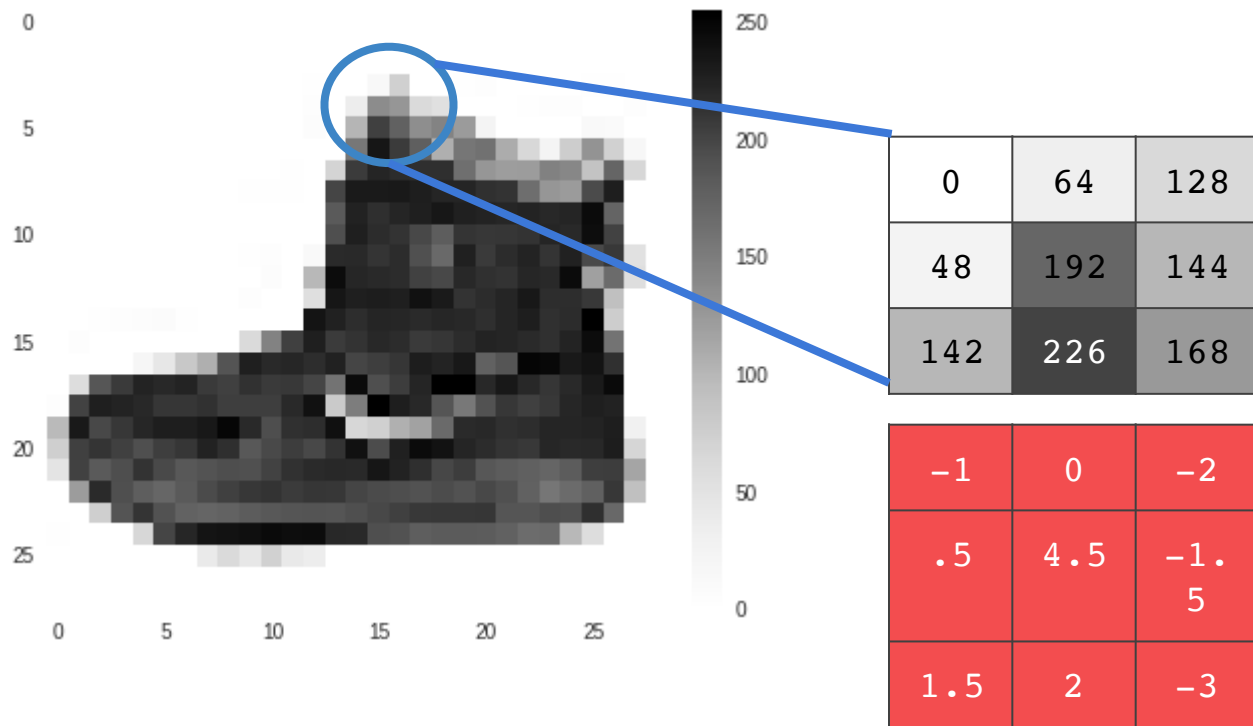


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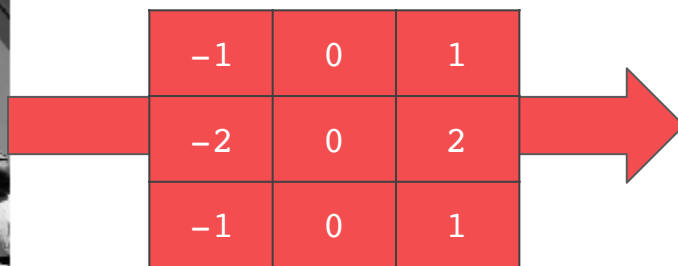


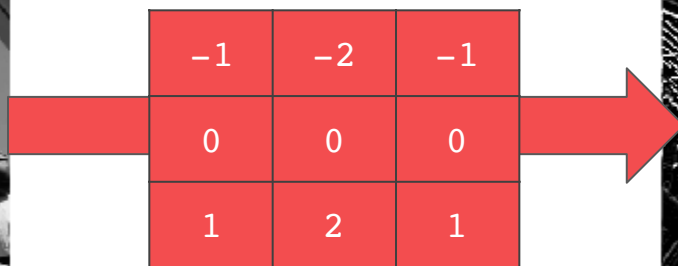
Current Pixel Value is
192

Consider neighbor Values

Filter Definition

$$\begin{aligned}\text{CURRENT_PIXEL_VALUE} &= 192 \\ \text{NEW_PIXEL_VALUE} &= (-1 * 0) + (0 * 64) + (-2 * 128) + \\ &\quad (.5 * 48) + (4.5 * 192) + (-1.5 * 144) \\ &\quad + \\ &\quad (1.5 * 142) + (2 * 226) + (-3 * 168)\end{aligned}$$





0	64	128	128
48	192	144	144
142	226	168	0
255	0	0	64

0	64
48	192

192

128	128
144	144

144

142	226
255	0

255

168	0
0	64

168

192	144
255	168

```
model = tf.keras.models.Sequential([  
    tf.keras.layers.Flatten(),  
    tf.keras.layers.Dense(128, activation=tf.nn.relu),  
    tf.keras.layers.Dense(10, activation=tf.nn.softmax)  
])
```

```
model = tf.keras.models.Sequential([  
    tf.keras.layers.Conv2D(64, (3,3), activation='relu',  
                           input_shape=(28, 28, 1)),  
    tf.keras.layers.MaxPooling2D(2, 2),  
    tf.keras.layers.Conv2D(64, (3,3), activation='relu'),  
    tf.keras.layers.MaxPooling2D(2,2),  
    tf.keras.layers.Flatten(),  
    tf.keras.layers.Dense(128, activation='relu'),  
    tf.keras.layers.Dense(10, activation='softmax')  
])
```

```
model = tf.keras.models.Sequential([
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                           input_shape=(28, 28, 1)),
    tf.keras.layers.MaxPooling2D(2, 2),
    tf.keras.layers.Conv2D(64, (3,3), activation='relu'),
    tf.keras.layers.MaxPooling2D(2,2),
    tf.keras.layers.Flatten(),
    tf.keras.layers.Dense(128, activation='relu'),
    tf.keras.layers.Dense(10, activation='softmax')
])
```


Computer Vision Problems

Image Classification

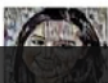


Cat? (0/1)

Neural Style Transfer



Object detection



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C4W1L01 Computer Vision

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5:44

2

Vertical edge detection



C4W1L02 Edge Detection Examples

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11:31

3

Vertical and Horizontal Edge Detection



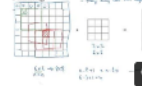
C4W1L03 More Edge Detection

Deeplearning.ai

7:58

4

Padding



C4W1L04 Padding

Deeplearning.ai

9:50

5

Technical note on cross-correlation vs. convolution

Derivatives in math, intuition.



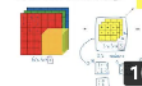
C4W1L05 Strided Convolutions

Deeplearning.ai

9:02

6

Convolutions on RGB image



C4W1L06 Convolutions Over Volumes

Deeplearning.ai

10:45

<https://bit.ly/2UGa7uH>

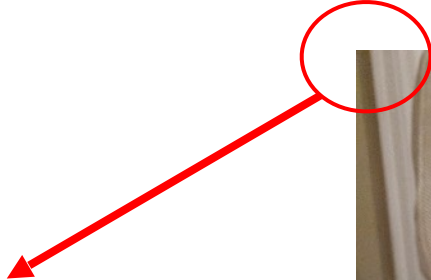
```
model = tf.keras.models.Sequential([  
    tf.keras.layers.Conv2D(64, (3,3), activation='relu',  
        input_shape=(28, 28, 1)),  
    tf.keras.layers.MaxPooling2D(2, 2),  
    tf.keras.layers.Conv2D(64, (3,3), activation='relu'),  
    tf.keras.layers.MaxPooling2D(2,2),  
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    tf.keras.layers.MaxPooling2D(2,2),  
    tf.keras.layers.Flatten(),  
    tf.keras.layers.Dense(128, activation='relu'),  
    tf.keras.layers.Dense(10, activation='softmax')  
])
```

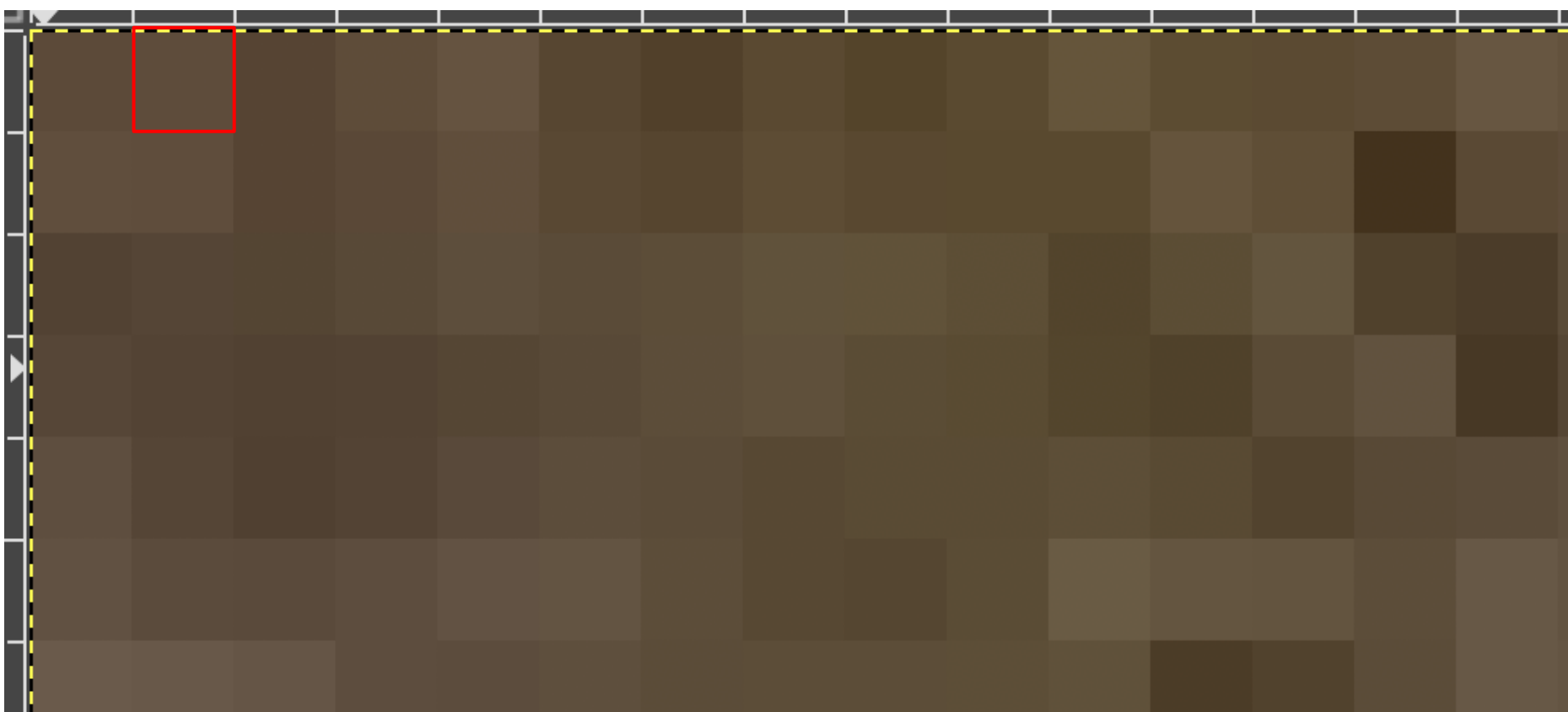
```
model.summary()
```

Layer (type)	Output Shape	Param #
conv2d_12 (Conv2D)	(None, 26, 26, 64)	640
max_pooling2d_12 (MaxPooling)	(None, 13, 13, 64)	0
conv2d_13 (Conv2D)	(None, 11, 11, 64)	36928
max_pooling2d_13 (MaxPooling)	(None, 5, 5, 64)	0
flatten_5 (Flatten)	(None, 1600)	0
dense_10 (Dense)	(None, 128)	204928
dense_11 (Dense)	(None, 10)	1290

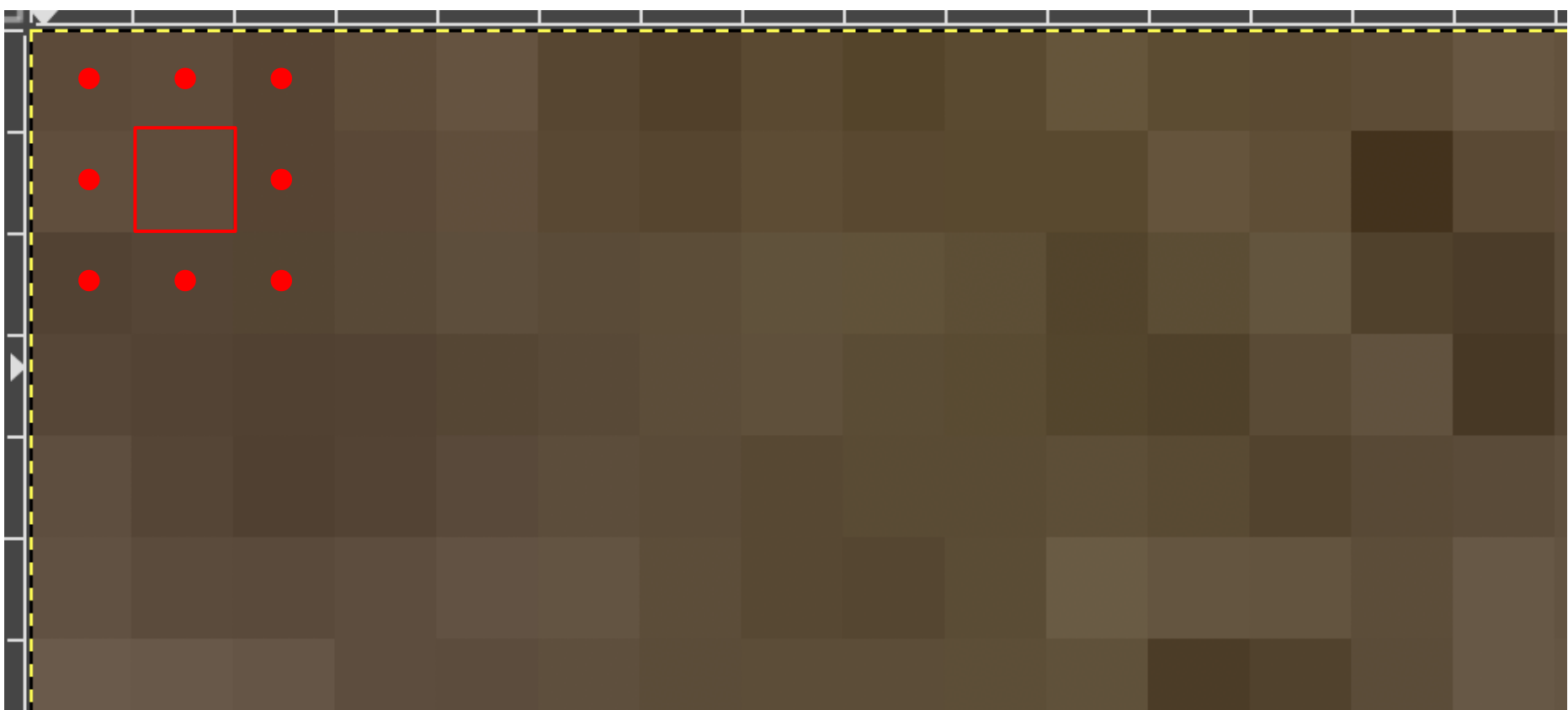
Layer (type)	Output Shape	Param #	
conv2d_12 (Conv2D)	(None, 26, 26, 64)	640	VÌ CÁC PIXELS TRÊN CÁC GÓC KHÔNG CÓ NEIGHBORS
max_pooling2d_12 (MaxPooling)	(None, 13, 13, 64)	0	LÀM FILTERS NÊN SIZE RESULT = ACTUAL SIZE - SIZE FILTER
conv2d_13 (Conv2D)	(None, 11, 11, 64)	36928	
max_pooling2d_13 (MaxPooling)	(None, 5, 5, 64)	0	
flatten_5 (Flatten)	(None, 1600)	0	
dense_10 (Dense)	(None, 128)	204928	
dense_11 (Dense)	(None, 10)	1290	











Layer (type)	Output Shape	Param #
conv2d_12 (Conv2D)	(None, 26, 26, 64)	640
max_pooling2d_12 (MaxPooling)	(None, 13, 13, 64)	0
conv2d_13 (Conv2D)	(None, 11, 11, 64)	36928
max_pooling2d_13 (MaxPooling)	(None, 5, 5, 64)	0
flatten_5 (Flatten)	(None, 1600)	0
dense_10 (Dense)	(None, 128)	204928
dense_11 (Dense)	(None, 10)	1290

Layer (type)	Output Shape	Param #	
conv2d_12 (Conv2D)	(None, 26, 26, 64)	640	
max_pooling2d_12 (MaxPooling)	(None, 13, 13, 64)	0	WHEN MAXPOOL THE RESULT = THE SIZE / POOL SIZE
conv2d_13 (Conv2D)	(None, 11, 11, 64)	36928	(13, 13) = (26, 26) / 2
max_pooling2d_13 (MaxPooling)	(None, 5, 5, 64)	0	
flatten_5 (Flatten)	(None, 1600)	0	
dense_10 (Dense)	(None, 128)	204928	
dense_11 (Dense)	(None, 10)	1290	

Layer (type)	Output Shape	Param #
conv2d_12 (Conv2D)	(None, 26, 26, 64)	640
max_pooling2d_12 (MaxPooling)	(None, 13, 13, 64)	0
conv2d_13 (Conv2D)	(None, 11, 11, 64)	36928
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