

Due Date: Feb. 15th 2006 Wednesday

Problem #1: Image histogram stretching (60%)

In this homework, we want to apply the contrast stretching technique to enhance the image shown below. We want to make the details on the following coin image more clear.



(1) modify the color histogram function you wrote in HW#1 so that it can generate the 1-D histogram of an grayscale image.

```
function hist = grayhist (imggray, n)
```

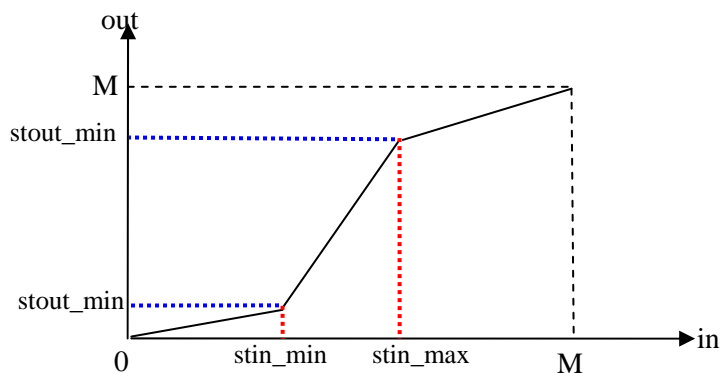
where `imggray` is a grayscale input image and `n` is the number of bins used in computing the histogram

(2) plot the histograms of the input image “`coin.bmp`” for `n=256` and `n=128`.

(3) write a function

```
function imgout = imghiststretch (imggray, stin_min,
stin_max, stout_min, stout_max)
```

where the mapping function is defined as follows and `M` is 256 in this case.

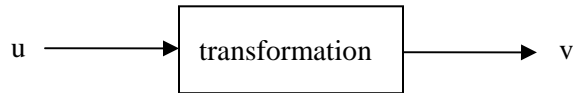


(4) Inspect the input image and its histogram and then determine the values you will use for the parameters (`stin_min`, `stin_max`, `stout_min`, and `stout_max`) in order to achieve the best quality. Explain how you come up with your choices.

(5) plot the output image and its histogram (`n=256`) after the contrast stretching process.

P.2 Histogram Transformation (40%)

In the class lecture, we have derived the equation for mapping an arbitrary input to an output that has uniform probability density distribution (pdf). In this problem, we want to derive the equation for the cube-root hyperbolic distribution.



We want the pdf of the output, v , to be as the following.

$$p(v) = \begin{cases} \frac{1}{3} \cdot v^{-2/3} / (v_{\max}^{1/3} - v_{\min}^{1/3}) & \text{if } v_{\min} \leq v \leq v_{\max} \\ 0 & \text{otherwise} \end{cases}$$

- (1) Derive the mapping function $v = T(u)$ that maps any arbitrary u to output v with the desired property. Show the derivation process and the final equation.
- (2) Assume the input, u , has a uniform pdf over $[0,1]$. Plot the input-output (u - v) mapping curve.