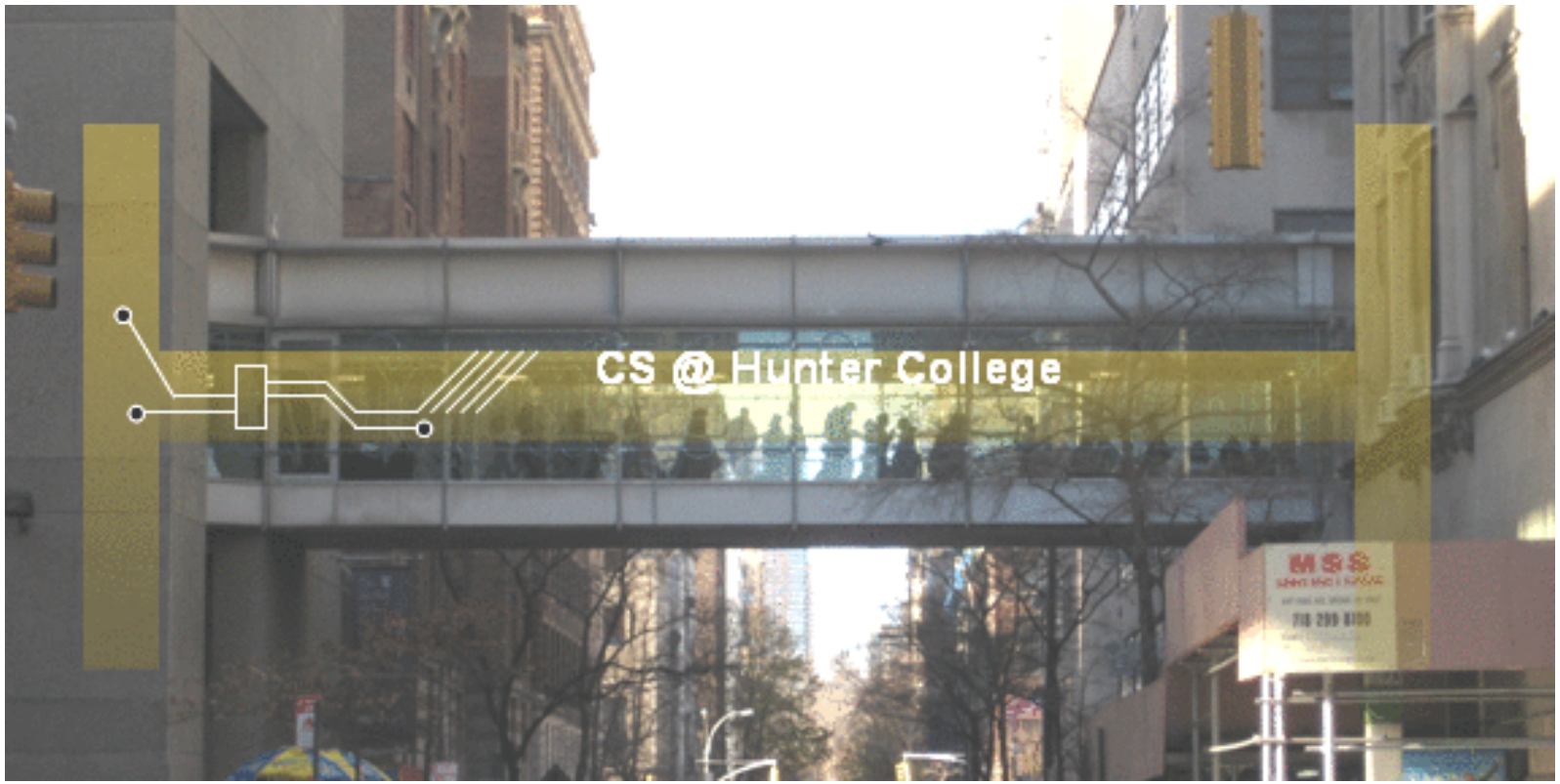
- Submit this week's 5 programming assignments **(programs 16-20)**
- If you need help, schedule an appointment for Tutoring in lab 1001G 11:30am-5:15pm
- Take the Lecture Preview on Blackboard on Monday (or no later than 10:15am on Tuesday)

Lecture Slips & Writing Boards



- Hand your lecture slip to a UTA.
- Return writing boards as you leave.