



deeplearning.ai

# Convolutional Neural Networks

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More edge  
detection

# Vertical edge detection examples

|    |    |    |   |   |   |
|----|----|----|---|---|---|
| 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 |




|   |   |   |    |    |    |
|---|---|---|----|----|----|
| 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 | 10 | 10 | 10 |

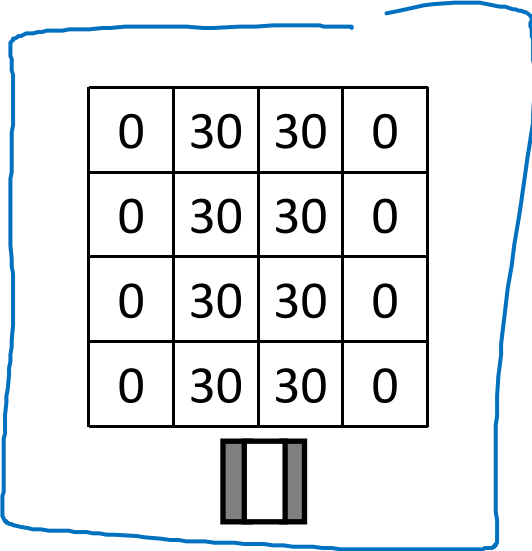


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|   |   |    |
|---|---|----|
| 1 | 0 | -1 |
| 1 | 0 | -1 |
| 1 | 0 | -1 |



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|   |    |    |   |
|---|----|----|---|
| 0 | 30 | 30 | 0 |
| 0 | 30 | 30 | 0 |
| 0 | 30 | 30 | 0 |
| 0 | 30 | 30 | 0 |

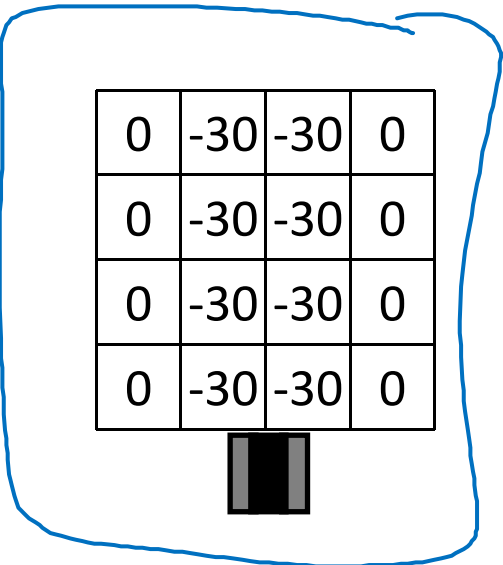


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|   |   |    |
|---|---|----|
| 1 | 0 | -1 |
| 1 | 0 | -1 |
| 1 | 0 | -1 |



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|   |     |     |   |
|---|-----|-----|---|
| 0 | -30 | -30 | 0 |
| 0 | -30 | -30 | 0 |
| 0 | -30 | -30 | 0 |
| 0 | -30 | -30 | 0 |



# Vertical and Horizontal Edge Detection

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|   |   |    |
|---|---|----|
| 1 | 0 | -1 |
| 1 | 0 | -1 |
| 1 | 0 | -1 |

Vertical

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|    |    |    |
|----|----|----|
| 1  | 1  | 1  |
| 0  | 0  | 0  |
| -1 | -1 | -1 |

Horizontal

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 10 | 10 | 10 | 0  | 0  | 0  |
| 10 | 10 | 10 | 0  | 0  | 0  |
| 10 | 10 | 10 | 0  | 0  | 0  |
| 0  | 0  | 0  | 10 | 10 | 10 |
| 0  | 0  | 0  | 10 | 10 | 10 |
| 0  | 0  | 0  | 10 | 10 | 10 |

6x6

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|    |    |    |
|----|----|----|
| 1  | 1  | 1  |
| 0  | 0  | 0  |
| -1 | -1 | -1 |

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|    |    |     |     |
|----|----|-----|-----|
| 0  | 0  | 0   | 0   |
| 30 | 10 | -10 | -30 |
| 30 | 10 | -10 | -30 |
| 0  | 0  | 0   | 0   |

# Learning to detect edges

|   |   |    |
|---|---|----|
| 1 | 0 | -1 |
| 1 | 0 | -1 |
| 1 | 0 | -1 |



→

|   |   |    |
|---|---|----|
| 1 | 0 | -1 |
| 2 | 0 | -2 |
| 1 | 0 | -1 |

Sobel filter



|    |   |     |
|----|---|-----|
| 3  | 0 | -3  |
| 10 | 0 | -10 |
| 3  | 0 | -3  |

Scharr filter



|   |   |   |   |   |   |
|---|---|---|---|---|---|
| 3 | 0 | 1 | 2 | 7 | 4 |
| 1 | 5 | 8 | 9 | 3 | 1 |
| 2 | 7 | 2 | 5 | 1 | 3 |
| 0 | 1 | 3 | 1 | 7 | 8 |
| 4 | 2 | 1 | 6 | 2 | 8 |
| 2 | 4 | 5 | 2 | 3 | 9 |

convolution  
×

|       |       |       |
|-------|-------|-------|
| $W_1$ | $W_2$ | $W_3$ |
| $W_4$ | $W_5$ | $W_6$ |
| $W_7$ | $W_8$ | $W_9$ |

3x3

=

45°  
70°  
73°

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |