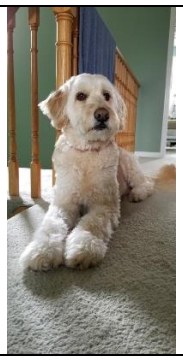
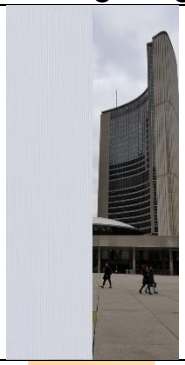
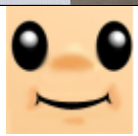
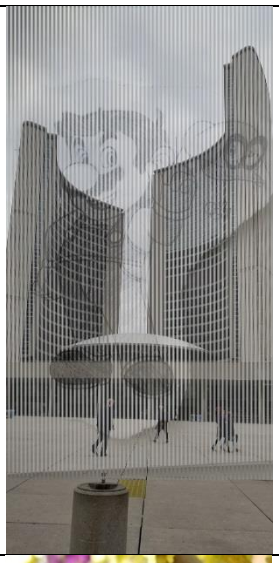
CPS109 Assignment #1

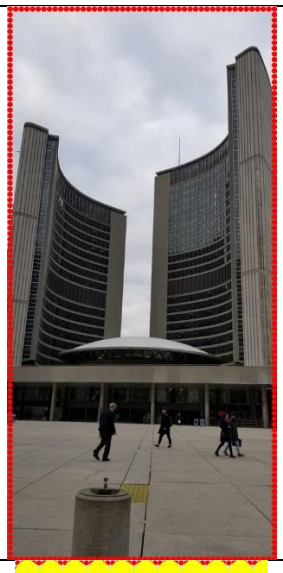
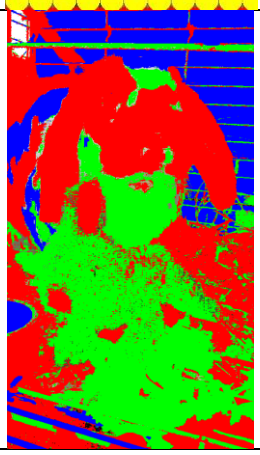
Owen Goodwin (500909196)

The Original Images					
					
cityhall	mario	grasshopper	bup	dog	bunny

Function	Given Parameters	Resulting Image
dougFord(img) where: *img* is the given image	cityhall	
reduce(img) where: *img* is the given image	bup	 (the original image is 128x128, this one is 64x64)
nightAndDay(img) where: *img* is the given image	dog	

negateHalf(img) where: *img* is the given image	dog	
shift(img,factor) where: *img* is the given image *factor* is the number of pixels to shift he image by	bup,24	
addColour(img) where: *img* is the given image	mario	
diagonalSplit(img) where: *img* is the given image	bunny	

combine(img1,img2) where: *img1 and img2* are the given images	cityhall,mario	
fall(img) where: *img* is the given image	grasshopper	
greyBox(img,startX,endX,startY,endY) where: *img* is the given image *startX* is the left bound of the box *endX* is the right bound of the box *startY* is the top bound of the box *endY* is the bottom bound of the box	dog,100,300,100,300	

styleBorder(img,col) where: *img* is the given image *col* is the colour for the border	cityhall,red	
styleBorder2(img,col,rad) where: *img* is the given image *col* is the colour for the border *rad* is the radius of the circles	cityhall,yellow,45 note: this was done on top of the previous output image	
triColour(img) where: *img* is the given image	bunny	

greyHare(img) where: *img* is the given image	bunny	
rot90CCW(img) where: *img* is the given image	mario	
flipBox(img,startX,endX,startY,endY) where: *img* is the given image *startX* is the left bound of the box *endX* is the right bound of the box *startY* is the top bound of the box *endY* is the bottom bound of the box	grasshopper,100,400,100,400	
recursiveRed(img,startX,endX,startY,endY) where: *img* is the given image *startX* is the left bound of the box *endX* is the right bound of the box *startY* is the top bound of the box *endY* is the bottom bound of the box	mario,0,479,0,852	

subtractCol(img,r,g,b) where: *img* is the given image *r, g,* and *b* are the components of the colour to subtract	grasshopper,128,0,128	
triColour2(img,factor) where: *img* is the given image *factor* is the number of pixels to alter before switching methods	bunny,14	

Source:

Full function descriptions and documentation is contained within.

```
cityhall = makePicture("C:\\Users\\Owen\\Documents\\Uni\\CPS109\\cityhall-min.jpg")
mario = makePicture("C:\\Users\\Owen\\Documents\\Uni\\CPS109\\mario-min.jpg")
grasshopper = makePicture("C:\\Users\\Owen\\Documents\\Uni\\CPS109\\grasshopper-min.jpg")
bup = makePicture("C:\\Users\\Owen\\Documents\\Uni\\CPS109\\bup.png")
dog = makePicture("C:\\Users\\Owen\\Documents\\Uni\\CPS109\\dog-min.jpg")
bunny = makePicture("C:\\Users\\Owen\\Documents\\Uni\\CPS109\\bunny-min.jpg")

# This function will cut City Hall in half. Why does that sound familiar?
def dougFord(img):
  skyCols = []#Initialize an empty array
  for i in range(getWidth(img)-1):#Loop through each column of the image...
    skyCols.append(getColor(getPixel(img, i, 0)))#...adding the color of each pixel in the first
10 rows of that colum to that array.
    skyCols.append(getColor(getPixel(img, i, 1)))#This is under the assumption that the top bit
of the image is sky.
    skyCols.append(getColor(getPixel(img, i, 2)))
    skyCols.append(getColor(getPixel(img, i, 3)))
    skyCols.append(getColor(getPixel(img, i, 4)))
    skyCols.append(getColor(getPixel(img, i, 5)))
    skyCols.append(getColor(getPixel(img, i, 6)))
    skyCols.append(getColor(getPixel(img, i, 7)))
    skyCols.append(getColor(getPixel(img, i, 8)))
    skyCols.append(getColor(getPixel(img, i, 9)))
  n = 0#Counter var
  for x in range(getWidth(img)/2):#Loop through each column in the left half of the image
    for y in range(getHeight(img)-1):#Loop through each row in the column
      setColor(getPixel(img,x,y), skyCols[n])#Set the colour of the current pixel to one of the
colours we collected in our array
```

```
      n = n+2#Increase our counter by 2
      if n>=len(skyCols):#If our counter is too high...
        n = n-len(skyCols)#Loop back around
  return img

#This function will reduce the size of an image by half
#Ex. If the input image is 128x128, the output image will be 64x64
def reduce(img):
  xOld = yOld = xNew = yNew = 0#These represent our current x-y coords in both the new and old
images. We start them at 0
  newimg = makeEmptyPicture(getWidth(img)/2, getHeight(img)/2)#Create a new empty image, half the
size of the old one
  while(true):#infinite loop
    px1 = getPixel(img, xOld,yOld)#Here we grab 4 pixels, like this....
    px2 = getPixel(img, xOld+1,yOld)#        px1|px2
    px3 = getPixel(img, xOld,yOld+1)#        ---|---
    px4 = getPixel(img, xOld+1,yOld+1)#      px3|px4
    r = (getRed(px1) + getRed(px2) + getRed(px3) + getRed(px4))/4#Take the average red value of
the 4 pixels
    g = (getGreen(px1) + getGreen(px2) + getGreen(px3) + getGreen(px4))/4#Do the same with the
green and blue values
    b = (getBlue(px1) + getBlue(px2) + getBlue(px3) + getBlue(px4))/4
    setColor(getPixel(newimg, xNew, yNew), makeColor(r,g,b))#Set the colour of the current pixel
in the new image to a colour created from the average values just taken
    xOld = xOld+2#Increase our x-value for the old picture by 2, since we already took care of
the pixel beside the old x-value
    if(xOld >= getWidth(img)-1):#If that new x-value is beyond the width of the old image...
      xOld = 1#Reset to 1. This is because if we reset to 0, our image will come out slanted, and
while that may look cool it's not what we want.
      yOld = yOld+2#Increase current y-value by 2, for the same reason we do it for the x-value
    xNew = xNew+1#Add one to our x-value in the new image
    if(xNew >= getWidth(newimg)-1):#Again, if we've gone beyond the bounds of the image...
      xNew=0#reset to 0
      yNew=yNew+1#go to the next row
    if(yOld >= getHeight(img) or yNew >=getHeight(newimg)):#Check if we've gone beyond the height
of either image, which would indicate that we're done here
      break#end the loop
  return newimg

#This function will alternate setting a pixel either lighter or darker, resulting in something
quite ugly
def nightAndDay(img):
  darken = true#Start off by darkening the pixel. If this is false, we lighten the pixel
  for px in getPixels(img):#Loop through each pixel
    if darken:#If we're supposed to darken it...
      setColor(px, makeDarker(getColor(px)))#...darken it
      darken = false#...make the next one lighter
    else:#Otherwise, we're supposed to make it lighter...
      setColor(px, makeLighter(getColor(px)))#...so do that
      darken = true#Make the next one darker

  for px in getPixels(img):#Here I'm repeating the same loop simply to make the effect a bit more
obvious
    if darken:
      setColor(px, makeDarker(getColor(px)))
      darken = false
```

```
    else:
      setColor(px, makeLighter(getColor(px)))
      darken = true
  return img

#Sort of similar to the last one, here we negate every other pixel for a true monstrosity
def negateHalf(img):
  negate = true#Start by negating
  for px in getPixels(img):#Loop through each pixel
    if negate:#If we're supposed to negate this pixel...
      setColor(px, makeColor(255-getRed(px), 255-getGreen(px), 255-getBlue(px)))#then do it
      negate = false#don't negate the next one
    else:#Otherwise we're not negating this pixel
      negate = true#just chill and negate the next one
  return img

#This function will shift an image horizontally by a specified number of pixels ('factor')
def shift(img, factor):
  newImg = makeEmptyPicture(getWidth(img),getHeight(img))#Create a new image to work with
  pixels = []#Empty array to store all of our pixels in
  for px in getPixels(img):#loop through each pixel
    pixels.append(px)#add it to the array
  #yes, I am totally aware that for loop was totally redundant. I did it anyways.
  for i in range(len(pixels)-1):#Loop through each index in our array
    j = i + factor#find the pixel x units ahead of this one (if factor is 5, find the pixel 5
ahead of this one)
    if(j>len(pixels)-1):#If we go beyond the bounds of the array...
      j=j-len(pixels)-1#Loop back around to the beginning
    temp = pixels[i]#Swap the two pixels
    pixels[i] = pixels[j]
    pixels[j] = temp
  i = 0#counter var
  for px in getPixels(newImg):#Loop through each pixel in our blank new image
    setColor(px, getColor(pixels[i]))#Get the colour from the current index in the array, and set
it to the current pixel
    i = i+1#Increase our counter
  return newImg

#This function will check if the sum of the R,G,and B values of a pixel is over a specified
value, and if it is, turn that pixel green.
def sum(img, value):
  for px in getPixels(img):#Loop through each pixel
    if(getRed(px)+getGreen(px)+getBlue(px)>value):#if the sum of r+g+b is greater than the
specified value,
      setColor(px, makeColor(0,255,0))#Set the colour of the current pixel to green
  return img

#This function will add colour to a pencil drawing of Mario
def addColour(img):
  for px in getPixels(img):
    if getX(px) < 250 and getX(px) > 200 and getY(px) < 630 and getY(px) > 360 and getRed(px) >
100 and getGreen(px) > 100 and getBlue(px) > 100 and getRed(px) < 150 and getGreen(px) < 150 and
getBlue(px) < 150:
      setColor(px, makeColor(0,0,255))
```

```
    elif getX(px) < 310 and getY(px) < 630 and getY(px) > 385 and getRed(px) > 100 and
getGreen(px) > 100 and getBlue(px) > 100 and getRed(px) < 150 and getGreen(px) < 150 and
getBlue(px) < 150:
      setColor(px, makeColor(0,0,255))
    elif getX(px) < 310 and getX(px) > 170 and getY(px) < 630 and getY(px) > 475 and getRed(px) >
100 and getGreen(px) > 100 and getBlue(px) > 100 and getRed(px) < 175 and getGreen(px) < 175 and
getBlue(px) < 175:
      setColor(px, makeColor(0,0,255))
    elif getY(px) < 360 and getY(px) > 170 and getRed(px) > 90 and getGreen(px) > 90 and
getBlue(px) > 90 and getRed(px) < 140 and getGreen(px) < 140 and getBlue(px) < 140:
      setColor(px, makeColor(131,92,59))
    elif getY(px) < 700 and getY(px) > 610 and getRed(px) > 90 and getGreen(px) > 90 and
getBlue(px) > 90 and getRed(px) < 140 and getGreen(px) < 140 and getBlue(px) < 140:
      setColor(px, makeColor(131,92,59))
  return(img)

#This is a bit of an odd one. I can't really put into words what exactly the purpose of it is.
def diagonalSplit(img):
  newImg = img#Create a copy of the input image
  i = 1#Counter var
  x = getWidth(img)-i#Our x will start at the far right side of the image, since we start i at 1.
As i increases, our starting x position will decrease.
  y = 0#Starting at the top of the image
  while(true):#Infinte loop
    px1 = getPixelAt(img, x, y)#Get the pixel at the current x-y coord
    px2 = getPixelAt(newImg, y, x)#swap the x-y coord, and get the pixel at that new location in
the copy of the image
    setColor(px2, getColor(px1))#Set the color of the pixel from the copy to the color of the
pixel form the original
    x = x-1#Move left 1 pixel
    if x<0:#If we've gone beyond the left edge of the image...
      i = i+1#Increase our counter
      x = getWidth(img)-i#Get our new starting x position
      y = y+1#Move down to the next row
      if y == getHeight(img) or x<0:#If we've reached the bottom of the image, or our starting x
position is less than 0, we're done!
        break#Get outta here
  return newImg

#Here we will combine two images
def combine(img1, img2):
  maxW = getWidth(img2)#We set the maximum width and height to the width and height of the second
image...
  maxH = getWidth(img2)
  if getWidth(img1)>getWidth(img2):#...however we check if the width and height of the first
image are greater and adjust our maximums accordingly.
    maxW = getWidth(img1)
  if getHeight(img1)>getHeight(img2):
    maxH = getHeight(img1)

  imgOut = makeEmptyPicture(maxW,maxH)#Create a new blank image with the maximum dimensions, this
will ensure both images can fit on our output image
  x = 0#Starting at position (0,0)
  y = 0
  while(true):#Infinite loop
```

```
    if (x <= getWidth(img1)-1) and (y <= getHeight(img1)-1) :#Check if we are in the bounds of
image 1
      setColor(getPixelAt(imgOut, x, y), getColor(getPixelAt(img1, x,y)))#if so, set the pixel at
(x,y) to the colour at the same position in image 1
    else:
      setColor(getPixelAt(imgOut, x, y), getColor(getPixelAt(img2, x,y)))#if we are outside the
bounds of image 1, we resort to using the colour at that position in image 2
    x = x+1#Move right one pixel
    if x > maxW-1:#Check if we have gone beyond the bounds of the output image
      x = 0#If so, reset our x to 0
      y = y+1#and move down one row
      if y > maxH-1:#check if moving down 1 row put us outside again
        break#If so, we're done! Woohoo!
    if (x <= getWidth(img2)-1) and (y <= getHeight(img2)-1):#Check if we're in the bounds of
image 2 now
      setColor(getPixelAt(imgOut, x, y), getColor(getPixelAt(img2, x,y)))#if so, set the color at
(x,y) in the output image to the color of the same position in image 2
    else:
      setColor(getPixelAt(imgOut, x, y), getColor(getPixelAt(img1, x,y)))#Otherwise, we resort to
taking the color from image 1
    x = x+1#move right one pixel again
    if x > maxW-1:#Same out-of-bounds checks as above
      x = 0
      y = y+1
      if y > maxH-1:
        break
  return imgOut

#Assuming the input has some green leaves in it, this function will result in some lovely fall
colours. Maybe.
def fall(img):
  for px in getPixels(img):#Loop through each pixel
    if(getGreen(px)>getRed(px) and getGreen(px)>getBlue(px)):#Check if green is the dominant
colour in that pixel
      setColor(px, makeColor(getGreen(px)+5,getRed(px),getBlue(px)))#if so, we swap the red and
green, and add 5 to the new red
  return img

#This function takes 4 ints as input, which we will use to define a rectangle
def greyBox(img, startX, endX, startY, endY):
  for px in getPixels(img):#Loop through each pixel
    if getX(px) in range(startX,endX) and getY(px) in range(startY,endY):#Check if we are in the
bounds of that arbitrary rectangle
      i = (getRed(px)+getGreen(px)+getBlue(px))/3#If so, we greyscale that pixel
      setColor(px,makeColor(i,i,i))#This calculation is pretty standard, nothing fancy
  return img

#This function will make a border of little circles around the edge of an image, in a specified
colour.
def styleBorder(img,col):
  x = 0#starting at the top left of the image
  y = 0
  while(y<getHeight(img)):#Loop through each y value top to bottom
    addOvalFilled(img,x,y,10,10,col)#Add a circle (radius 10)
    y = y+10#Move down 10 pixels for the next one
  while(x<getWidth(img)):#Loop through each x value left to right
```

```
    addOvalFilled(img,x,y-10,10,10,col)#add a circle
    x = x+10#Move right 10 pixels
  while(y>0):#Loop through each y value bottom to top
    addOvalFilled(img,x-10,y,10,10,col)#I think you know how this works by now
    y = y-10
  while(x>0):#Loop through each x value right to left
    addOvalFilled(img,x,y,10,10,col)#If you haven't realized by now that we are making our way
around the edges of the image counterclockwise, adding circles as we go, I'm ashamed of you.
    x = x-10
  return img

#This function is IDENTICAL to the previous one, with the only exception being that you now
specify the radius ('rad'), instead of us setting it to 10 for you. Documentation not needed.
def styleBorder2(img,col,rad):
  x = 0
  y = 0
  while(y<getHeight(img)):
    addOvalFilled(img,x,y,rad,rad,col)
    y = y+rad
  while(x<getWidth(img)):
    addOvalFilled(img,x,y-rad,rad,rad,col)
    x = x+rad
  while(y>0):
    addOvalFilled(img,x-rad,y,rad,rad,col)
    y = y-rad
  while(x>0):
    addOvalFilled(img,x,y,rad,rad,col)
    x = x-rad
  return img

#The name of this function is a lie. Basically it checks if any of the components (r, g, b) are
greater than the other two, and if so, sets the pixel to that color.
#But what if they're equal? ???????????
def triColour(img):
  for px in getPixels(img):#Loop through each pixel
    if(getRed(px)>getGreen(px) and getRed(px)>getBlue(px)):#if red is the dominant color...
      setColor(px,makeColor(255,0,0))#set it to red
    elif(getGreen(px)>getRed(px) and getGreen(px)>getBlue(px)):#if green is the dominant color...
      setColor(px,makeColor(0,255,0))#set it to green
    elif(getBlue(px)>getRed(px) and getBlue(px)>getGreen(px)):#if blue is the dominant color...
      setColor(px,makeColor(0,0,255))#set it to purple
      #kidding
  return img

#This will change Archie's ginger fur to grey
def greyHare(img):
  for px in getPixels(img):#Loop through each pixel
    if 100<getRed(px)<200 and 85<getGreen(px)<190 and 60<getBlue(px)<175:#Check if the components
are within the rnage that would signify the colour of his fur
      i = (getRed(px)+getGreen(px)+getBlue(px))/3#greyscale that pixel
      setColor(px,makeColor(i,i,i))
  return img

#This will rotate an image 90 degrees counterclockwise. Rotating it the other way would require
just a few simple changes to this
def rot90CCW(img):
```

```
  imgOut = makeEmptyPicture(getHeight(img),getWidth(img))#Make an empty picture we will fill
later
  x = y = 0#start at (0,0)
  while(y<getHeight(img)):#Loop
    setColor(getPixelAt(imgOut,y,x),getColor(getPixelAt(img,x,y)))#set the color at the flipped
coordinates in the empty image to the color at the proper coordinates in the original image
    x = x+1#move to the next pixel right
    if x>=getWidth(img)-1:#Check if we've gone out of bounds
      x = 0#if so, reset to 0
      y = y+1#and move down one row
  return imgOut

#This one allows the user to specify a rectangle like the greyscale one from earlier, but now
we're gonna fli the box's contents horizontally
def flipBox(img, startX,endX,startY,endY):
  imgOut = img#Copy of the original image to work with
  for px in getPixels(img):#Loop through each pixel
    if(getX(px) in range(startX,endX) and getY(px) in range(startY,endY)):#Check if the current
pixel is within the box
      setColor(getPixelAt(imgOut,endX-getX(px)+startX,getY(px)),getColor(px))#Set the pixel (in
the output image) at the opposite position of the current one (in the input image) to the color
of the current one
      #|12345678|
      #Looking at the line above, we would take the color of pixel #1 in the original image and
apply it to pixel #8 in the output image
      #Afterwards, we would repeat the process, applying the color of #2 to #7, and so forth
  return imgOut

#Who doesn't love recursion?
#Who doesn't love recursion?
#Who doesn't love recursion?
#Who doesn't love recursion?
#Who doesn't love recursion?
#Who doesn't love recursion?
#Base case: This function takes 4 ints in order to define a rectangle, which we will make redder
recursively because why not
def recursiveRed(img,startX,endX,startY,endY):
  for px in getPixels(img):#Loop through each pixel
    if (getX(px) in range(startX,endX) and getY(px) in range(startY,endY)):#Check if the pixel is
within the bounds of the box
      setColor(px, makeColor(getRed(px)+20,getGreen(px),getBlue(px)))#Increase the pixel's r
value by 20
  if startX==endX==startY==endY:#Base case: our box has become 0x0
    return img#We're done
  else:#keep going!
    return recursiveRed(img,startX,endX/2,startY,endY/2)#Do it again with a box half the size

#This takes in a color as r, g, and b values, and subtracts that from each pixel.
def subtractCol(img,r,g,b):
  for px in getPixels(img):#Loop through each pixel
    setColor(px,makeColor(getRed(px)-r,getGreen(px)-g,getBlue(px)-b))#Subtract the given rgb
values from the pixel's rgb values
  return img

#No relation to the first triColour. Basically, we go through each pixe and switch up the pixel's
rgb values. The way this is done is influenced by the int 'factor'
```

```
def triColour2(img, factor):
  i = 0#Counter
  phase = 0#Int that determines the order we switch the r, g and b
  for px in getPixels(img):#Loop through each pixel
    if phase == 0:#Phase = 0: B,R,G
      setColor(px, makeColor(getBlue(px),getRed(px),getGreen(px)))
    elif phase == 1:#phase = 1: G,R,B
      setColor(px, makeColor(getGreen(px),getRed(px),getBlue(px)))
    elif phase == 2:#Phase = 2: B,G,R
      setColor(px, makeColor(getBlue(px),getGreen(px),getRed(px)))
    elif phase == 3:#Phase = 3: G,B,R
      setColor(px, makeColor(getGreen(px),getBlue(px),getRed(px)))
    elif phase == 4:#Phase = 4: R,B,G
      setColor(px, makeColor(getRed(px),getBlue(px),getGreen(px)))
    i = i+1#Increase our counter each time
    if i%factor==0:#Check if the counter is divisible by the factor
      phase = phase+1#If so, use the next phase
      if phase==5:#if phase = 5, loop back to 0
        phase = 0
      #Checking for divisibility means that if the factor is 62, we will change phases every 62
pixels
  return img
```