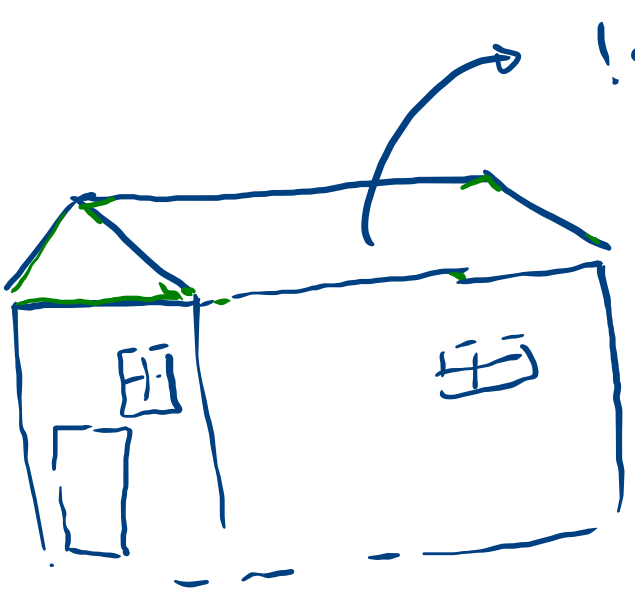
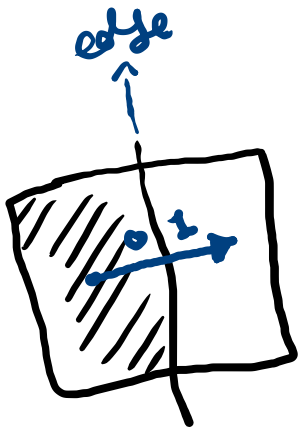

Edge
Detection

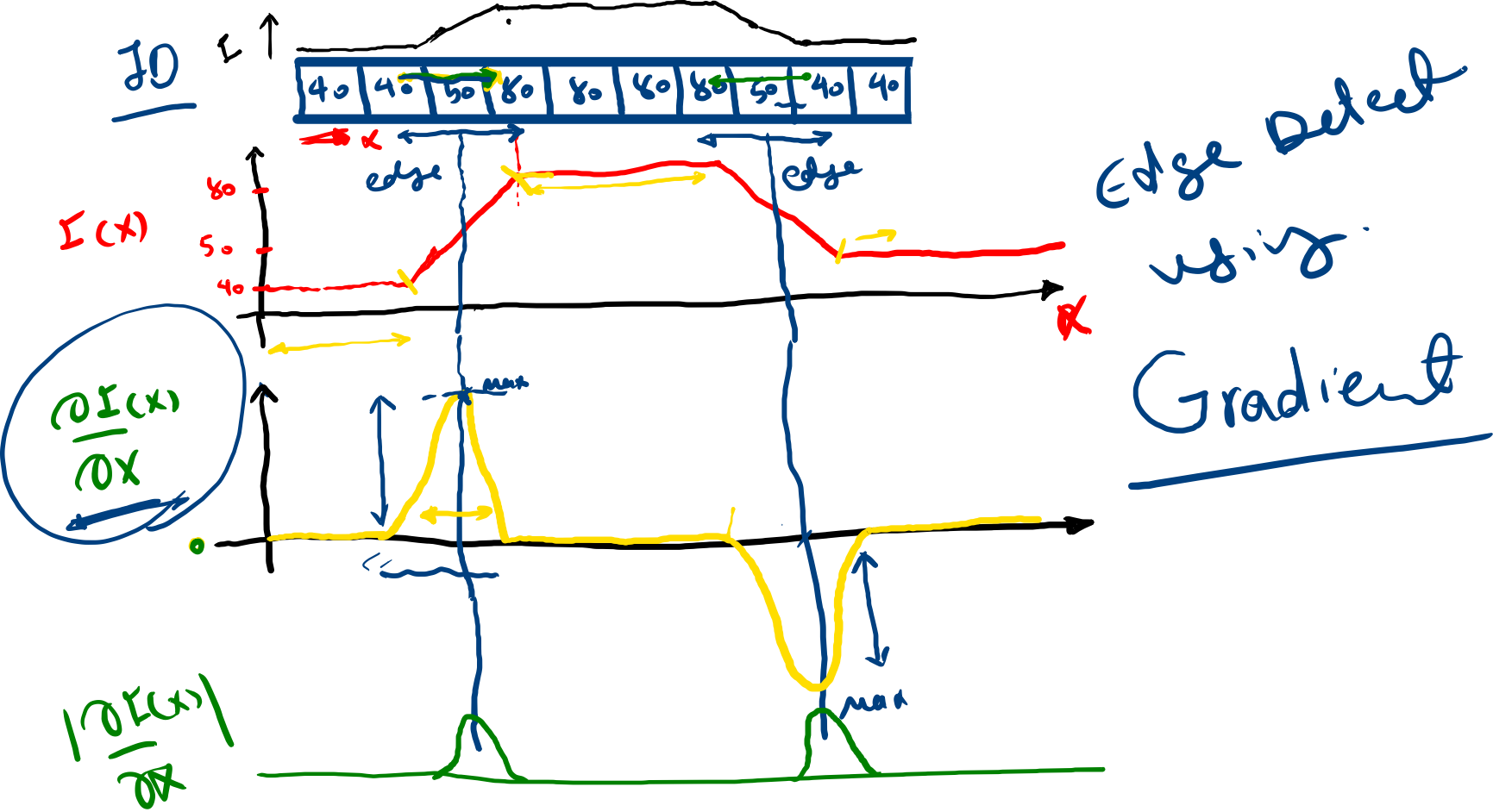


به

Edge : تغییر سریع شدت

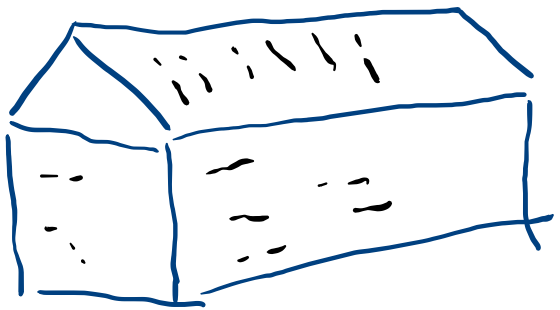
روشنی فضای کوچک





Edge Detect using Gradient

edge strength



→ threshold

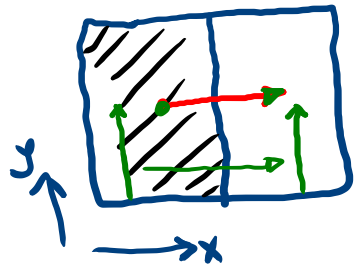
$|\nabla I| \geq T$ ✓ ok edge

$|\nabla I| < T$ → No edge!

edge orientation

هر پیکسل لبه [illegible] مرتبط با [illegible]

2D



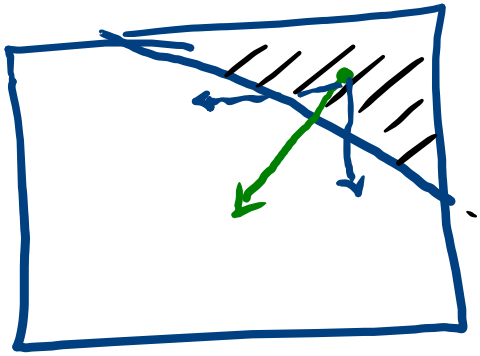
$$1D \rightarrow \nabla I = \frac{\partial I}{\partial x}\hat{x}$$

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

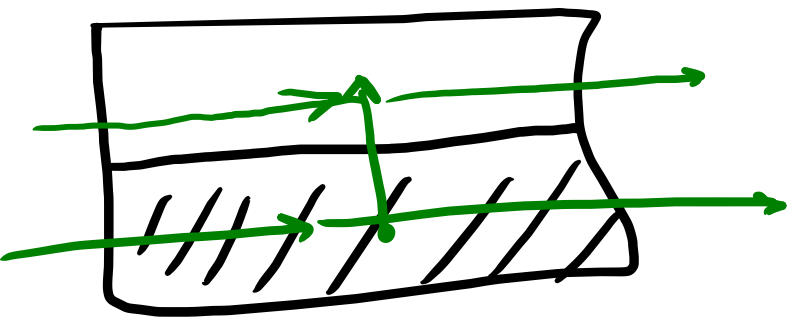
$$\nabla I = \frac{\partial I}{\partial x}\hat{x} + \frac{\partial I}{\partial y}\hat{y} \rightarrow \nabla I = \frac{\partial I}{\partial x}$$

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

تغیرات intensity در جهت x و y در یک پیکسل



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



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

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

✓ edge localization!

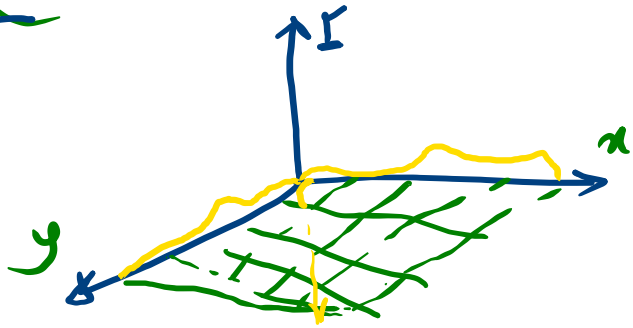
Gradient magnitude:

Gradient →

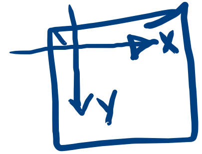
- $\|\nabla I\| = \sqrt{\left(\frac{\partial I}{\partial x}\right)^2 + \left(\frac{\partial I}{\partial y}\right)^2}$

- $\theta = \tan^{-1}\left(\frac{\partial I}{\partial y} / \frac{\partial I}{\partial x}\right)$

orientation!

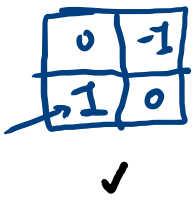
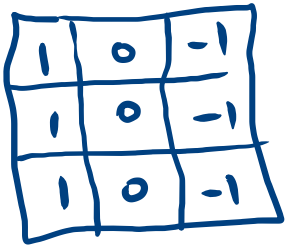
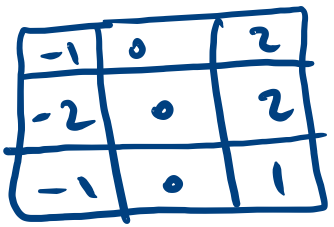
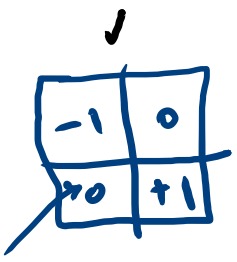
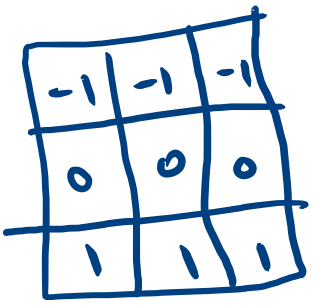
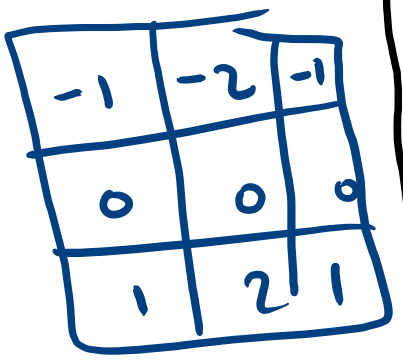


در گرادیان جهت داریم →

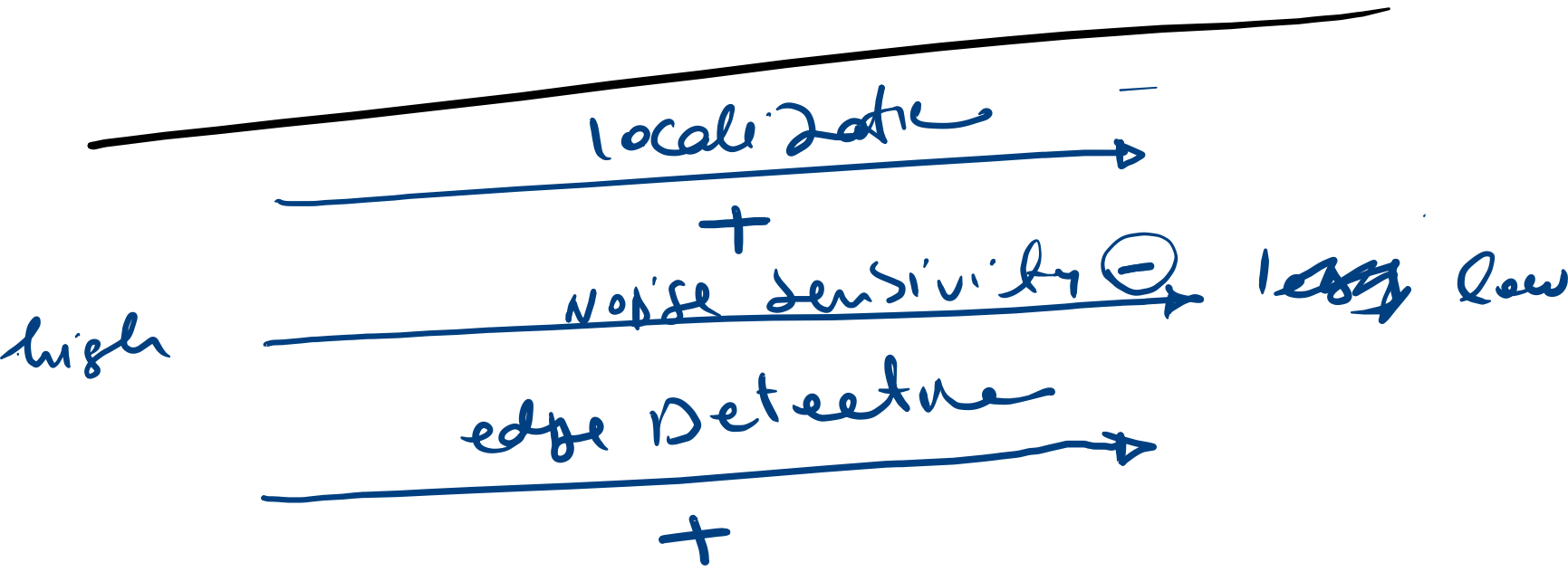


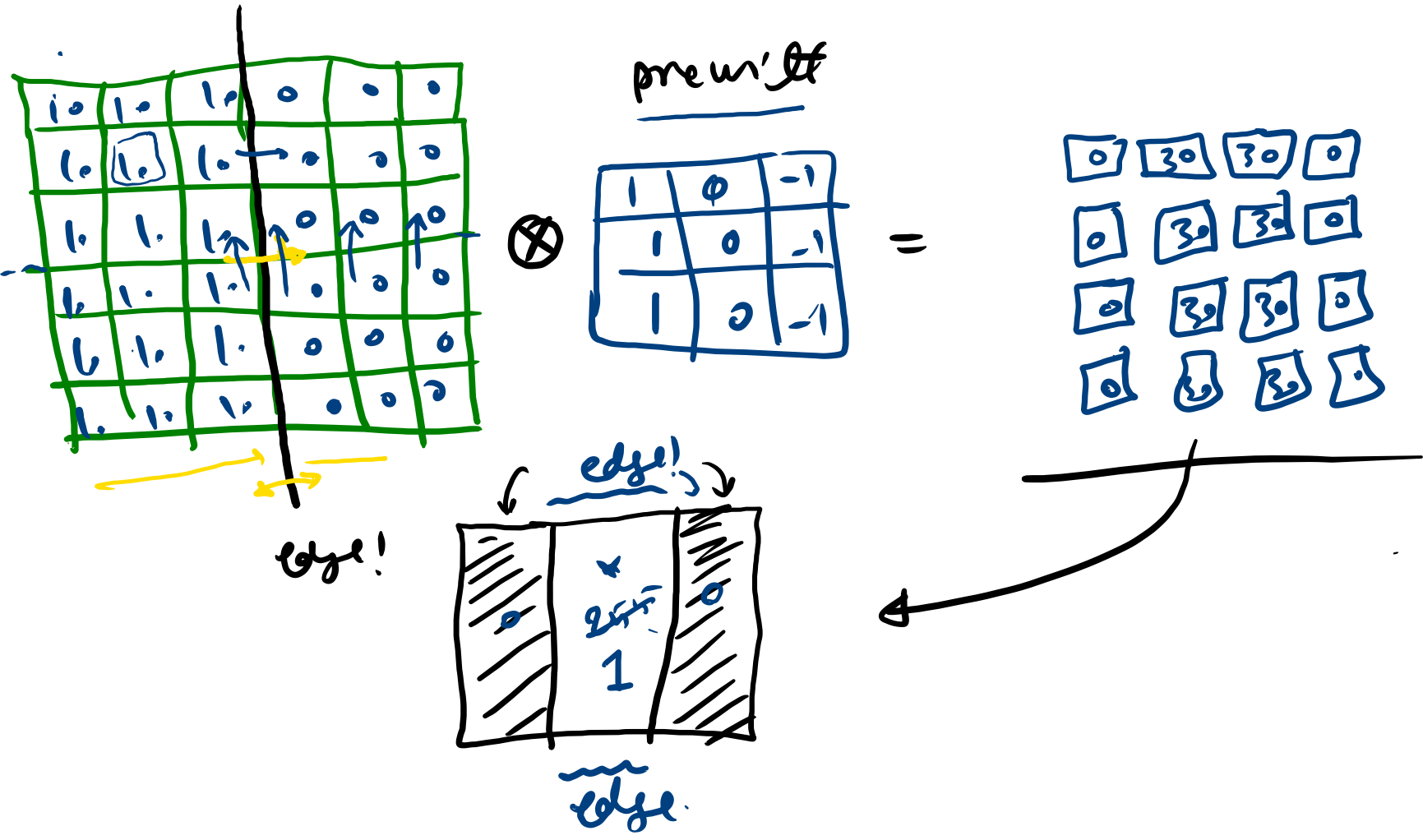
Convolution

Kernel → Gradient → edge Detection

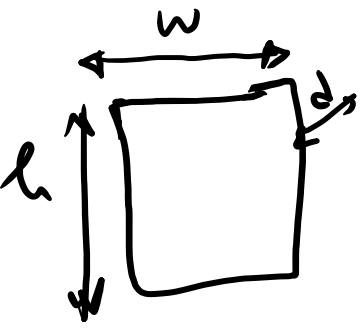
Gradient	Robert	Prewitt	Sobel (3x3)
$\frac{\partial I}{\partial x}$			
$\frac{\partial I}{\partial y}$			

Robert prewitt Sobel




prewitt
edge!
edge!
edge

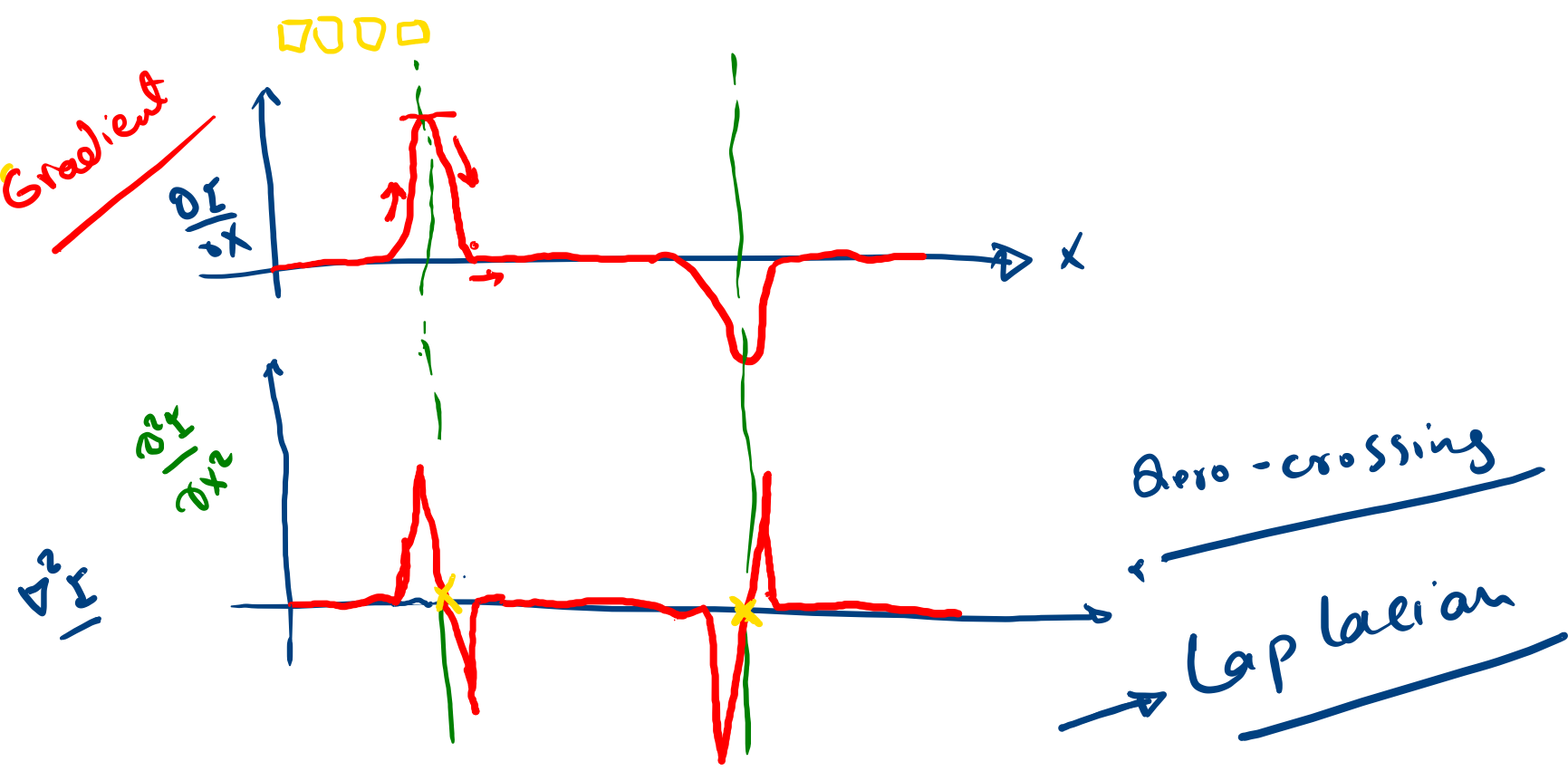
Color Image ⟶ 2D



Gradient

↳ for edge detection

problem of Gradient → { PDE localization


Gradient
$\frac{\partial I}{\partial x}$
x
$\frac{\partial^2 I}{\partial x^2}$
$\nabla^2 I$
Zero-crossing
Laplacian

Laplacian

- Localization (more accurate)
- → ~~magnitude~~
- → ~~Orientation~~

0	-1	0
-1	4	-1
0	-1	0

more accurate

-1	-1	-1
-1	8	-1
-1	-1	-1

Grad → X → $\frac{\partial I}{\partial x}$ → Sobel x
Y → $\frac{\partial I}{\partial y}$ → Sobel y

Canny → once

Sobel xy

Sobel

0. Gaussian ✓

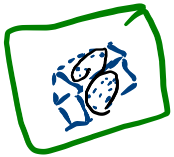
1. Gaussian → mag (M)
orientation (θ)

2. Laplacian → localization ←

2M

M, θ, (x, y)

Canny edge detector!



Gradient → Robert / prewitt / sobel

laplacian

mix : Canny

$T_1 < |\nabla I| < T_2$

✓

$\exists\ T_1 < T_2$

بررسی edge ها:
کدام edge ها edge نیستند؟

دو آستانه گذاشتیم!

Not a edge!

$|\nabla I| < T_1$

$T_1 < |\nabla I| < T_2$.

edge ← $|\nabla I| > T_2$

End

orientation