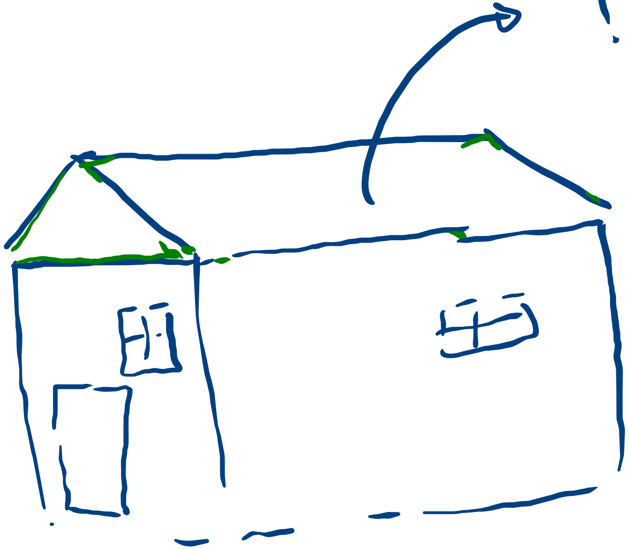
Edge Detection



[illegible]

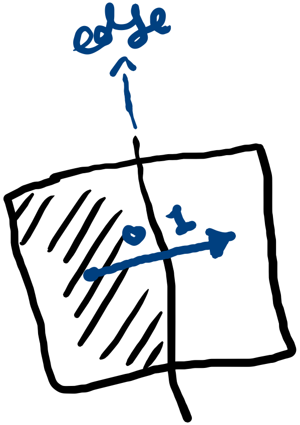
[illegible]

لبه

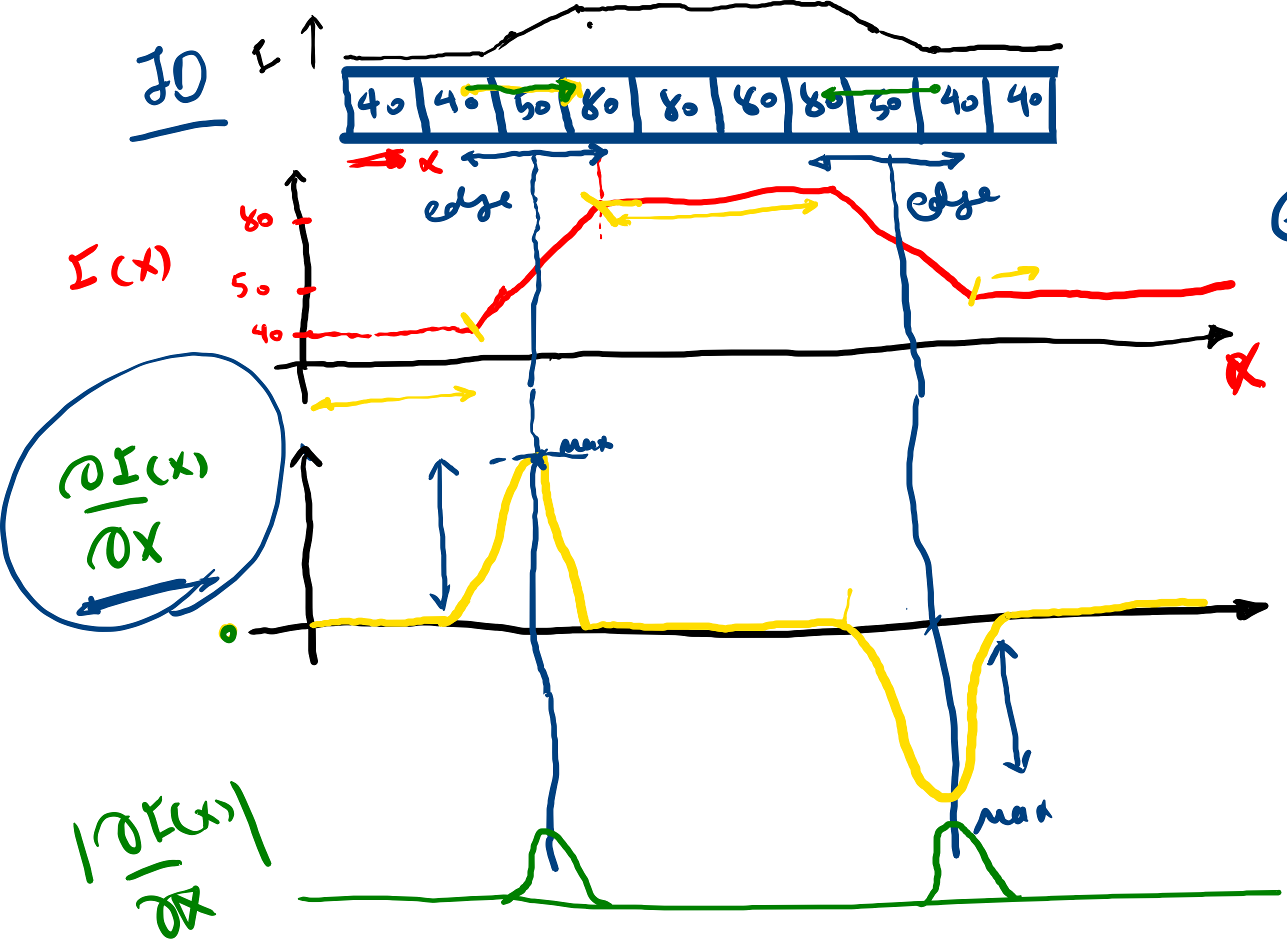
Edge :

تغییر شدت

در یک فضای کوچک

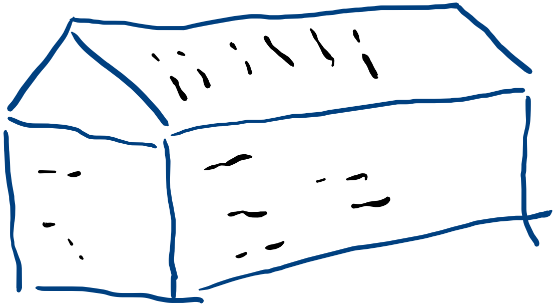


Edge Detect using Gradient



1D
I
40
40
50
80
80
80
80
50
40
40
x
edge
edge
I(x)
80
50
40
x
∂I(x)/∂x
max
0
|∂I(x)/∂x|
max

edge strength

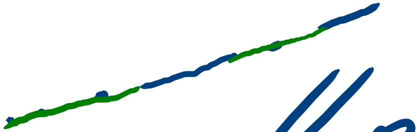


→ threshold

$|\nabla I| \geq T$ ✓ ok edge

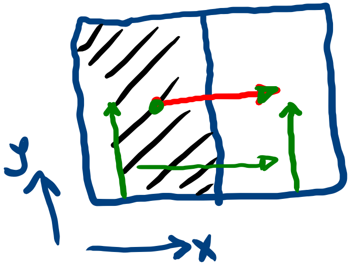
$|\nabla I| < T$ → No edge!

edge orientation



برای وصل کردن لبه‌های مرتبط با همدیگر

$\underline{2D}$



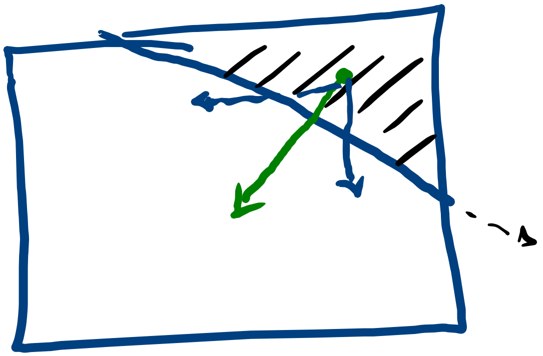
$$1D \rightarrow \nabla I = \frac{\partial I}{\partial x}\hat{x}$$

$$2D \rightarrow \underline{\nabla I} = \frac{\partial I}{\partial x}\hat{x} + \frac{\partial I}{\partial y}\hat{y}$$

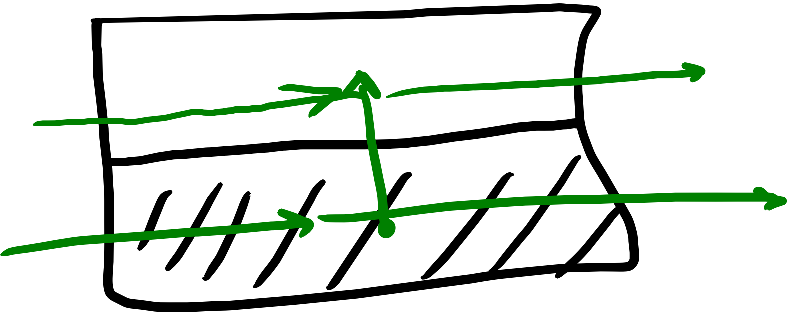
$$\rightarrow \left(\underline{\frac{\partial I}{\partial x}}, \underline{\frac{\partial I}{\partial y}}\right)$$

$$\nabla I = \frac{\partial I}{\partial x}\hat{x} + \cancelto{0}{\frac{\partial I}{\partial y}}\hat{y} \rightarrow \nabla I = \frac{\partial I}{\partial x}$$

تغییرات intensity در جهت x (رو) در جهت چ حرکت کنیم !



$$\nabla I = \left(\frac{\partial I}{\partial x}, \frac{\partial I}{\partial y}\right)$$



$$\frac{\partial I}{\partial x} \sim 0$$

$$\nabla I = \frac{\partial I}{\partial y}$$

✓ edge.

- localization! ←

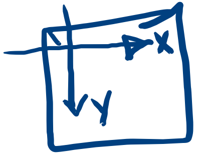
Gradient magnitude

Gradient →

- $\|\nabla I\| = \sqrt{\left(\frac{\partial I}{\partial x}\right)^2 + \left(\frac{\partial I}{\partial y}\right)^2}$
- $\theta = \tan^{-1}\left(\frac{\partial I}{\partial y} \Big/ \frac{\partial I}{\partial x}\right)$

orientation!

در گرادیان جهت داریم →



Convolution

Kernel → Gradient → edge Detection

Gradient	Robert	Prewitt	Sobel (3x3)
$\frac{\partial I}{\partial x}$	$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ ✓	$\begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix}$	$\begin{bmatrix} -1 & 0 & 2 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$
$\frac{\partial I}{\partial y}$	✓ $\begin{bmatrix} -1 & 0 \\ 0 & +1 \end{bmatrix}$	$\begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$	$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$

Robert prewitt Sobel

−

localization →

+

high noise sensitivity ⊖ → ~~less~~ low

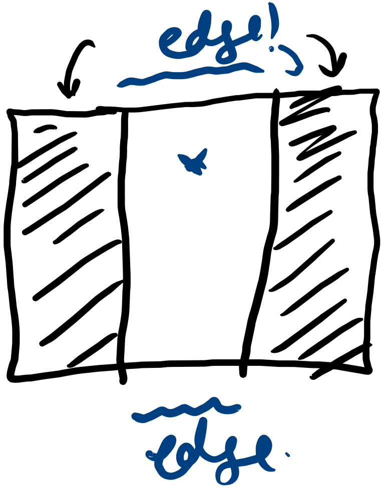
edge Detection →

+

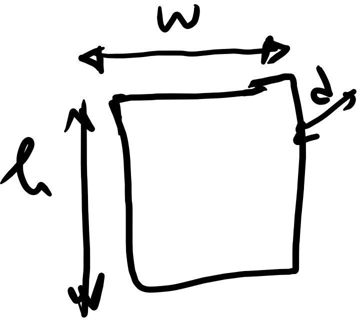
prewitt

$$\begin{bmatrix} 10 & 10 & 10 & 0 & 0 & 0 \\ 10 & 10 & 10 & 0 & 0 & 0 \\ 10 & 10 & 10 & 0 & 0 & 0 \\ 10 & 10 & 10 & 0 & 0 & 0 \\ 10 & 10 & 10 & 0 & 0 & 0 \\ 10 & 10 & 10 & 0 & 0 & 0 \end{bmatrix} \otimes \begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix} = \begin{bmatrix} 0 & 30 & 30 & 0 \\ 0 & 30 & 30 & 0 \\ 0 & 30 & 30 & 0 \\ 0 & 30 & 30 & 0 \end{bmatrix}$$

edge!



~~③~~ Color Image → 2D



Gradient

→ for edge detection

End