CSc 110
Images, PPM

Adriana Picoral (she/her/hers)

Announcements

- SCS completion rate at this moment: 34% (goal: 70%)
- Last PA due dec 2

Image Files

- How do computers represent image files?
- There are lots of formats out there
  - .jpg .gif .bmp .png .psd etc…
- .jpg is one of the most common, but understanding the format is a complex because it uses ***compression***
- In this lecture, we'll talk about the simpler .ppm format
- First, let's talk about how computers display images

Image Files

- On a screen, each pixel has a red, green, and blue (RGB) component
- By varying the brightness of each color dot in a pixel, each pixel can be a different overall color
- When these pixels are combined, they create graphics and images

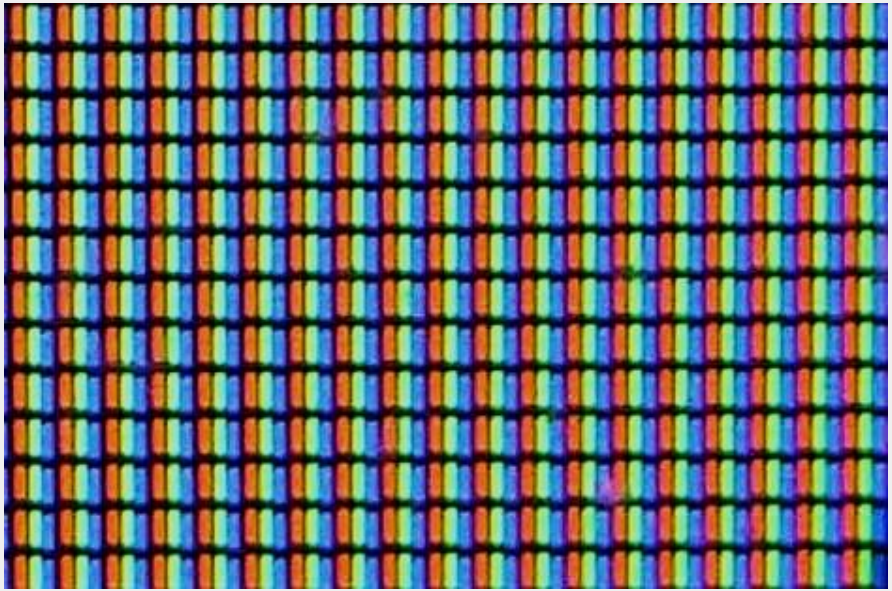


Image Files

- Common resolutions are
  - 1920 x 1080 (1080p)
  - 3840 x 2160 (4k)
  - 2880 x 1800 (13” Retina)

Image Files

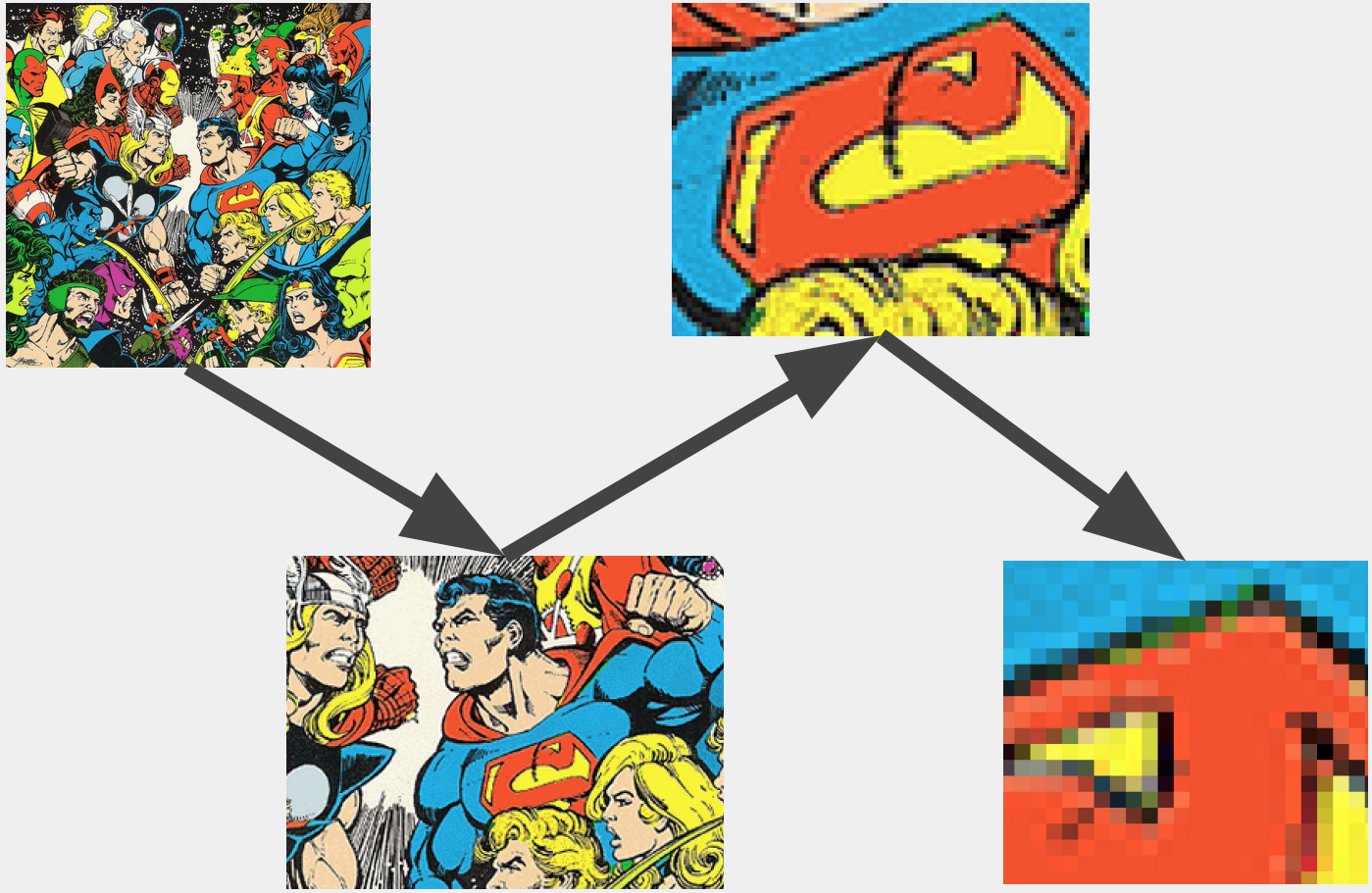
- Images files come in many “flavors”
  - One thing most image formats have in common: They specify what each pixel of the image should look like
- A .ppm image specifies what the red, green, and blue value should be for each dot within each pixel for the entire image
- The specification starts from the top-left of the image, and goes across

PPM Image Format

PPM Image Format

PPM Image Format

PPM Image Format

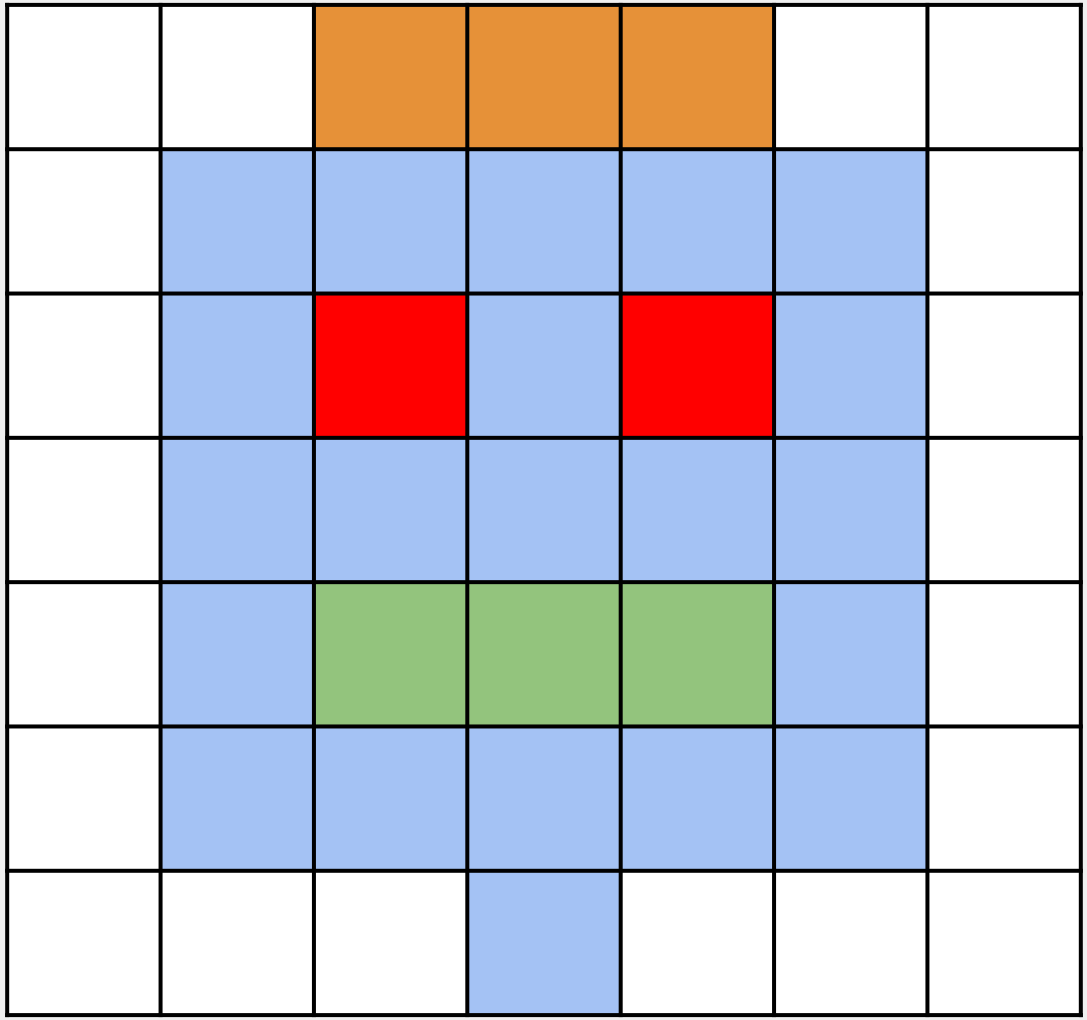


PPM Image Format

PPM Image Format

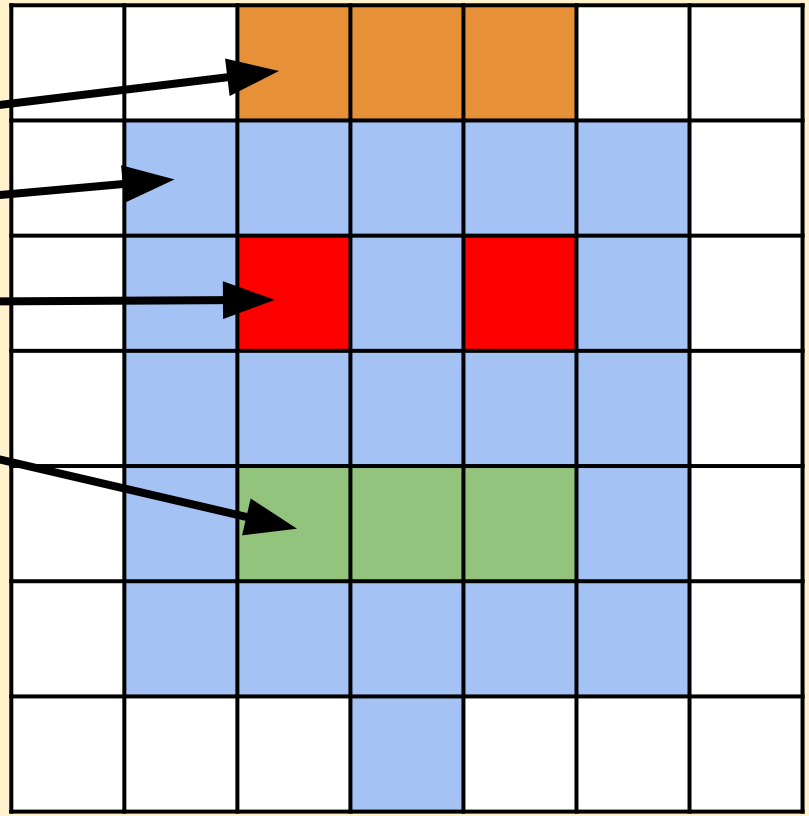
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

PPM Image Format



Determine the Pixel values

- Need four colors (other than white):
  - The orange hair
  - The blue face
  - The red eyes
  - The green mouth
- Use the color picker (or your intuition) to find these . . .



PPM Image Format

255 255 255	255 255 255	230 145 56	230 145 56	230 145 56	255 255 255	255 255 255
255 255 255	164 194 244	164 194 244	164 194 244	164 194 244	164 194 244	255 255 255
255 255 255	50 50 255	255 0 0	164 194 244	255 0 0	164 194 244	255 255 255
255 255 255	164 194 244	164 194 244	164 194 244	164 194 244	164 194 244	255 255 255
255 255 255	164 194 244	147 196 125	147 196 125	147 196 125	164 194 244	255 255 255
255 255 255	164 194 244	164 194 244	164 194 244	164 194 244	164 194 244	255 255 255
255 255 255	255 255 255	255 255 255	164 194 244	255 255 255	255 255 255	255 255 255

With

Red

Green

Blue

Decimal values

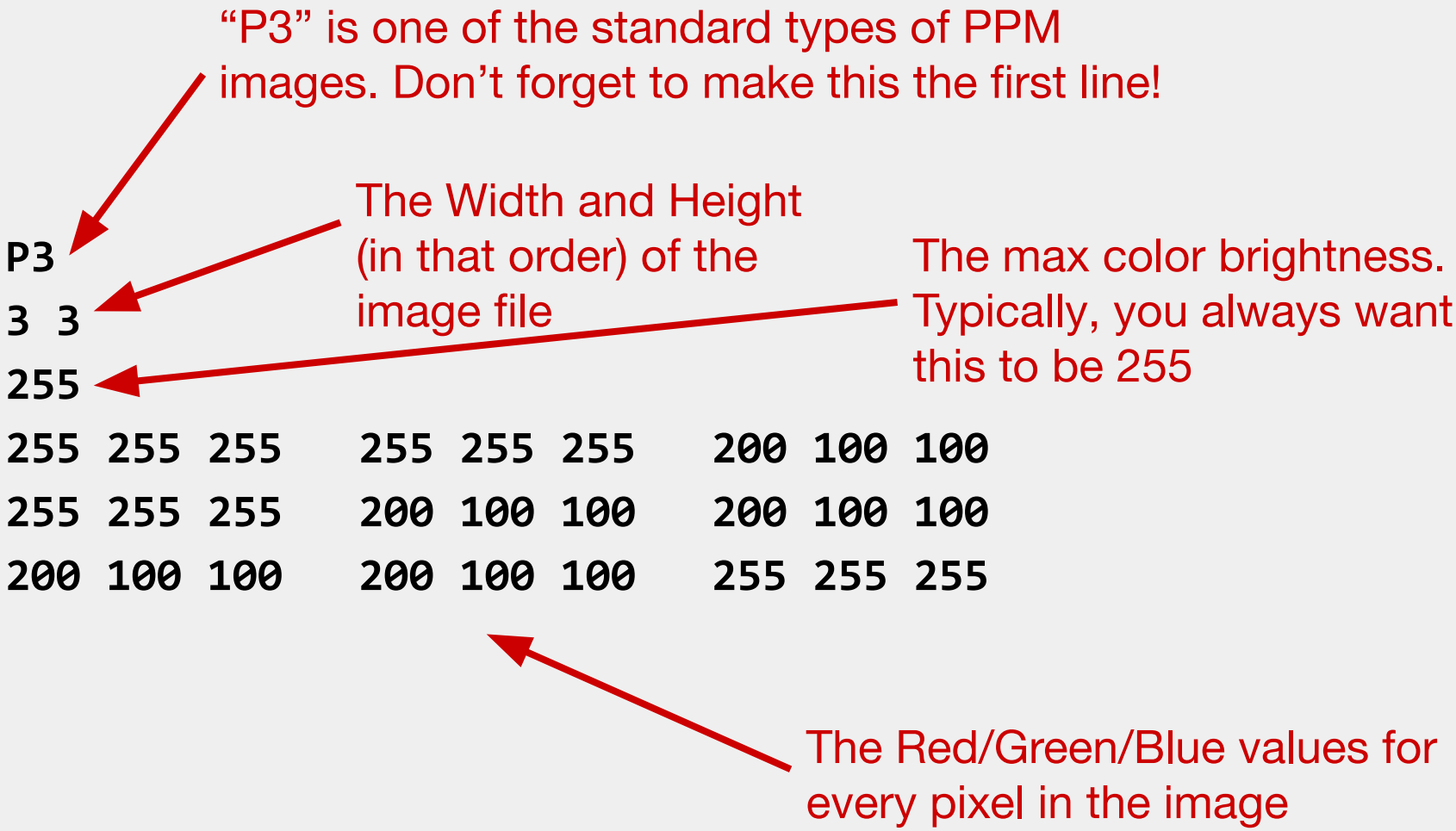
All of the pixels

```
11111111 11111111 11111111 11111111 11111111 11111111 11100110 10010001 00111000 11100110 10010001
00111000 11100110 10010001 00111000 11111111 11111111 11111111 11111111 11111111 11111111
11111111 11111111 11111111 10100100 11000010 11110100 10100100 11000010 11110100 10100100 11000010
11110100 10100100 11000010 11110100 10100100 11000010 11110100 11111111 11111111 11111111
11111111 11111111 11111111 10100100 11000010 11110100 11111111 00000000 00000000 10100100 11000010
11110100 11111111 00000000 00000000 10100100 11000010 11110100 11111111 11111111 11111111
11111111 11111111 11111111 10100100 11000010 11110100 10100100 11000010 11110100 10100100 11000010
11110100 10100100 11000010 11110100 10100100 11000010 11110100 11111111 11111111 11111111
11111111 11111111 11111111 10100100 11000010 11110100 10010011 11000100 01111101 10010011 11000100
01111101 10010011 11000100 01111101 10100100 11000010 11110100 11111111 11111111 11111111
11111111 11111111 11111111 10100100 11000010 11110100 10100100 11000010 11110100 10100100 11000010
11110100 10100100 11000010 11110100 10100100 11000010 11110100 11111111 11111111 11111111
11111111 11111111 11111111 11111111 11111111 11111111 11111111 11111111 11111111 10100100 11000010
11110100 11111111 11111111 11111111 11111111 11111111 11111111 11111111 11111111 11111111
```

PPM Image Files

- If writing a PPM file, specify four things
  - Image format
  - Width/Height
  - Max Color
  - The pixels!
- For example...

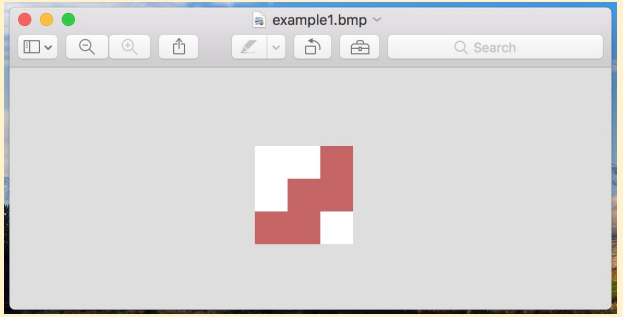
```
P3
3 3
255
255 255 255   255 255 255   200 100 100
255 255 255   200 100 100   200 100 100
200 100 100   200 100 100   255 255 255
```


"P3" is one of the standard types of PPM images. Don't forget to make this the first line!
The Width and Height (in that order) of the image file
The max color brightness. Typically, you always want this to be 255
P3
3 3
255
255 255 255 255 255 255 200 100 100
255 255 255 200 100 100 200 100 100
200 100 100 200 100 100 255 255 255
The Red/Green/Blue values for every pixel in the image

What image will this produce?

```
P3
3 3
255
255 255 255   255 255 255   200 100 100
255 255 255   200 100 100   200 100 100
200 100 100   200 100 100   255 255 255
```

What image will this produce?

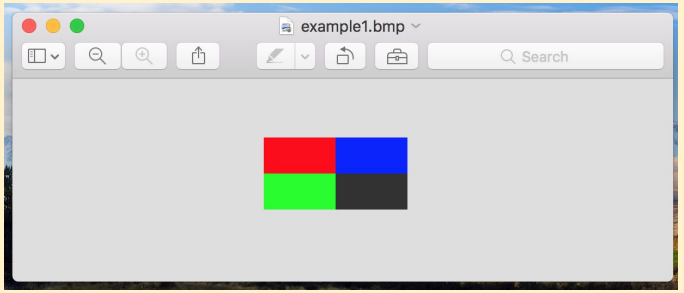



```
P3
3 3
255
255 255 255   255 255 255   200 100 100
255 255 255   200 100 100   200 100 100
200 100 100   200 100 100   255 255 255
```

What image will this produce?

```
P3
4 2
255
255 0 0    255 0 0    0 0 255      0 0 255
0 255 0    0 255 0    50 50 50     50 50 50
```

What image will this produce?

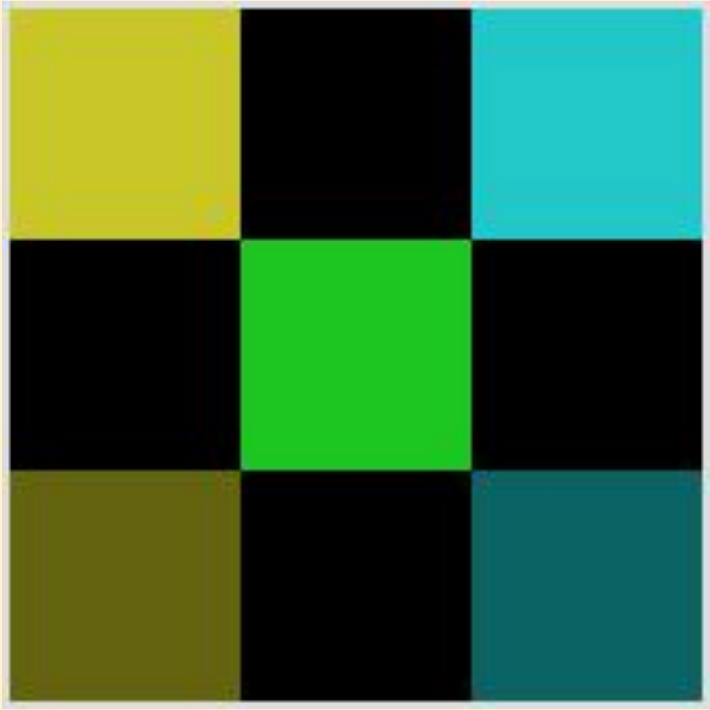



```
P3
4 2
255
255 0 0    255 0 0    0 0 255      0 0 255
0 255 0    0 255 0    50 50 50     50 50 50
```

What PPM content would produce this image?

What PPM content would produce this image?

```
P3
3 3
255
200 200 0    0 0 0      0 200 200
0 0 0        0 200 0    0 0 0
100 100 0    0 0 0      0 100 100
```



Storing image data

- Discuss
  - How would you read a PPM file in python?
  - What data structure(s) would you use to store PPM image data so that you could access all of the rows, columns, and RGB values?

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```
P3
4 2
255
255 0 0   255 0 0   0 0 255     0 0 255
0 255 0   0 255 0   50 50 50    50 50 50
```

```
image = [ [[255, 0, 0],  [255, 0, 0],  [0, 0, 255],    [0, 0, 255]],
          [[0, 255, 0],  [0, 255, 0],  [50, 50, 50],  [50, 50, 50]] ]
```

Read a PPM file

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')


# Write the missing code to read in the PPM file
```

Read a PPM file

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()
```

```
# ?
```

```
P3
3 3
255
255 255 255 255 255 255 0 100 200
255 255 255 0 100 200 0 100 200
0 100 200 0 100 200 255 255 255
```

Activity

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()

for line in ppm_file:
    line = line.strip('\n').split()
    # ?
```

```
P3
3 3
255
255 255 255 255 255 255 0 100 200
255 255 255 0 100 200 0 100 200
0 100 200 0 100 200 255 255 255
```

Activity

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()

for line in ppm_file:
    line = line.strip('\n').split()
    row = []
    # ?
```

```
P3
3 3
255
255 255 255 255 255 255 0 100 200
255 255 255 0 100 200 0 100 200
0 100 200 0 100 200 255 255 255
```

Activity

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()

for line in ppm_file:
    line = line.strip('\n').split()
    row = []
    for i in range(0, len(line), 3):
        # ?
```

```
P3
3 3
255
255 255 255 255 255 255 0 100 200
255 255 255 0 100 200 0 100 200
0 100 200 0 100 200 255 255 255
```

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()

for line in ppm_file:
    line = line.strip('\n').split()
    row = []
    for i in range(0, len(line), 3):
        pixel = line[i:i+3]
        row.append(pixel)
    image.append(row)
```

Get the width and height

How would you get the width and height here?

```
P3
3 3
255
255 255 255   255 255 255   200 100 100
255 255 255   200 100 100   200 100 100
200 100 100   200 100 100   255 255 255
```

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()

for line in ppm_file:
    line = line.strip('\n').split()
    row = []
    for i in range(0, len(line), 3):
        pixel = line[i:i+3]
        row.append(pixel)
    image.append(row)
```

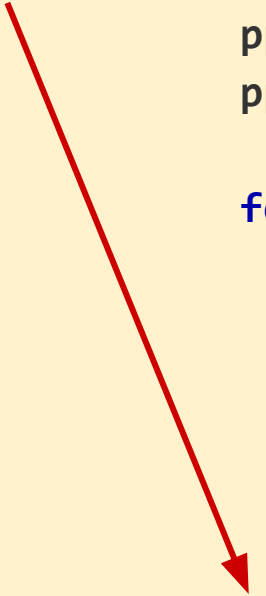
Get the width and height

```
w_h = ppm_file.readline()
sp = w_h.split(' ')
width = int(sp[0])
height = int(sp[1])
```

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()

for line in ppm_file:
    line = line.strip('\n').split()
    row = []
    for i in range(0, len(line), 3):
        pixel = line[i:i+3]
        row.append(pixel)
    image.append(row)
```

Get the width and height

How would you get the width and height here?

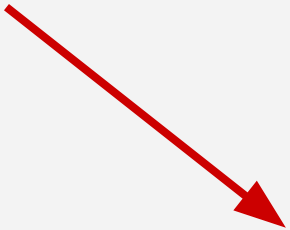


```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()

for line in ppm_file:
    line = line.strip('\n').split()
    row = []
    for i in range(0, len(line), 3):
        pixel = line[i:i+3]
        row.append(pixel)
    image.append(row)
```

Get the width and height

```
image = []
file_name = input('Enter file name: ')
ppm_file = open(file_name, 'r')
ppm_file.readline()
ppm_file.readline()
ppm_file.readline()

for line in ppm_file:
    line = line.strip('\n').split()
    row = []
    for i in range(0, len(line), 3):
        pixel = line[i:i+3]
        row.append(pixel)
    image.append(row)
```

```
width = len(image[0])
height = len(image)
```



What next?

After the width, height, and pixel info are available, what can be done?

What next?

After the width, height, and pixel info are available, what can be done?

- Display it!
- Process it!
- Implement a greenscreen!