Solutions

1. [10] What is the output of the following program? Write your answer in the box. (Hint: Take your time and be careful. Just “play computer” and trace the program on paper like we've done in class.)

   count = 0
   i = 0
   while count < 5:
      if i % 5 == 0 or i % 3 == 0:
          count = count + 1
      print i,
   i = i + 1

   0 3 5 6 9

2. [10] Write a Python program that produces the image below in a 255-by-255 window. The upper left corner is black and the lower right corner is white.

   Solution:
   This one was a little tricky because you had to see that you needed to draw 512 diagonal lines, not 256. And you also needed to be careful about the color and scale it appropriately to make sure the RGB values didn't go over 255.

   import pygame
   pygame.init()
   window = pygame.display.set_mode((255,255))

   # draw the upper triangle
   for i in range(256):
       pygame.draw.line(window, (i/2,i/2,i/2), (0,i), (i,0))
   pygame.display.update()

   # draw the lower triangle
   for i in range(256):
       pygame.draw.line(window, (128+i/2, 128+i/2,128+i/2), (i,255), (255,i))
   pygame.display.update()
3. [10] Assume we have a Pygame surface named `surf`. Write a short Python code segment that makes the pixel in the center of the surface black if the amount of red and green in that pixel are equal.

Solution:

```python
x = surf.get_width()/2
y = surf.get_height()/2
color = surf.get_at((x,y))
if color.r == color.g:
    surf.set_at((x,y),(0,0,0))
```

4. [10] What is the output of the following python program. Write your answer in the box. Hint: take your time and be careful.

```python
for y in range(3):
    for x in range(4,y,-1):
        print y+x,
    print
```

```
4 3 2 1
5 4 3
6 5
```

5. [15] Assume a population of size $p$ grows at a rate $r$. Write a Python program that will print the size of the population after 20 years. The program should have the values for $p$ and $r$ be entered by the user from the keyboard.

Solution:

```python
p = input("please enter a population size: ")
r = input("please enter a growth rate: ")

for i in range(20):
    p = p + p*r

print p
```

6. [20] In order to encrypt a message in the green component of an image we must first “make room” in the image for the message by making all the green components even. Write a Python function named `makeRoom` that takes a pygame surface as a parameter and makes room for a message in the green component.

Solution:

```python
def makeRoom(pic):
    for y in range(pic.get_height()):
        for x in range(pic.get_width()):
            color = pic.get_at((x,y))
            if color.g % 2 == 1:
                pic.set_at((x,y),(color.r,color.g-1,color.b))
```
7. [15] Write a complete Python program that calls your function from problem 6 for the image named `image.png`. You do not need to repeat the definition of the function `makeRoom` in this question.

**Solution**

```python
import pygame
pygame.init()
image = pygame.image.load("image.png")
makeRoom(image)
```

8. [10] Assume we have the 3-by-3 image below with the given RGB color values and that we wish to hide the letter `L` in the image in the left most vertical column and bottom row.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(201,99,243)</td>
<td>(98,123,55)</td>
<td>(20,80,90)</td>
</tr>
<tr>
<td>(187, 102, 56)</td>
<td>(44, 56, 240)</td>
<td>(111, 255, 18)</td>
</tr>
<tr>
<td>(18, 97, 203)</td>
<td>(222, 42, 16)</td>
<td>(100, 101, 102)</td>
</tr>
</tbody>
</table>

What would the modified RGB color values for the resulting image be after encrypting the `L` in the green component. Write your answer in the table below.

**Solution:**

We first need to make room in the image, so if the green value is odd we need to subtract one to make it even. Here is the resulting image.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(201, <strong>98</strong>, 243)</td>
<td>(98,<strong>122</strong>, 55)</td>
<td>(<strong>20</strong>, 80, 90)</td>
</tr>
<tr>
<td>(187, <strong>102</strong>, 56)</td>
<td>(44, <strong>56</strong>, 240)</td>
<td>(111, <strong>254</strong>, 18)</td>
</tr>
<tr>
<td>(18, <strong>96</strong>, 203)</td>
<td>(222, <strong>42</strong>, 16)</td>
<td>(100, <strong>100</strong>, 102)</td>
</tr>
</tbody>
</table>

Now all the green values are even and we need to encode an `L` in the left column and bottom row. This just means changing all the even values in the left column and bottom row back to odd by adding one. Here is the resulting image final image with the encode `L`. Notice that it is very similar to the original image.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(201, <strong>99</strong>, 243)</td>
<td>(98, 122, 55)</td>
<td>(20, <strong>80</strong>, 90)</td>
</tr>
<tr>
<td>(187, <strong>103</strong>, 56)</td>
<td>(44, 56, 240)</td>
<td>(111, <strong>254</strong>, 18)</td>
</tr>
<tr>
<td>(18, <strong>97</strong>, 203)</td>
<td>(222, <strong>43</strong>, 16)</td>
<td>(100, <strong>101</strong>, 102)</td>
</tr>
</tbody>
</table>