# Derivation of Coefficients in 3x3 kernel

## Coefficients:

Based on Figure 1, given a pixel (in red) and there are 8 pixels surrounding the pixel (central pixel),

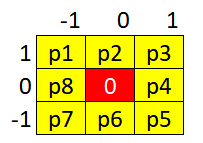


Figure 1. Central pixel with 8 surrounding pixels

is the rate of change of image in direction, while is the rate of change of image in direction. Assume this is in cartesian coordinate system and central pixel (red pixel) is the origin, the coefficients for each pixel within the kernel could be summarized in Equation 1 and Equation 2.

|  |  |
| --- | --- |
|  | (1) |
|  | (2) |
|  |  |

Where is the pixel index, is the coefficients of kernel, is the rate of change of image in direction, is the rate of change of image in direction.

For and , it could be computed with the Equation 3 and Equation 4.

|  |  |
| --- | --- |
|  | (3) |
|  |  |
|  | (4) |
|  |  |

Where and are the opposing index of pixels.

Based on Figure 1:

m = p1, n =p5

m = p2, n =p6

m = p3, n =p7

m = p4, n =p8

m = p5, n =p1

m = p6, n =p2

m = p7, n =p3

m = p8, n =p4

For example, if m = p1, n = p5,

By applying similar equations from p2 to p8, the coefficients for and are shown in Figure 2.

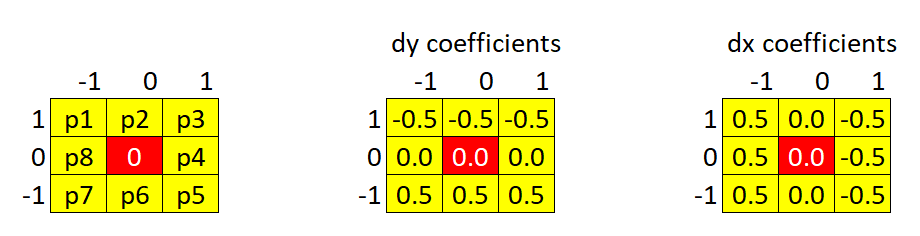


Figure 2. Coefficients for and

The resulting coefficients of kernel are very similar with Prewitt operator, but with weaker power and different direction.

Further information of Prewitt operator:

<https://en.wikipedia.org/wiki/Prewitt_operator>