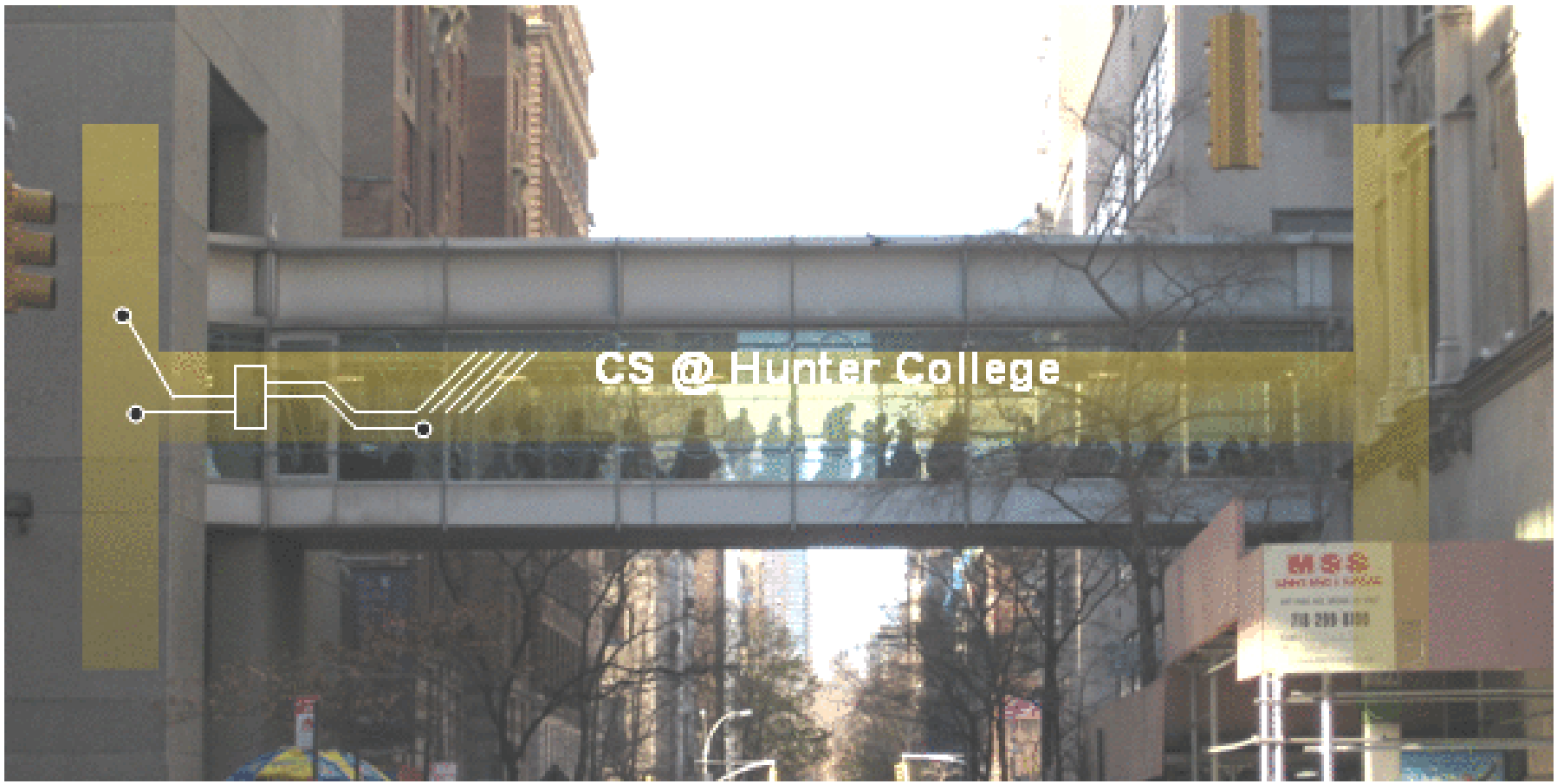
CSci 127: Introduction to Computer Science



Finished the lecture preview?

hunter.cuny.edu/csci

Today's Topics

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

index, slice, and split of string and list

```
string = "I love python!" #Can we name string as str?
#Better not. Otherwise, error happens when calling
#str(12) to convert integer 12 to string "12" later
    on.
#This is because, by
#str = "I love python!",
#str is redefined as a variable. As a result, str
#cannot be used as a function name in the same
    program.

print(string[2:6])
print(string[-7:-1])
print(string[2:6:2])
print(string[-7:-1:2])
print(string[-1])
print(string[:-1])
```

index, slice, and split of string and list: II

```
#Get a list of words from a sentence. That is,
#split a string to a list of words by a delimiter.
mylist = string[:-1]. split (' ') #delimiter is ' '

#Concatenate elements of a list to get a string
#using join method.
string2 = ' '.join(mylist)
print("string2 =", string2)
```

index, slice, and split of string and list: III

```
print(mylist)
print(len(mylist))
print(mylist[0])
print(mylist[0:2])
print(mylist[-1])
print(mylist[0::2])
```

index, slice, and split of string and list: IV

```
abbr = ""
for word in mylist: #mylist is ['I', 'love', 'python']
    abbr = word[-1] + abbr
    #word[-1] is the last character in word,
    #which is a string object.
    #pad last character of word to left of abbr

print(abbr)
```

index, slice, and split of string and list: V

```
abbr2 = ""
for word in mylist: #mylist is ['I', 'love', 'python']
    abbr2 += word[-1] #same as abbr2 = abbr2 + word
        [-1]
    #pad last character of word to right of abbr2

print(abbr2)
```

link to program

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- **Recap: Colors**
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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:

```
import turtle
thomasH = turtle.Turtle()
```

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

`thomasH.color("#` [ ][ ][ ][ ][ ][ ] `")`

ii. `#Change thomasH to be the color white:`

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iii. `#Change thomasH to be the brightest color blue:`

`thomasH.color("#` [ ][ ][ ][ ][ ][ ] `")`

iv. `#Change thomasH to be the color purple:`

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v. `#Change thomasH to be the color gray:`

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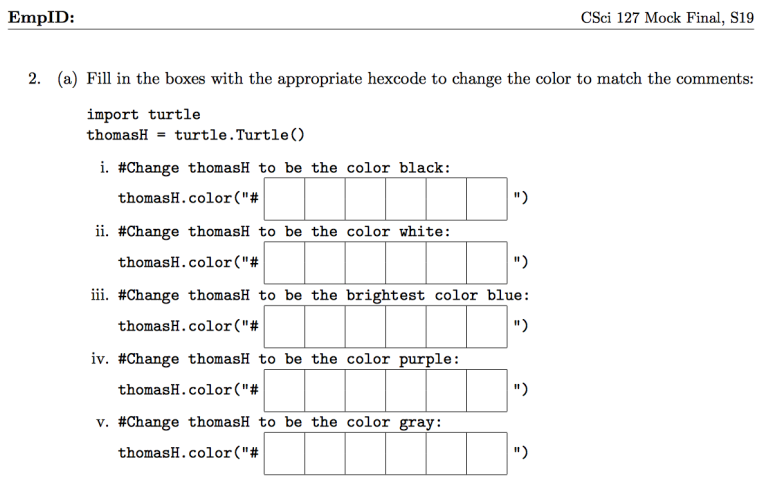

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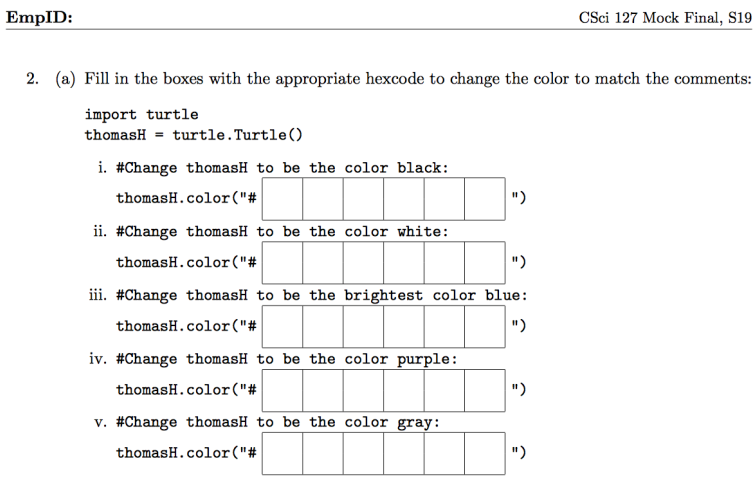

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- Need to fill in hexcodes (always start with #): `R R G G B B`
- Black: `0 0 0 0 0 0`
- White: `F F F F F F`
- Blue: `0 0 0 0 F F`
- Purple: `F F 0 0 F F`
- Gray: `4 2 4 2 4 2` (any choice where RR = GG = BB and RR, GG, BB not 00 or FF).

Recap: Colors

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

- Can specify by name. See named color in python and scroll down to section CSS color.
- Can specify by numbers:
  - Amount of Red, Green, and Blue (RGB).
  - Adding light, not paint:
    - ★ Black: 0% red, 0% green, 0% blue
    - ★ White: 100% red, 100% green, 100% blue

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- Can specify by numbers (RGB):
  - Fractions of each:
    e.g. `(1.0, 0, 0)` is 100% red, no green, and no blue.
  - 8-bit colors: numbers from 0 to 255 $= 2^8 - 1$, a total of $2^8 = 256$ choices (related: 3-bit has 2^3 choices, from 0 to $2^3 - 1 = 7$):
    e.g. `(0, 255, 0)` is no red, 100% green, and no blue.
  - Hexacodes (base-16 numbers)...

Decimal and Hexadecimal

	decimal	hexadecimal
base	10	16
digits	0-9	0-9, A (10) - F (15)
eg	$123 = 1 * 10^2 + 2 * 10^1 + 3 * 10^0$	$7B_{16} = 7 * 16^1 + B * 16^0 = 112 + 11 * 1 = 123_{10}$
	$255 = 2 * 10^2 + 5 * 10^1 + 5 * 10^0$	$FF_{16} = 15 * 16^1 + 15 = 255_{10}$

```
      ___7_
16   / 123
       112
     ------
         11
```

Colors

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    e.g. `#0000FF` is no red, no green, and 100% blue.

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- **2D Arrays & Image Files**
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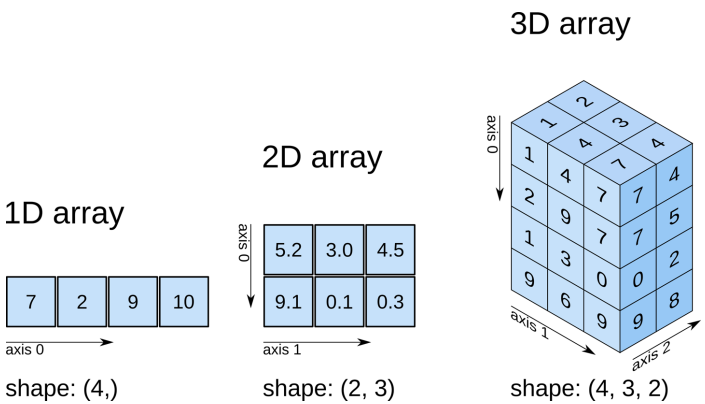
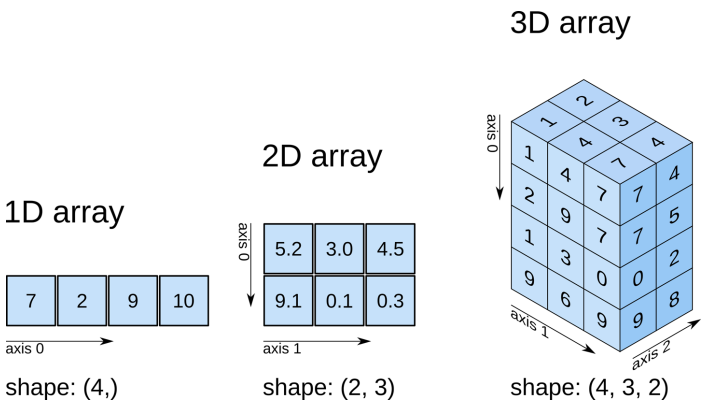
Arrays



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

Arrays



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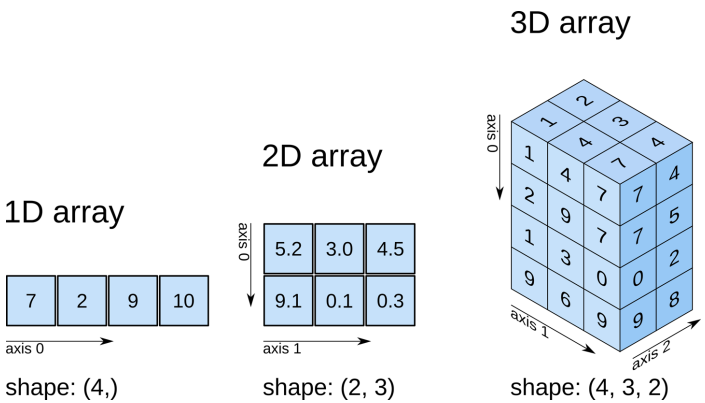

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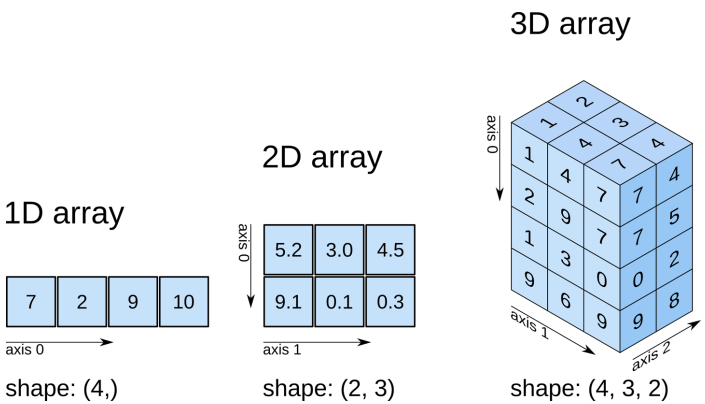
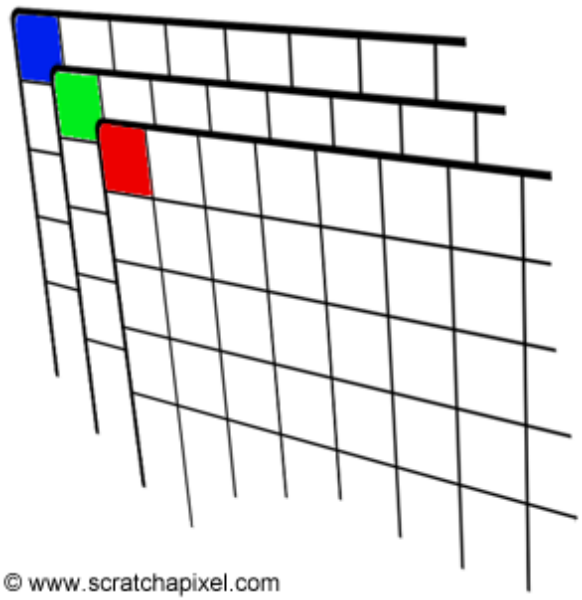


- An **array** is a sequence of elements, much like a list.
- A **2D array** is like a grid of elements, think a list of lists.
- Can keep on adding dimensions (3D, etc.)
- Can access pieces/slices as we do with strings and lists

Images



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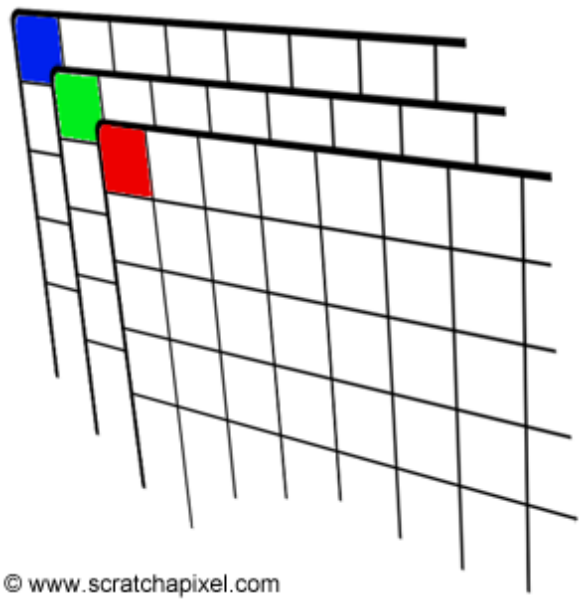

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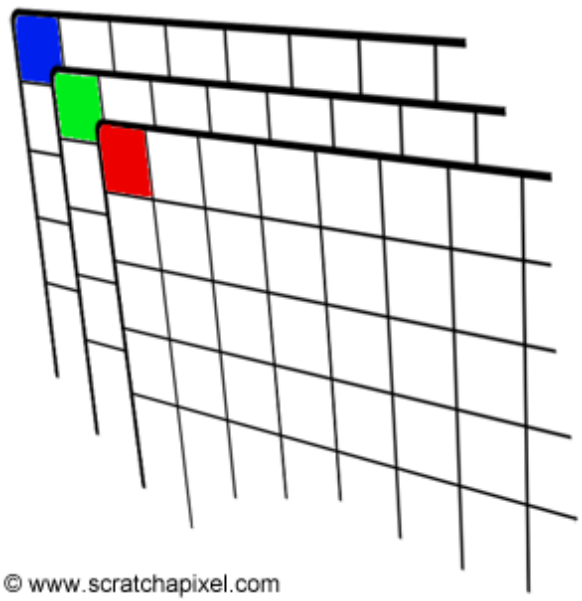

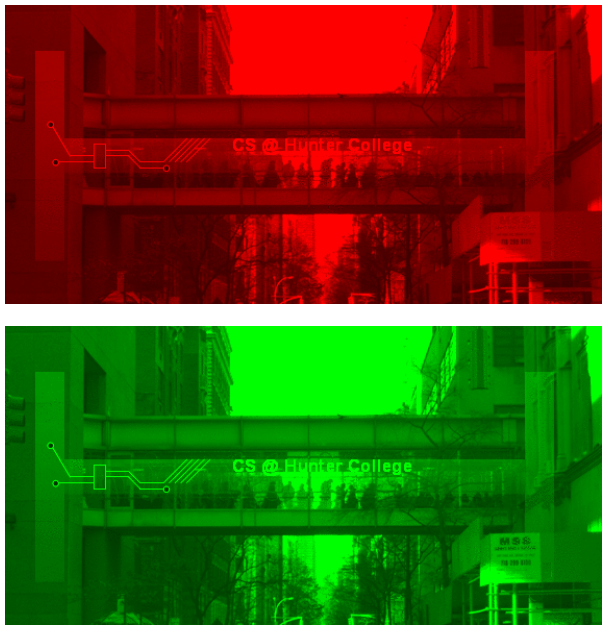

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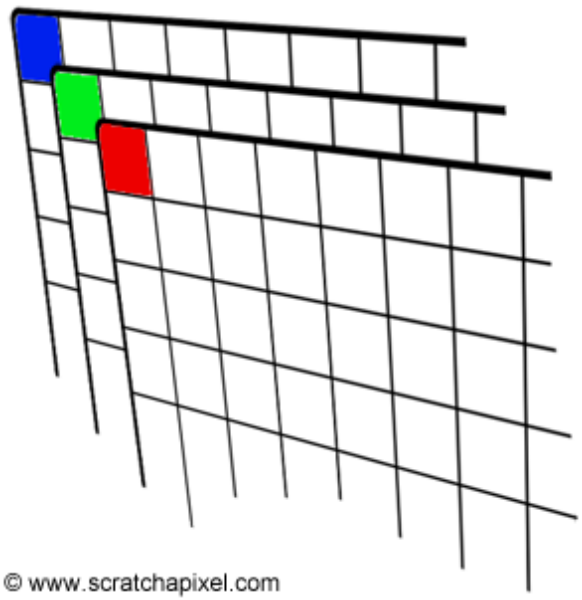
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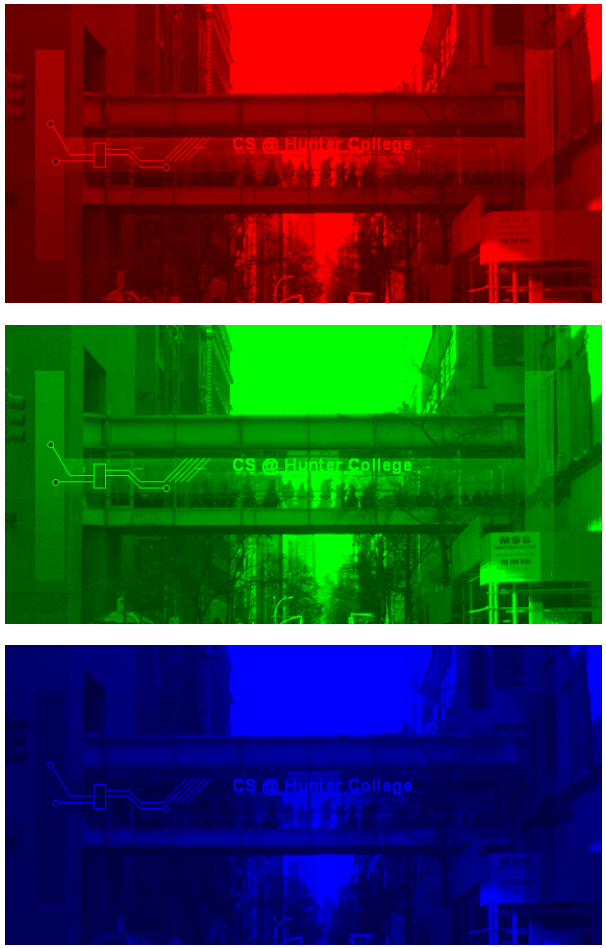
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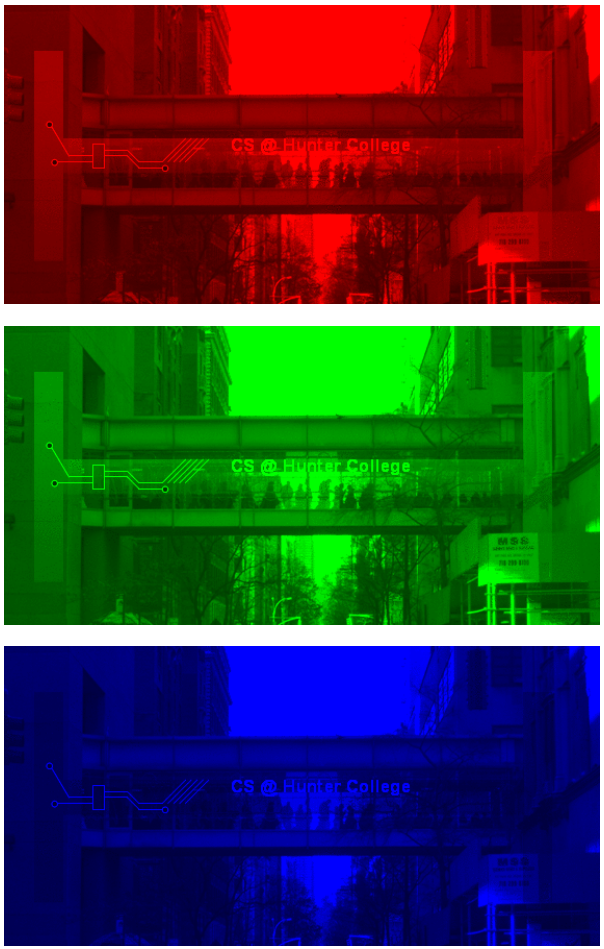
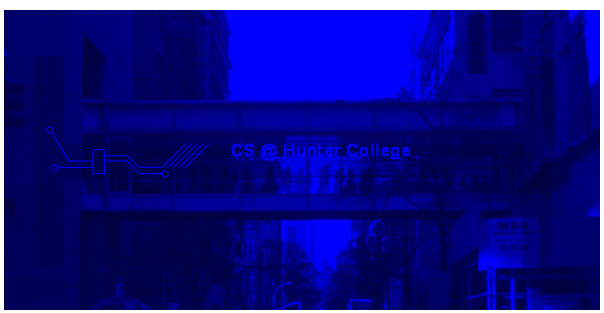
Useful Packages



- We will use 2 useful packages for images:

Useful Packages



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  - `numpy`: numerical analysis package

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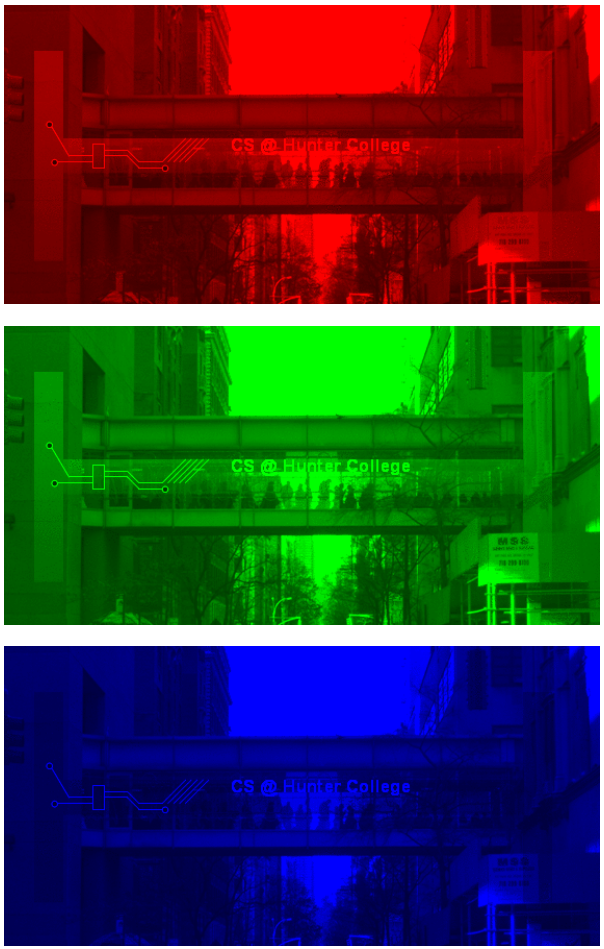

- We will use 2 useful packages for images:
  - `numpy`: numerical analysis package
  - `pyplot`: part of `matplotlib` for making graphs and plots

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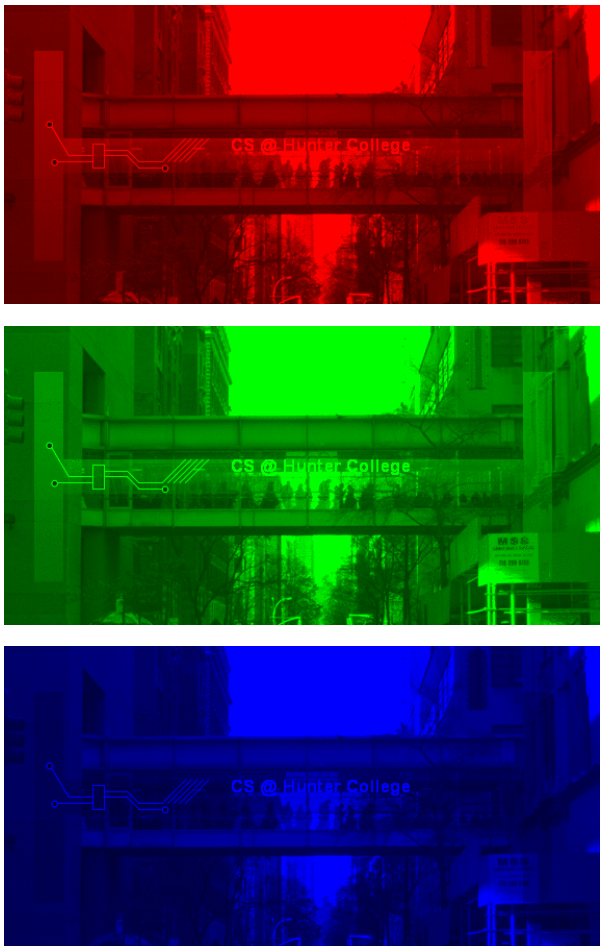
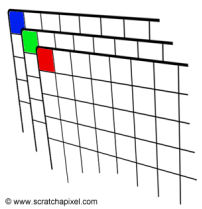


- We will use 2 useful packages for images:
  - `numpy`: numerical analysis package
  - `pyplot`: part of `matplotlib` for making graphs and plots
- See lab notes for installing on your home machine.

Images with pyplot and numpy



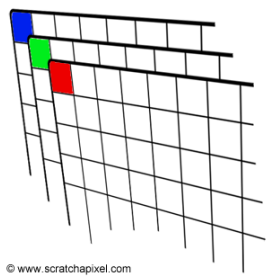

```
1  import matplotlib.pyplot as plt
2  #plt reads a picture and put the result in an array
3  #might need to run the following for one time
4  #if matplotlib is not installed before
5  #pip3 install matplotlib
6  import numpy as np
7  #np is to work with array
8
9  img = plt.imread('csBridge.png')
10 plt.imshow(img)
11 plt.show()
12
13 img2 = img.copy() #copy img to img2
```

Images with `pyplot` and `numpy`

```
1  img2[:, :, 1] = 0 #turn green channel at 1 to 0
2  img2[:, :, 2] = 0 #turn blue channel at 2 tp 0
3
4  plt.imshow(img2)
5  plt.show()
6
7  plt.imsave('red_csBridge.png', img2)
8  #save img2 to red_csBridge.png
```

Creating Images

To create an image from scratch:



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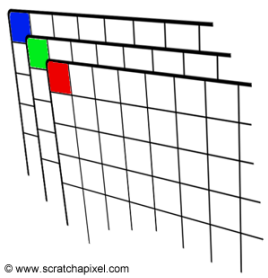

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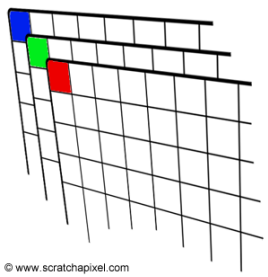

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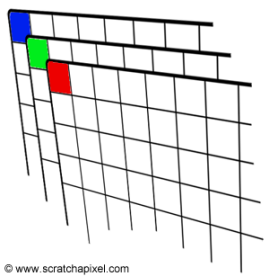
2. Create the image– easy to set all color



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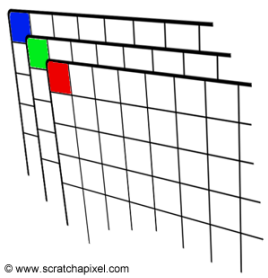
   1. to 0% (black):



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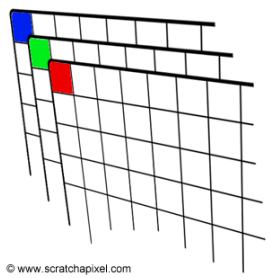

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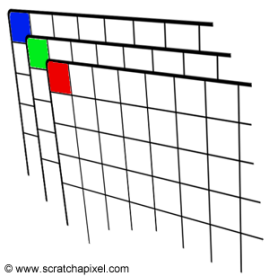

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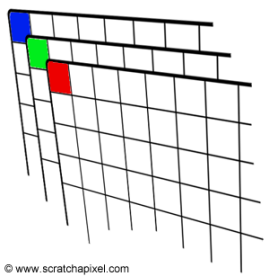

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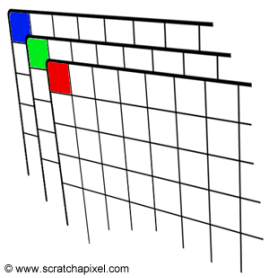
3. *Do stuff to the pixels to make your image*



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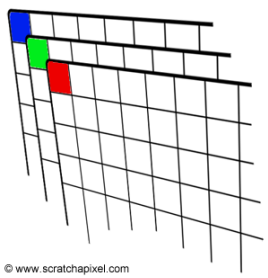

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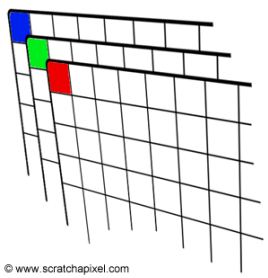

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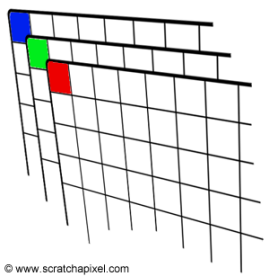


3. *Do stuff to the pixels to make your image*
4. You can display your image:

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

5. And save your image:

Creating Images

To create an image from scratch:

1. Import the libraries.

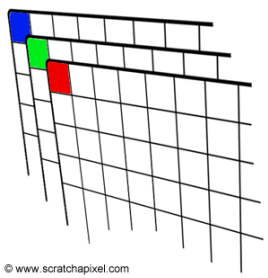
```
import matplotlib.pyplot as plt
import numpy as np
```

2. Create the image– easy to set all color
   1. to 0% (black):
      `img = np.zeros( (num,num,3) )`
   2. to 100% (white):
      `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)
```



Two Dimensional Array Slicing

```
1 import numpy as np
2
3 numRows = 6
4 numCols = 6
5 a = np.zeros((numRows, numCols))
6 #create a table with 6 rows and 6 columns,
7 #each element is initialized to be zero.
8 #Do not forget parentheses around
9 #numRows, numCols.
```

Two Dimensional Array Slicing: II

```
8  for i in range(numRows):
9      for j in range(numCols):
10         a[i, j] = i*10 + j
11 #range(numRows) returns [0, 1, 2, 3, 4, 5],
12 #where outer loop variable i chooses from.
13 #When i is 0, run
14 #     for j in range(numCols):
15 #         a[i, j] = i*10 + j
16 #When i is 1, run
17 #     for j in range(numCols):
18 #         a[i, j] = i*10 + j
19 #The last round of i is 5.
```

Two Dimensional Array Slicing: III

```
20 for i in range(numRows):
21     for j in range(numCols):
22         print("%3i"%(a[i, j]), end="")
23         #"%3i"%(a[i, j]) prints a[i, j] --
24         #element of a at ith row and
25         #jth column -- as an 3-digit int.
26         #"%3i" is a place holder and is filled by a[i,
               j].
27         #If a[i, j] does not have 3 digits,
28         #pad space(s) to the left.
29         #end="" print w/o a new line.
30
31     print() #print a new line after each row
```

Two Dimensional Array Slicing: III

```
32 print(a[0, 3:5])
```

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

Two Dimensional Array Slicing: III

```
32 print(a[0, 3:5])
```

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

print

```
[3. 4.]
```

Two Dimensional Array Slicing: IV

```
33 print(a[4:, 4:])
```

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

Two Dimensional Array Slicing: IV

```
33 print(a[4:, 4:])
```

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

Print out

```
[[44. 45.]
 [54. 55.]]
```

Two Dimensional Array Slicing: V

```
34 print(a[:, 2])
```

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

Two Dimensional Array Slicing: V

```
34 print(a[:, 2])
```

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

row \ col	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

Print out

```
[ 2. 12. 22. 32. 42. 52.]
```

Two Dimensional Array Slicing: VI

```
35 print(a[2::2, ::2])
```

	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

Two Dimensional Array Slicing: VI

```
35 print(a[2::2, ::2])
```

	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

	0	1	2	3	4	5
0	0	1	2	3	4	5
1	10	11	12	13	14	15
2	20	21	22	23	24	25
3	30	31	32	33	34	35
4	40	41	42	43	44	45
5	50	51	52	53	54	55

print

```
[[20. 22. 24.]
 [40. 42. 44.]]
```

Slicing & Image Examples

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

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:
  - ```
    img = np.zeros( (10,10,3) )
    img[0:10,0:5,0:1] = 1
    ```
    ```

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:
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    img = np.zeros( (10,10,3) )
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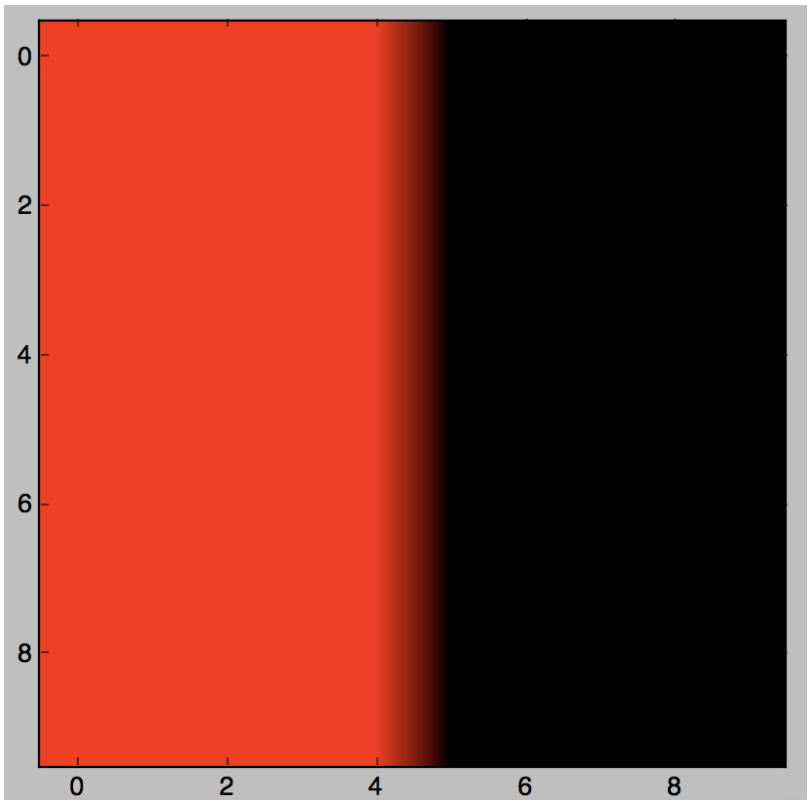
    ```

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

- 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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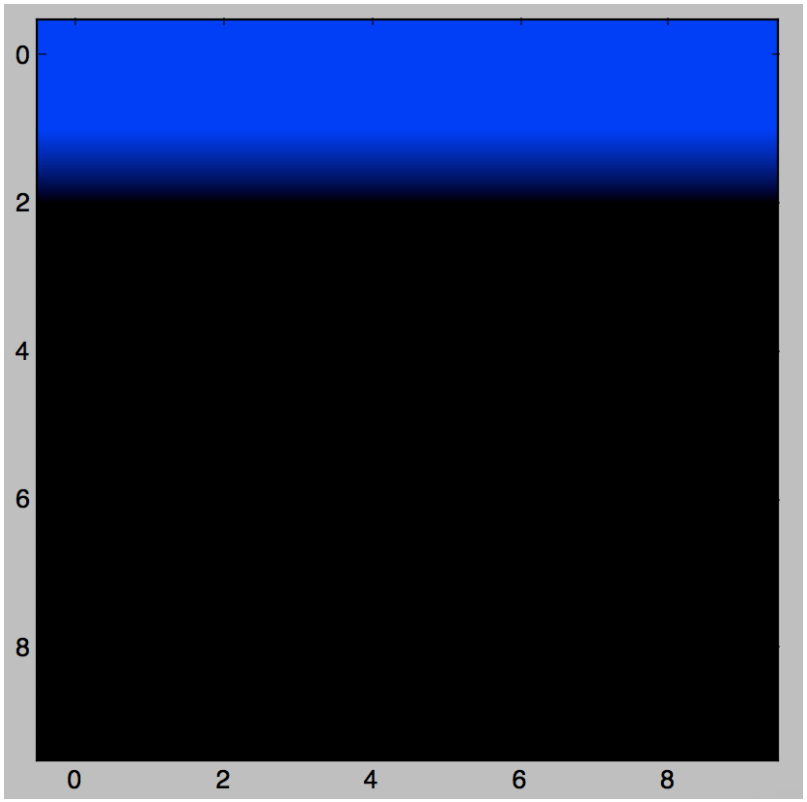
    ```


    ```

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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    ```

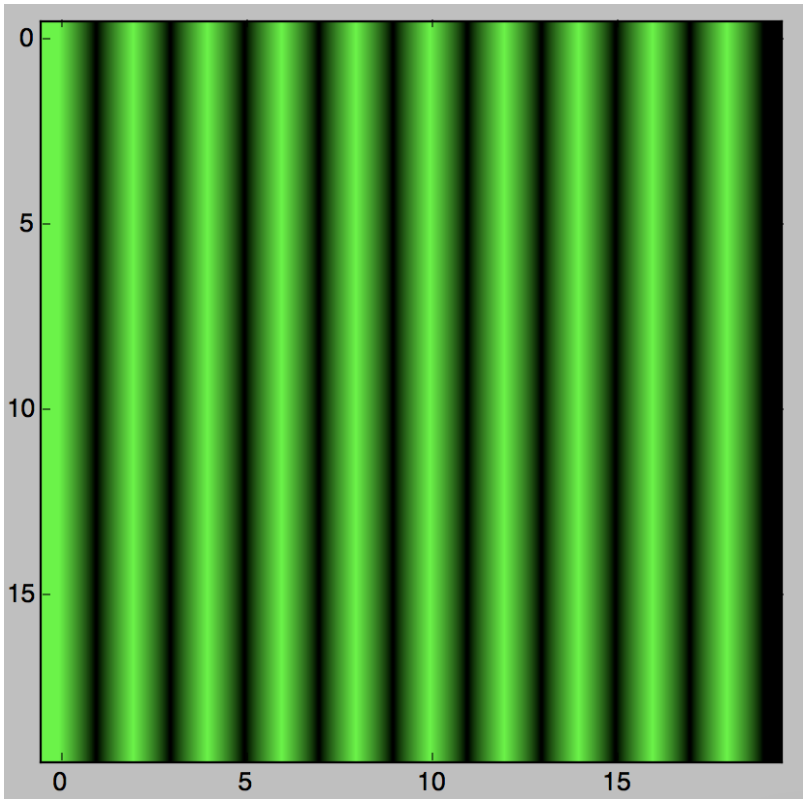
    ```

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:

  - ```
    img = np.ones( (10,10,3) )
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    ```

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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
    ```
    ```

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) )
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    ```
    ```

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    ```

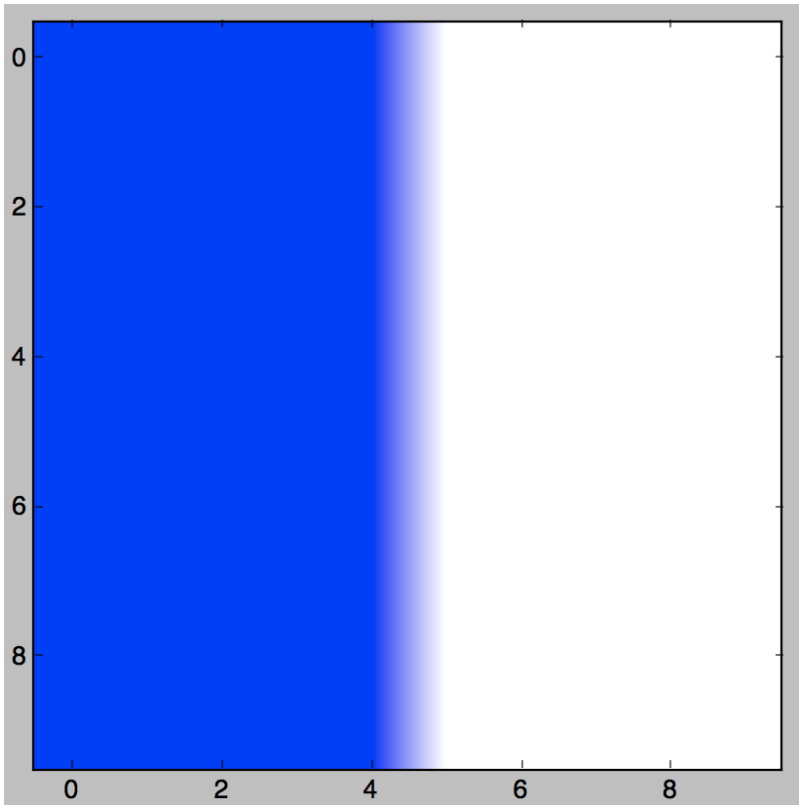
    ```

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:

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

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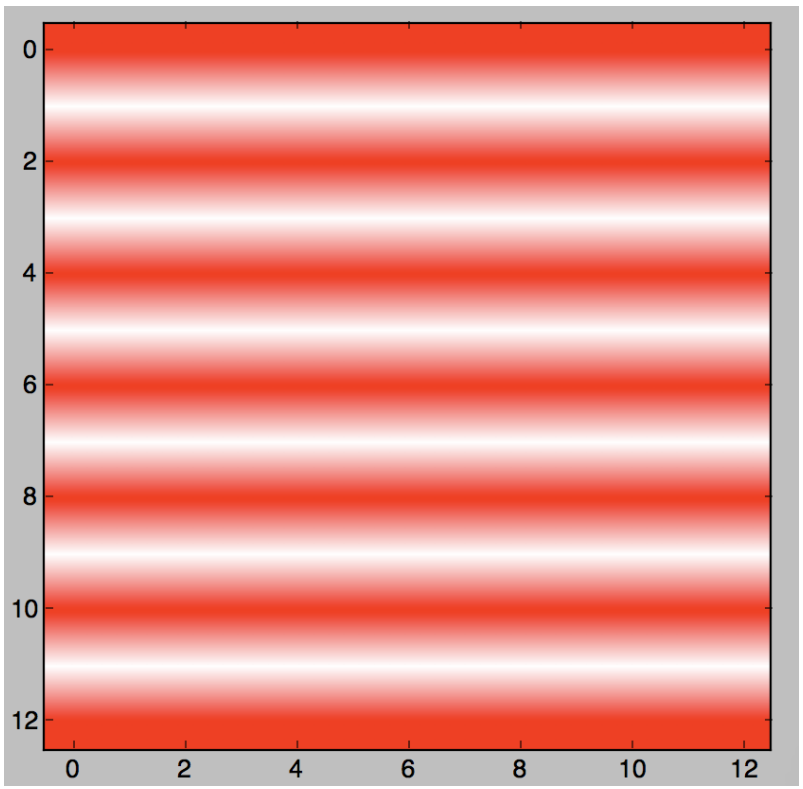
  - ```
    num = int(input('Enter size '))
    img = np.ones( (num,num,3) )
    img[::2,:,1:]  = 0
    ```


    ```

Challenge (Group Work)

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

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    img[::2,1::2,0] = 1
    ```
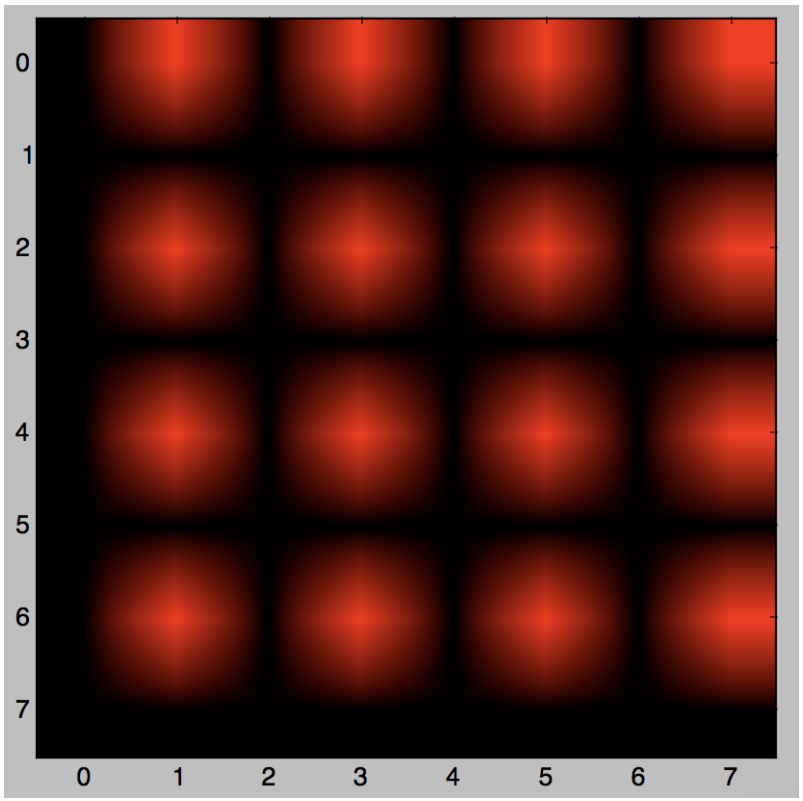
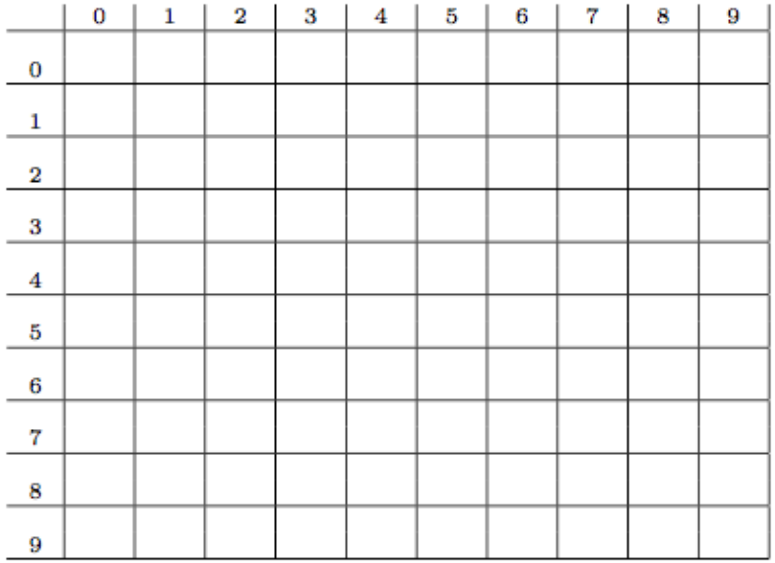
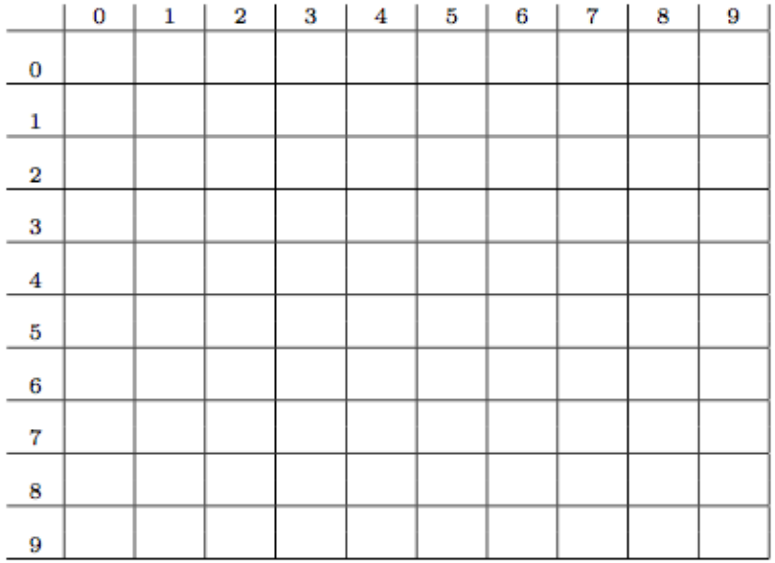
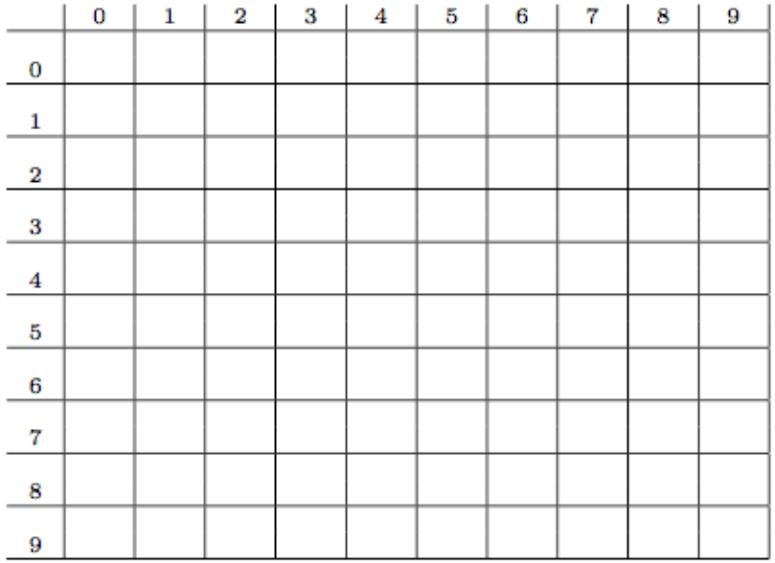
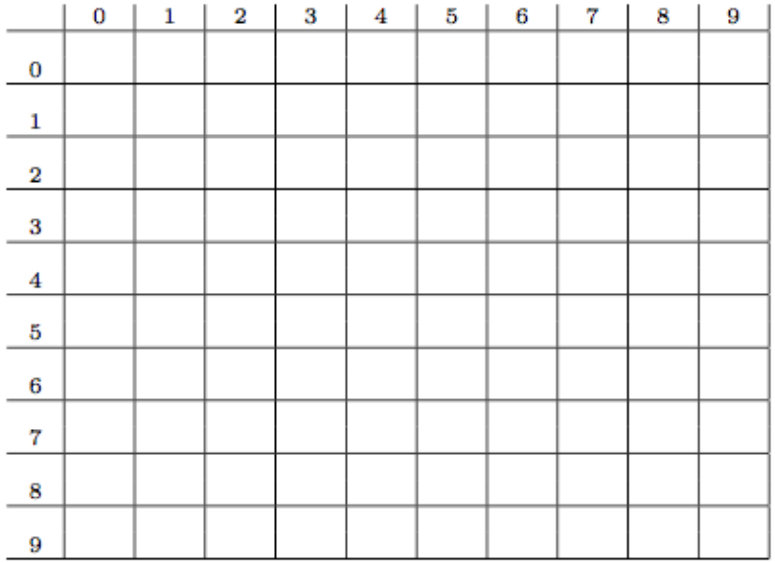
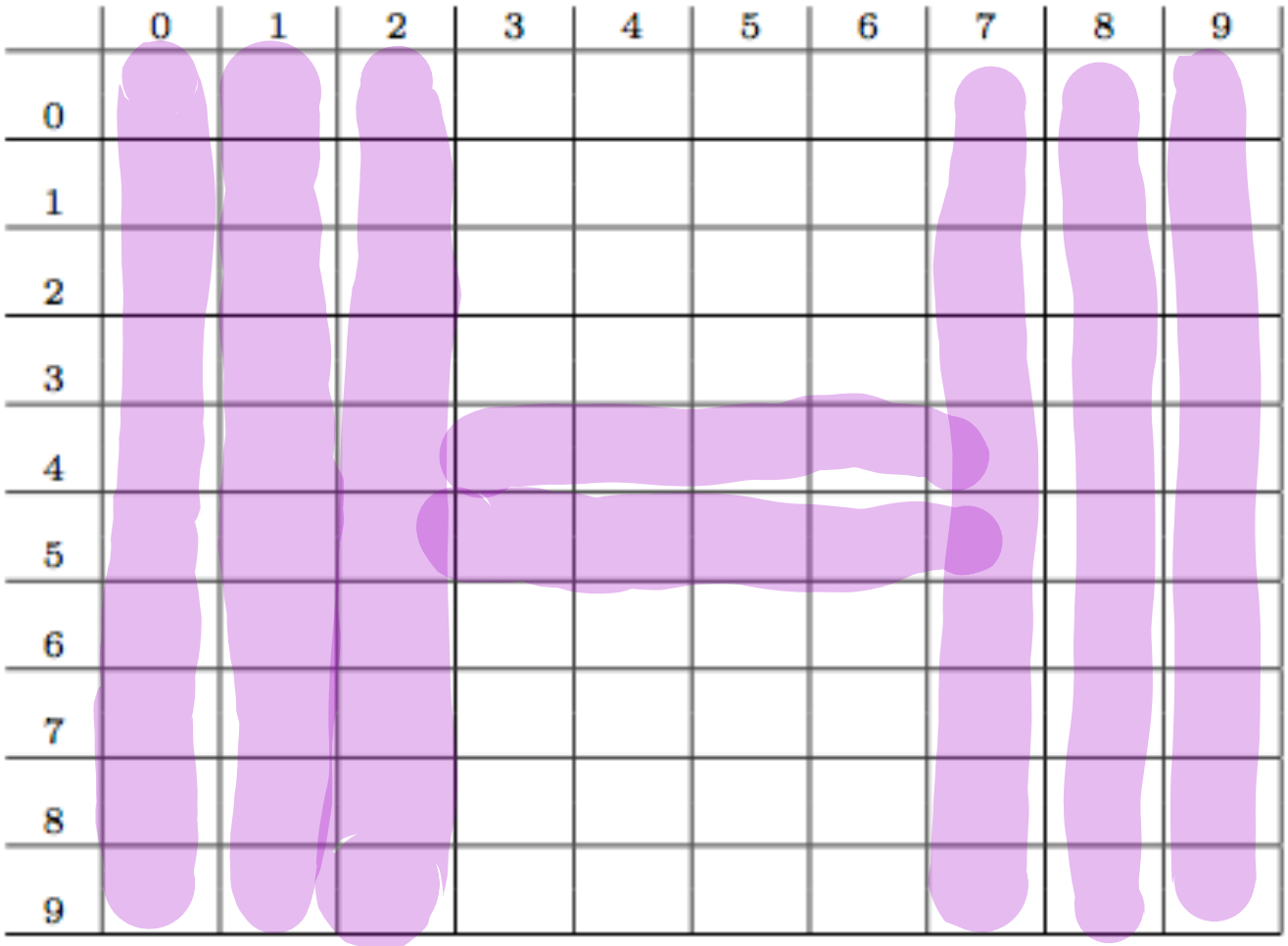
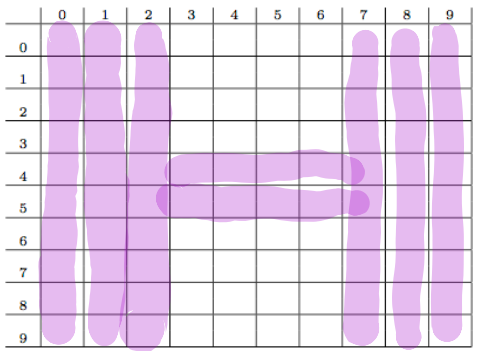
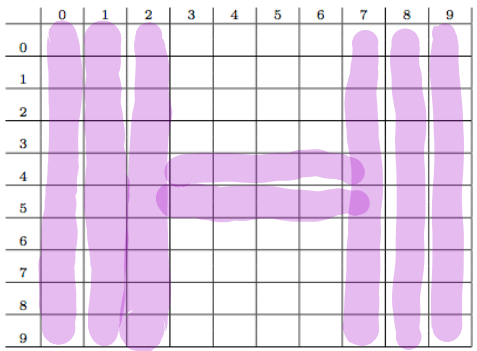
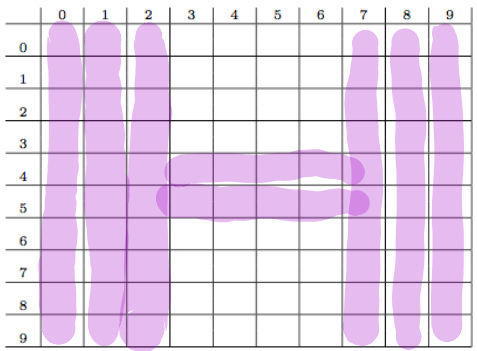
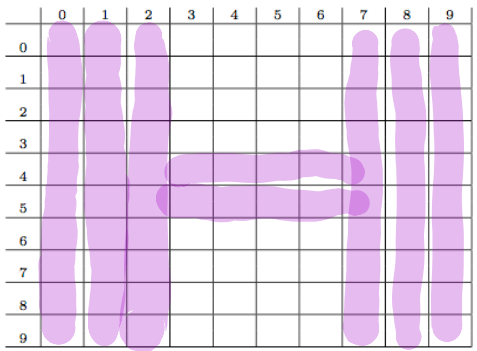
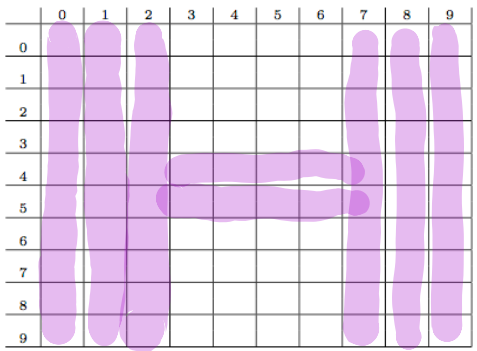
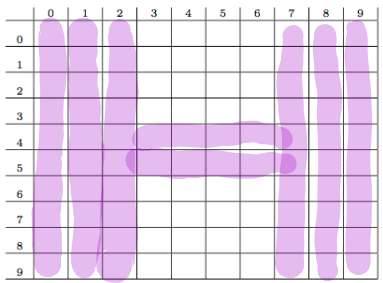
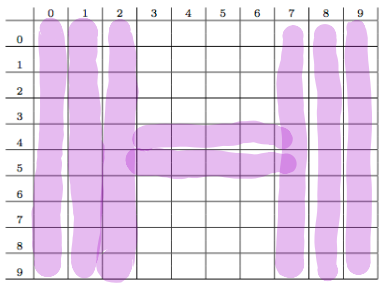


    ```

Challenge (Group Work)



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

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.

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
```



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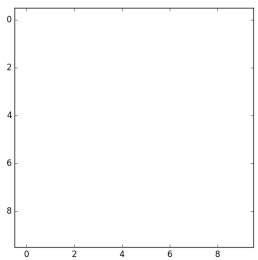

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```
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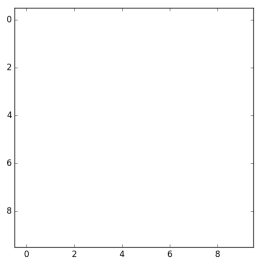
logoImg = np.ones((10,10,3))    #10x10 array with 3 sheets of 1's
```

2. Set the 3 left columns to be purple.



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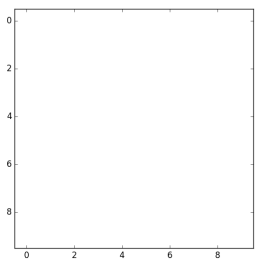
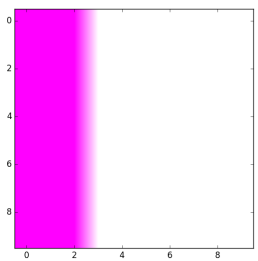
```
import matplotlib.pyplot as plt #import libraries for plotting
import numpy as np              #and for arrays (to hold images)
logoImg = np.ones((10,10,3))    #10x10 array with 3 sheets of 1's
```

2. Set the 3 left columns to be purple.

```
#To make purple, we'll keep red and blue at 100% and turn green to 0%
logoImg[:,:3,1] = 0 #Turn the green to 0 for first 3 columns
```



Translating the Design to Code



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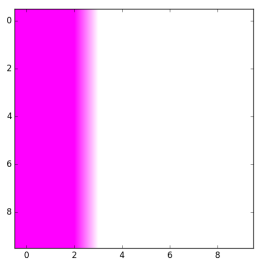

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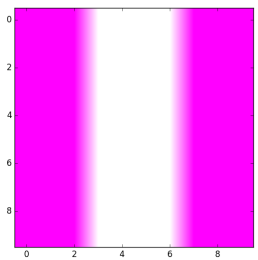

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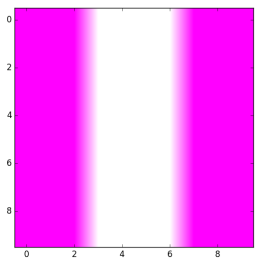

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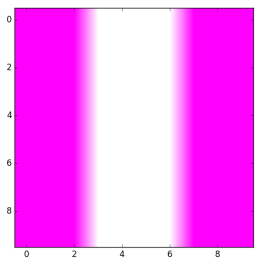

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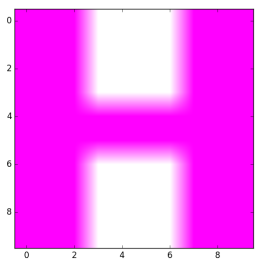

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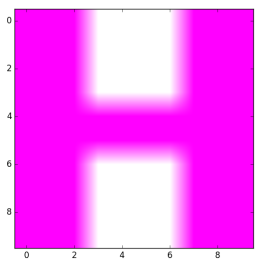

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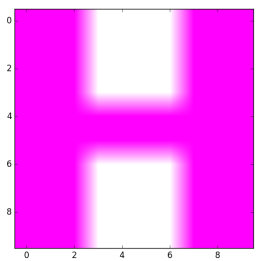

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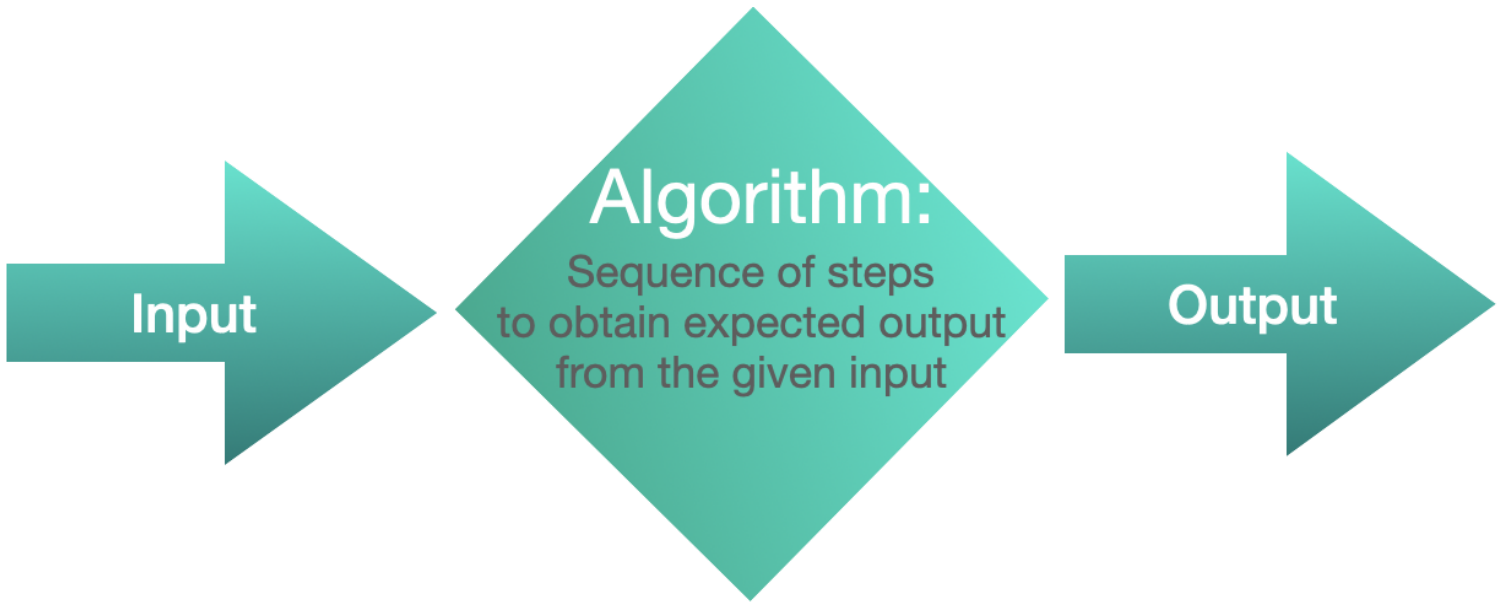
5. Save logo array to file.

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

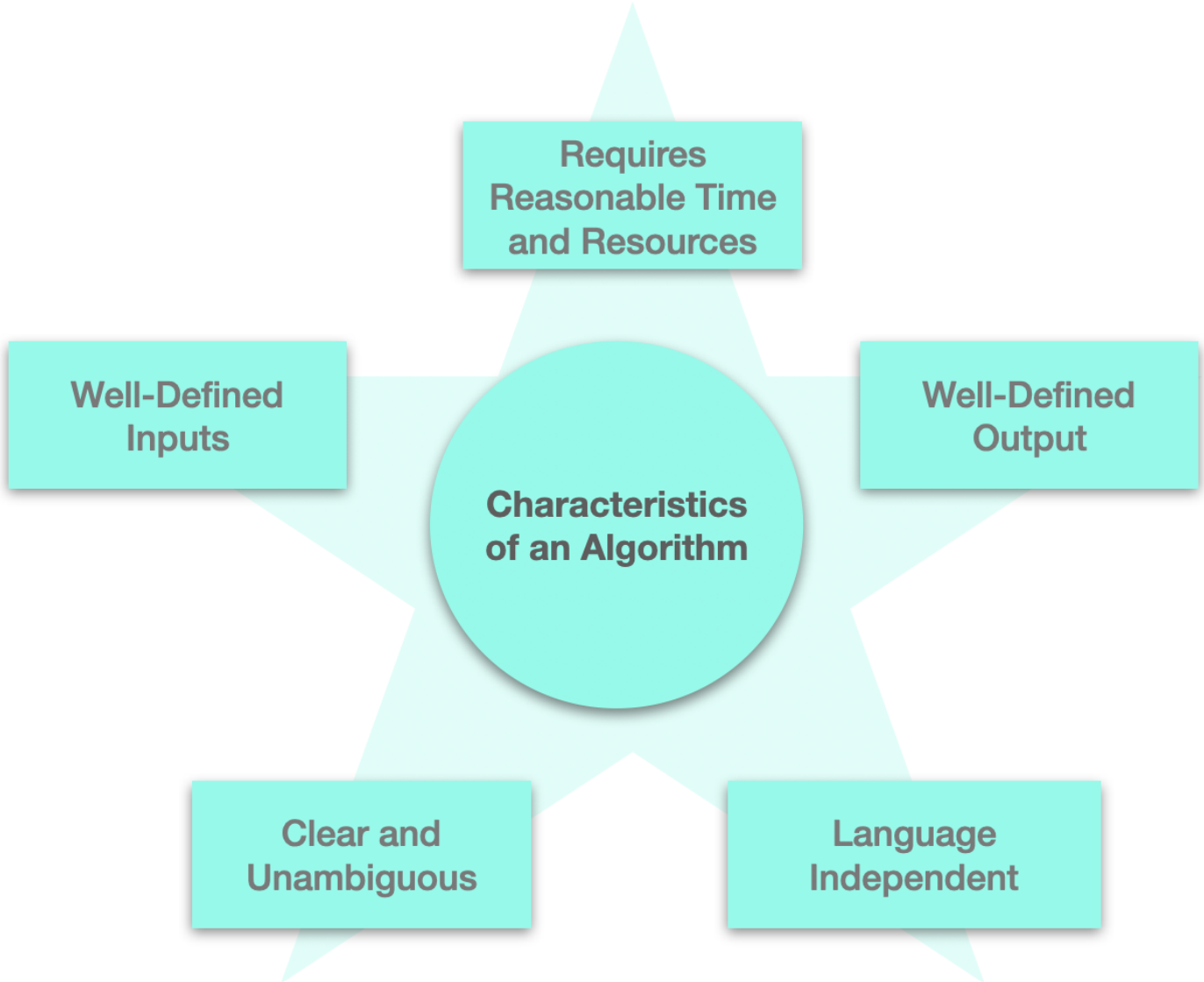
Today's Topics

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

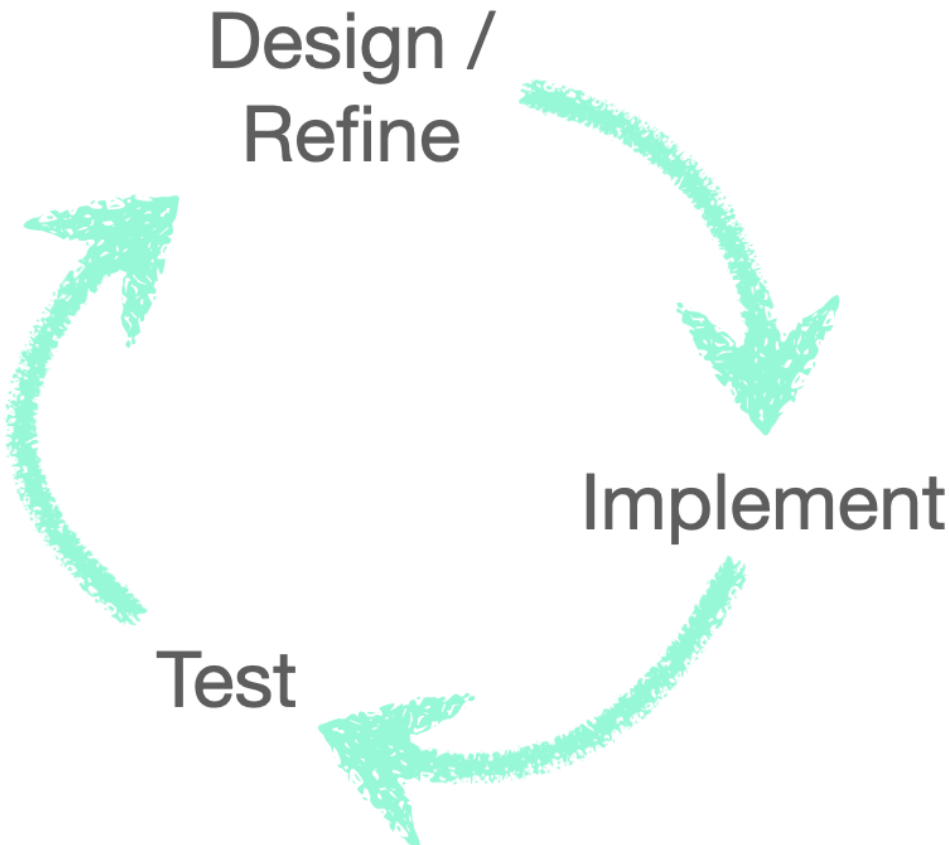
What is an Algorithm?



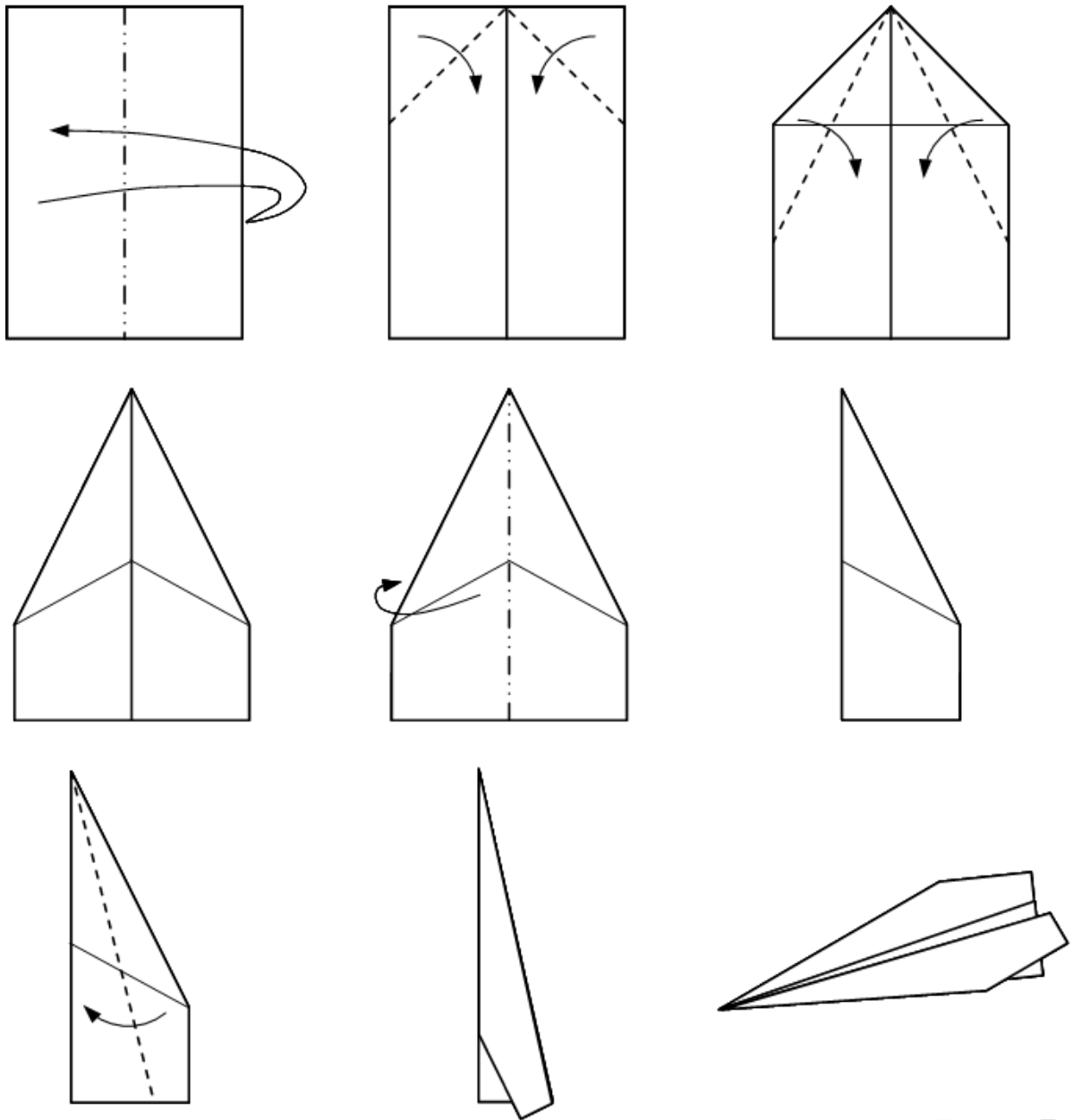
Characteristics of an Algorithm



Algorithm Design Cycle



Design Challenge: Planes



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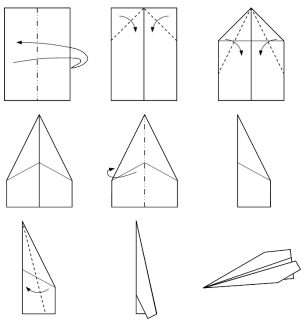

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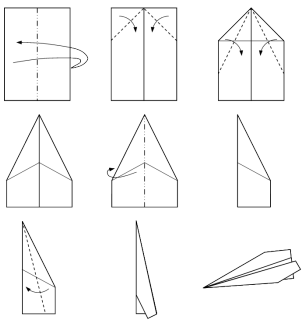

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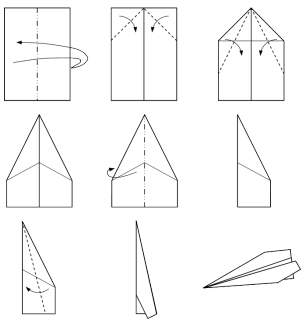

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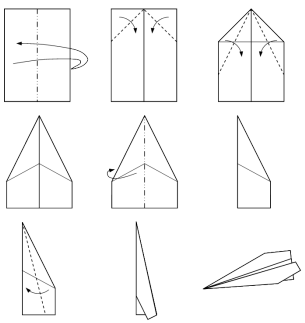

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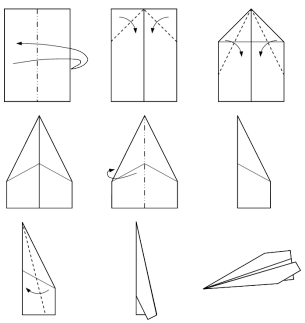

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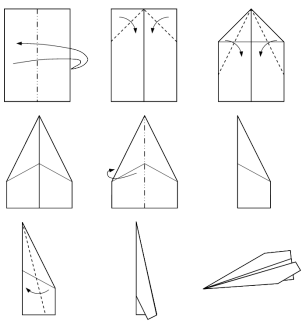

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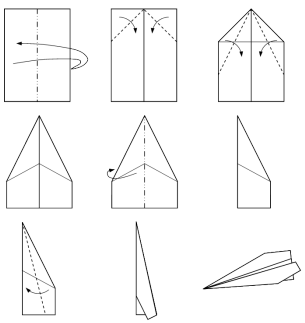

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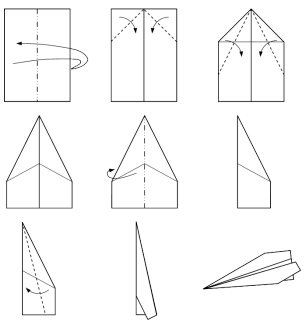

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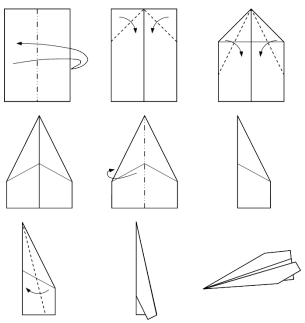

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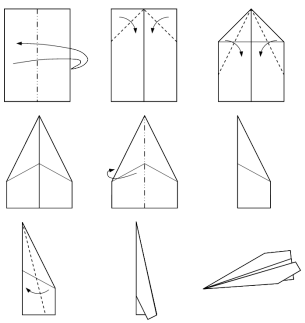

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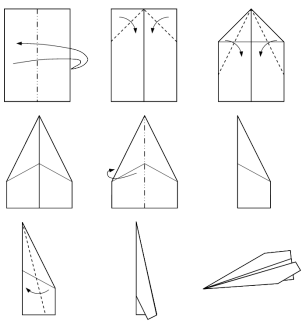

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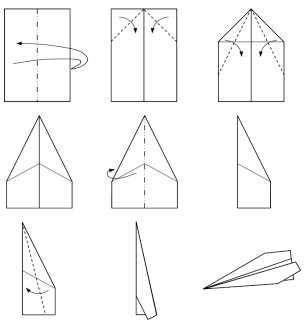

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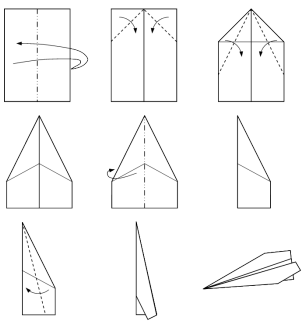
Design Challenge: Initial Design **(2 Minutes)**



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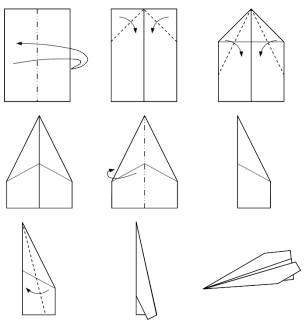
Design Challenge: Test Build **(2 Minutes)**



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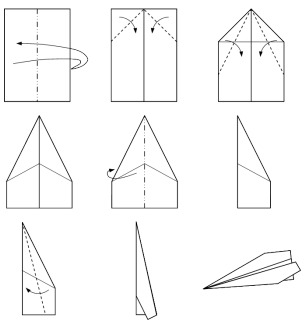
Design Challenge: Revise Design **(3 Minutes)**



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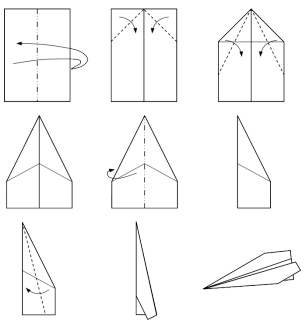
Design Challenge: Build Final Planes **(2 Minutes)**



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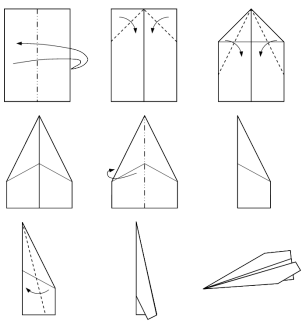
Design Challenge: Test Planes **(3 Minutes)**



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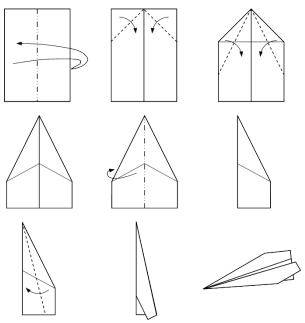
Design Challenge: Retrieve Planes **(2 Minutes)**



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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

```
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')
```

(Demo with pythonTutor)

IDLE

```
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
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        tess.color("blue")
    else:                   #for any other character
        print("Error: do not know the command:", c)
```

(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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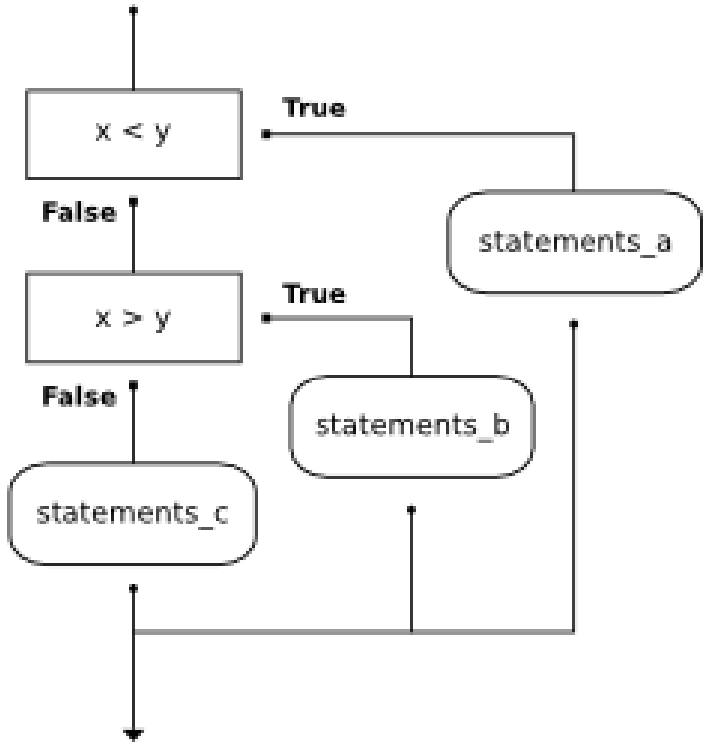

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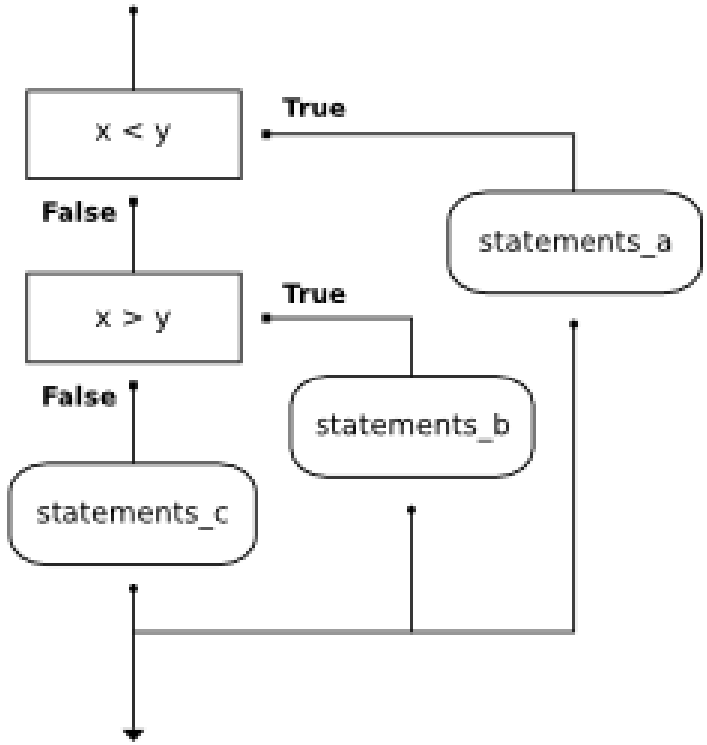


(This was just a first glance, will do much more on decisions over the next several weeks.)

Recap

- In Python, we introduced:

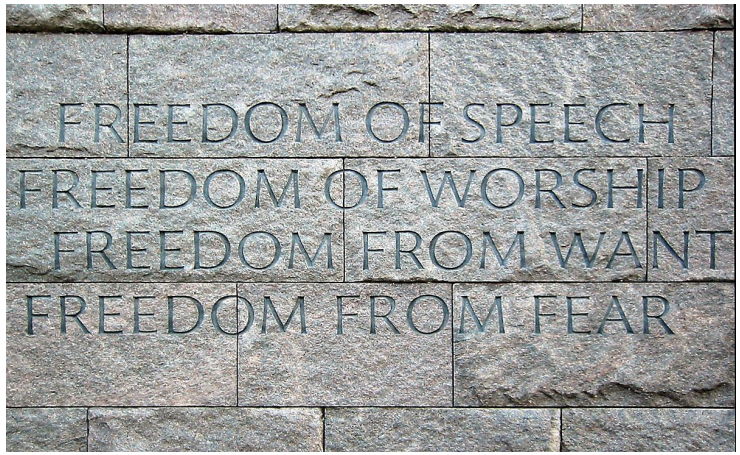
Recap

- In Python, we introduced:
  - 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).

Practice Quiz & Final Questions

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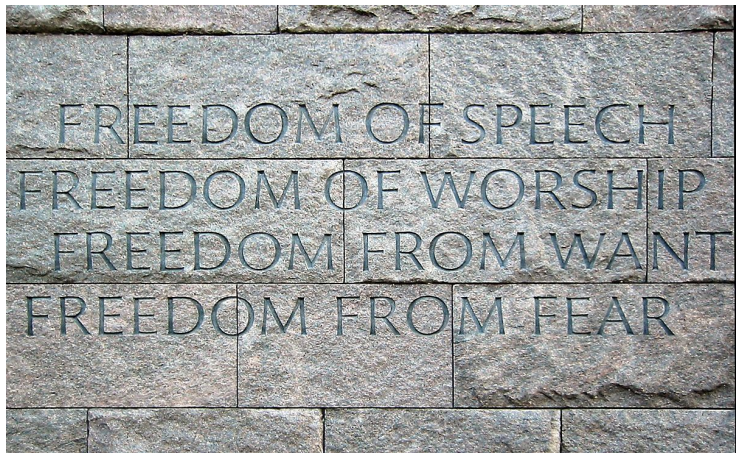
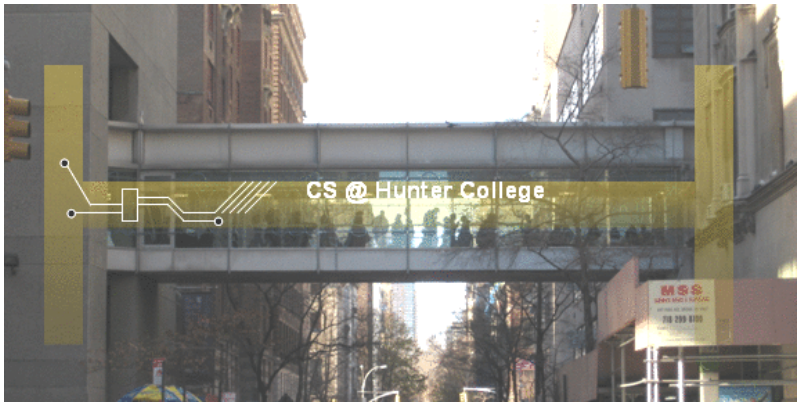


(FDR 4 FP)

- 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!



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- Work on this week's Online Lab

Weekly Reminders!

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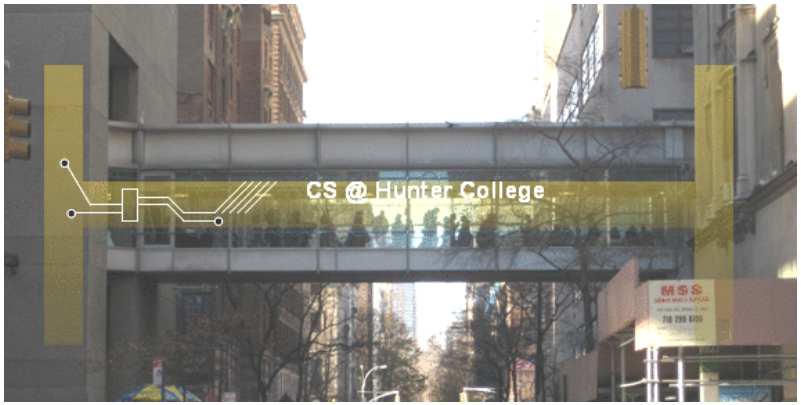

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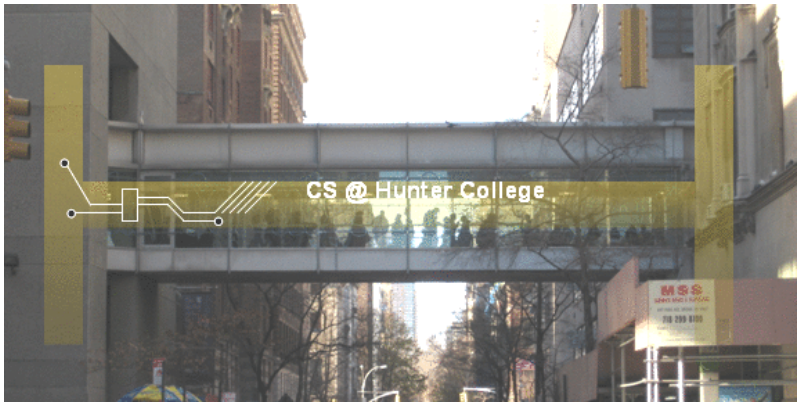
- Submit this week's 5 programming assignments **(programs 16-20)**

Weekly Reminders!



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- 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.