Image Processing

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Review: Structure of a Robot Brain

- Read sensors
- Decide what to do
- Make Movement
- Repeat
while True:
    left = getLight("left")
    right = getLight("right")
    if left < right:
        turnLeft(1, .4)
    else:
        turnRight(1, .4)
Image Processing

- Picture
  - A width and height
  - A list of picture elements, or Pixels

- Pixel
  - There are width * height Pixels in a Picture
  - Each is composed of a Red, Green, and Blue component
  - Knows its location (x, y) in the Picture
Picture

- **takePicture()**
  - Function which takes a picture on the robot, and returns it
  - `pic = takePicture()`

- To display picture in a window
  - `show(pic)`

- Related functions
  - `getWidth(pic)`, `getHeight(pic)`
Taking a Picture

>>> pic = takePicture()
>>> show(pic)
Taking a Picture

```python
>>> pic = takePicture()
>>> show(pic)
```
Taking a Picture

```python
>>> pic = takePicture()
>>> show(pic)
>>> getWidth(pic)
256
>>> getHeight(pic)
192
```
What is a Picture?

• Matrix of pixels
  - `getWidth(pic) * getHeight(pic)`

• Each Pixel is composed of three components
  - Red
  - Green
  - Blue

• Each component has a value between 0 and 255
What is a Picture?
What is a Picture?
>>> pic = takePicture()
>>> getPixel(pic, 97, 115)
<Pixel instance (r=179, g=85, b=171, a=255) at (97, 115)>
>>> pix = getPixel(pic, 97, 115)
>>> getRed(pix)
179
>>> getGreen(pix)
85
>>> getBlue(pix)
171
>>> getRGB(pix)
(179, 85, 171)
Working with Pixels

- `getPixel(PICTURE, X, Y)`
  - `pix = getPixel(pic, 97, 115)`
    - `red = getRed(pix)`
    - `green = getGreen(pix)`
    - `blue = getBlue(pix)`
    - `r, g, b = getRGB(pix)`

- `for VARIABLE in getPixels(PICTURE): COMMAND`
  ...

- `Pixels know where they are in a picture`
  - `getX(PIXEL), getY(PIXEL)`
Working with Pixels

```python
pic = takePicture()
for pix in getPixels(pic):
    print getRed(pix)
    print getRGB(pix)
    print getX(pix)
```
Find the Pyramid

How could we use these functions to locate a bright orange Pyramid in a picture?
Finding the Pyramid in a Picture

def findCenter(picture):
    X = 0
    for pixel in getPixels(picture):
        R, G, B = getRGB(pixel)
        if BOOLEANEXPRESSION:
            X = X + getX(pixel)
            count = count + 1
    return x/count

pic = takePicture()
x = findCenter(pic)