COMP120: Workshop

3: Tinkering Graphics III

Learning Outcomes

- **Explain how** to duplicate parts of an image
- **Explain how** to identify the spaces and features of an image
- **Apply** mathematical knowledge to **write** computer programs that manipulate the spaces and features of an image
- **Implement** executable code that can `tinker' graphics

Mirroring

- Mirroring is averaging across pixels
- A mirror will:
  - Define a dimension of inflexion
  - Duplicate pixels from the one side of the inflextion to the other, in reverse order


mediasources\blueMotorcycle.jpg
Zoom
X:
0
Y:
0
R: 73 G: 81 B: 32 Color at location:

Source Code: Mirroring (1)

```
def mirror_vertical(picture):
  width = get_width(picture)
  height = get_height(picture)
  mirror_point = width / 2
  for y in xrange(0, height):
      for x in xrange(0, mirror_point):
          left_pixel = get_pixel(picture, x, y)
          right_pixel = get_pixel(picture, width - x - ↩
              1, y)
          set_colour(right_pixel, get_colour( ↩
              left_pixel))
```

Source Code: Mirroring (2)

```
def mirror_vertical(picture):
  width = get_width(picture)
  height = get_height(picture)
  mirror_point = height / 2
  for x in xrange(0, width):
      for y in xrange(0, mirror_point):
          top_pixel = get_pixel(picture, x, y)
          bottom_pixel = get_pixel(picture, x, height
              - y - 1)
          set_colour(bottom_pixel, get_colour(
              top_pixel))
```

Activity #1: Mirroring

In pairs:

- Use your function to repair the temple
- 20 minutes
- Post your repaired temple on Slack!

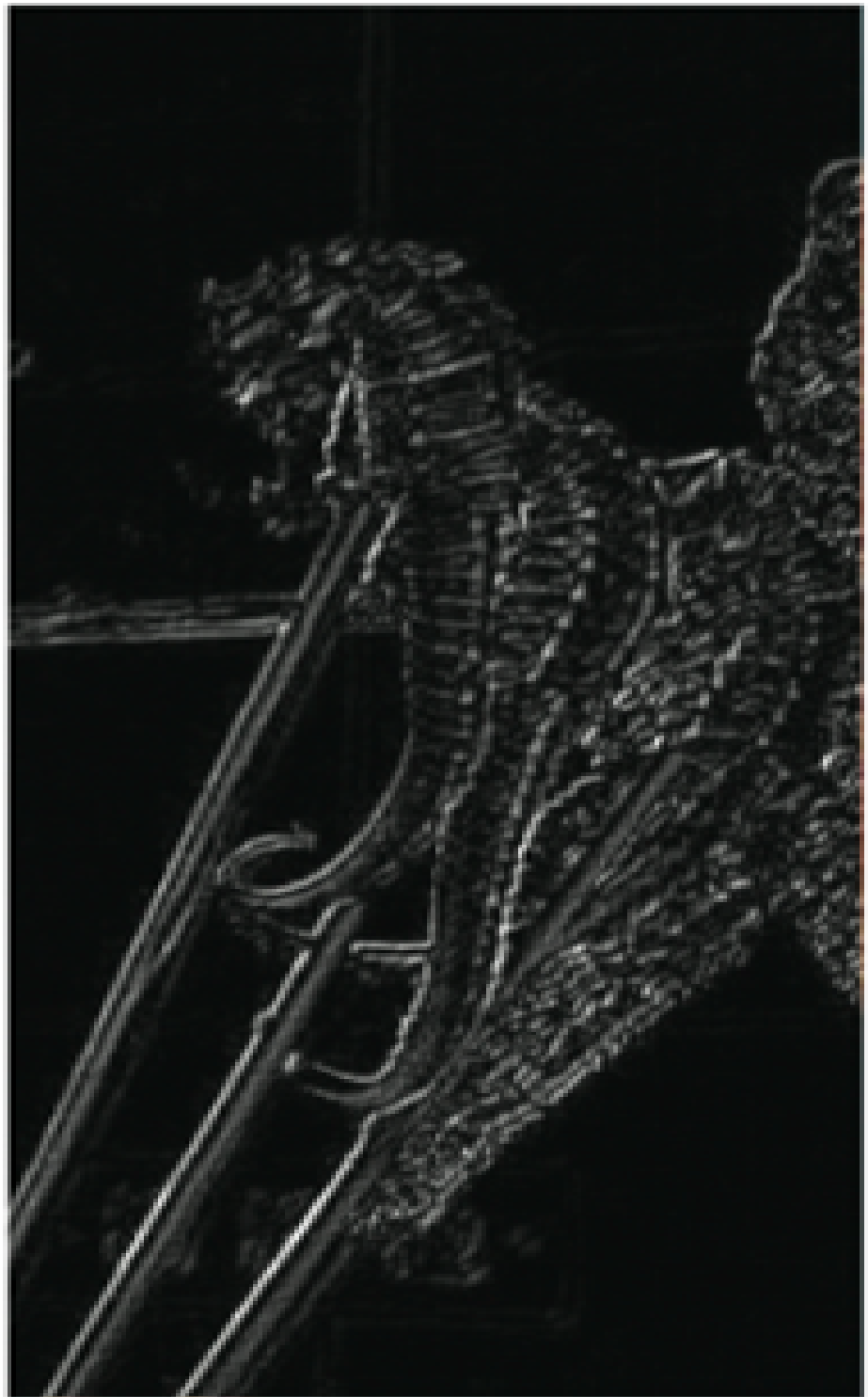
Edge Detection

- Blurring is averaging across pixels
- Edge detection is looking for *differences* between pixels:
  - We draw lines that our eyes see — where the luminance changes
- If the pixel changes left-to-right, or up-and-down, make a pixel black. Else, white.

Source Code: Edge Detection

```
def drawEdges(picture):
  for x in xrange(0, picture.length - 1):
      for y in xrange(0, picture.height - 1):
          pixelSum = getRed(pixel) + getGreen(pixel) + ↩
               getBlue(pixel)
          nextPixel = getPixel(picture, x+1, y+1)
          nextPixelSum = getRed(nextPixel)+ getGreen( ↩
              nextPixel) + getBlue(nextPixel)
          diff = abs(nextPixelSum-pixelSum)
          newColor = makeColor(diff,diff,diff)
          setColor(pixel, newColor)
```

Note: This source code excerpt will not work in PyGame.



Source Code: Edge Detection (1)

```
def drawBetterEdges(picture):
  orig = makePicture(filename)
  makeBw = makePicture(filename)

  for x in xrange(0,getWidth(picture)-1):
    for y in xrange(0,getHeight(picture)-1):
      here=getPixel(makeBw,x,y)
      down=getPixel(orig,x,y+1)
      right=getPixel(orig,x+1,y)

      hereL=(getRed(here)+getGreen(here)+getBlue(here)
          )/3
      downL=(getRed(down)+getGreen(down)+getBlue(down)
          )/3
      rightL=(getRed(right)+getGreen(right)+getBlue(
          right))/3
...
```

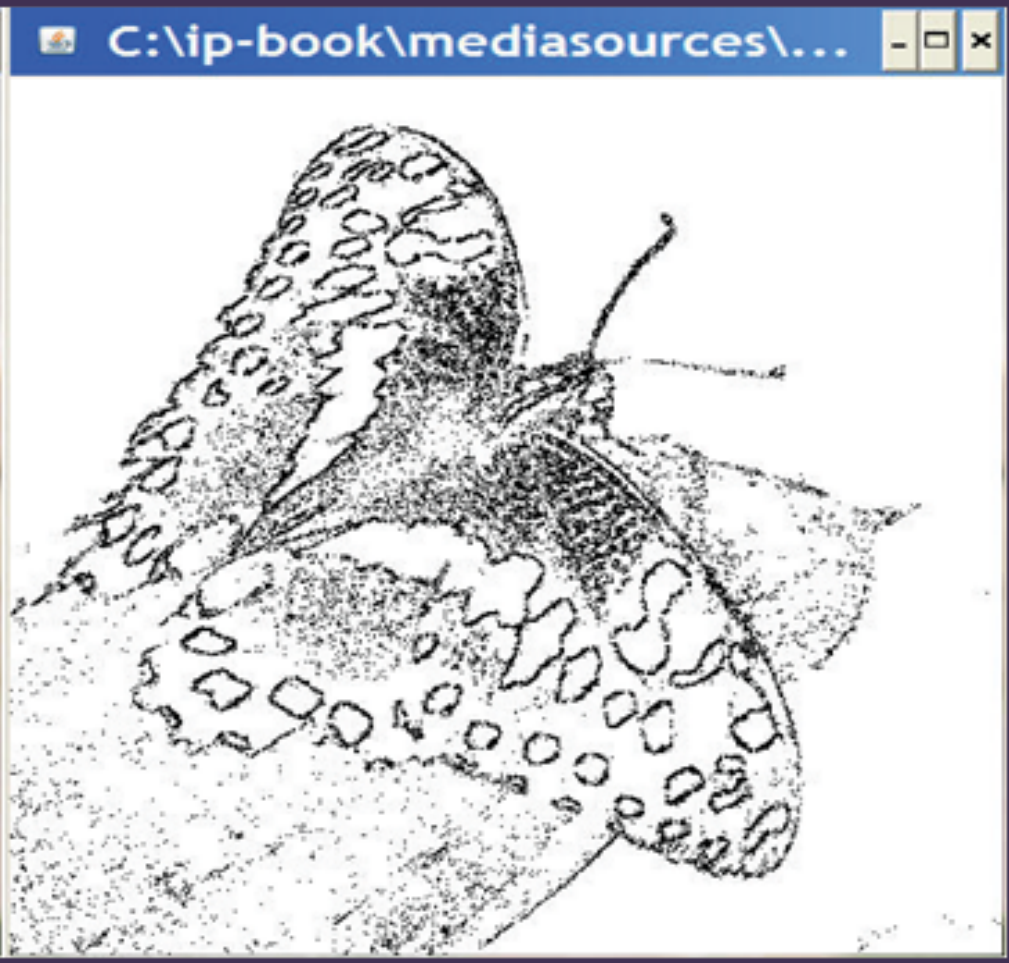
Note: This source code excerpt will not work in PyGame.

Source Code: Edge Detection (2)

```
...
      if abs(hereL-downL)>10 and abs(hereL-rightL)>10:
        setColor(here,black)
      if abs(hereL-downL)<=10 and abs(hereL-rightL) ↩
          <=10:
        setColor(here,white)
  return makeBw
```

Note: This source code excerpt will not work in PyGame.


C:\ip-book\mediasources\...


C:\ip-book\mediasources\...

Activity #2: Edge Detection

In pairs:

- Setup a basic project in PyGame
- Refer to the following documentation
- Refactor the function: `drawBetterEdges(picture)` to use better variable names
- Test your solution

Background Subtraction

- Let's say that you have a picture of someone, and a picture of the same place (same background) without the someone there, could you subtract out the background and leave the picture of the person?
- Maybe even change the background?
- What we most need to do is to figure out whether the pixel in the Person shot is the same as the in the Background shot.
- Will they be the EXACT same colour? Probably not.

Source Code: Background Subtraction

```
def swapBackground(picture, back, newBack, tolerance):
  for pixel in getPixels(picture):
    x = getX(pixel)
    y = getY(pixel)
    backPixel = getPixel(back, x, y)
    pixelColour = getColour(pixel)
    backColour = getColour(backPixel)
    if (distance(pixelColour,backColour) < tolerance):
      newColour = getColour(getPixel(newBack, x, y))
      setColor(pixel, newColour)
```

Note: This source code excerpt will not work in PyGame.

Problems

- We've got places where we got pixels swapped that we didn't want to swap
- We've got places where we want pixels swapped, but didn't get them swapped
  - Shirt stripes
  - Shadows
  - etc.

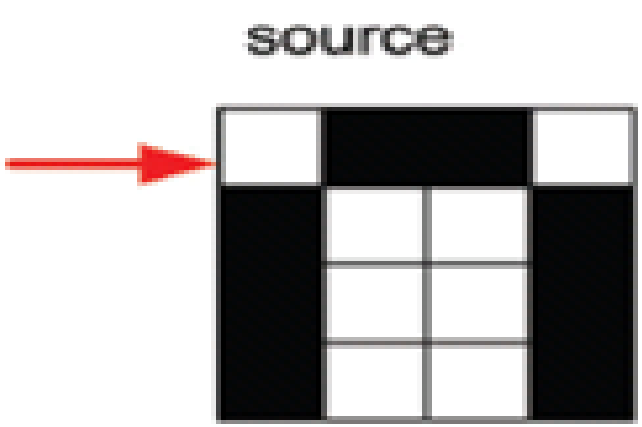
Activity #3: Background Subtraction

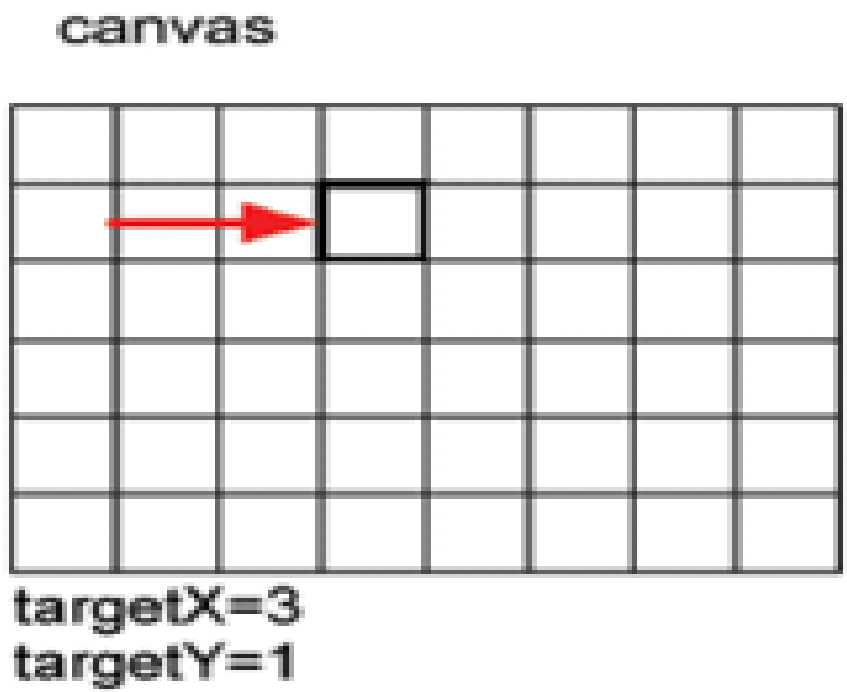
In pairs:

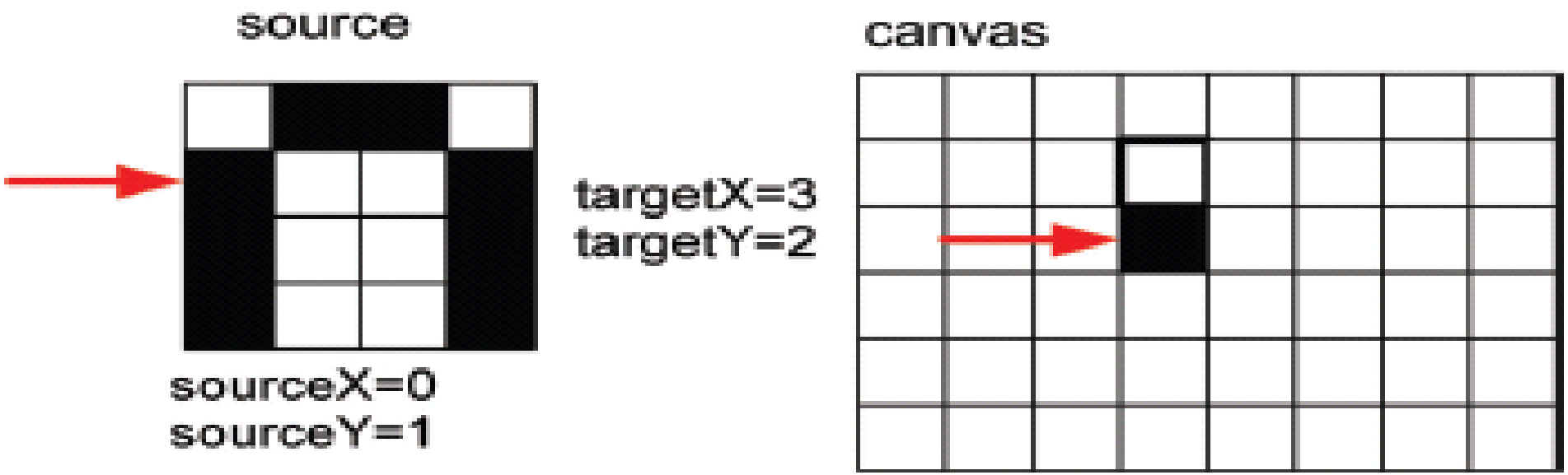
- Setup a basic project in PyGame
- Refer to the following documentation:
  - `http://www.cs.utah.edu/~michael/chroma/`
- Implement chroma key as a form of background subtraction
- Test your solution

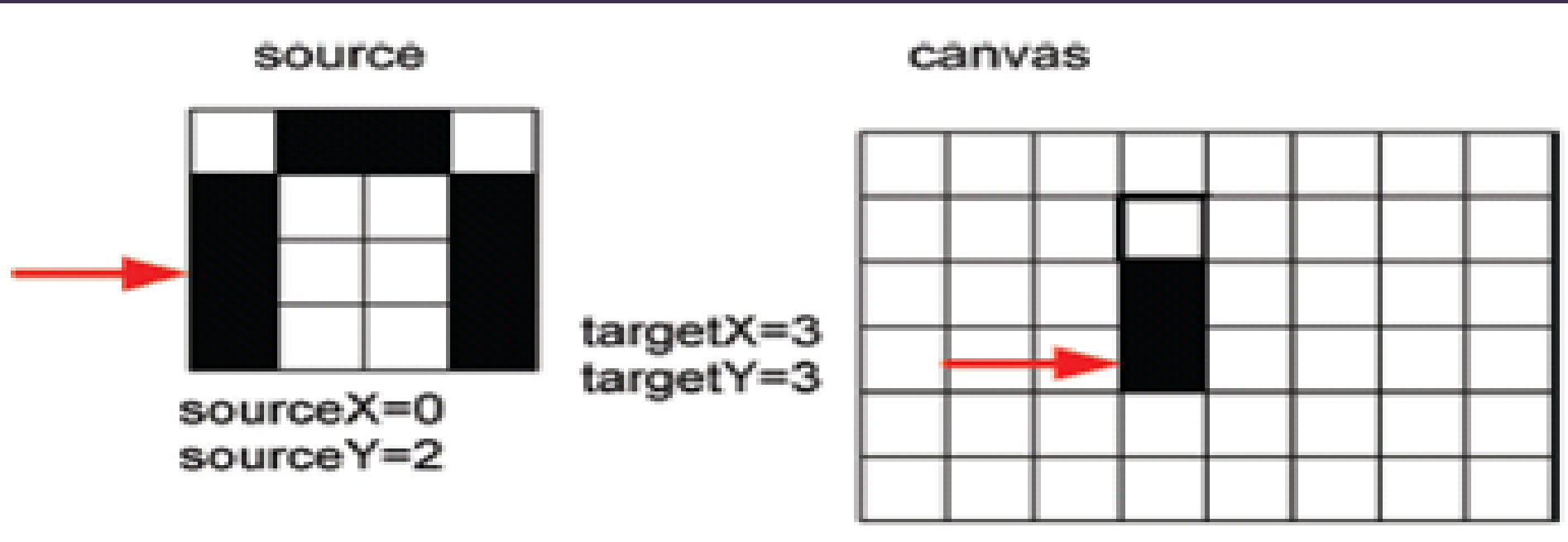
Source Code: Collage

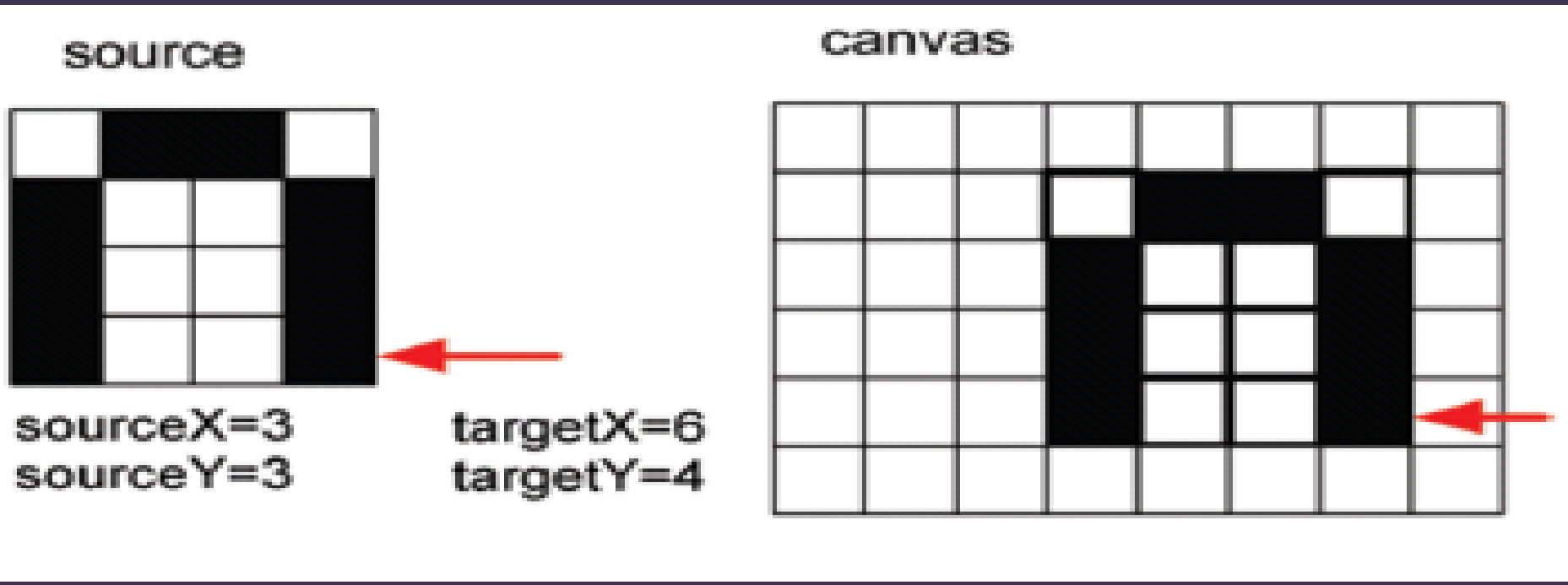
```
def copyBarb():
  # Set up the source and target pictures
  barbf=getMediaPath("barbara.jpg")
  barb = makePicture(barbf)
  canvasf = getMediaPath("7inX95in.jpg")
  canvas = makePicture(canvasf)
  # Now, do the actual copying
  targetX = 0
  for sourceX in range(0,getWidth(barb)):
    targetY = 0
    for sourceY in range(0,getHeight(barb)):
      color = getColor(getPixel(barb,sourceX,sourceY))
      setColor(getPixel(canvas,targetX,targetY), color
          )
      targetY = targetY + 1
    targetX = targetX + 1
  show(barb)
  show(canvas)
  return canvas
```

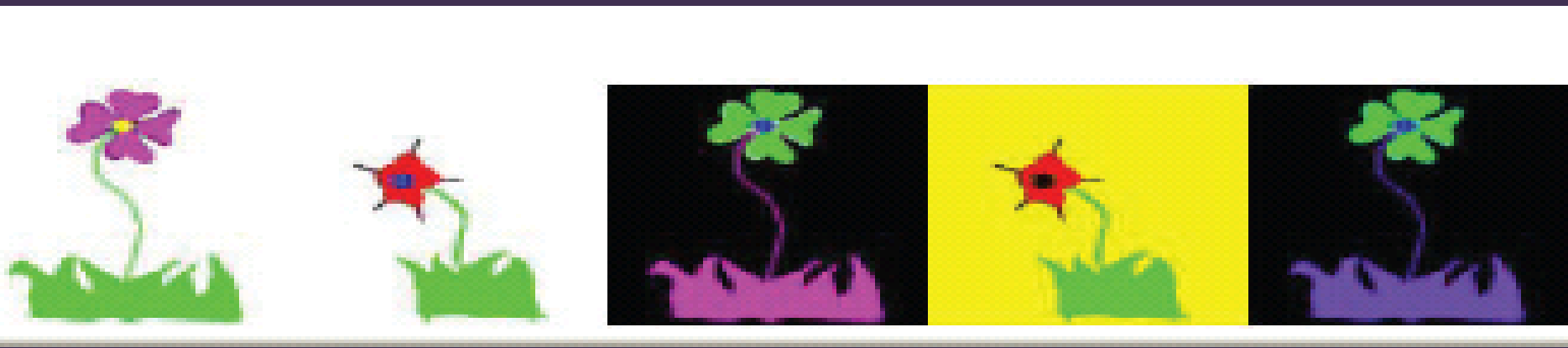

source
sourceX=0
sourceY=0


canvas
targetX=3
targetY=1


source
canvas
targetX=3
targetY=2
sourceX=0
sourceY=1


source
canvas
targetX=3
targetY=3
sourceX=0
sourceY=2


source
canvas
sourceX=3
sourceY=3
targetX=6
targetY=4



Activity #4: Collage

In pairs:

- Find some smaller images online
- Integrate the copy algorithm into your tinkering graphics project
- Create a collage of the images you found

Sprite Sheets and Animations

Review Al Swigart's pyganim python module:

`http://inventwithpython.com/pyganim/`

Activity #5: Sprite Sheets

In pairs:

- Find a sprite sheet online
- Integrate pyganim into your tinkering graphics project
- Animate something

What Next?

If you have implemented all of these algorithms, then use the rest of the workshop to:

- You now have a range of image manipulation algorithms at your disposal
- You only need to successfully implement and repurpose a set of these to do well on your Tinkering Graphics assignment!
- So, finish implementing the algorithms needed to complete your coursework
- Tidy up your code, ready for next session's peer-review activity
- Extend the code beyond the brief as appropriate to your particular game