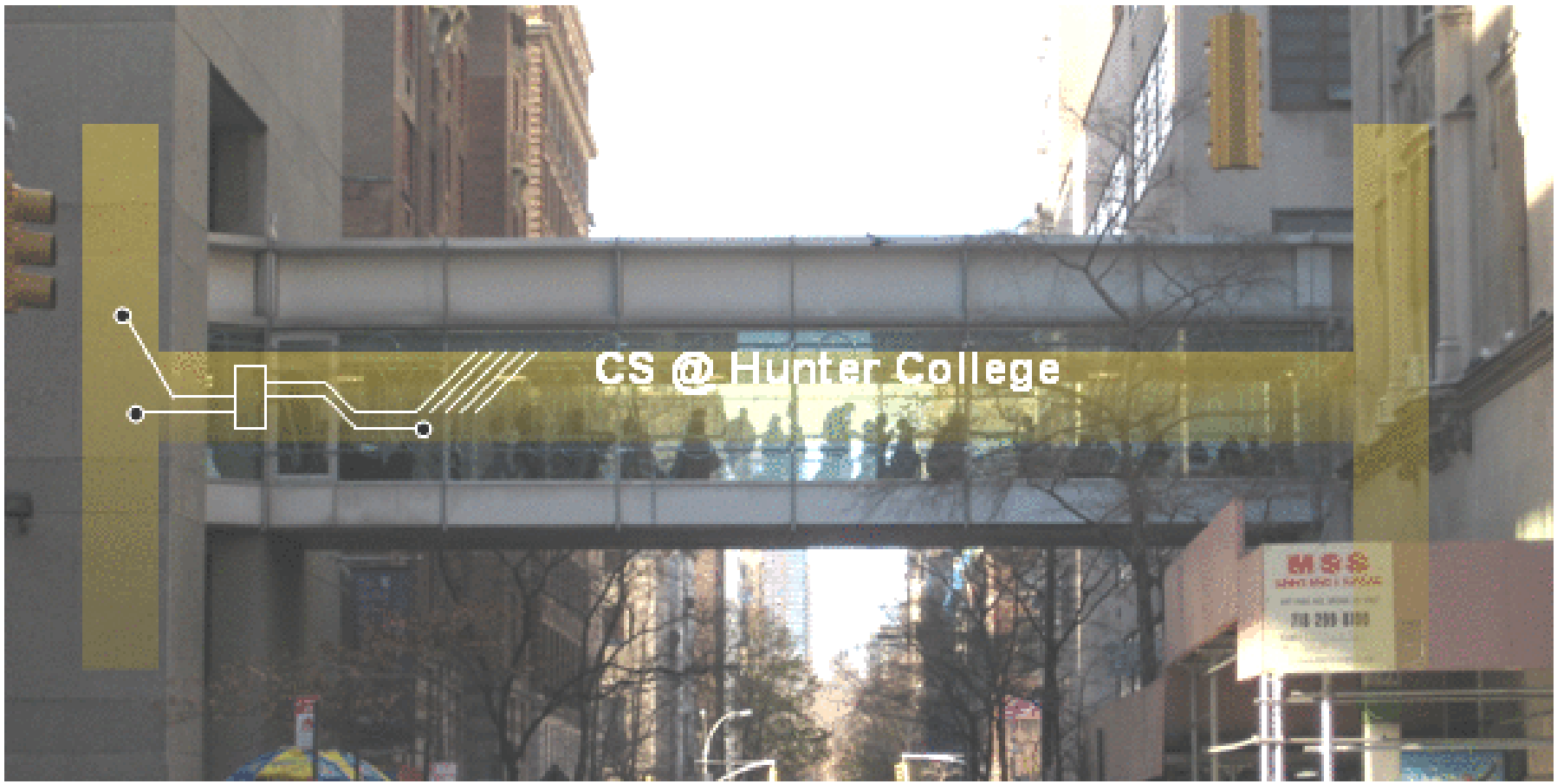
CSci 127: Introduction to Computer Science



Frequently Asked Questions

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- Could you spend more time on problem solving & algorithms?
  Yes! More in upcoming lectures & labs.

Today's Topics

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

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EmpID: CSci 127 Mock Final, S19

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

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- Can specify by name.

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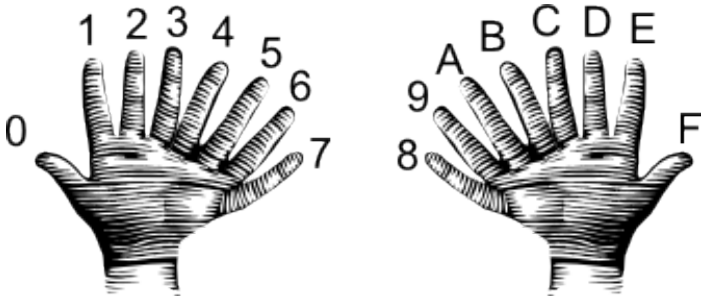
  - Hexcodes (base-16 numbers)...

Recap: Hexadecimal

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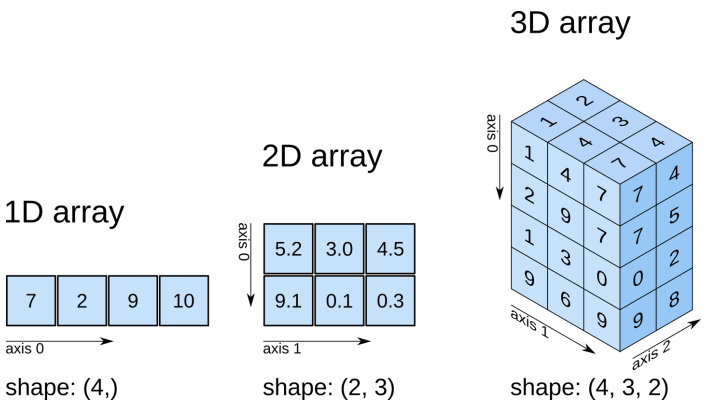
- Recap: Colors
- **2D Arrays & Image Files**
- Decisions
- Design Challenge: Airplanes

Arrays



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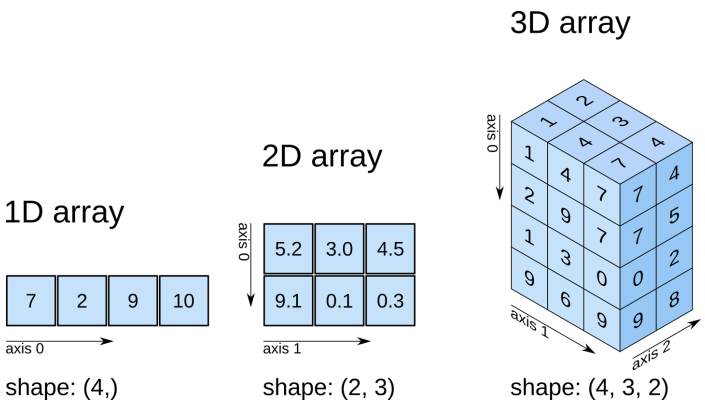
Arrays



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- A **2D array** is like a grid of elements, think a list of lists.

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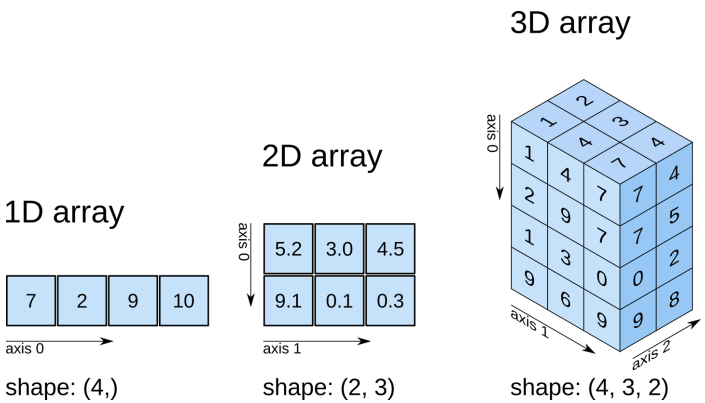

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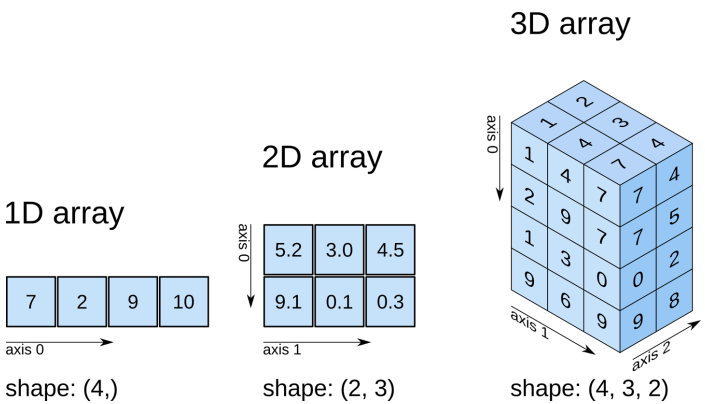
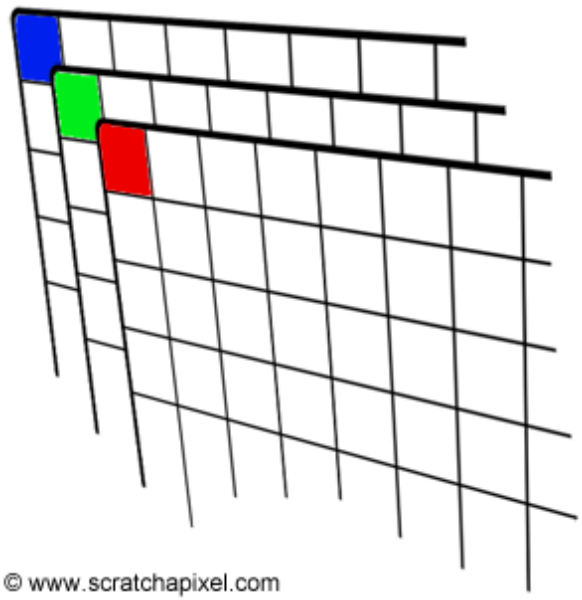


- An **array** is a sequence of elements, much like a list.
- A **2D array** is like a grid of elements, think a list of lists.
- Can keep on adding dimensions (3D, etc.)
- Can access pieces/slices as we do with strings and lists

Images



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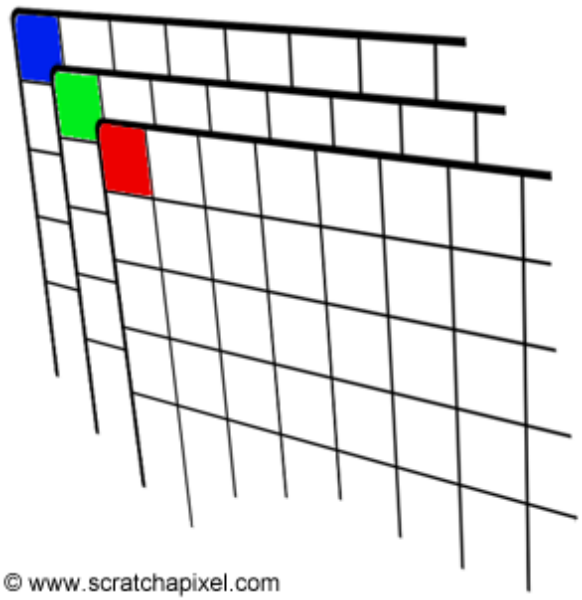
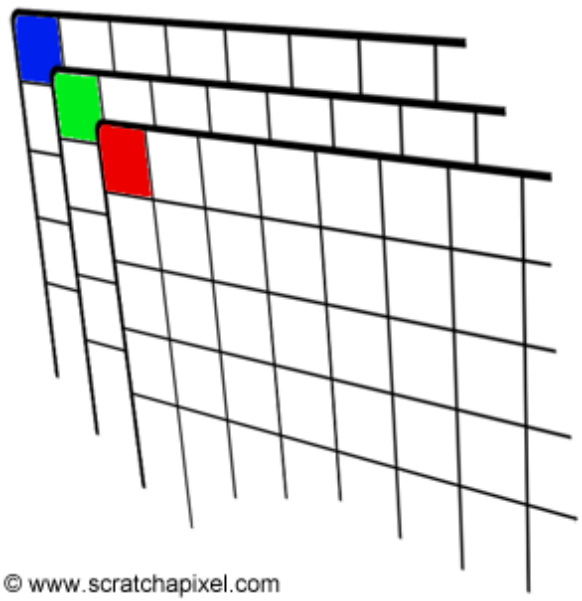
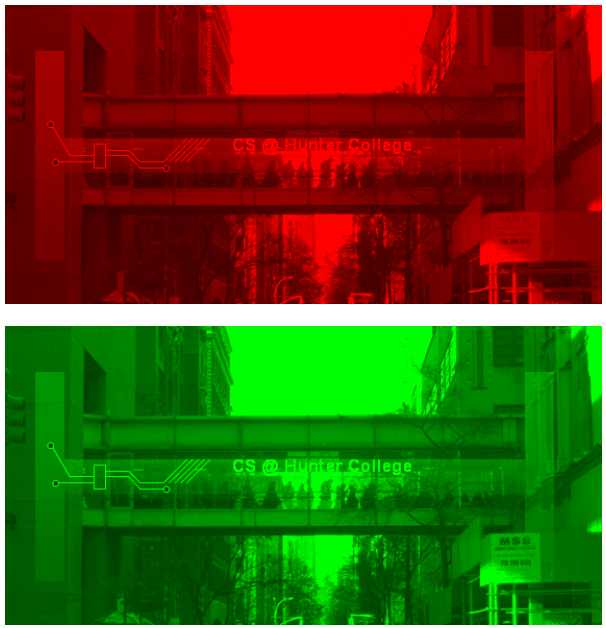
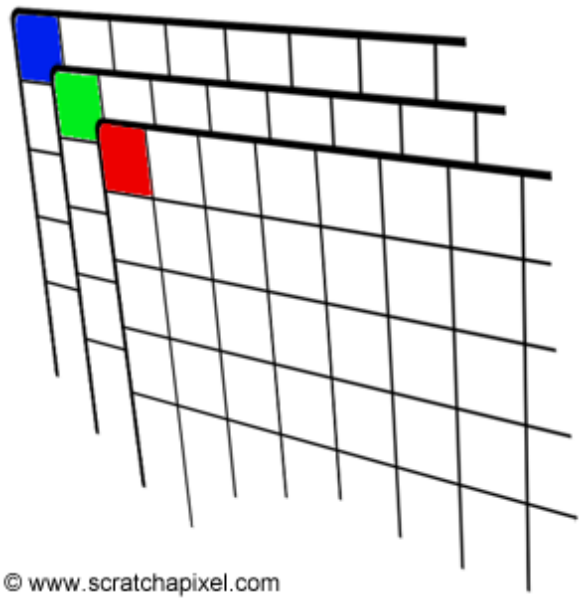


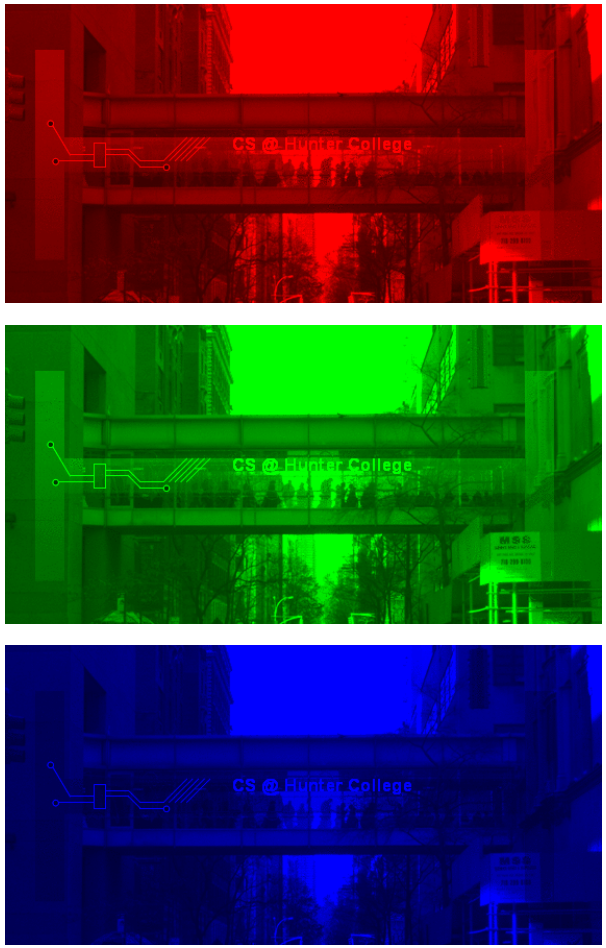
Images





Images


© www.scratchapixel.com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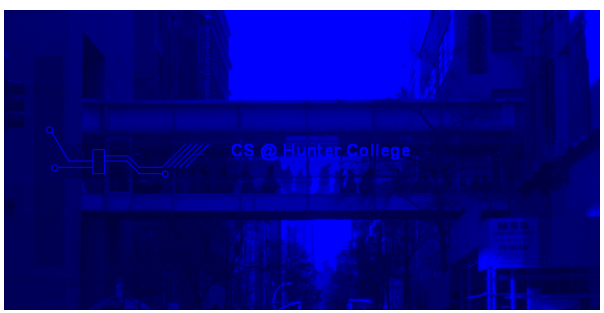
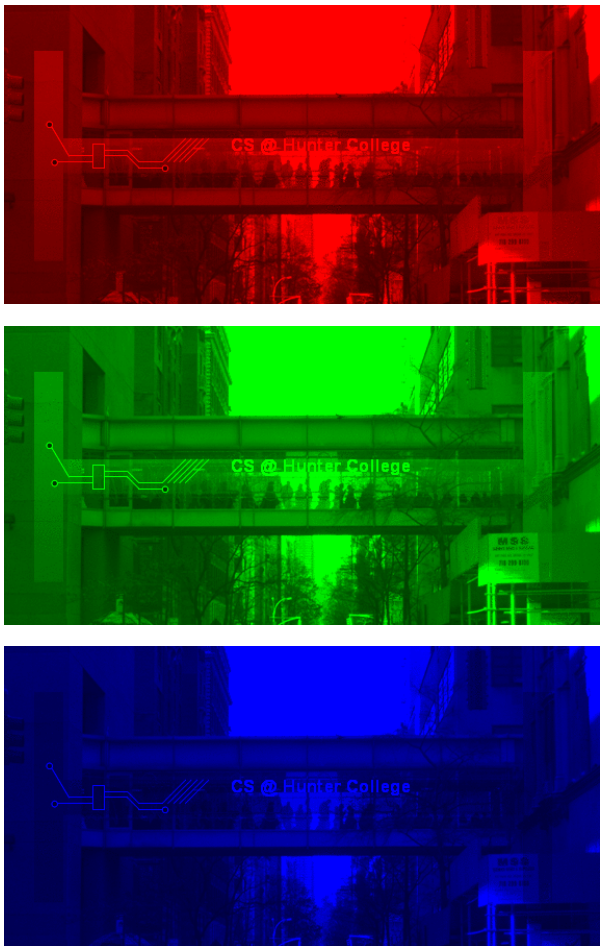
Useful Packages



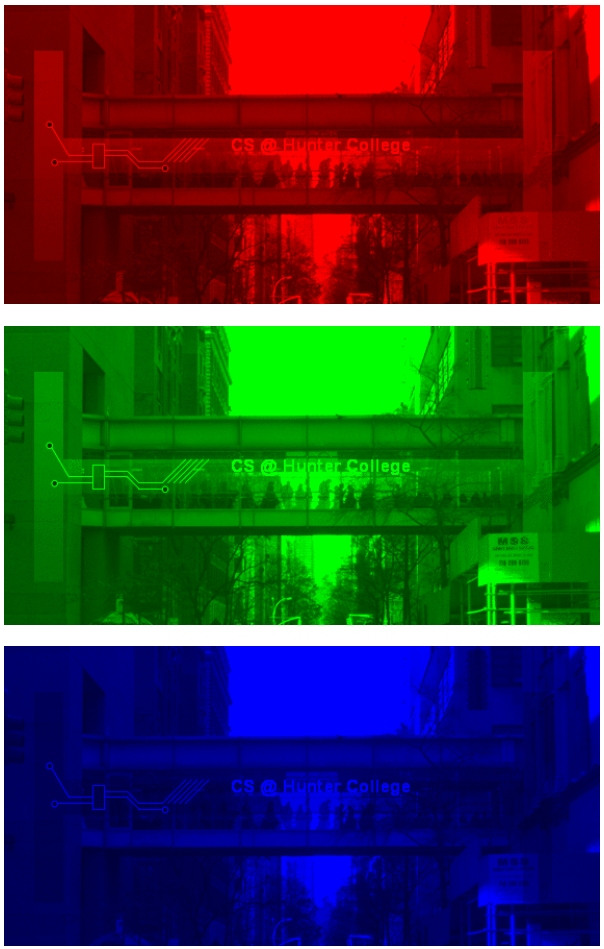
- We will use 2 useful packages for images:

Useful Packages



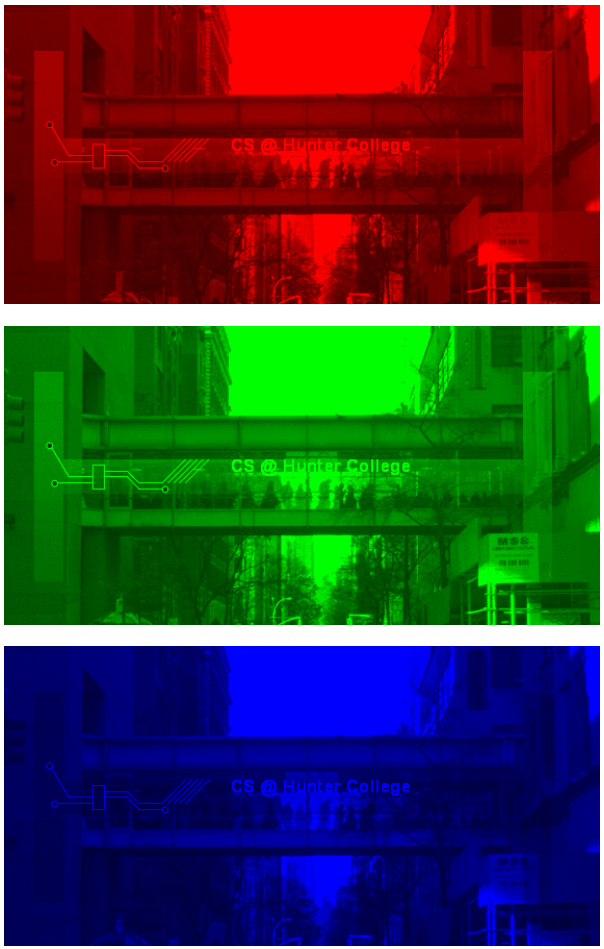
- We will use 2 useful packages for images:
  - `numpy`: numerical analysis package

Useful Packages



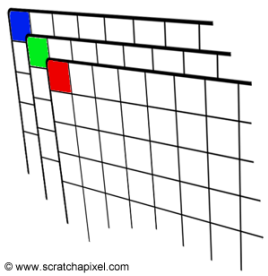
- We will use 2 useful packages for images:
  - `numpy`: numerical analysis package
  - `pyplot`: part of `matplotlib` for making graphs and plots

Useful Packages



- 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

```
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import matplotlib.pyplot as plt
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img = plt.imread('csBridge.png')    #Read in image from csBridge.png
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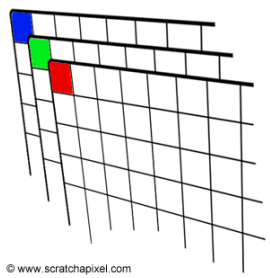
Creating Images

To create an image from scratch:



Creating Images

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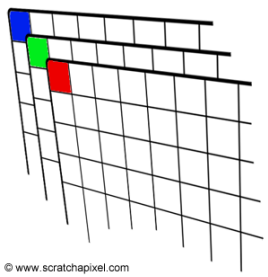

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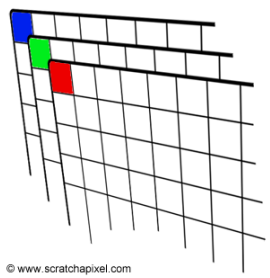

Creating Images

To create an image from scratch:

1. Import the libraries.

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import matplotlib.pyplot as plt
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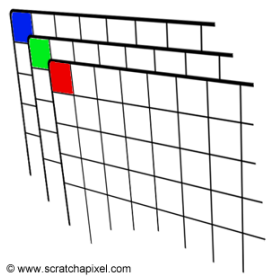
2. Create the image– easy to set all color



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To create an image from scratch:

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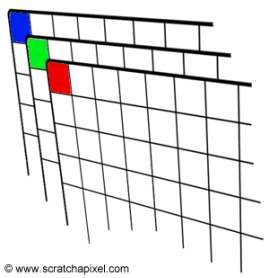
   1. to 0% (black):



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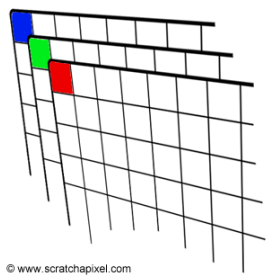

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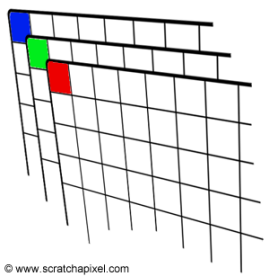
   2. to 100% (white):



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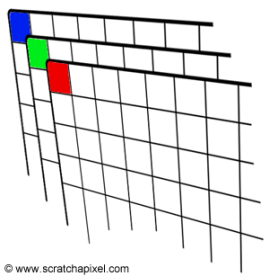

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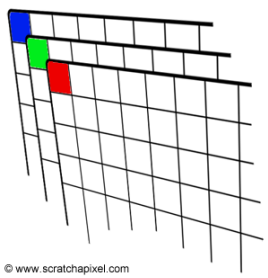
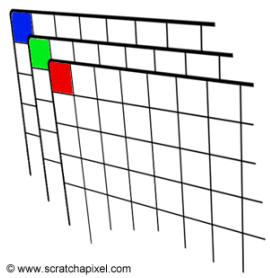
3. *Do stuff to the pixels to make your image*



Creating Images



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plt.imshow(img)
plt.show()
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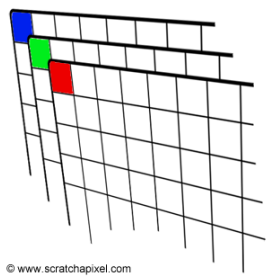
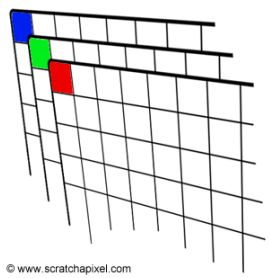


Creating Images



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5. And save your image:

Creating Images

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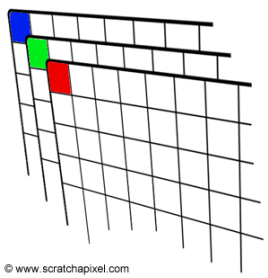
3. *Do stuff to the pixels to make your image*
4. You can display your image:

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

5. And save your image:

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



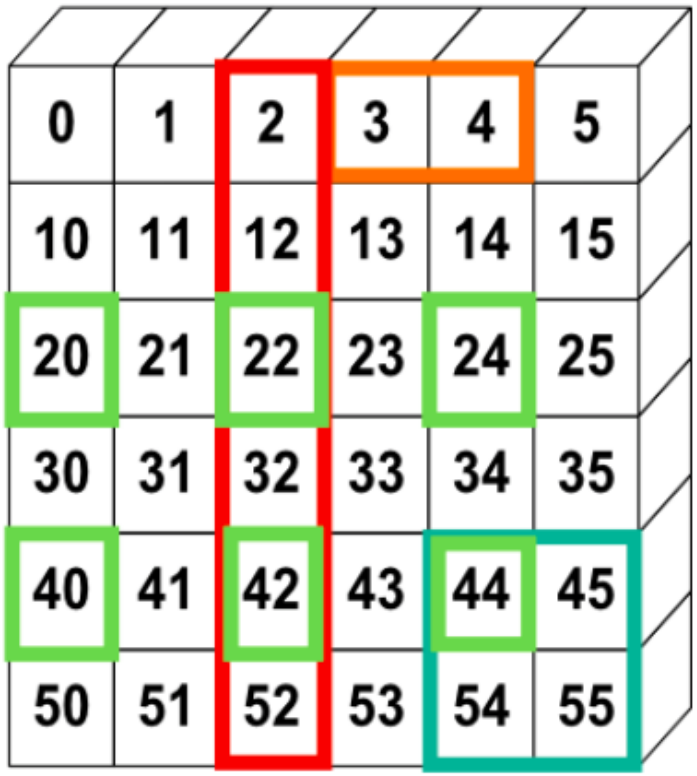
More on numpy arrays

```
>>> 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

- 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

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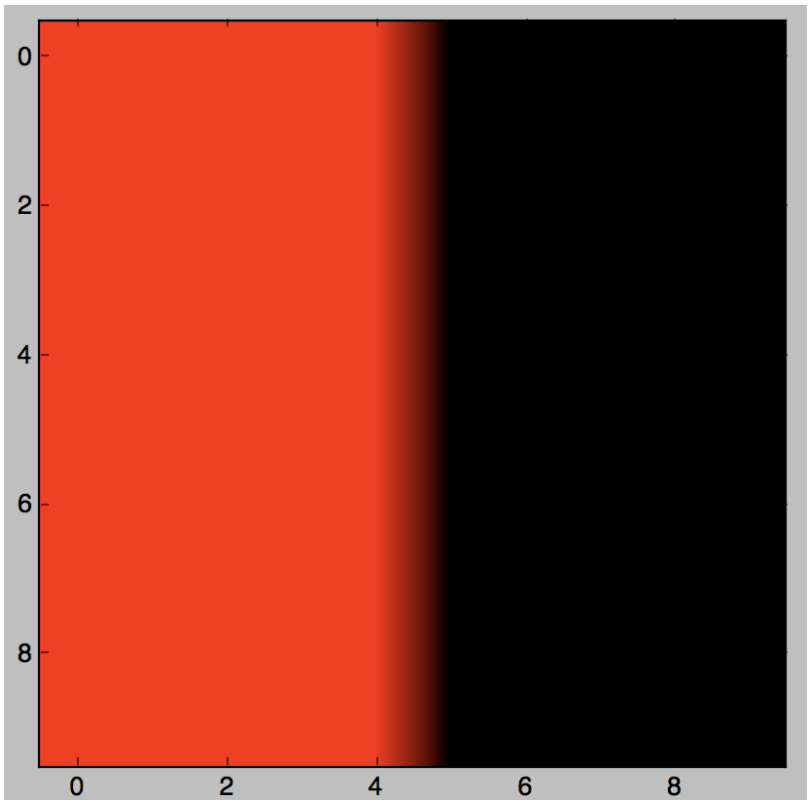
    ```

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:
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    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:
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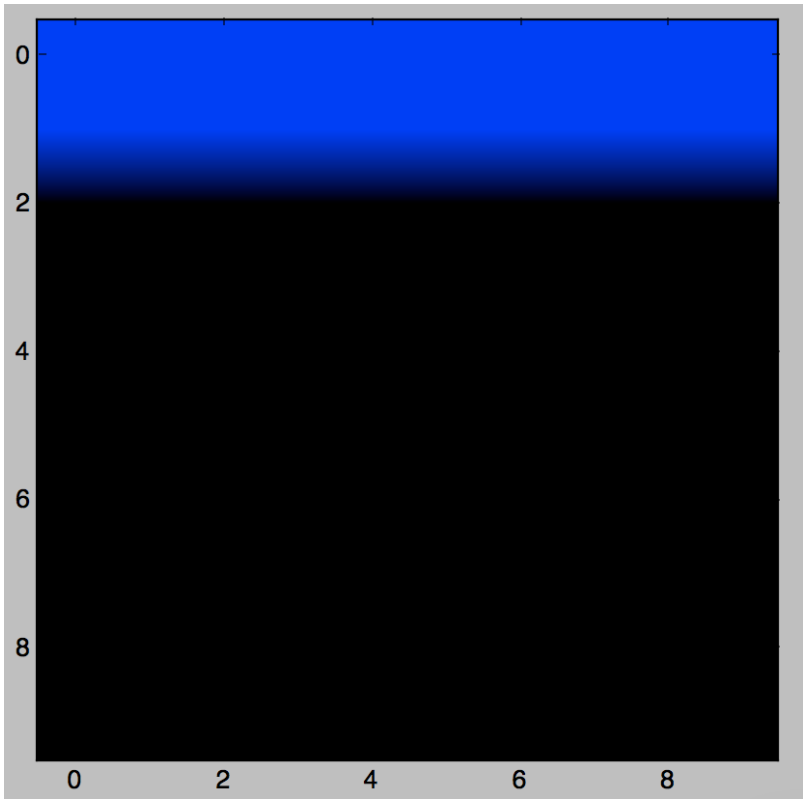
    ```

Slicing & Image Examples

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    img = np.zeros( (num,num,3) )
    img[:,::2,1] = 1.0
    ```
    ```

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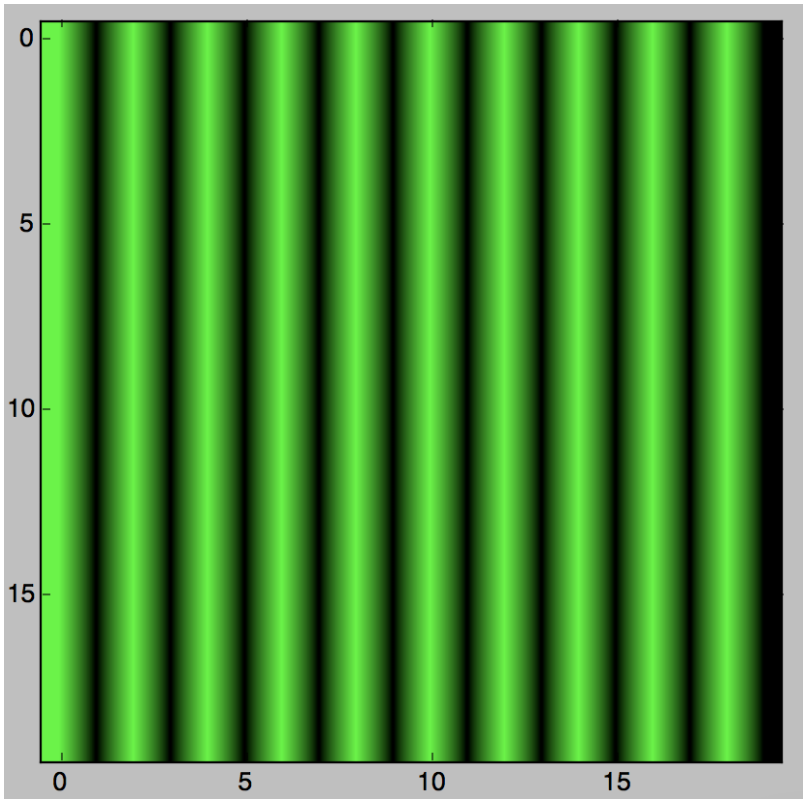
    ```

Challenge Problem

- 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[0:10,0:5,0:2] = 0
    ```
    ```

Challenge Problem

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

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

Challenge Problem

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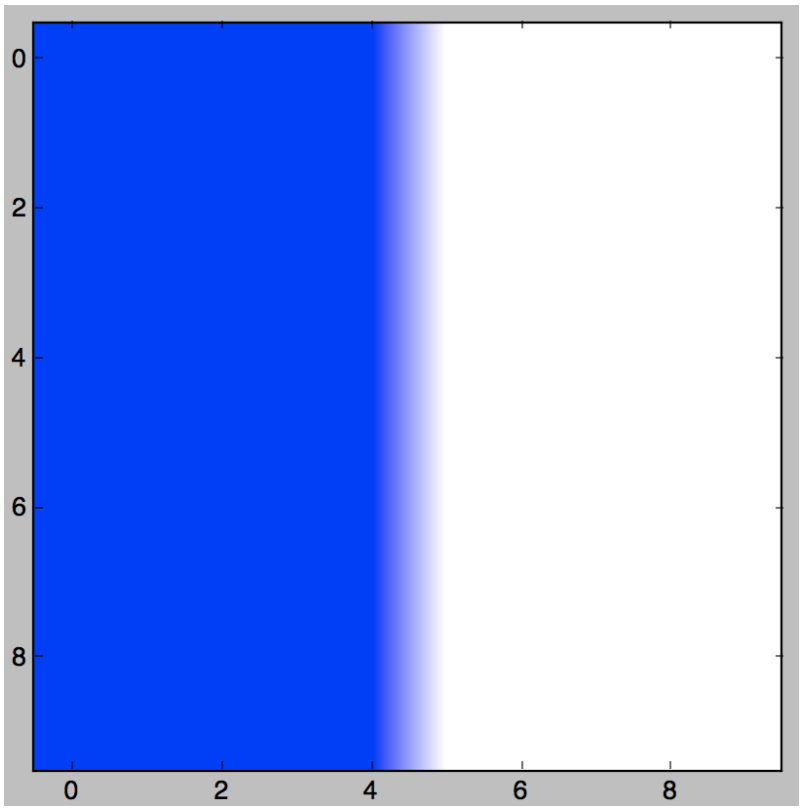
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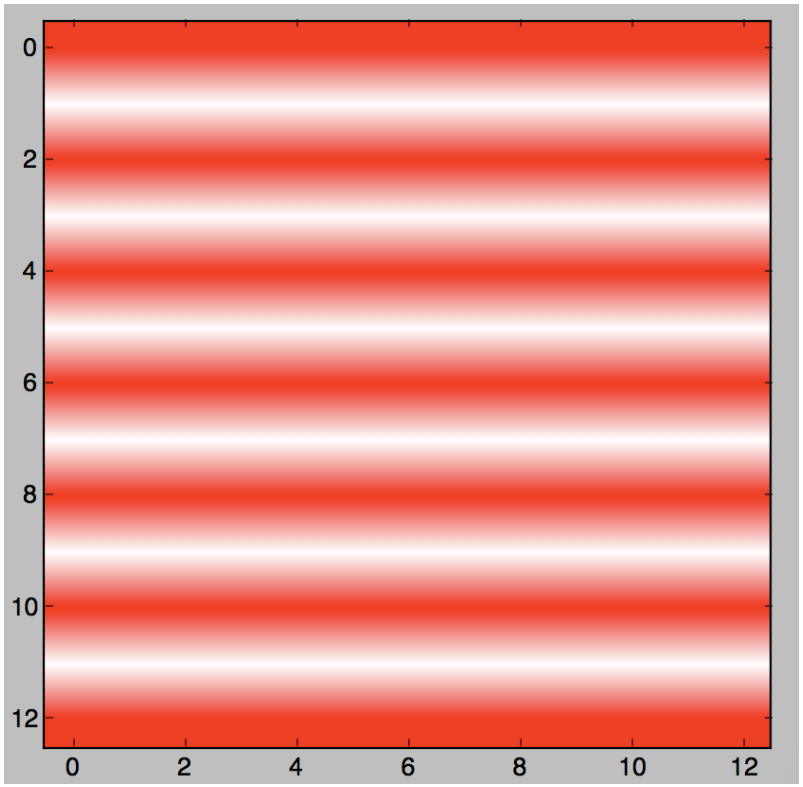
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  - ```
    img = np.zeros( (8,8,3) )
    img[::2,1::2,0] = 1
    ```
    ```

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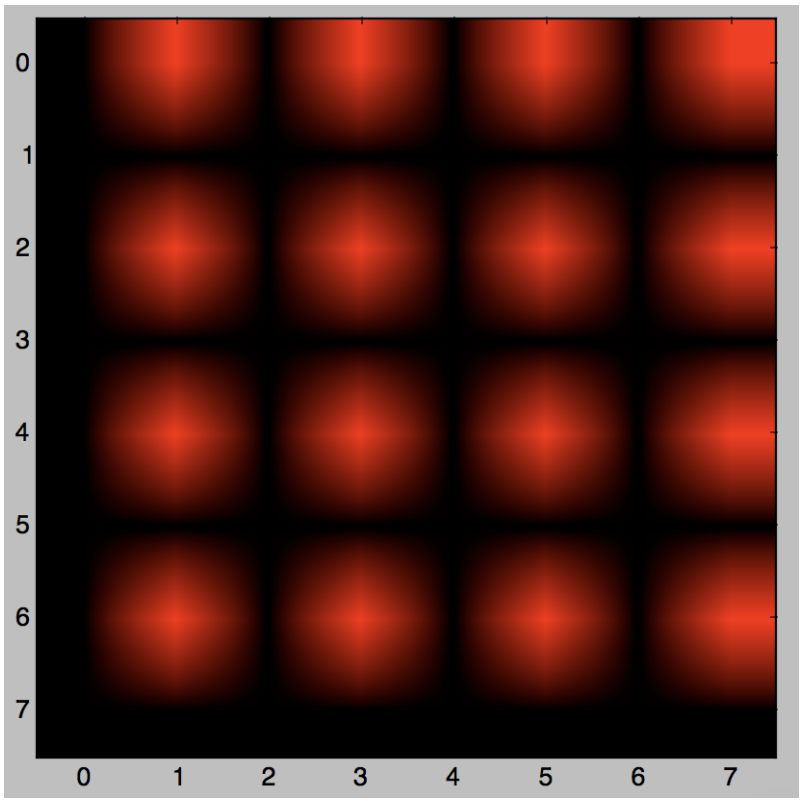

    ```

Challenge Problem...

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

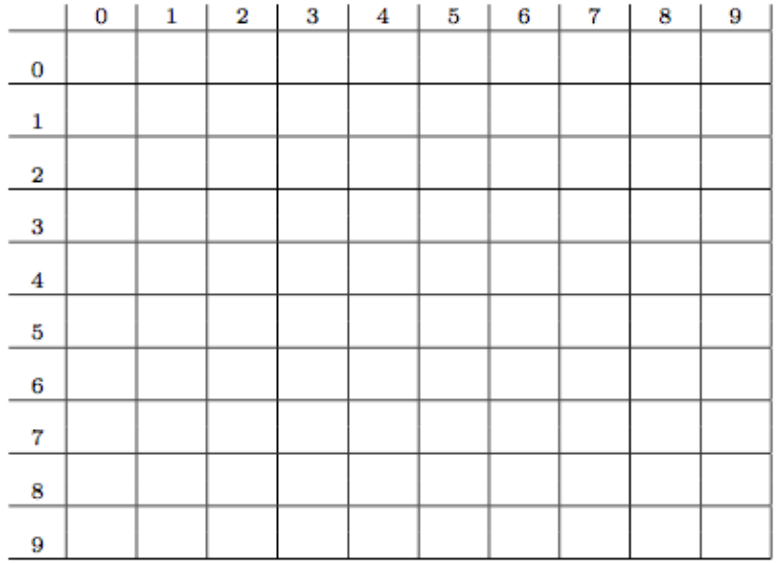
1. Design a 10 by 10 logo for Hunter College that contains a purple 'H'.

Challenge Problem...

	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.

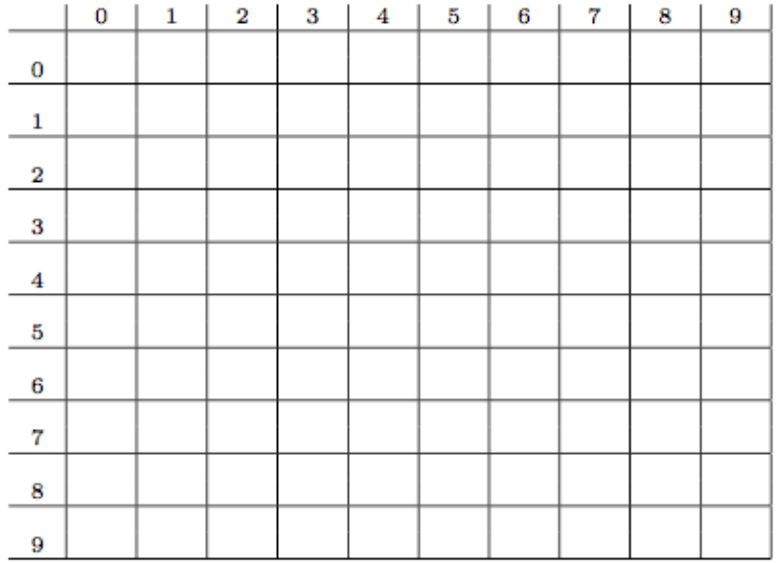
Challenge Problem...



	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.
3. How can you make Python draw the logo?
   Write down a "To Do" list of things you need to do.

Challenge Problem...



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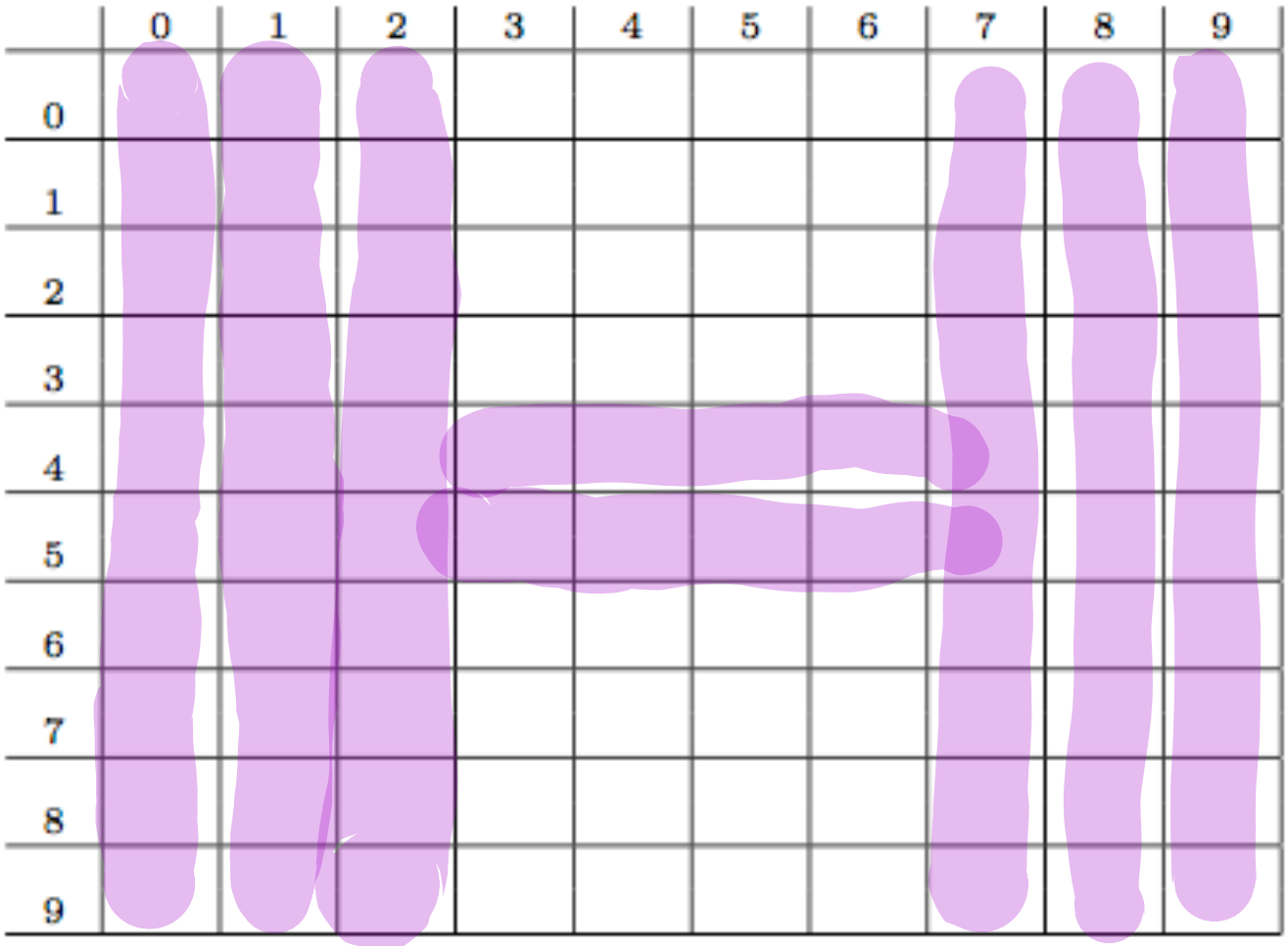
8										
9										

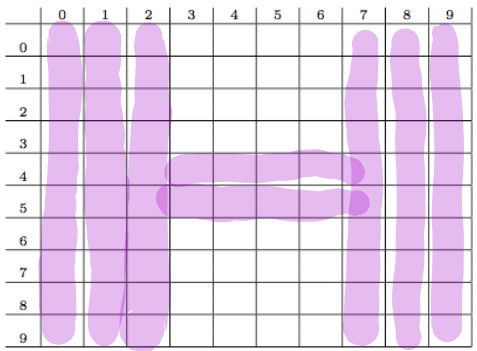
1. Design a 10 by 10 logo for Hunter College that contains a purple 'H'.
2. Your logo should only contain the colors purple and white.
3. How can you make Python draw the logo?
   Write down a "To Do" list of things you need to do.
4. If time, refine your steps above into a Python program.

Design a Hunter Logo

One possible solution:



Design a Hunter Logo



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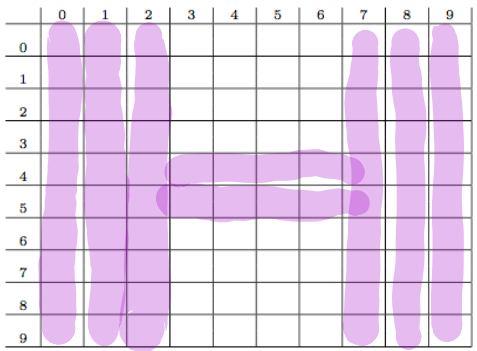

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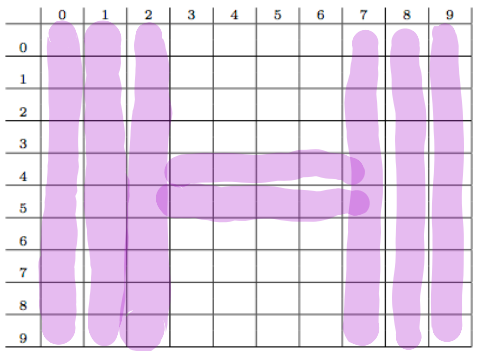

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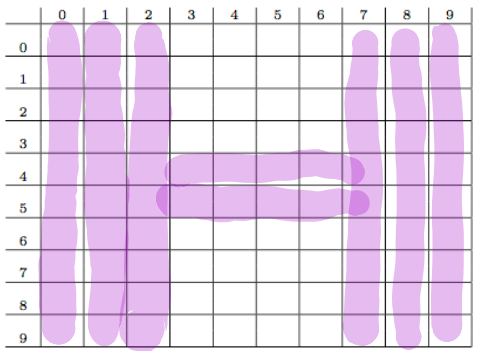

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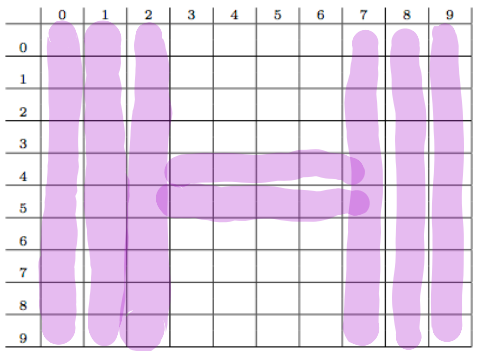

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Translating the Design to Code

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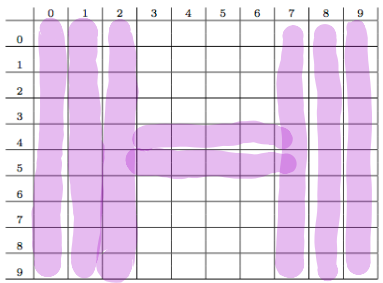

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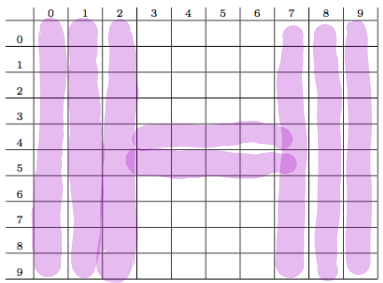

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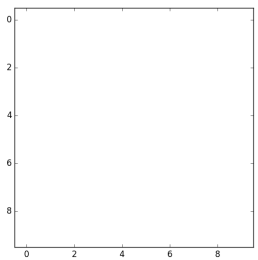

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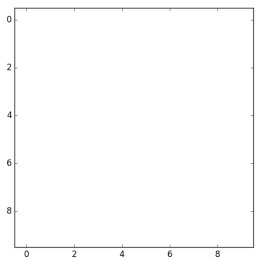

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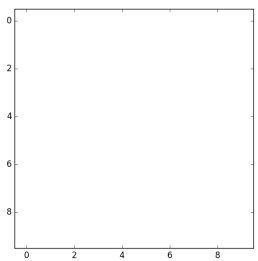

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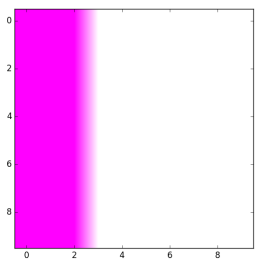

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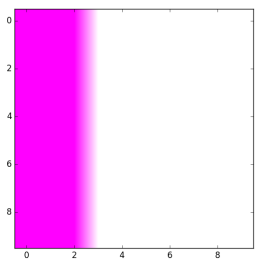

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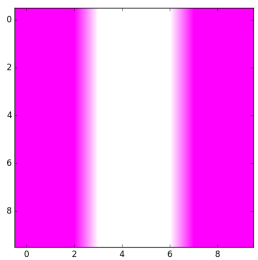

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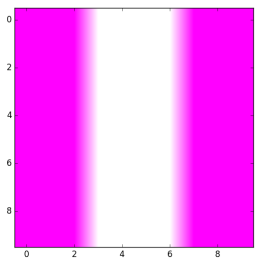

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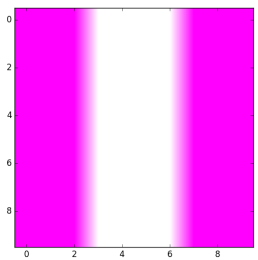

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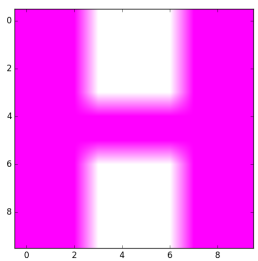

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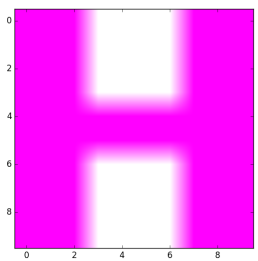

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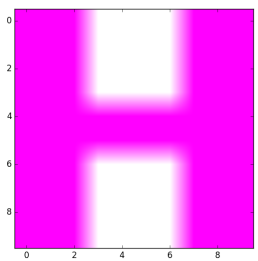

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5. Save logo array to file.

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

Today's Topics

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

Challenge Problem...

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
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    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

```
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    print("x is less than y")
elif x > y:
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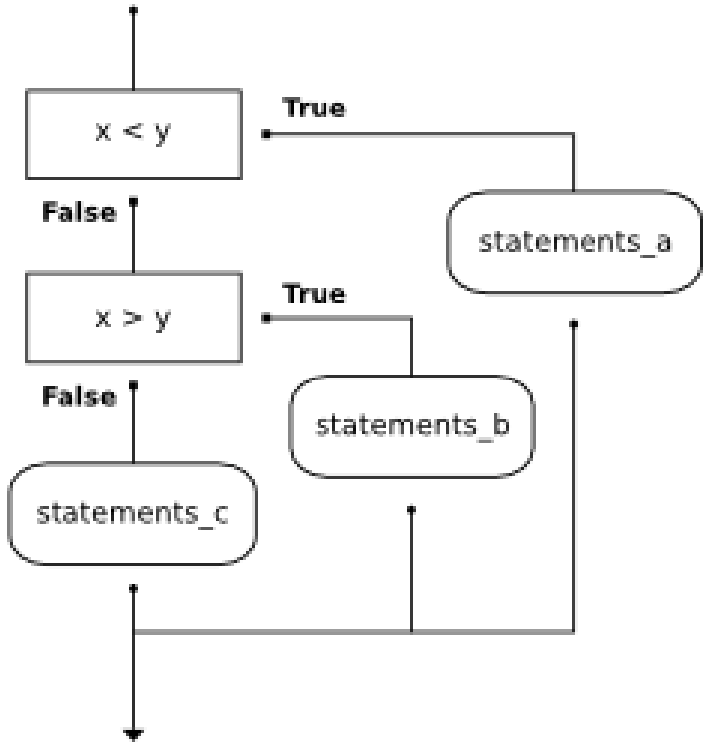

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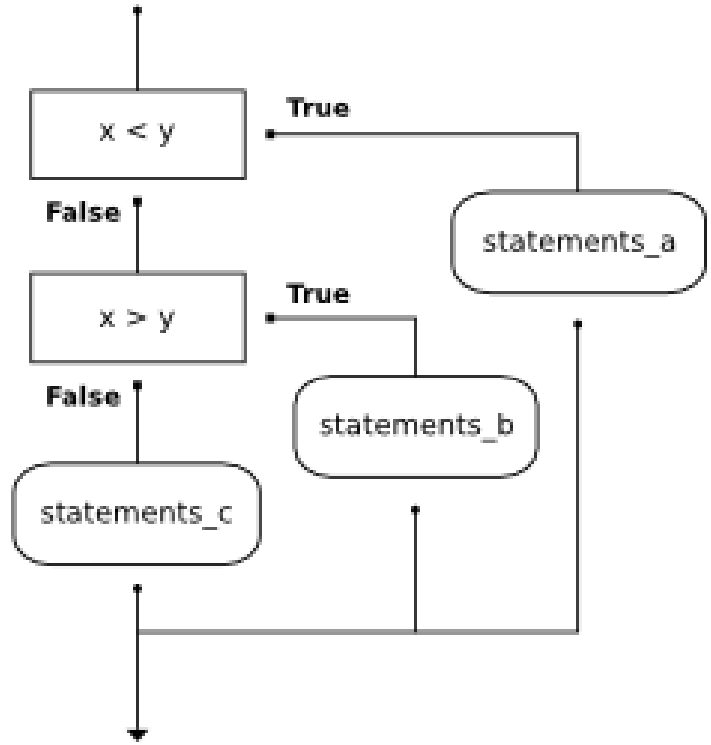
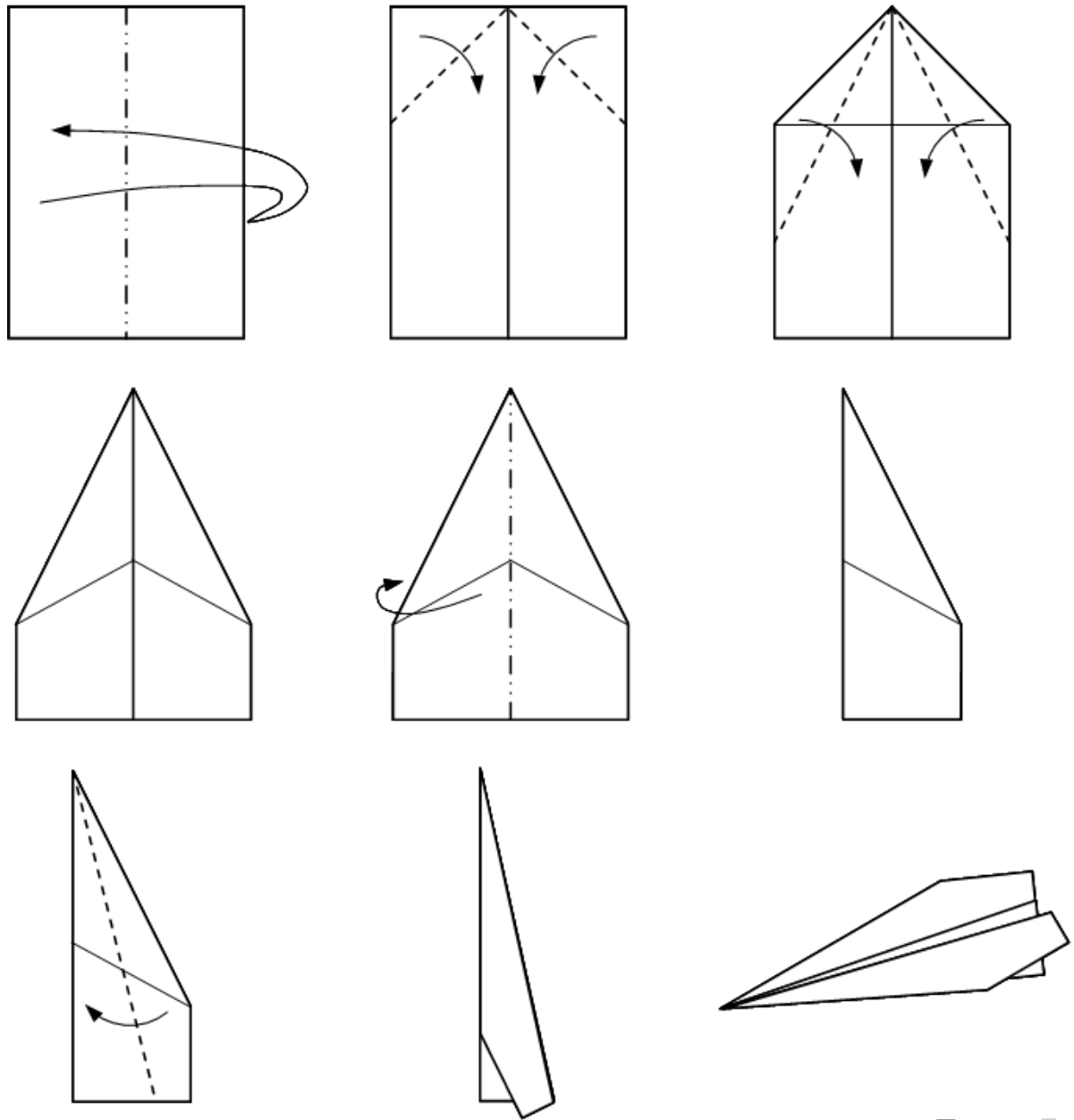


(This was just a first glance, will do much more on decisions over the next several weeks.)

Today's Topics

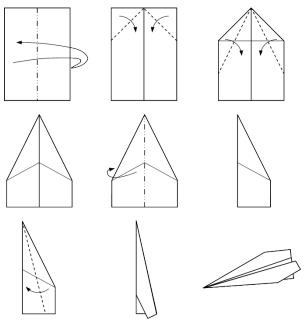
- Recap: Colors
- 2D Arrays & Image Files
- Decisions
- **Design Challenge: Airplanes**

Design Challenge: Planes



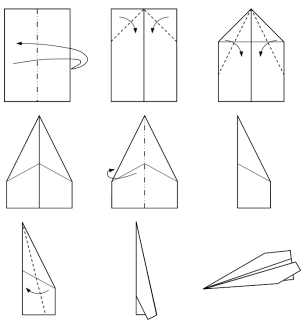
Design Challenge: Planes

- A classic write-an-algorithm challenge for introductory programming.



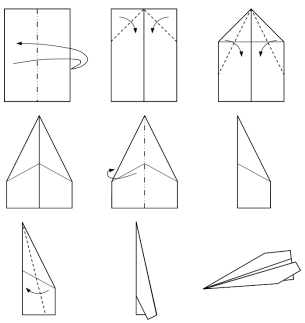
Design Challenge: Planes

- A classic write-an-algorithm challenge for introductory programming.
- With a slight twist:



Design Challenge: Planes

- A classic write-an-algorithm challenge for introductory programming.
- With a slight twist: refining designs



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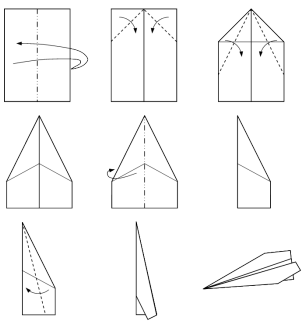
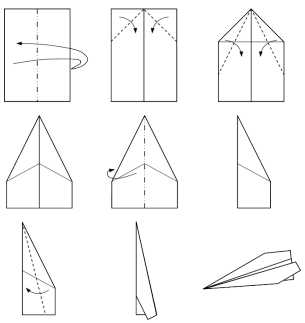


- A classic write-an-algorithm challenge for introductory programming.
- With a slight twist: refining designs
  - Write down your design.

Design Challenge: Planes



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  - Volunteers share with a everyone.

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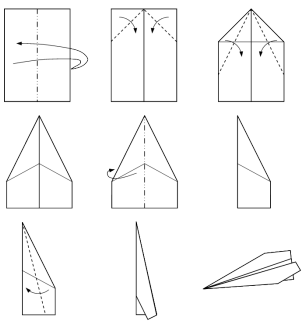

- A classic write-an-algorithm challenge for introductory programming.
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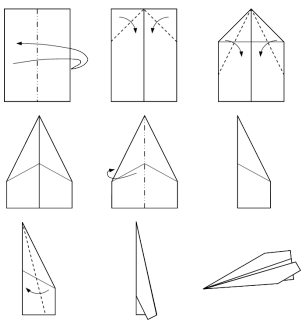
  - Everyone build an airplane to that design (test plane) **without consulting the designer**.

Design Challenge: Planes



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  - Reveal test planes, and **revise the algorithm**.

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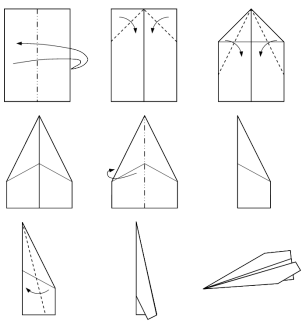

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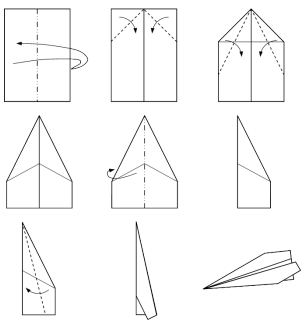
  - Reveal test planes, and **revise the algorithm**.
  - Build a revised test plane

Design Challenge: Planes



- A classic write-an-algorithm challenge for introductory programming.
- With a slight twist: refining designs
  - Write down your design.
  - Volunteers share with a everyone.
  - Everyone build an airplane to that design (test plane) **without consulting the designer**.
  - Reveal test planes, and **revise the algorithm**.
  - Build a revised test plane and fly it.

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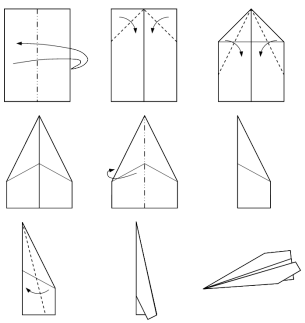

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- Remember to pick up all your airplanes!

Recap

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  - Recap: Colors
  - 2D Array & Image Files
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