

Assignment II (130 pts)

Goal of this assignment:

- Object Oriented Programming
- Getting familiar with the image processing libraries
- Getting acquainted with image creation/mask

Task I - Install the library numpy/scipy/matplotlib (5 pts)

We will be using numpy/scipy/matplotlib for a lot of assignments.

Take time to get familiar with these libraries.

Task II - Install the library PIL (5 pts)

We will be using numpy/scipy/matplotlib for a lot of assignments.

To show that you installed this library, just run the following import:

```
# if you are on 32 bit os
# import Image

# 64 bit with pillow:
from PIL import Image
import numpy as np
```

Task III - Install the library openCV (20 pts)

This task is much more difficult than the other tasks.

<http://opencv.org/downloads.html>

This library will help us to analyze images/video.

To show that you installed this library, just run the following import:

```
import cv2
```

Task IV – Enjoy your time with the PIL library (100pts)

1- Return to the future (10pts)

Mario Bros was born in July 14, 1983 (at least the first release of the video game).

An image of Mario Bros can be found in the zip file images.zip.

<https://piazza.com/uchicago/winter2017/msca32016/resources>

You will load this file in your python code and convert this image in Numpy array.
For that, you can use the following function:

```
i = Image.open('images/XXXX.png')  
iar = np.asarray(i)
```

If you print the array, you can see many numbers, they represent the colors (Red Green Blue) and one number for Alpha (transparency).

2- Santa Claus time (50pts)

Since you became an expert in image with the first question, it is time for you to create some Christmas trees. Don't forget that a Christmas tree, that's green.

- 1- Define a class Tree being the base class for all the trees. This base class has a constructor (you will define the different parameters you need later on). A tree has three main parts: leaves, trunk and root. The proportion of this tree will depend on the type of this tree (Christmas, Oval, Square) .
- 2- Define a derived class ChristmasTree being derived from the base class Tree. The constructor of this class will have the height, the proportion of each part of the tree (leaves, trunk, root).
- 3- Define the function DisplayTree for the class ChristmasTree displaying a christmas tree on the screen.

Please try to be simple in the approach of creating a tree. Just use a simple algorithm such as the one used in this URL:

<http://stackoverflow.com/questions/13408728/drawing-a-christmas-tree>

- 4- Define another class OvalTree being derived from the base class Tree. The shape of this tree will just be an oval.
- 5- You will make a last derived class called SquareTree.

3- Mario likes Trees (20pts)

Using a larger numpy array, you will now create an image with Mario looking at the 3 types of Trees that you just created and you will display this image.

4- Thresholding (20pts)

Recognizing a pattern in one image can be difficult because of the different colors. One of the naive approaches to reduce this problem is to use thresholding. You are going to create a function *threshold* that takes a numpy array as a parameter.

Here is the step of this function.

- 1- You need to calculate the mean for every pixel.
- 2- You calculate the mean of the previous question to find a number which will be the mean of all the pixels
- 3- Now you go through all the pixels of this the numpy array and each time there is mean of one pixel \geq mean of all the pixels create a black pixel
numpyarray[0]=255, numpyarray[1]=255, numpyarray[2]=255,
numpyarray[3]=255. If mean of one pixel , numpyarray[0]=0,
numpyarray[1]=0, numpyarray[2]=0, numpyarray[3]=255.
- 4- You should obtain the following image if you apply this conversion to Mario.

