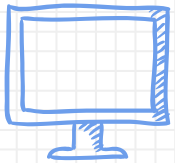
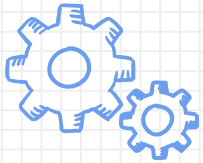
EE16A Lab
Friday 11am-2pm

TA: Seiya

LA: Cameron, Ed, Ryan

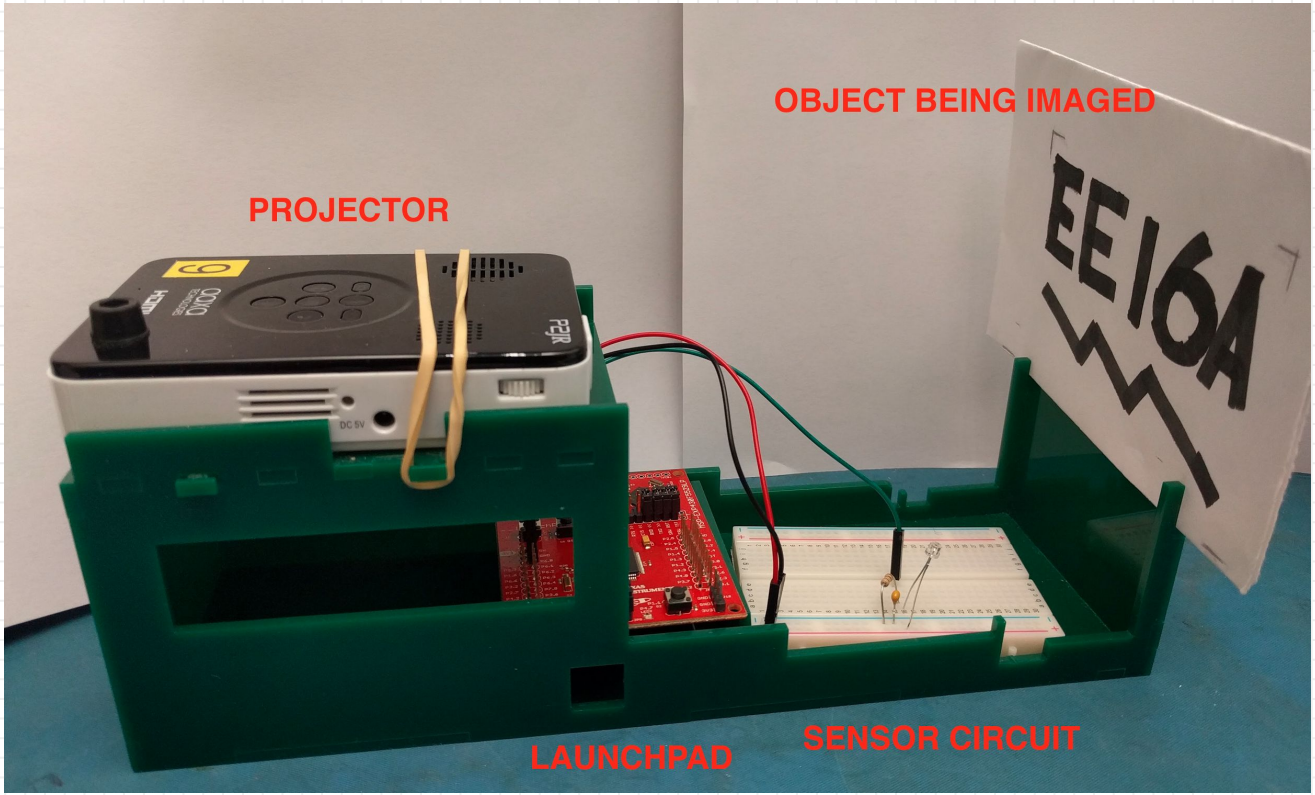




Imaging – Part 2

Today's Lab: Single Pixel Scanning

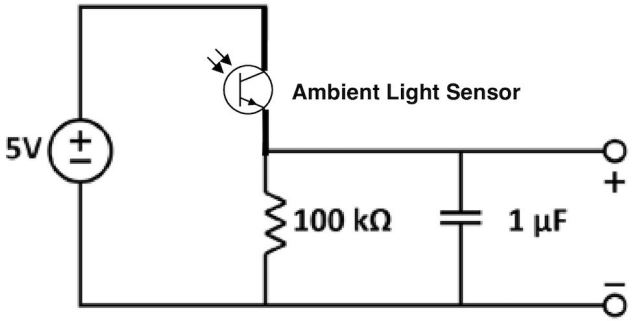
- ✘ Circuit from last week measures **light** intensity
- ✘ Projector illuminates card in a controlled way
- ✘ Python programming to reconstruct image

Setup:

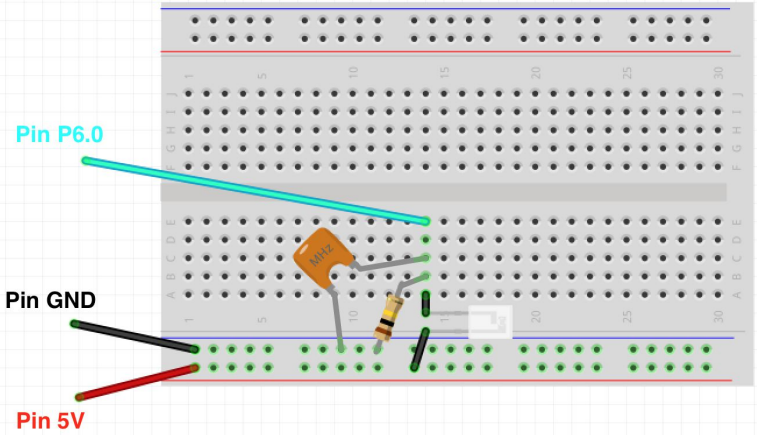

OBJECT BEING IMAGED
PROJECTOR
EE 16A
LAUNCHPAD
SENSOR CIRCUIT

Circuit From Last Week

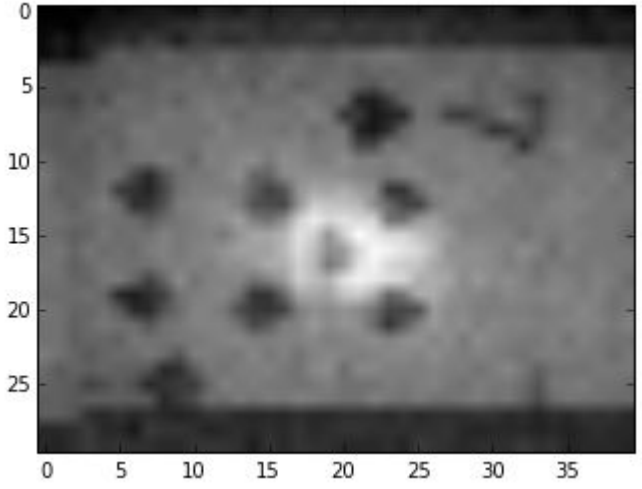
Circuit Diagram



Breadboard Diagram

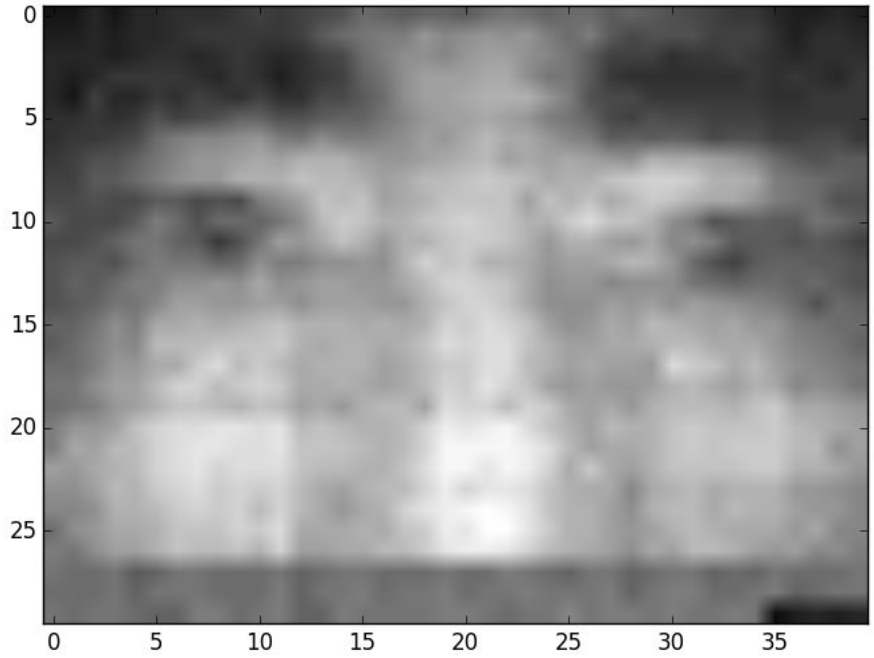


Sample Images



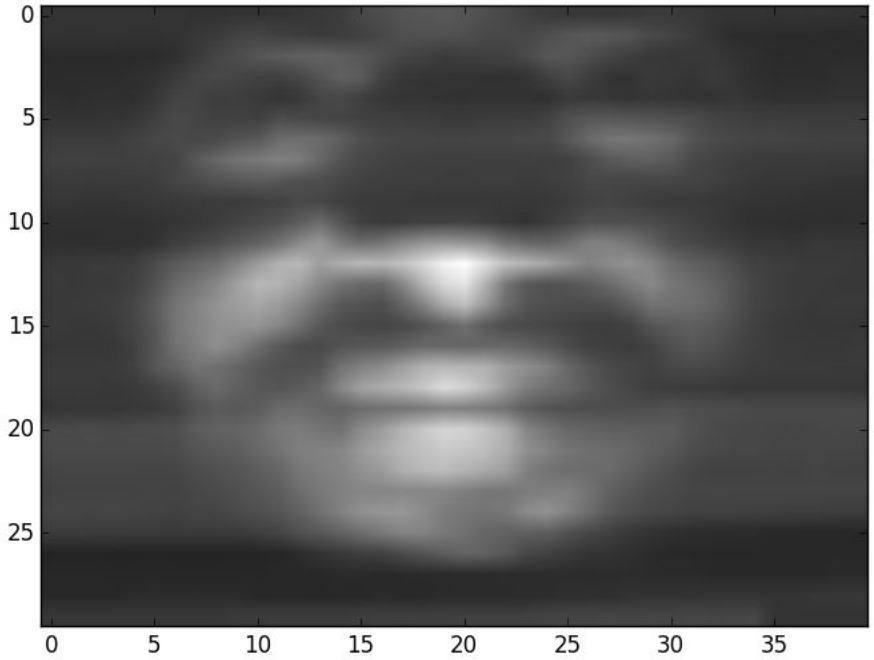
Sample Images

Me:

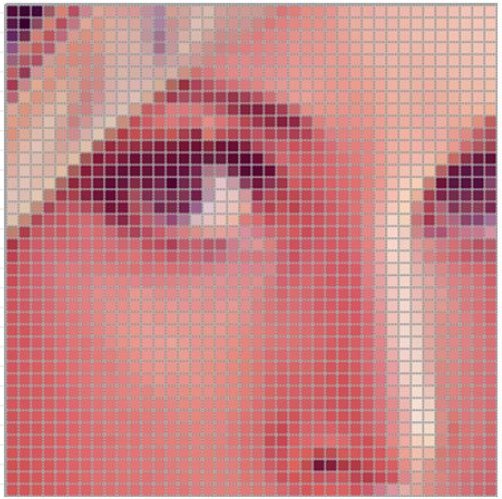


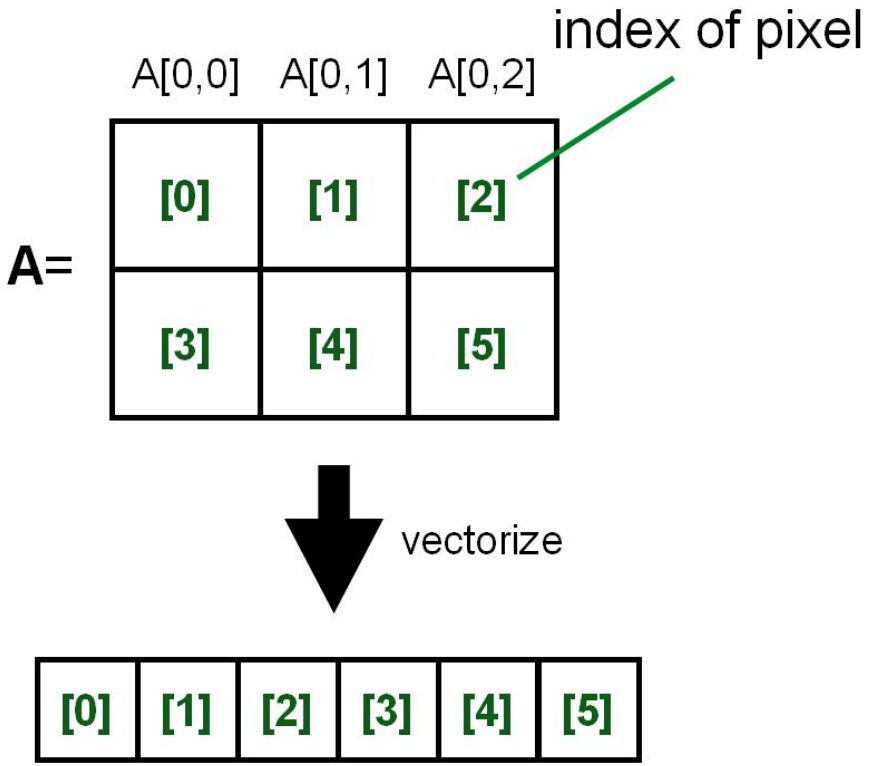
Sample Images

Nightmare Fuel: Lab Assistant Nick



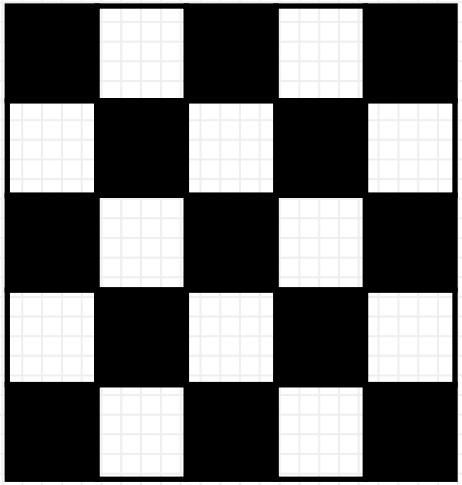
Images, Matrices, Vectors





How Scanning Works?

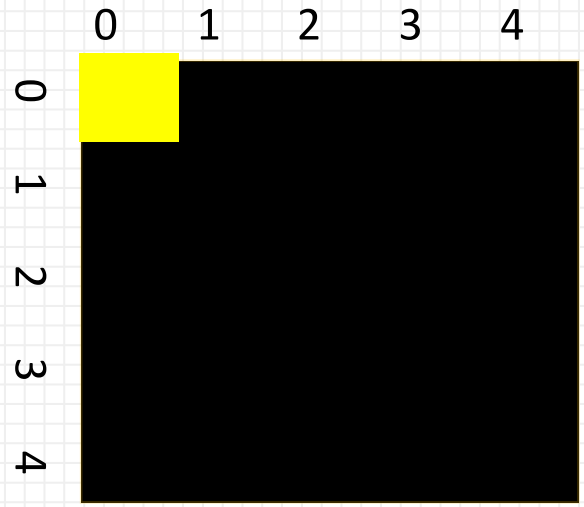
Real World Object



Imaging Mask

How Scanning Works: iPython

Imaging Mask 0



mask0 =

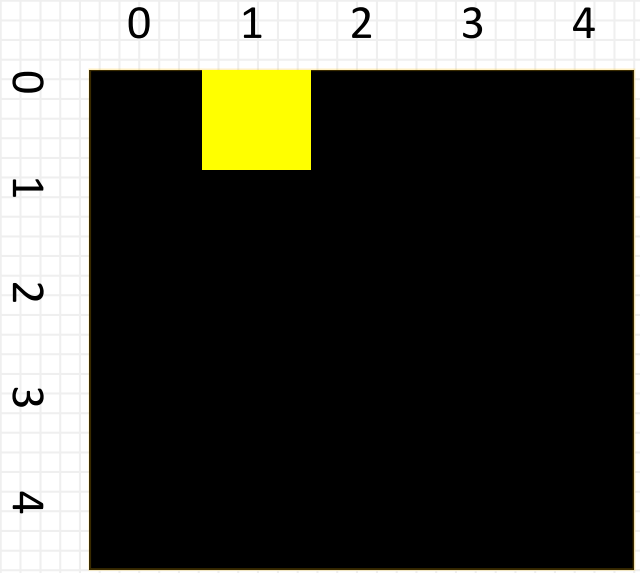
np.array([

[	**1,**	**0,**	**0,**	**0,**	**0**]
[	**0,**	**0,**	**0,**	**0,**	**0**]
[	**0,**	**0,**	**0,**	**0,**	**0**]
[	**0,**	**0,**	**0,**	**0,**	**0**]
[	**0,**	**0,**	**0,**	**0,**	**0**]]

)

How Scanning Works: iPython

Imaging Mask 1



mask1 =

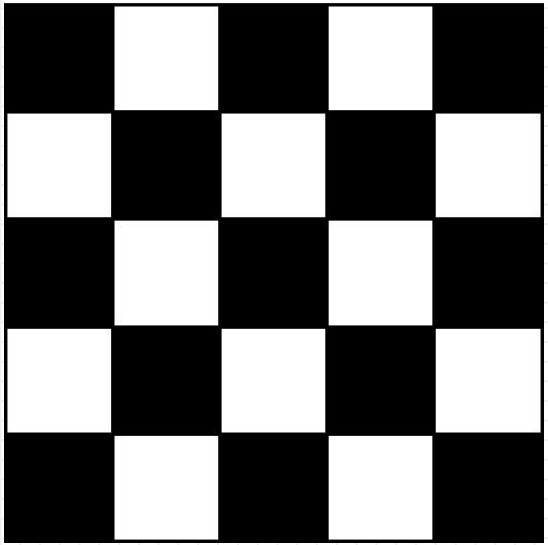
np.array([

[0,	1,	0,	0,	0] ,
[0,	0,	0,	0,	0] ,
[0,	0,	0,	0,	0] ,
[0,	0,	0,	0,	0] ,
[0,	0,	0,	0,	0]]

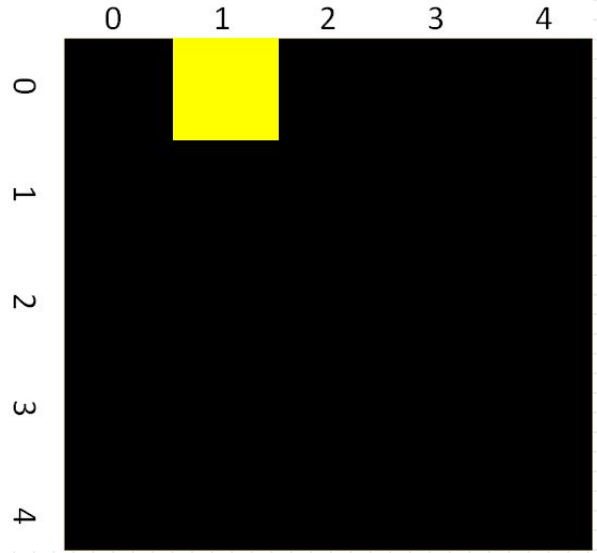
)

How Scanning Works: iPython

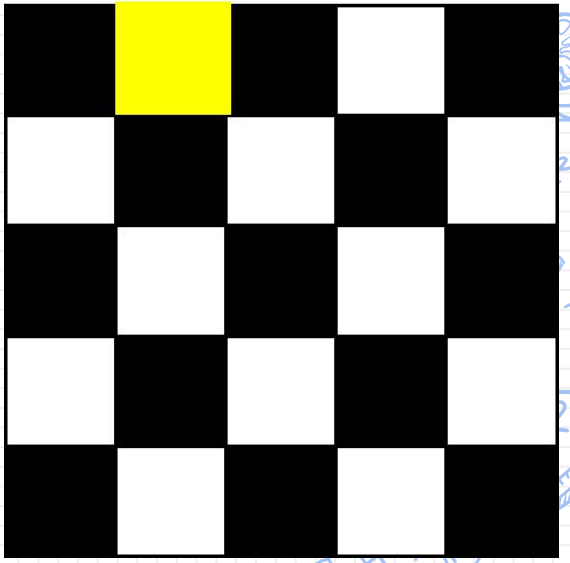
Real World Object



Imaging Mask 1

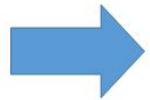


Measurement



How Scanning Works: iPython

```
mask0 = [[ 1, 0, 0, 0, 0 ],
         [ 0, 0, 0, 0, 0 ],
         [ 0, 0, 0, 0, 0 ],
         [ 0, 0, 0, 0, 0 ],
         [ 0, 0, 0, 0, 0 ]]
```

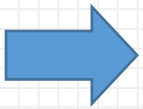


Row 0	1
Row 1	0
Row 2	0
Row 3	0
Row 4	0
⋮	
Row 24	0

How Scanning Works: iPython

mask1 =

```
[[ 0, 1, 0, 0, 0 ],
 [ 0, 0, 0, 0, 0 ],
 [ 0, 0, 0, 0, 0 ],
 [ 0, 0, 0, 0, 0 ],
 [ 0, 0, 0, 0, 0 ]]
```

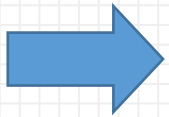


Row 0	0
Row 1	1
Row 2	0
Row 3	0
Row 4	0
⋮	
Row 24	0

How Scanning Works: iPython

mask2 =

[[	0,	0,	1,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0]]



Row 0	0
Row 1	0
Row 2	1
Row 3	0
Row 4	0
⋮	
Row 24	0

How Scanning Works: iPython

mask0 =

[[	1,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0]]

mask1 =

[[	0,	1,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0]]

mask2 =

[[	0,	0,	1,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0],
[	0,	0,	0,	0,	0]]

H =

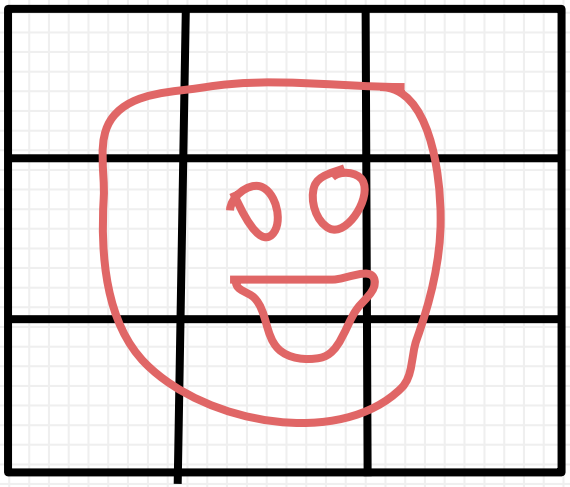
	mask0	mask1	mask2
Row 0	1	0	0
Row 1	0	1	0
Row 2	0	0	1
Row 3	0	0	0
Row 4	0	0	0
⋮	⋮	⋮	⋮
Row 24	0	0	0

.....

What is the total size of this matrix?

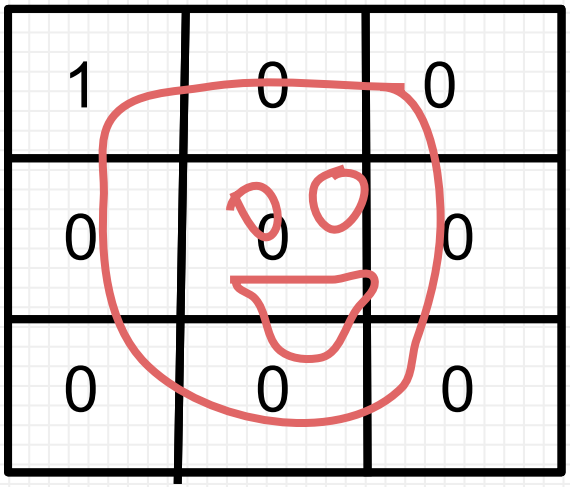
How does H relate to the masks?

How Scanning Works: iPython



What will the scanning matrix's dimensions be?

How Scanning Works: iPython

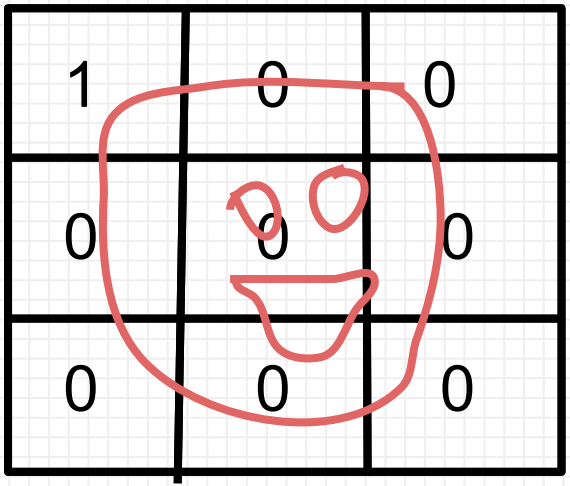


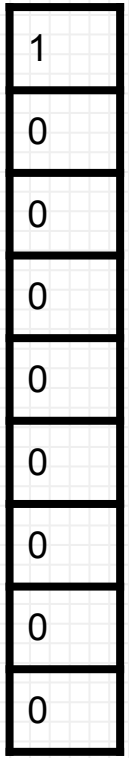
What will the scanning matrix's dimensions be?

How many total pixels are in the picture?

How Scanning Works: iPython

What will the scanning matrix's dimensions be? How many pixels?

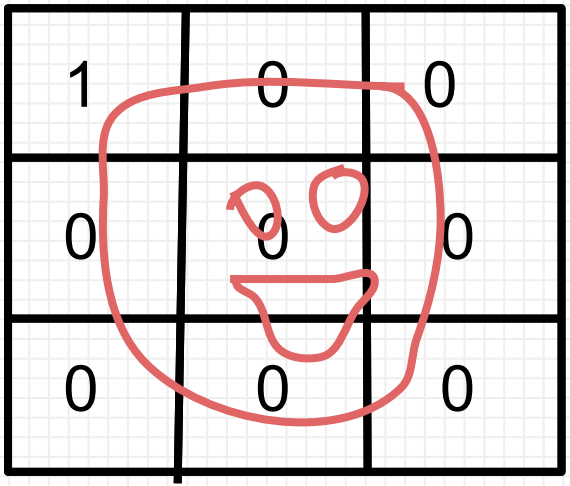


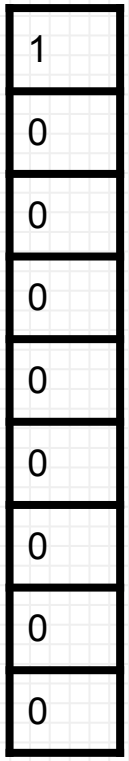


....

How Scanning Works: iPython

What will the scanning matrix's dimensions be? How many pixels?

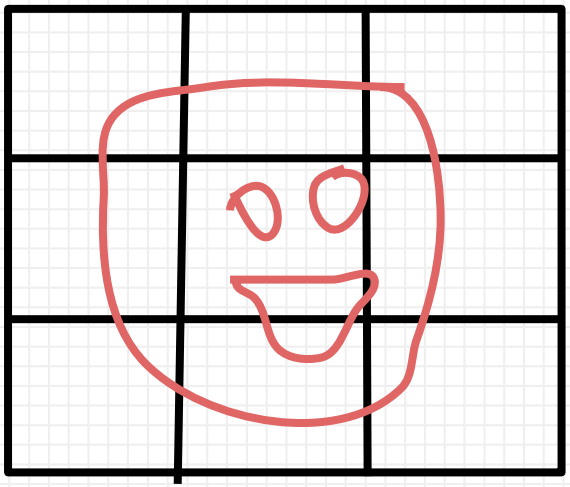




....

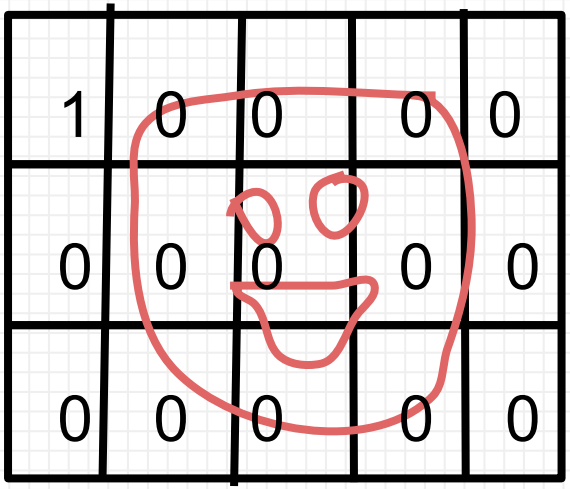
9x9

How Scanning Works: iPython



What will the scanning matrix's dimensions be?

How Scanning Works: iPython

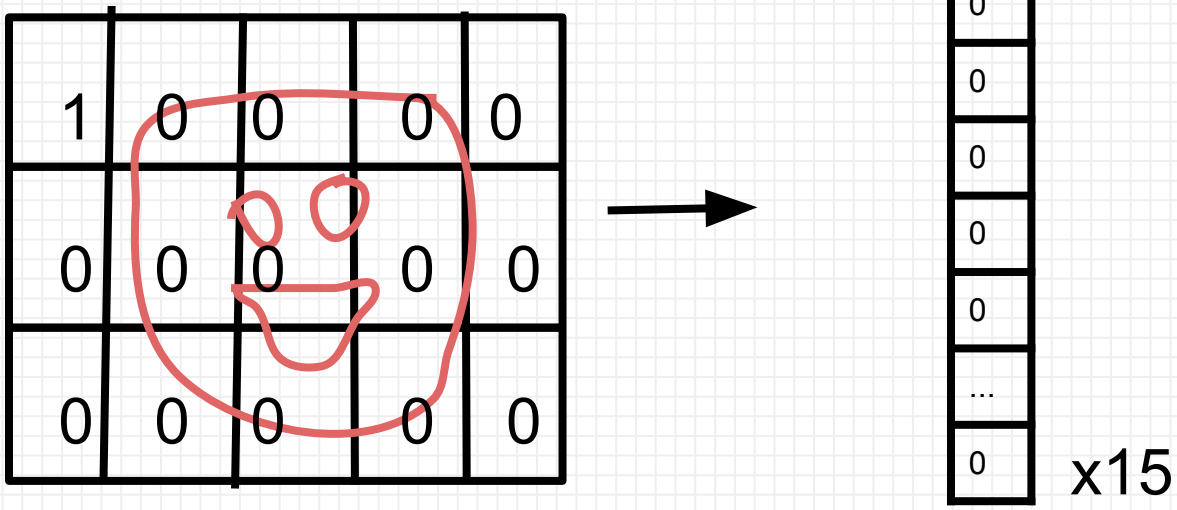


What will the scanning matrix's dimensions be?

How many pixels?

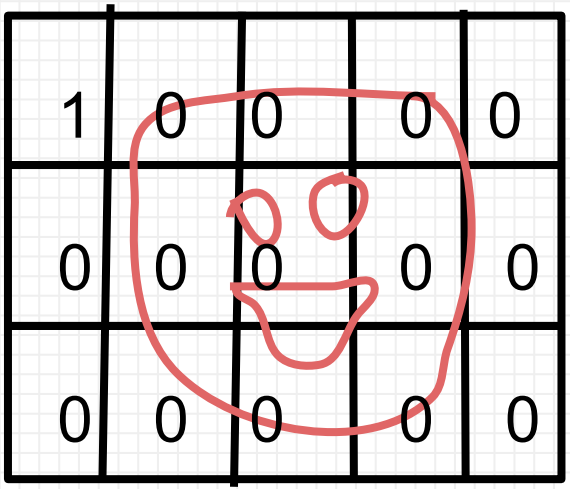
How Scanning Works: iPython

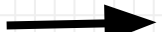
What will the scanning matrix's dimensions be? How many pixels?

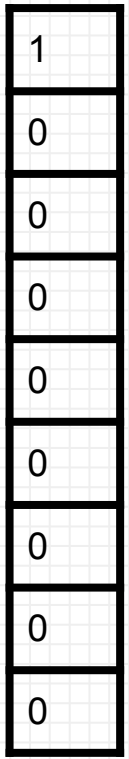


How Scanning Works: iPython

What will the scanning matrix's dimensions be? How many pixels?





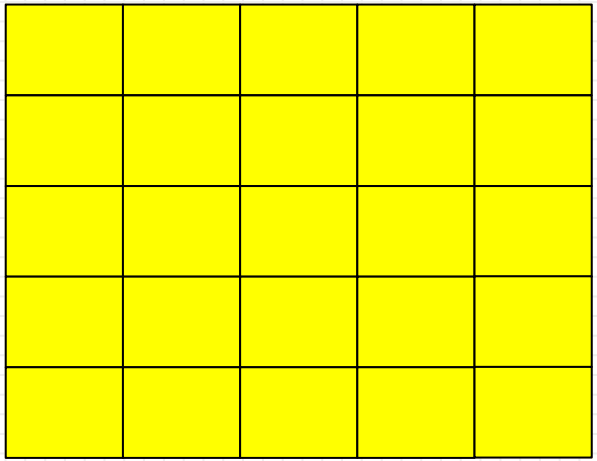


....

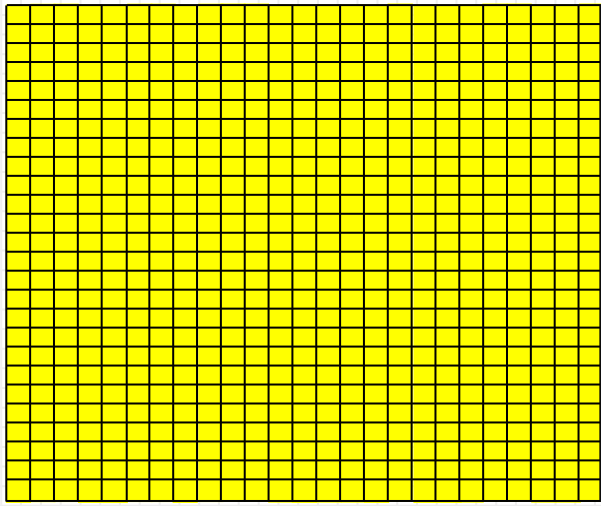
15x15

Using H to scan our image!

Mask Projected onto Real World Object



Masking Matrix H



IPython Review:

```
for i in range(0,5):
    print(i)
```

```
A = np.zeros((5,5))
counter = 0;
for i in range(0,5):
    for j in range(0,5):
        A[i,j] = counter/24;
        counter = counter + 1
```

```
A = (np.arange(0,25,1)/24).reshape((5,5))
```

IPython Review:

```
>>> import numpy as np
>>> A = np.array([ [1, 2, 3], [4, 5, 6] ])
>>> B = np.matrix( '1 2; 3 4 ' )
>>> C = np.matrix ( [ [1, 2], [3, 4] ] )
```

Some numpy functions:

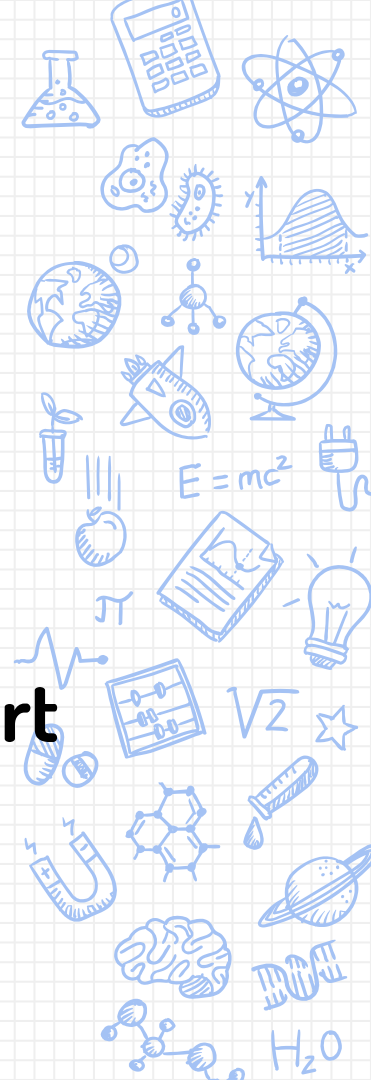
- A.shape, A.T, np.dot
- A[i , j], A[i , :], A[: , j], A[:, ::-1]
- And many more... **Google is your friend!**

Tips for a Good Image

- ✘ Adjust contrast and brightness of projector
  - ✗ Projector's Home Screen —> "Setting"
  - ✗ Change Picture Mode from "standard" to "User" by first pushing OK then right bottom X2
  - ✗ Select Contrast and increase to 100
  - ✗ Select Brightness and decrease to 0
  - ✗ Return back to main menu
- ✘ Focus projector using dial on the side
- ✘ Close the box firmly & scan under dark conditions

Important Notes

- ✘ You should have your kit from last week
- ✘ Equipment in cardboard box:
  - ✗ Don't break the plastic stand!
  - ✗ Put everything back before you leave!
    - Including Projector's Power
- ✘ Make sure you are using the right com port at all times
  - ✗ Not COM1, and not the debugger



Notes

- ✘ No signal when testing the oscope on their previous circuit
  - ✘ **Unplug P6.0 from MSP and debug if necessary**
- ✘ UART Application Com Port not showing up as an option when scanning
  - ✘ **Close serial monitor!**
- ✘ Do not take sharpies from the desk
- ✘ Limited number of Light Sensors: Share if necessary
- ✘ If something isn't working, close everything and turn it back on (works 9/10 times)

FAQ

- **SHIFT+RIGHT CLICK** on a window to open in **CMD**
  - '**ipython notebook**' to open ipython notebook
- Point ALS at the index card [and not top of box]
  - Make sure it's not in the way of projection
- If no pictures show up, copy the URL and open it in Chrome
- **Check off:**tinyurl.com/lab108-checkoff
- **Ask Questions:** tinyurl.com/lab108-Q