

1. Suppose I TRULY wanted to make a “black and white” photo (nothing but black pixels and white pixels).

a) What would I need to do in order to make that image?



This is an example of *posterizing* -- reducing the number colors to a much smaller number (e.g., 2).

```
def blackAndWhite(picture):
    for y in range(0, getHeight(picture)):
        for x in range(0, getWidth(picture)):
            pixel = getPixel(picture, x, y)

            total=getRed(pixel)+getGreen(pixel)+getBlue(pixel)

            luminance=total/3

            if
                setColor(pixel,black)
            else:
                setColor(pixel,white)
```

2. You might recognize a recent classic posterization example and a more recently "Obamified" President Ruud.



a) Besides luminance, how might you select a color for posterization?

```
def obamifyMe(picture):
    ltBlue = makeColor(113,150,159)
    myRed = makeColor(215,26,33)
    myBlue = makeColor(0,50,77)
    myTan = makeColor(252,228,168)
    for y in range(0, getHeight(picture)):
        for x in range(0, getWidth(picture)):
            pixel = getPixel(picture, x, y)
            total=getRed(pixel)+getGreen(pixel)+getBlue(pixel)
            luminance=total/3
            if luminance<64:
                setColor(pixel,myBlue)
            elif luminance<128:
                setColor(pixel,myRed)
            elif luminance<192:
                setColor(pixel,ltBlue)
            else:
                setColor(pixel,myTan)
```

b) Complete the following code based on this method.

```
def obamifyMe(picture):
    ltBlue = makeColor(113,150,159)
    myRed = makeColor(215,26,33)
    myBlue = makeColor(0,50,77)
    myTan = makeColor(252,228,168)
    for y in range(0, getHeight(picture)):
        for x in range(0, getWidth(picture)):
            pixel = getPixel(picture, x, y)
```

c. How might posterization be used as a picture compression technique?

3. When we scaled up our picture (1 pixel became a square of 4) we get a grainy (i.e., rough saw-tooth edges, etc.) image due to *pixelation*. For example, after scaling up President Ruud's picture twice, his left eye looks like (top eye):



We can reduce pixelation by *blurring* an image. A simple way to blur an image is to set each pixel to a color that is the average of the pixels around it. Blurring after each scaling we get the bottom eye to the right. a) Complete the blur code below:



b) Why do the x and y range parameters stop one short of the borders?

```
def blur(pict):
    """ Blurs a pict by setting each pixel's color to the
        average of its four neighbors. """

    for x in range(1,getWidth(pict)-1):
        for y in range(1,getHeight(pict)-1):
            center = getPixel(pict, x, y)
            top = getPixel(pict, x, y-1)

            bottom = getPixel(pict,
                               x, y+1)
            right = getPixel(pict,
                              x+1, y)
            left = getPixel(pict,
                             x-1, y)

            newRed = (getRed(center)+getRed(top)+getRed(bottom)+getRed(right)+getRed(left))/5

            newGreen=(getGreen(center)+getGreen(top)+getGreen(bottom)
                       + getGreen(right)+getGreen(left))/5

            newBlue =

            setColor(center, makeColor(newRed, newGreen, newBlue))
```

4. How does the following edge detection code work?

```
def edgeDetector(pict):
    """ Draws a black-and-white line drawing using edge detection. """
    for x in range(getWidth(pict)-1):
        for y in range(1,getHeight(pict)-1):
            here = getPixel(pict, x, y)
            down = getPixel(pict, x, y+1)
            right = getPixel(pict, x+1, y)

            hereLum = (getRed(here)+getGreen(here)+getBlue(here))/3
            downLum = (getRed(down)+getGreen(down)+getBlue(down))/3
            rightLum = (getRed(right)+getGreen(right)+getBlue(right))/3

            if abs(hereLum - downLum) > 10 and abs(hereLum - rightLum) > 10:
                setColor(here, black)
            if abs(hereLum - downLum) <= 10 or abs(hereLum - rightLum) <= 10:
                setColor(here, white)
```



b) Could we make the body of the second if-statement the else of the first if-statement without changing the results?