Prewitt Filter

The Prewitt filter is similar to the Sobel in that it uses two 3 x 3 kernels. One for changes in the horizontal direction, and one for changes in the vertical direction.

The two kernels are convolved with the original image to calculate the approximations of the derivatives.

If we define Gx and Gy as two images that contain the horizontal and vertical derivative approximations respectively, the computations are:

$$G_x = \begin{pmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{pmatrix} * A \quad \text{and} \quad G_y = \begin{pmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{pmatrix} * A$$

Where A is the original source image.

The x coordinate is defined as increasing in the right-direction and the y coordinate is defined as increasing in the down-direction.

Prewitt Filter

To compute G_x and G_y we move the appropriate kernel (window) over the input image, computing the value for one pixel and then shifting one pixel to the right. Once the end of the row is reached, we move down to the beginning of the next row.

The example below shows the calculation of a value of G_x:

a11	a12	a13	…	
a21	a22	a23	…	
a31	a32	a33	…	
…	…	…	…	

Input image

kernel =

1	0	-1
1	0	-1
1	0	-1

b11	b12	b13	…	
b21	b22	b23	…	
b31	b32	b33	…	
…	…	…	…	

Output image (G_x)

$b_{22} = -a_{11} + a_{13} - a_{21} + a_{23} - a_{31} + a_{33}$

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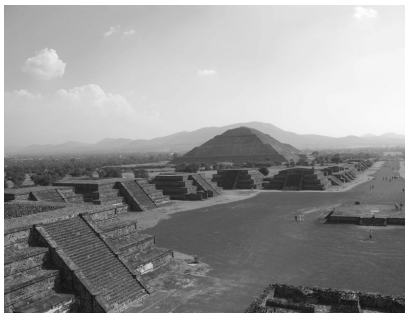
Prewitt Filter



The image to the right above is G_x, calculated as: $G_x = \begin{pmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{pmatrix} * A$

Where A is the original image to the left.

Notice the general orientation of the edges.

What would you expect to be different in G_y?

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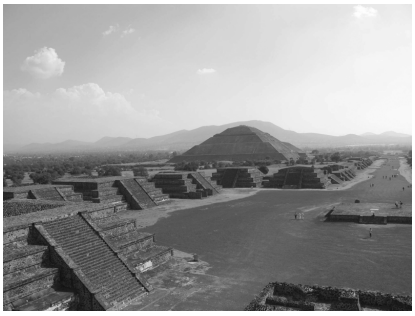
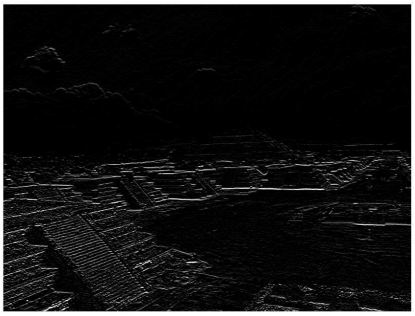
Prewitt Filter





The image to the right above is G_y, calculated as: $G_y = \begin{pmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{pmatrix} * A$

Where A is the original image to the left.

What do we expect from the combined image?

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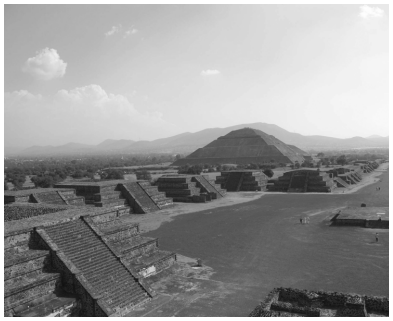
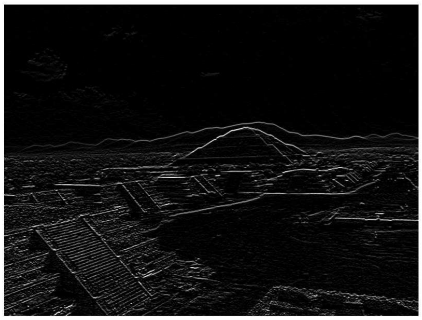
Prewitt Filter





The image to the right above is the result of combining the G_x and G_y derivative approximations calculated from image A on the left.

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Prewitt Filter example

Convolve the Prewitt kernels to the original image

10	50	10	50	10
10	55	10	55	10
10	65	10	65	10
10	50	10	50	10
10	55	10	55	10

Original image

1	0	-1
1	0	-1
1	0	-1

-1	-1	-1
0	0	0
1	1	1

