CSI 758 Spring 2017 MID TERM

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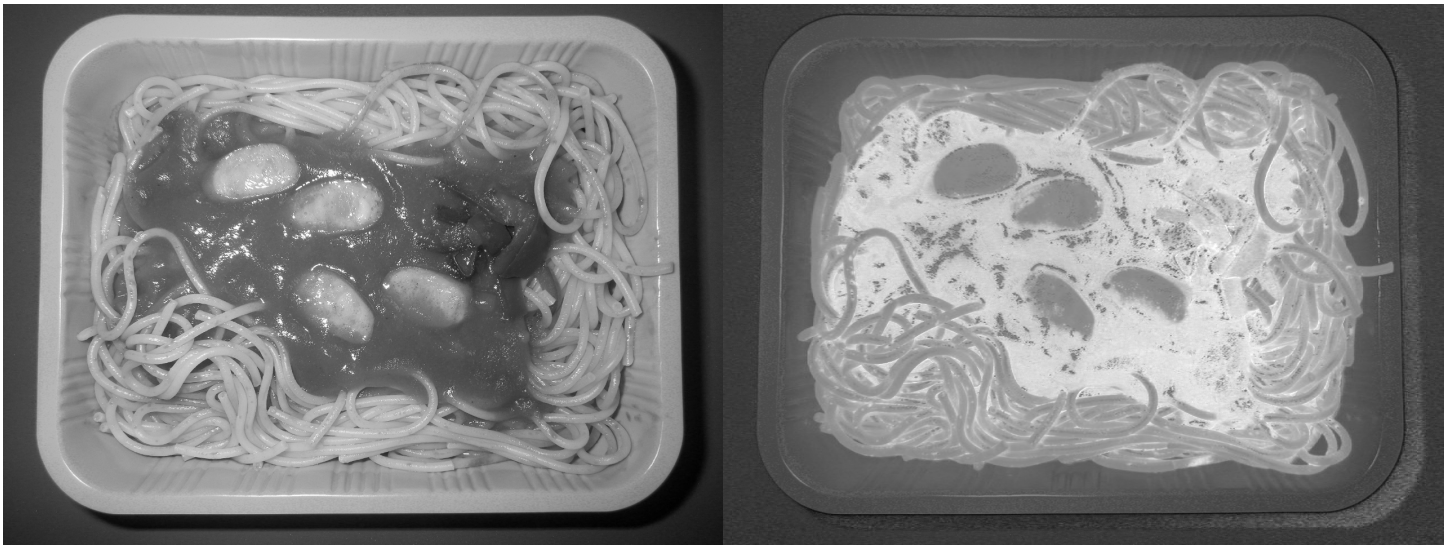
For all of the questions in this exam we will be using the following two input image files. The first being the quite delicious looking meal with a bit of greenery on right. The other is a truth image to be used throughout as a mask and also as a check of our algorithms. These images are shown below:

(a) Yummy Food (b) Truth

Figure 1: Input Images

1 Question 1

The R, G and B rectilinear coordinates are converted using the function **ToSpherical(filename)**. This function uses the given formulas to convert the coordinates returning three images - ρ, θ, and ϕ. The justification is that the ρ component is the intensity and the two angle components are dedicated to the hue. The images are shown below:



(a) rho (b) theta

(c) phi

Figure 2: Spherical Coordinate Images

This function can be tested using the following code after importing in the python file included called "midterm.py".

```
rho, theta, phi = ToSpherical ( "mydir/1.JPG" )
sm.imshow( rho )
sm.imshow( theta )
sm.imshow( phi)
```

2 Question 2

To test this conversion I employed the reversed transformation and get an image that is very close to the original. The function **ToRect(rho,theta,phi)** returns the image file which closely matches the original input image. This image is shown below: You can run my program by:

(a) Converted Image

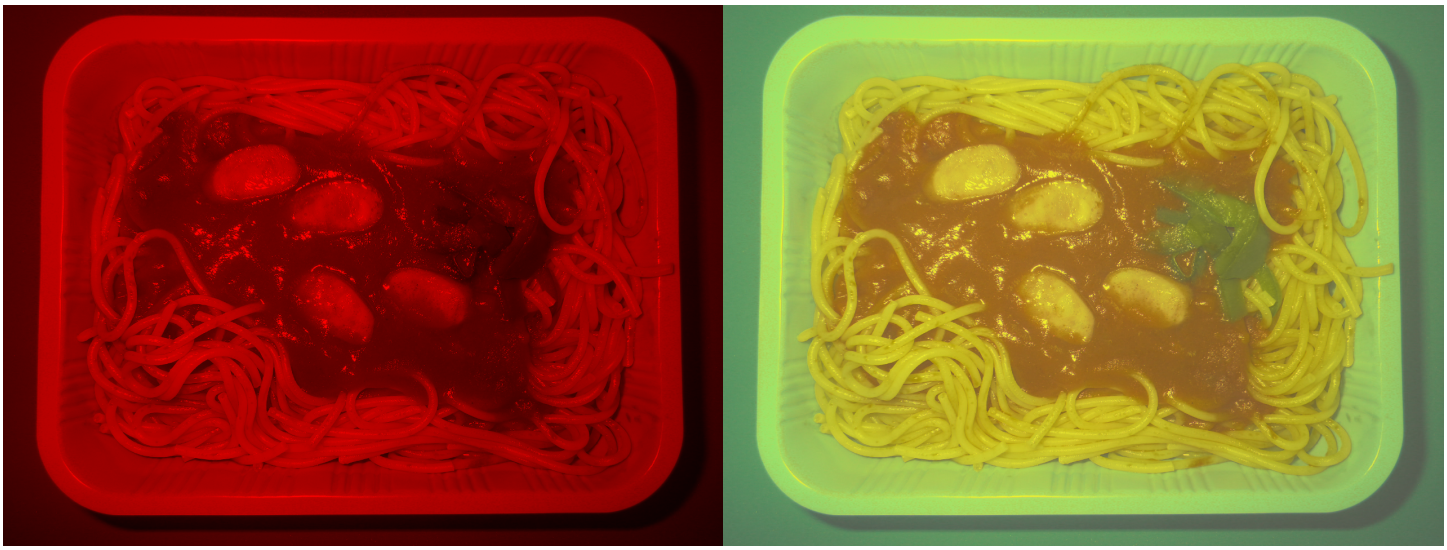
Figure 3: Spherical Coords Converted back to Rectilinear

```
mg = ToRect(rho, theta, phi )
sm.imshow(mg)
```

3 Question 3

The function **RotateGreen** which receives as an input the file name of the food image and returns a matrix with the theta shifted by a value of $\pi/4$ which is b$[\vec{x}]$. The images below represent that image in spherical coordinates and then again after it is converted back to rectilinear coords. The conversion to rectilinear is accomplished using the following code:

```
mg = RotateGreen( "mydir/1.JPG" )
sm.imshow(mg)
mg2 = ToRect(mg[:,:,0],mg[:,:,1],mg[:,:,2])
sm.imshow(mg2)
```



(a) Matrix in Spherical Coords (b) Converted back to Rectilinear Coords and RGB

Figure 4: Green Shifted image in Spherical Coords and in Rectilinear Coords

You can run my program by:

```
mg = RotateGreen( "mydir/1.JPG" )
sm.imshow(mg)
```

4 Question 4

The **GetStats** function returns four floats representing the mean and the standard deviation for the theta pixels and phi pixels. This returned:

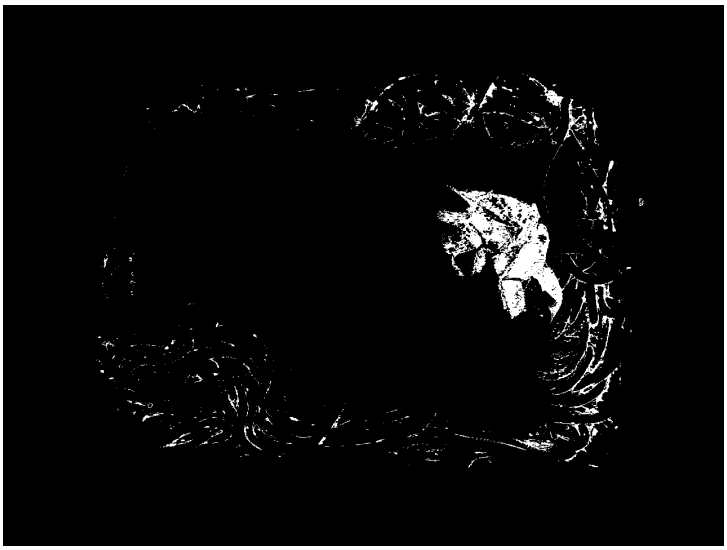
```
>>> m1,s1,m2,s2 = GetStats("truth.png","1.jpg")
>>> m1,s1,m2,s2
(1.3054029473241031, 0.09934194603367931, 0.78085135352757407, 0.10681206316251182)
```

The call should be:

```
m1, s1, m2, s2 = GetStats( "mydir/truth.png", "mydir/1.JPG")
```

5 Question 5

Using the function named **Threshold** I applied both thresholds. I used the outputs from **GetStats**, used the value of one (1) for α and β. The resulting image is a matrix of binary-valued pixels (either 1 or 0)and is below:



(a) Binary-Valued Output

Figure 5: Threshold output using alpha and beta of 1

```
answ = Threshold( m1, s1, m2, s2, alpha, beta, "mydir/1.JPG" )
sm.imshow( answ )
```

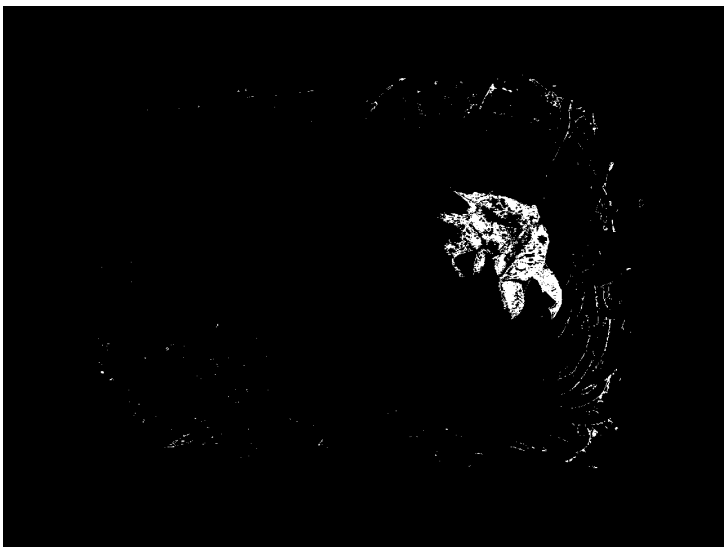
6 Question 6

The function named **SimAnn** is a simulated annealing program which finds the optimum values of α and β. The inputs are the name of the truth file and the name of the food file. The outputs are the determined values ofα, β and an image that shows the pixels that are classified as on-target when using these values.

I used a random from -1 to 1 for both alpha and beta independently. As the Threshold function failed on negative numbers I put in a floor and ceiling of 0.1 and 3 respectively if the new guesses were outside of those ranges. I chose a default scaling down of 0.99 for the sake of time. Most successful runs had a resulting cost of less than 19,000. The results for alpha and beta are:

```
>>> alpha,beta
(0.8404207530543323, 0.7200160149024841)
```

The final image is shown below:



(a) Final Output

Figure 6: Output from the Simulated Annealing

The call is:

```
alpha, beta, mg = SimAnn( "mydir/truth.png", "mydir/1.JPG")
print( alpha, beta )
sm.imshow( mg )
```