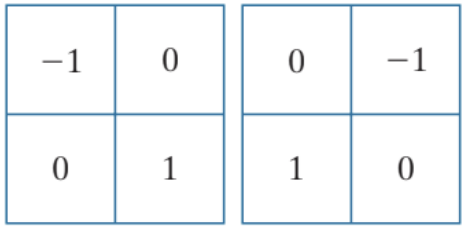
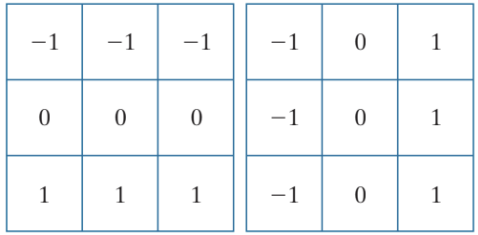
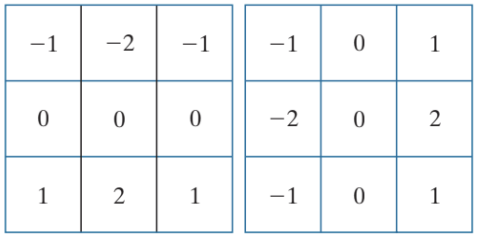
Comparison of Edge Detection Operators

Roberts, Prewitt, and Sobel Operators

Comparison Table: Roberts vs Prewitt vs Sobel

Feature	Roberts	Prewitt	Sobel
Kernel Size	2×2	3×3	3×3
Edge Orientation	Diagonal (45°, 135°)	Vertical & Horizontal	Vertical & Horizontal
Kernel Example			
Noise Sensitivity	High	Moderate	Low (better smoothing)
Computational Cost	Very Low	Moderate	Moderate-High
Smoothing Effect	None	None	Yes
Edge Accuracy	High (for fine details)	Moderate	Better for strong, smooth edges
Best For	Diagonal edges, fast detection	Simple edge detection	Robust edges in noisy images

When to Use Which Operator?

Roberts

- Use for fast detection of small, diagonal edges.
- Suitable for high-contrast, low-resolution images.
- Avoid if the image contains significant noise.

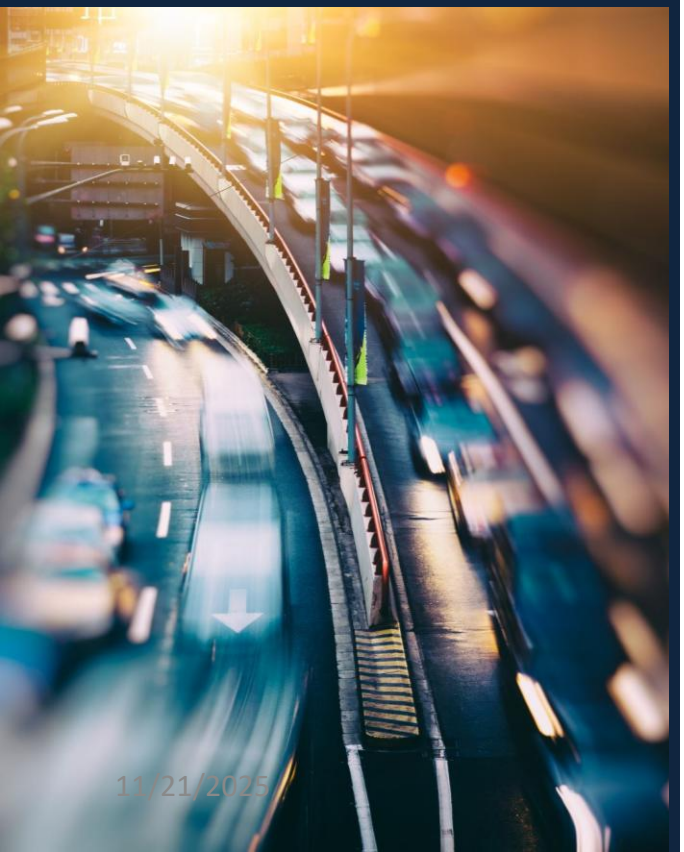
Prewitt

- Use for simple, basic edge detection.
- Works well with moderate noise levels.

Sobel

- Best for noisy, real-world images.
- Provides smoother, more continuous edges.
- Includes slight smoothing (like a Gaussian effect).

Practice Scenario



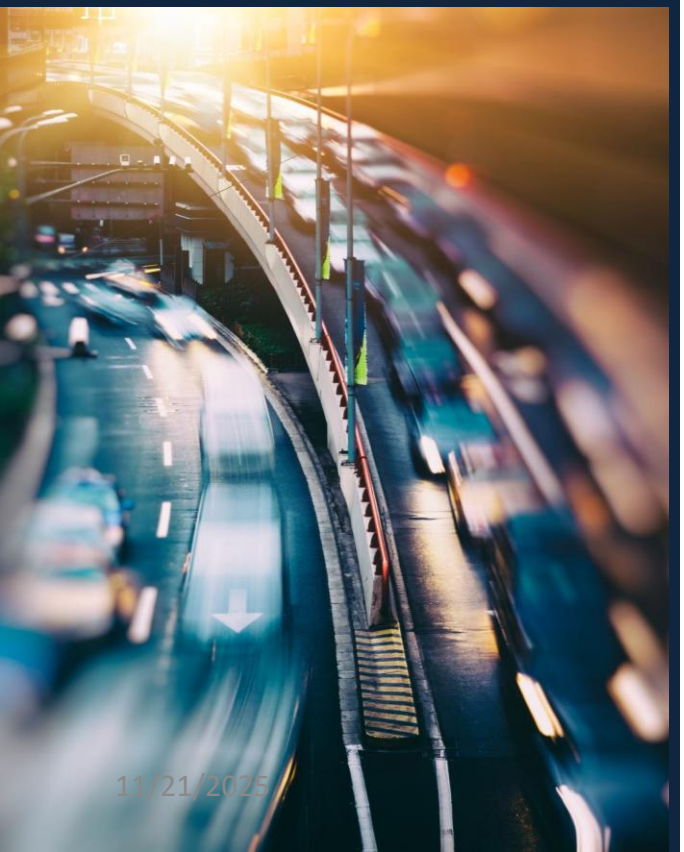
You are working on a **real-time traffic monitoring system** using roadside surveillance cameras. The goal is to detect the edges of vehicles (cars, trucks, bikes) for lane tracking and object recognition. The images:

- Are captured in **outdoor environments** with varying lighting.
- Often include **motion blur**, **shadow**, and **moderate noise**.
- Require **consistent edge detection** for reliable tracking.
- Are processed on a **mid-range processor** (not mobile, but not very powerful either).

Which edge detection method would you choose in this situation? **Roberts, Prewitt, or Sobel? Justify** your answer based on:

- ✓Noise handling
- ✓Smoothness of edges
- ✓Performance under variable lighting
- ✓ Resource availability

Practice Scenario (Answer)



Expected Answer: Sobel

Why?

- **Sobel includes smoothing**, which helps reduce the effect of noise and blur.
- Better suited for **noisy outdoor images**.
- More accurate and **stable edges** than Roberts or Prewitt.
- A good trade-off between **quality and performance** for real-time systems.

Summary

- - All three operators are based on intensity gradient calculation.
- - Roberts is fast and accurate for diagonal details.
- - Prewitt is simple and easy to implement.
- - Sobel is the most robust for practical applications.

- Sobel is most commonly used in digital image processing tasks.