EE264 Histogram Equalization
HL, 2009.1.15

1) Given a digital Image $f(x,y)$
Enhance this image by histogram equalization.

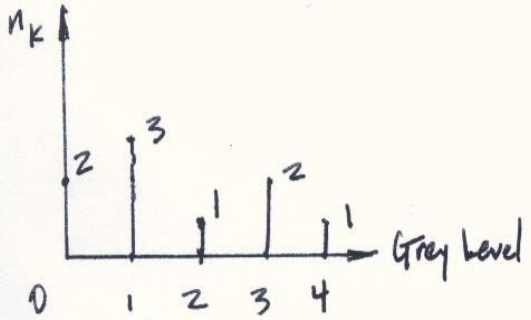
Sol:

$f(x,y)$

0	0	3
4	1	3
2	1	1

First, calculate the histogram,

Grey Level	n_k
0	2
1	3
2	1
3	2
4	1



Second, Normalize the frequency n_k

n_k	n_k/N
$n_0=2$	2/9 (.22)
$n_1=3$	3/9 (.33)
$n_2=1$	1/9 (.11)
$n_3=2$	2/9 (.22)
$n_4=1$	1/9 (.11)

Third, now construct mapping function

$$l_0 = \sum_{K=0}^{0} n_K/N = n_0/N = 0.22$$

$$l_1 = \sum_{K=0}^{1} n_K/N = n_0/N + n_1/N = 0.22+0.33 = 0.55$$

$$l_2 = \sum_{K=0}^{2} n_K/N = n_0/N + n_1/N + n_2/N = 0.22+0.33+0.11 = 0.66$$

$$l_3 = \sum_{K=0}^{3} n_K/N = n_0/N + n_1/N + n_2/N + n_3/N = 0.22+0.33+0.11+0.22 = 0.88$$

$$l_4 = \sum_{K=0}^{4} n_K/N = n_0/N + n_1/N + \cdots + n_4/N \cong 0.99$$

Forth Step, Scale up to desired intensity range (Note: For 8bit image we scale up to $[0,\cdots,255]$, but for simplicity in this handout, we use $[0,1,\cdots,4]$).

$l_k \cdot 4$	l'_k
$l_0 \cdot 4 = .22 \times 4$	$0.88 \cong 1$
$l_1 \cdot 4 = 2.2$	$\cong 2$
$l_2 \cdot 4 = 2.64$	$\cong 3$
$l_3 \cdot 4 = 3.52$	$\cong 4$
$l_4 \cdot 4 = 3.96$	$\cong 4$

Finally, the new image after the equalization:

$f(x,y)$

1	1	4
4	2	4
3	2	2

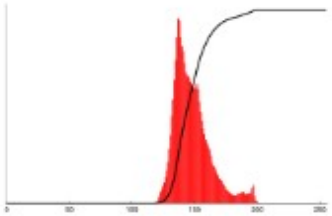
Note: You may want to plot the new histogram to observe the change.

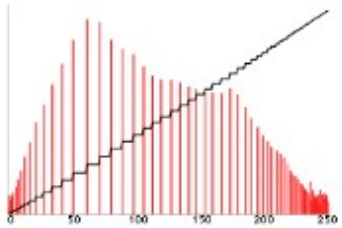
(END)

Histogram Equalization Example

http://en.wikipedia.org/wiki/Histogram_equalization

Before





After