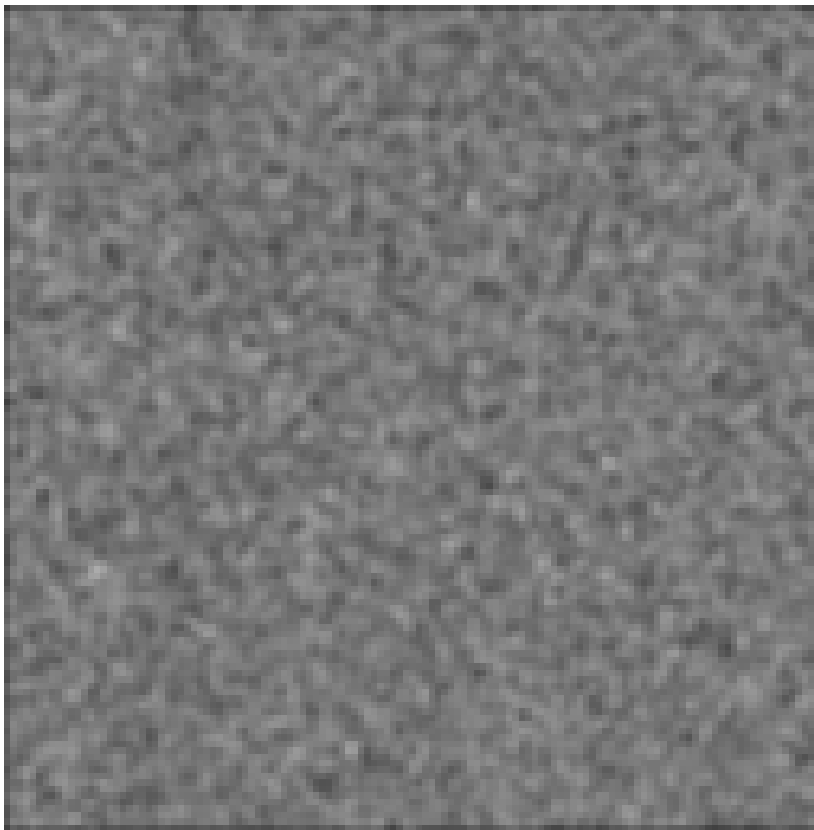


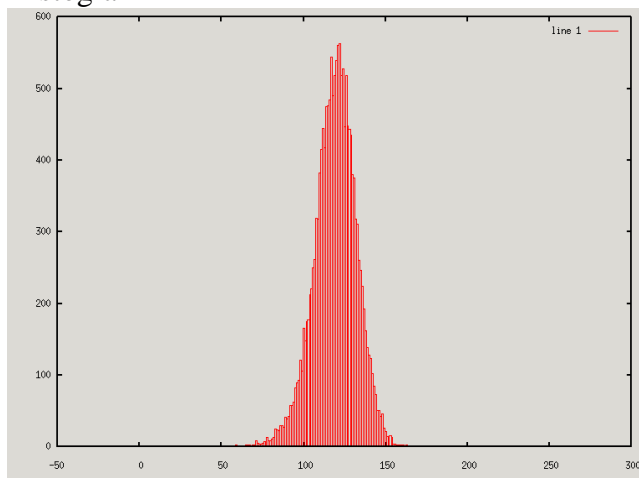
```

I = randn(128); % Normal random dist.
I -= min(min(I)); % Make all positive
I = round( (I/max(max(I)) * 255 ) ); % map to [0, 255]
I = conv2(I, gauss, 'same'); % Smooth

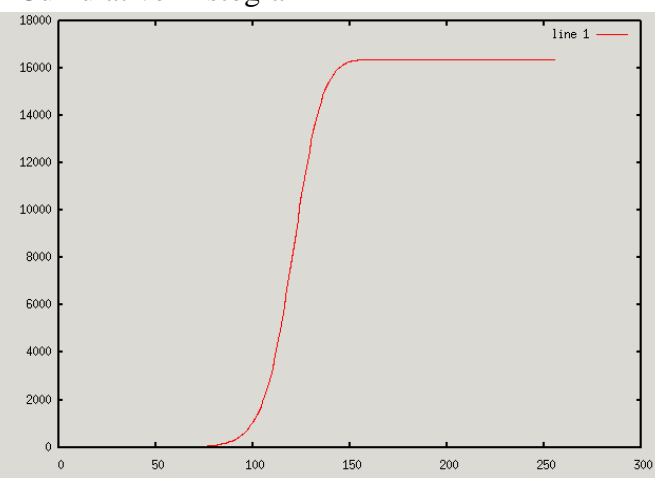
```



Histogram



Cumulative Histogram

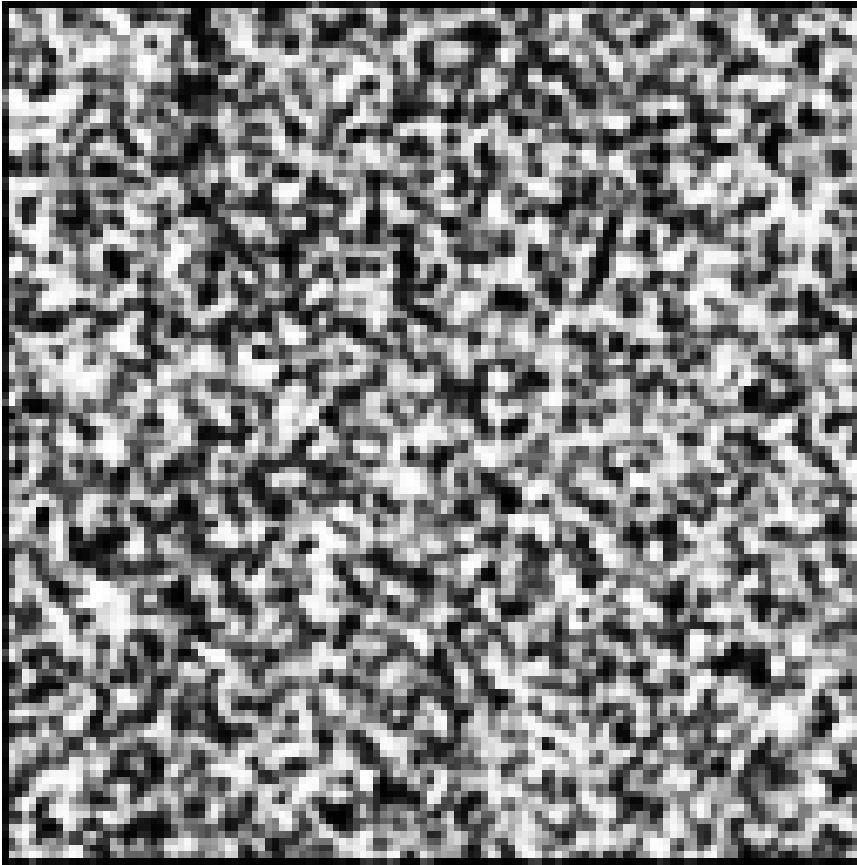


```

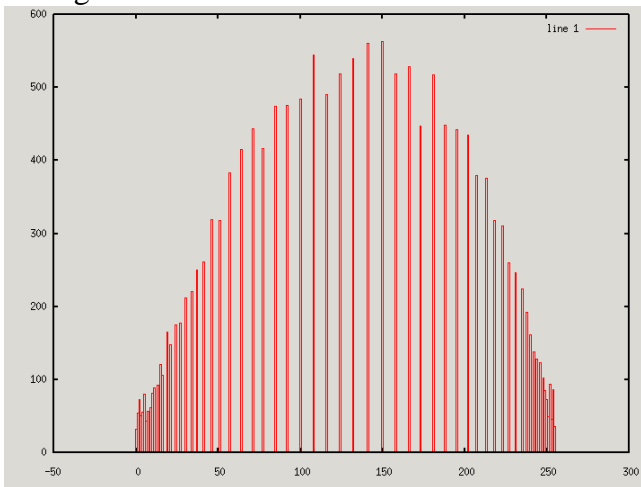
H = hist(I(:), 0:255);
C = cumsum(H);

bar(0:255, H);
plot(C);
Inew = histeq(I, 255);

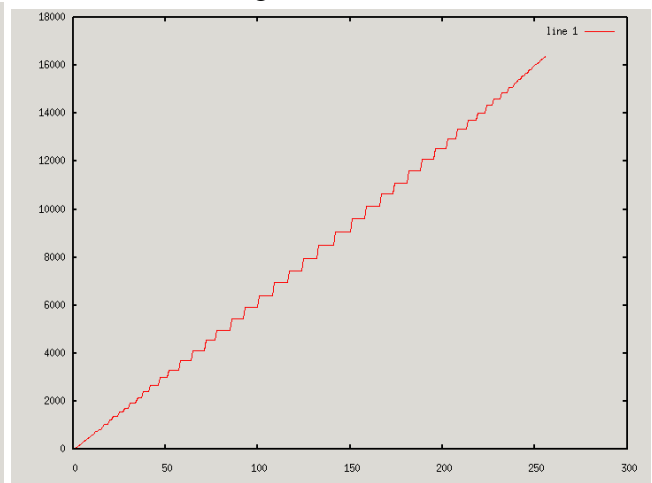
```



Histogram

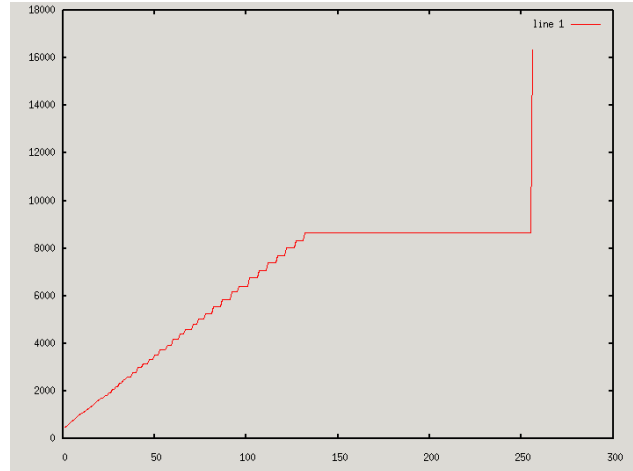
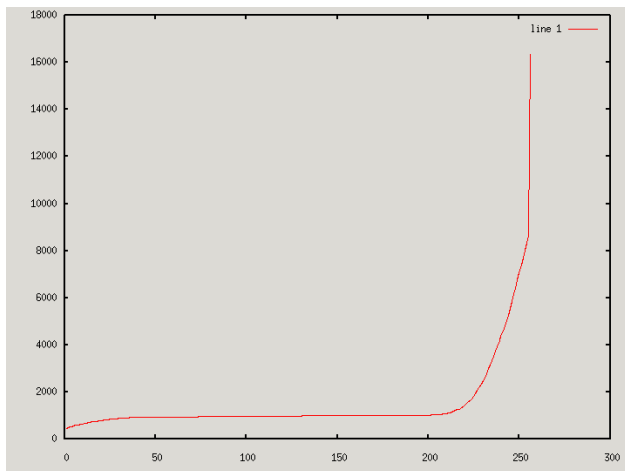
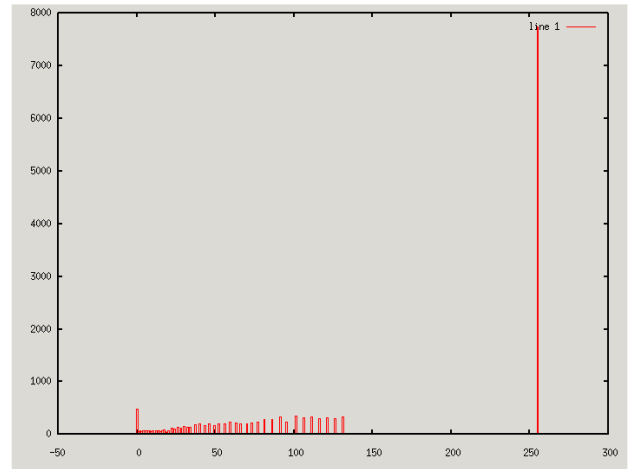
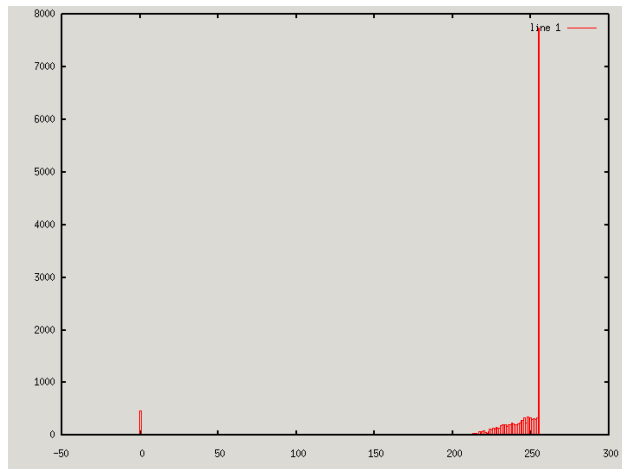
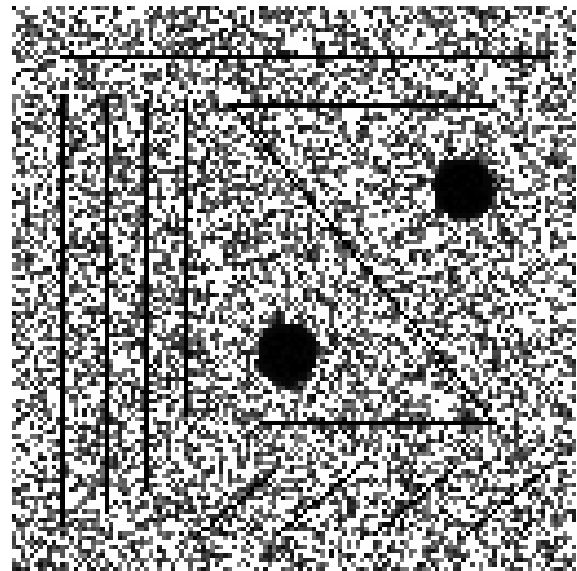
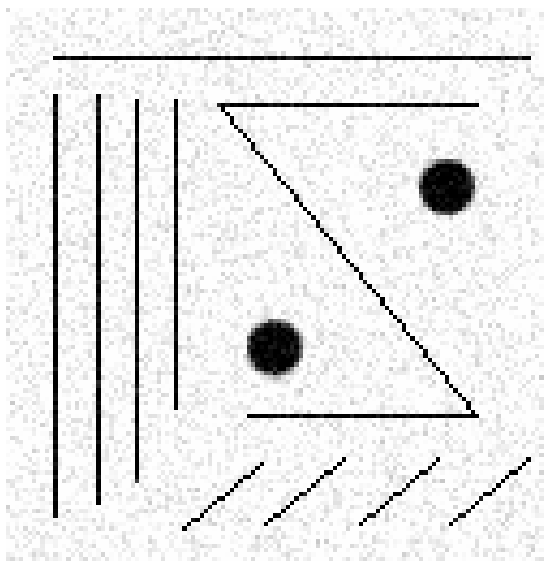


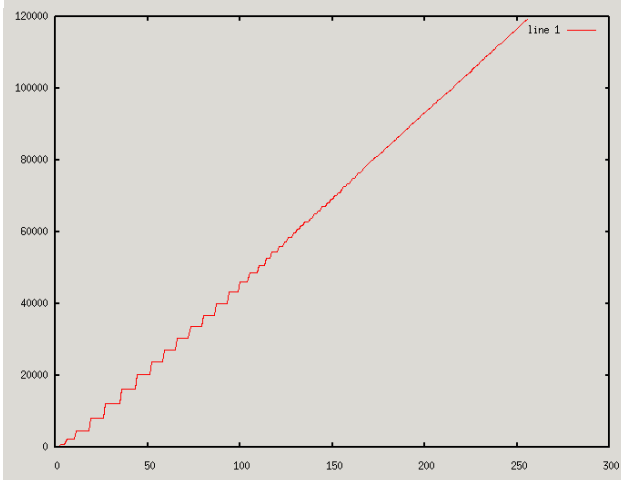
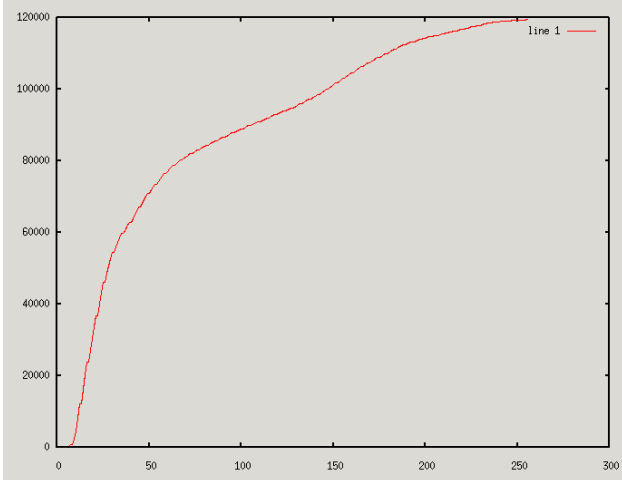
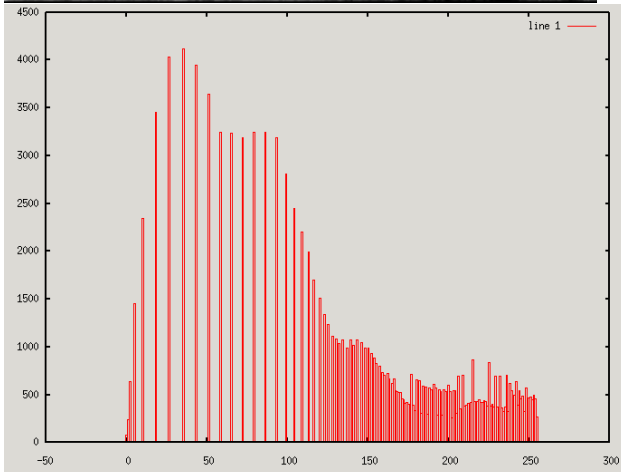
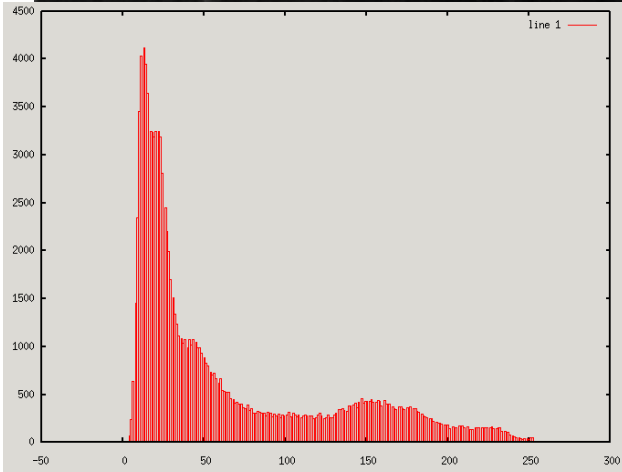
Cumulative Histogram



```
Hnew = hist(Inew (:), 0:255);  
Cnew = cumsum(Hnew);
```

```
bar(0:255, Hnew);  
plot(Cnew);
```





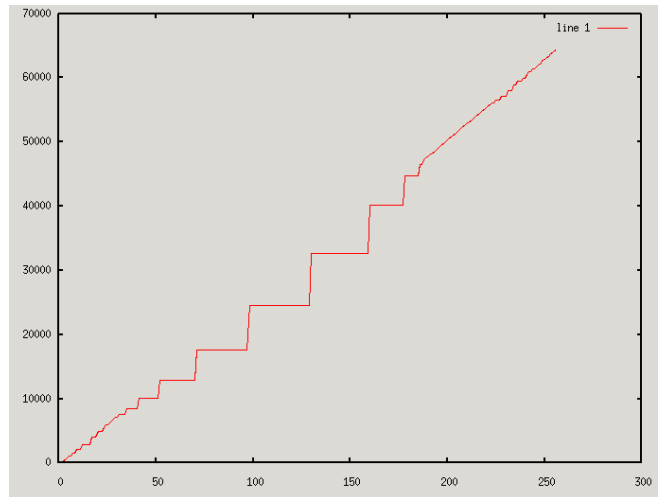
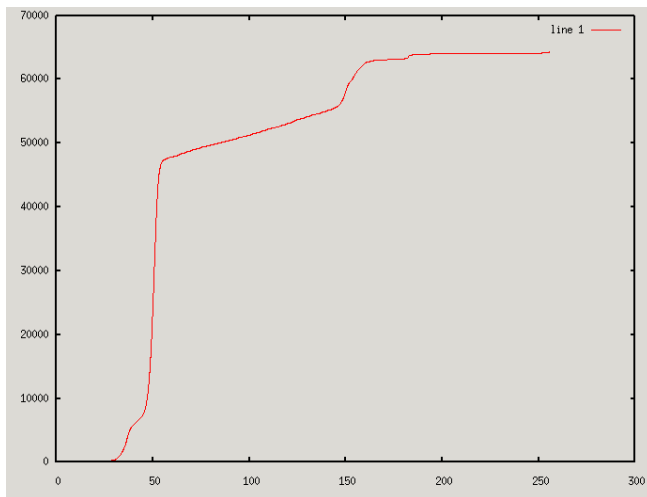
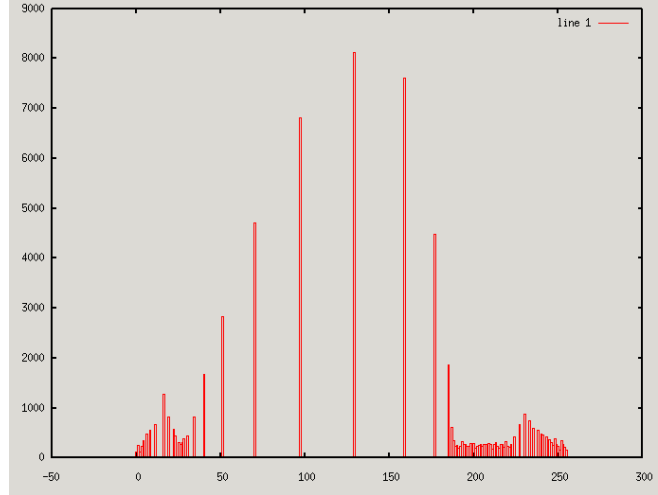
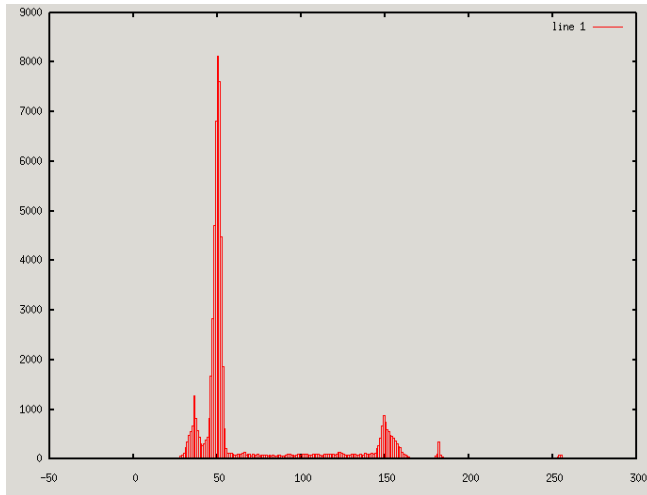
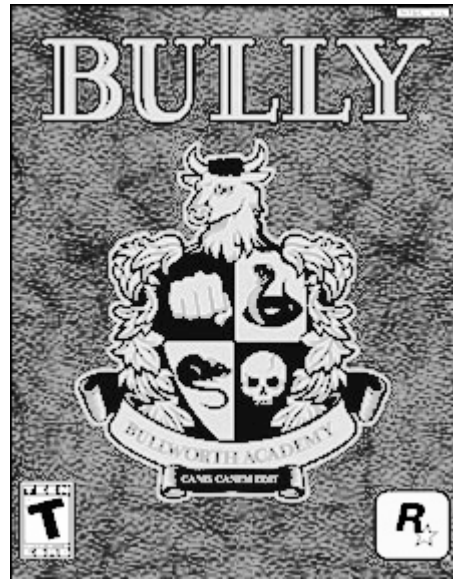
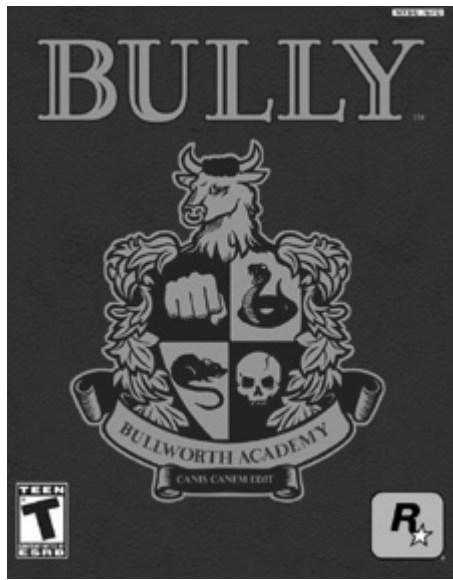


Image Processing with Masks



3x3 Box filter

$$\frac{1}{9} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$



7x7 Box filter

$$\frac{1}{49} \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$



3x3 Gaussian

$$\frac{1}{16} \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$$



7x7 Gaussian

$$\frac{1}{1098} \begin{bmatrix} 1 & 3 & 7 & 9 & 7 & 3 & 1 \\ 3 & 12 & 26 & 33 & 26 & 12 & 3 \\ 7 & 26 & 55 & 70 & 55 & 26 & 7 \\ 9 & 33 & 70 & 90 & 70 & 33 & 9 \\ 7 & 26 & 55 & 70 & 55 & 26 & 7 \\ 3 & 12 & 26 & 33 & 26 & 12 & 3 \\ 1 & 3 & 7 & 9 & 7 & 3 & 1 \end{bmatrix}$$



1st Derivative - rows

$$\begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$



1st Derivative - columns

$$\begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$



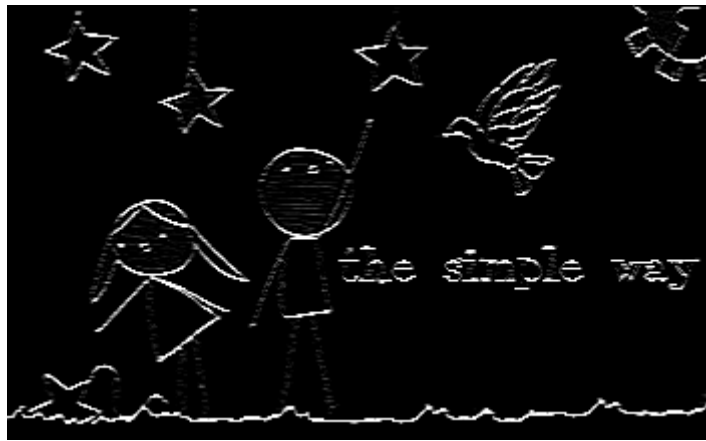
2nd Derivative - rows

$$\begin{bmatrix} 1 & -2 & 1 \\ 1 & -2 & 1 \\ 1 & -2 & 1 \end{bmatrix}$$



2nd Derivative - columns

$$\begin{bmatrix} 1 & 1 & 1 \\ -2 & -2 & -2 \\ 1 & 1 & 1 \end{bmatrix}$$



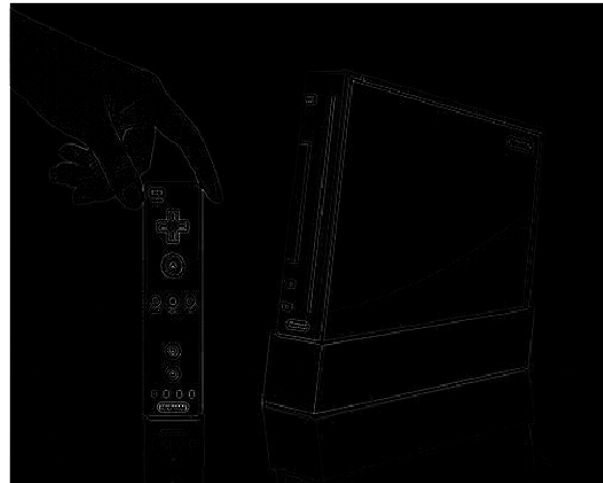
LOG filter

$$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

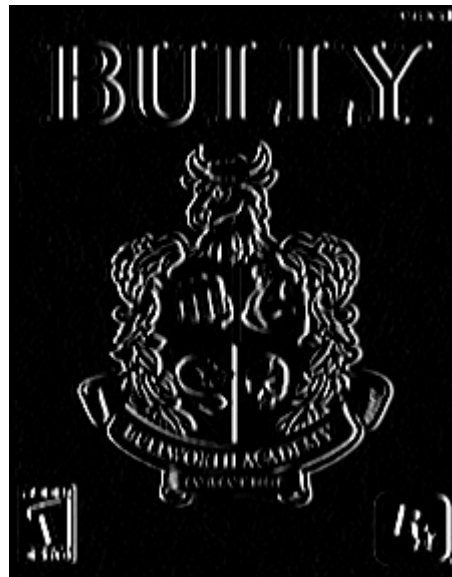
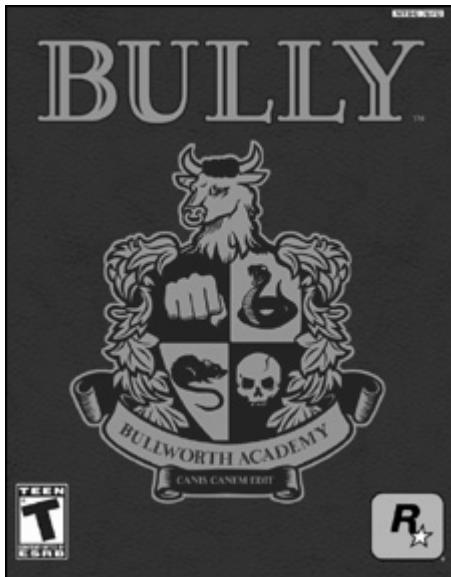


Quiz:

Which filter applied to the left image produces the right image?



a.



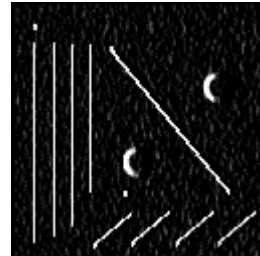
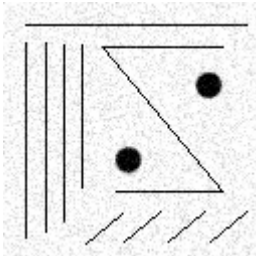
b.



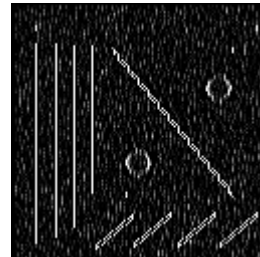
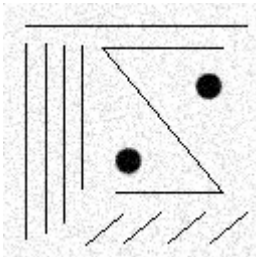
c.



d.



e.



f.

So Easy...
So Simple 

**YOU CAN OPERATE THEM
 BLINDFOLDED**

So Easy...
So Simple 

**YOU CAN OPERATE THEM
 BLINDFOLDED**

g.

So Easy...
So Simple 

**YOU CAN OPERATE THEM
 BLINDFOLDED**

So Easy...
So Simple 

**YOU CAN OPERATE THEM
 BLINDFOLDED**

h.



i.

Answers:

- a. LOG
- b. 1st derivative - rows
- c. Histogram equalization
- d. 2nd derivative - columns
- e. 1st derivative - rows
- f. 2nd derivative - rows
- g. 7x7 box
- h. LOG
- i. 1st derivative - rows