3.6

a) if set the lower-order bit planes to zero, then the overall intensity level of all pixels will decrease. Then the right side of histogram part(high intensity level part) will decrease, and the rest part of histogram height will increase.

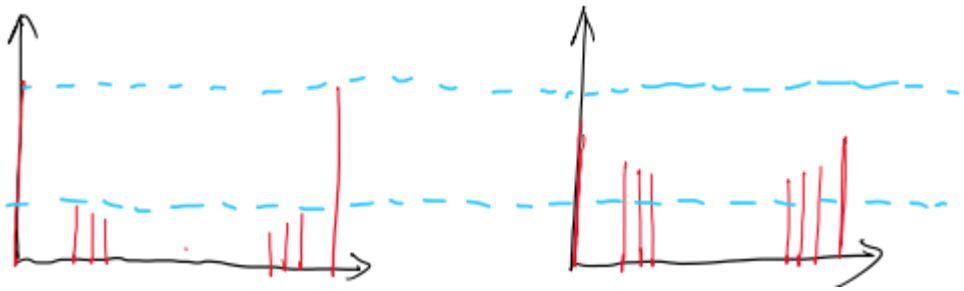
b) if set the higher order bit planes to zero, generally speaking, overall intensity level of all pixels will also decrease, but the decrease more. Then the height of high intensity level of histogram will decrease more, the peak will move to the left side of histogram more.

3.34

a) yes, after blurring, the histogram of each picture will different. Since the left picture have two big mono gray lever, the mask just blurred the cross part and has nothing to do with left and right part of the picture.

On the other side, right picure (chess board) has many intersection part, after mask, the intersection part will cause the histogram different.

b)



3.36

1) the filter w is still a Gaussian filter, since the convolution operator is linear.

2) the stander deviation is $\sqrt{1.5^2 + 2^2 + 4^2} = 4.71$

3) size=(3+5-1+7-1)x(3+5-1+7-1)=11x11

3.48 if we do the filter reversely, the result will be different, as the correlation is not commutative.

3.55 1) they are not separable as the rank of each mask is 2.

2) they are not separable as the rank of each mask is 2

3)v=[-1 0 1]T w=[1 2 1]T

V=[1 -2 1]T w=[-1 0 1]T

Extra Credit:

2D kernel=$0.25\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$

After smoothed by Gaussian filter, the particular differentiate filter might not able to sharp the edge of the image. We can note that

$$\frac{\partial f}{\partial x} = (z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3) = 0;$$

$$\frac{\partial f}{\partial y} = (z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7) = 0$$

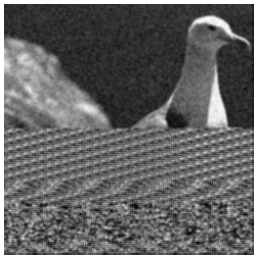
So, the differentiate filter might not be a good sharp filter to detect the edge.

Part 2:

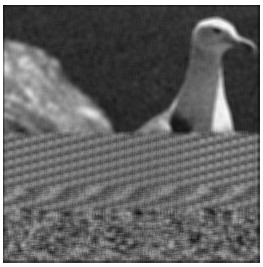
Box filter: the filter is an average filter with every element of kernel is the same value.1st assign the kernel center at the zero point of image coordinate, correlate all pixel covered by kernel and divided by coefficient as the target pixel new intensity value. Do the same average procedure row by column through the image.

Result:

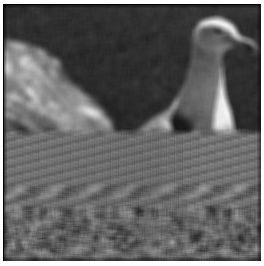
3x3 kernel:



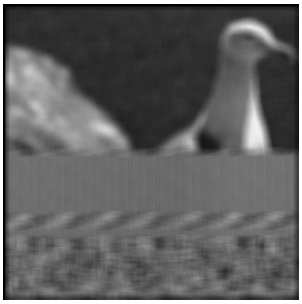
5x5 kernel:



7x7 kernel:



9x9 kernel:

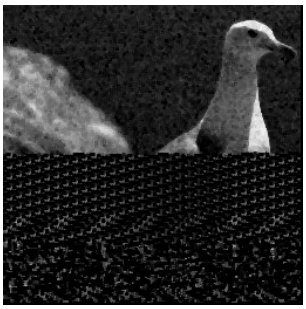


Median filter:

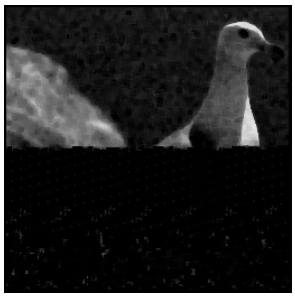
1) Assign the filter size
2) Assign kernel center to image zero coordinate
3) Sorted all pixel value covered by the kernel from small to big, pick the median value as the target pixel new value
4) Do the same procedure row by column through the whole image.

Result:

3x3 kernel



5x5 kernel:



7x7 kernel

We can see from the results of two filters, the Median filter to this picture will make the filtered image dark. But when kernel size=3, it can increase the contrast from the result. To the box-filter, the bigger kernel is the more fuzzy the result is.