$$f(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}} \tag{1}$$

$$\begin{aligned} \frac{\partial I}{\partial x}(x,y) &= I(x+1,y) - I(x-1,y) \\ \frac{\partial I}{\partial x}(x,y) &= I(x+1,y) - I(x-1,y) \end{aligned} \tag{2}$$

$$\begin{aligned} G_x &= h_x * A \\ G_y &= h_y * A \end{aligned} \tag{3}$$

$$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \tag{4}$$

$$\begin{pmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{pmatrix} \begin{pmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{pmatrix} \tag{5}$$

$$\begin{pmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{pmatrix} \begin{pmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{pmatrix} \tag{6}$$

$$\begin{pmatrix} -3 & 0 & 3 \\ -10 & 0 & 10 \\ -3 & 0 & 3 \end{pmatrix} \begin{pmatrix} -3 & -10 & -3 \\ 0 & 0 & 0 \\ 3 & 10 & 3 \end{pmatrix} \tag{7}$$

$$G = \sqrt{G_x^2 + G_y^2} \tag{8}$$

$$\Theta = \arctan\left(\frac{G_y}{G_x}\right) \tag{9}$$