

0	0	1	0	0
0	0	1	0	0
0	0	1	0	0
0	0	1	0	0
0	0	1	0	0

**VERTICAL BAR IMAGE**

## FILTERS USED

-1	0	1
-1	0	1
-1	0	1

**VERTICAL EDGE FILTER**

-1	-1	-1
0	0	0
1	1	1

**HORIZONTAL EDGE FILTER**

# CONVOLUTION RESULTS: VERTICAL EDGE FILTERS

Multiply and Sum: Top row + Middle row + Bottom row

**Position (1,1): Top-Left**

$$(-1 \times 0) + (0 \times 0) + (1 \times 1) + (-1 \times 0) + (0 \times 0) + (1 \times 1) + (-1 \times 0) + (0 \times 0) + (1 \times 1) = 3$$

**Position (1,2): Slide Right**

$$(-1 \times 0) + (0 \times 1) + (1 \times 0) + (-1 \times 0) + (0 \times 1) + (1 \times 0) + (-1 \times 0) + (0 \times 1) + (1 \times 0) = 0$$

**Position (1,3): Slide Right Again**

$$(-1 \times 1) + (0 \times 0) + (1 \times 0) + (-1 \times 1) + (0 \times 0) + (1 \times 0) + (-1 \times 1) + (0 \times 0) + (1 \times 0) = -3$$

3	0	-3
3	0	-3
3	0	-3

## VERTICAL EDGE RESULT:

**3:** The filter aligns with the left edge of the bar (where 0s turn to 1s), giving a high positive value because the 1s match the filter's 1s.

**0:** The filter is over the bar itself (all 1s) or background (all 0s), where there's no edge, so the positives and negatives cancel out.

**-3:** The filter aligns with the right edge (1s turn to 0s), giving a negative value because the 1s match the filter's -1s.

This shows the filter detecting the **left edge** (3) and **right edge** (-3) of the vertical bar!

# CONVOLUTION RESULTS: HORIZONTAL EDGE FILTERS

## HORIZONTAL EDGE RESULT:

- This looks for changes from top to bottom (e.g., a horizontal line).
- Our image has a vertical bar, so every 3x3 section has no top-to-bottom change
- Every position cancels out like this because the vertical bar is consistent top-to-bottom.

### *Example (1,1)*

$$\begin{aligned} &(-1 \times 0) + (-1 \times 0) + (-1 \times 1) + (0 \times 0) + (0 \times 0) + (0 \times 1) + (1 \times 0) + (1 \times 0) + (1 \times 1) \\ &= (0 + 0 + -1) + (0 + 0 + 0) + (0 + 0 + 1) = -1 + 0 + 1 = \mathbf{0} \end{aligned}$$

0	0	0
0	0	0
0	0	0

# INTERPRETATIONS

## FEATURE DETECTION INSIGHTS

- Vertical Edge Filter: High values (3) and low values (-3) indicate left and right edges of the bar.
- Horizontal Edge Filter: All zeros show no horizontal features, as expected for a vertical bar.

### Key Takeaway

- Convolution is just sliding, multiplying, and summing.
- The filter's numbers decide what it “sees” (e.g., vertical or horizontal edges).
- The output shows where those features are in the image.