Homework 7 (Due: 5/2)

(1) Create an image $g(x,y)$ whose pixels all have the same gray value of 100. Show the image $g(x,y)$.

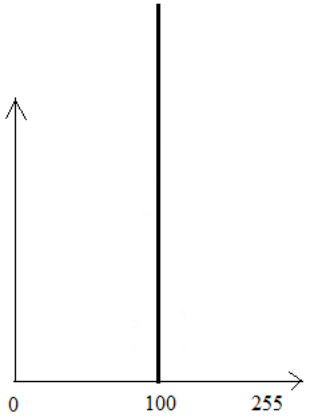
(2) Generate Gaussian noise $n(x,y)$, with $\mu = 0$, $\sigma^2 = 25$, using the algorithm shown in the next page.
Show the noisy image $f(x,y) = g(x,y) + n(x,y)$.

(3) Display the histogram $h(i)$ of $f(x,y)$.

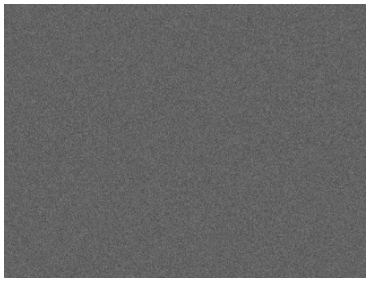
(4) Comment on your results.

Example:

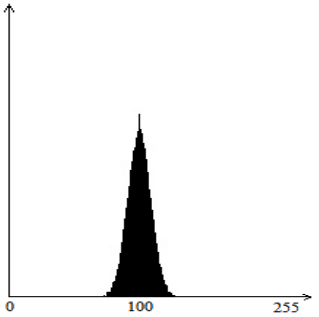
Input image $g(x,y)$ of gray values of 100



Histogram of $g(x,y)$



Noisy image $f(x,y)$



Histogram of $f(x,y)$

Algorithm : Generation of zero mean Gaussian noise

1. Suppose an image has gray-level range $[0, G-1]$. Select $\sigma > 0$;
2. For each pair of horizontally neighboring pixels (x, y), $(x, y+1)$ generate a pair of uniform random numbers r, ϕ in the range $[0, 1]$.
3. Calculate $z_1 = \sigma \cos(2\pi\phi)\sqrt{-2 \ln r}$, $z_2 = \sigma \sin(2\pi\phi)\sqrt{-2 \ln r}$.
4. Set $f'(x, y) = g(x, y) + z_1$ and $f'(x, y+1) = g(x, y+1) + z_2$, where g is the input image.
5. Set
$$f(x,y) = \begin{cases} 0 & \text{if } f'(x,y) < 0\,, \\ G-1 & \text{if } f'(x,y) > G-1\,, \\ f'(x,y) & \text{otherwise,} \end{cases}$$
$$f(x,y+1) = \begin{cases} 0 & \text{if } f'(x,y+1) < 0\,, \\ G-1 & \text{if } f'(x,y+1) > G-1\,, \\ f'(x,y+1) & \text{otherwise.} \end{cases}$$
6. Go to 3 until all pixels have been scanned.