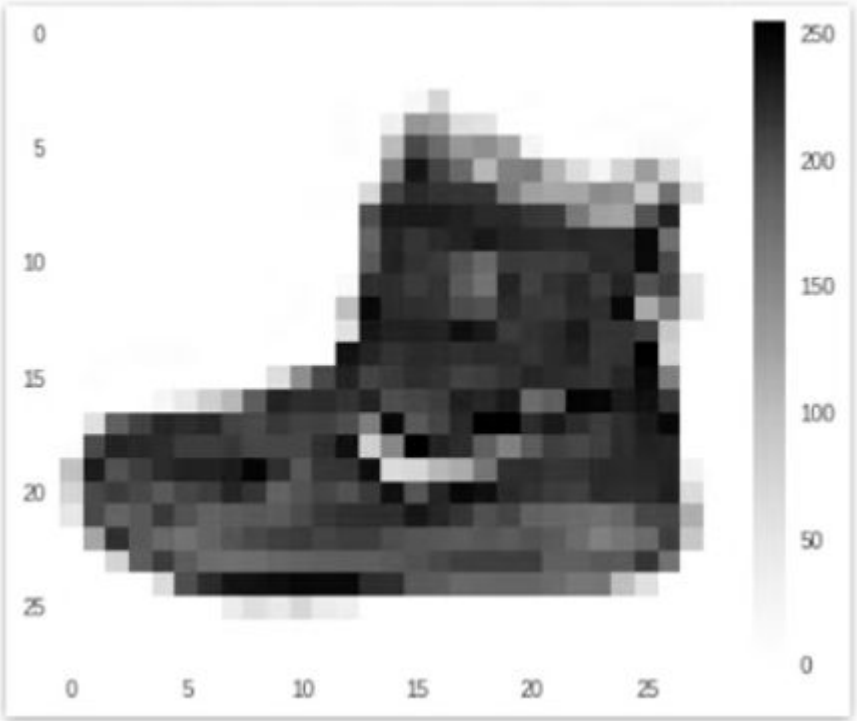
Convolutional neural networks

Computer vision

Prof. Dr. Jan Kirenz
HdM Stuttgart

Fashion MNIST

- Images are greyscale 28x28
- They are centered
- Only one item per image

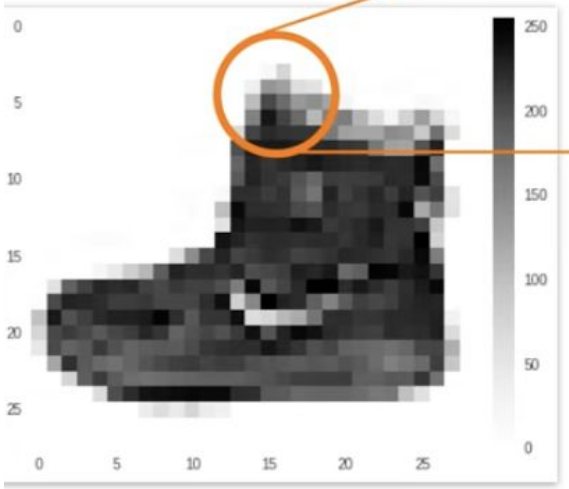


Source: Moroney (2019)

Source: Moroney (2019)

In a convolutional neural network, we first filter the images to spot features

Take a look at a particular pixel with value 192

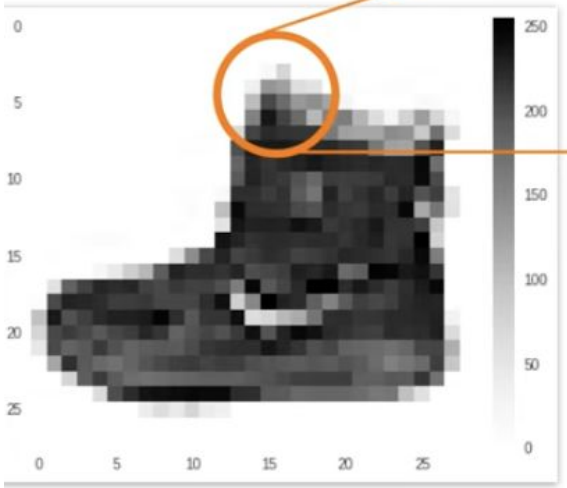


0	64	128
48	192	144
142	226	168

Current pixel value is 192

Consider neighbor values

A filter is simply a set of multipliers



0	64	128
48	192	144
142	226	168

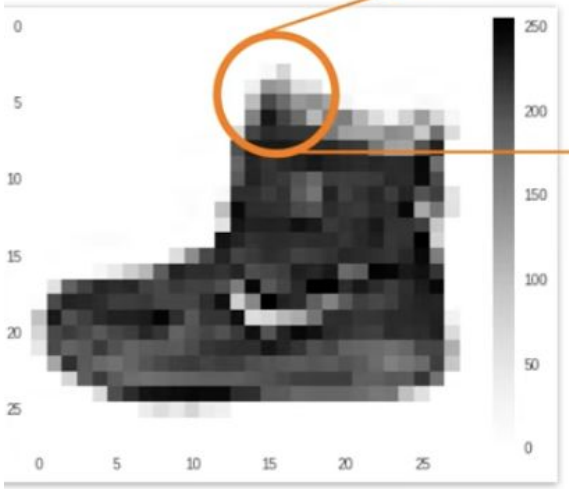
Current pixel value is 192

Consider neighbor values

-1	0	-2
.5	4.5	-1.5
1.5	2	-3

Filter definition

Multiply and sum up the result to get the new value



0	64	128
48	192	144
142	226	168

Current pixel value is 192

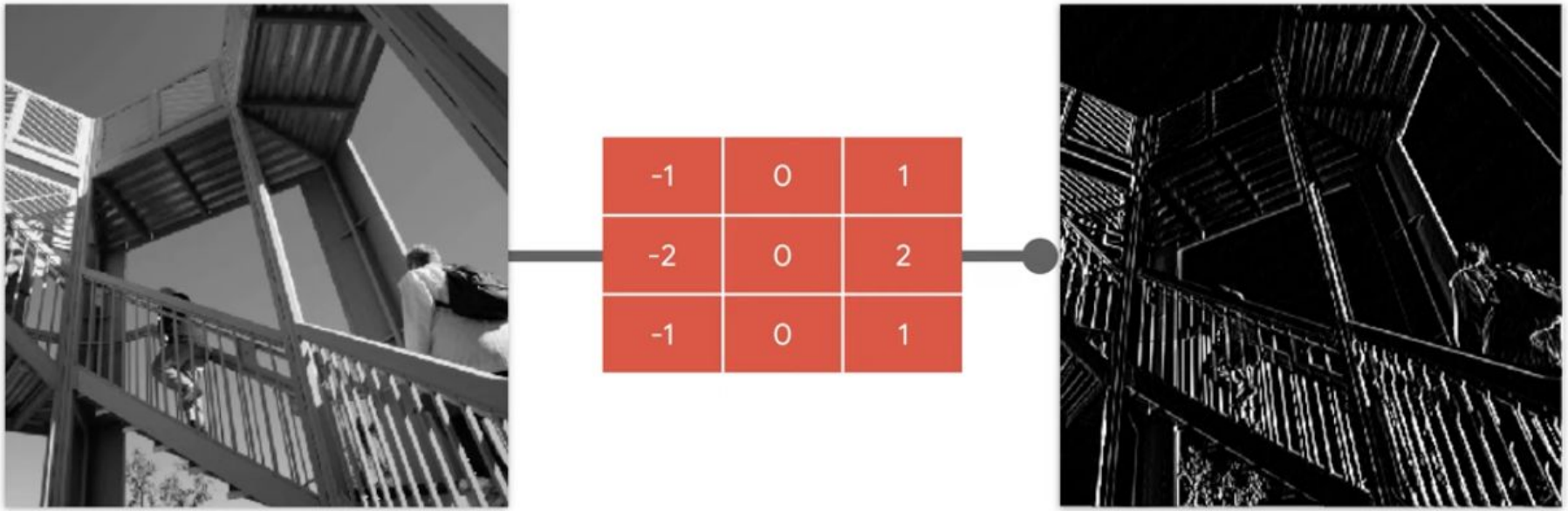
Consider neighbor values

-1	0	-2
.5	4.5	-1.5
1.5	2	-3

Filter definition

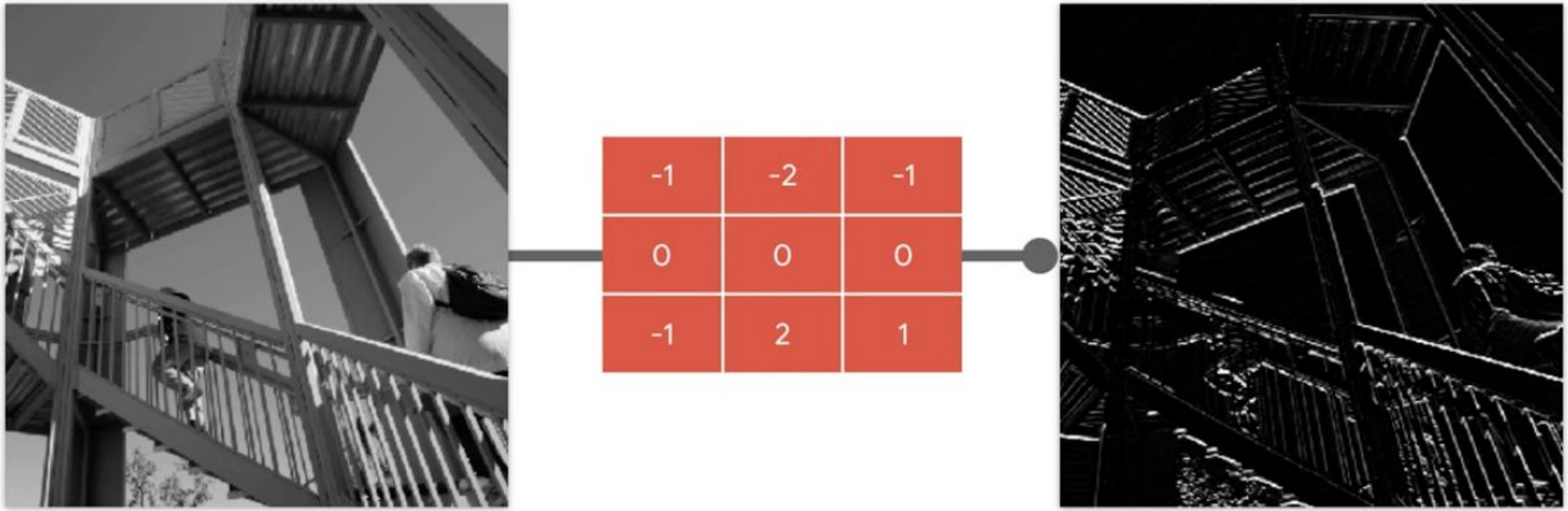
```
CURRENT_PIXEL_VALUE = 192

NEW_PIXEL_VALUE = (-1 * 0) + (0 * 64) + (-2 * 128) +
                  (.5 * 48) + (4.5 * 192) + (-1.5 * 144) +
                  (1.5 * 42) + (2 * 226) + (-3 * 168)
```

This filter removes almost everything except **vertical** lines



Source: Moroney (2019)

This filter removes almost everything except **horizontal** lines



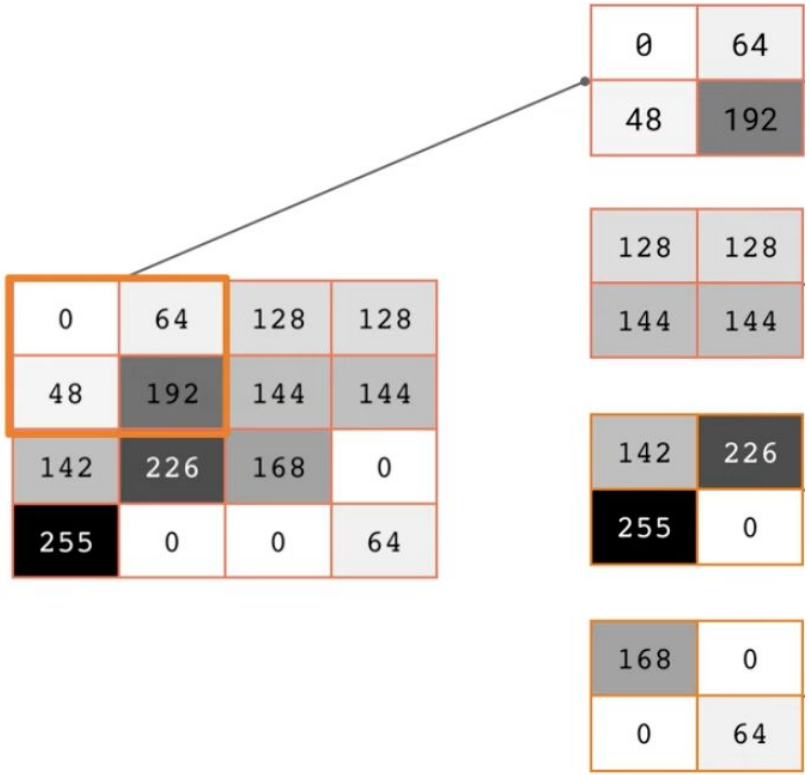
Source: Moroney (2019)

Pooling groups up the pixels in the image

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

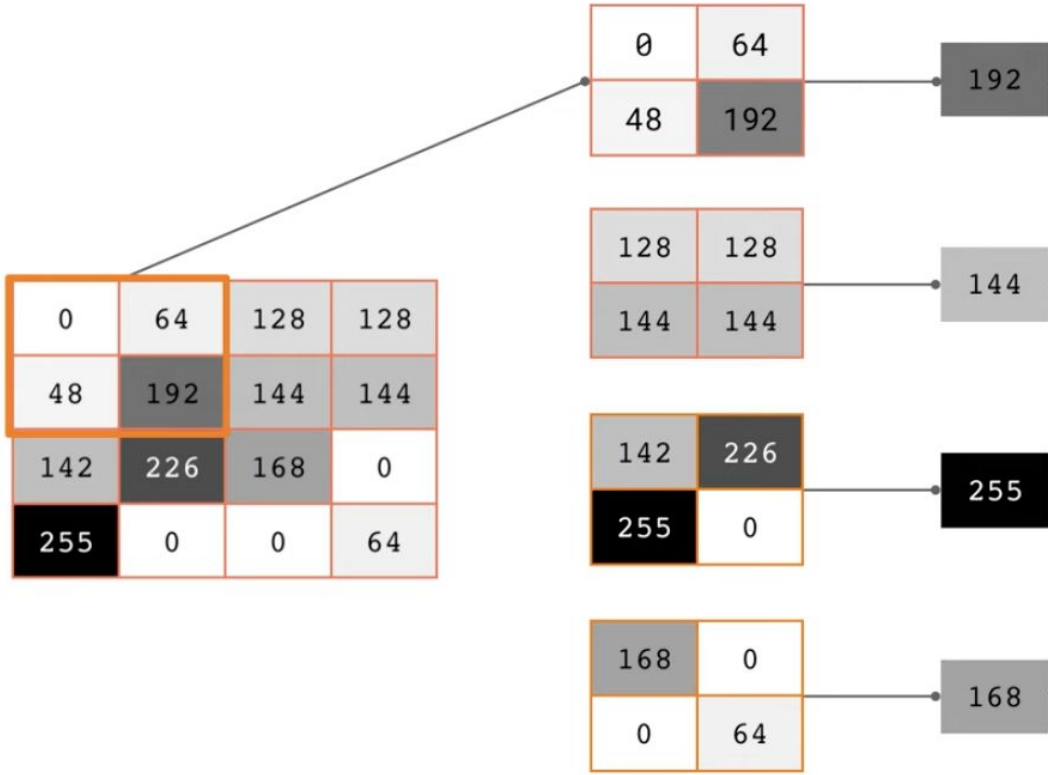
Source: Moroney (2019)

Max Pooling 2 by 2 will group image into sets of 2x2 pixels



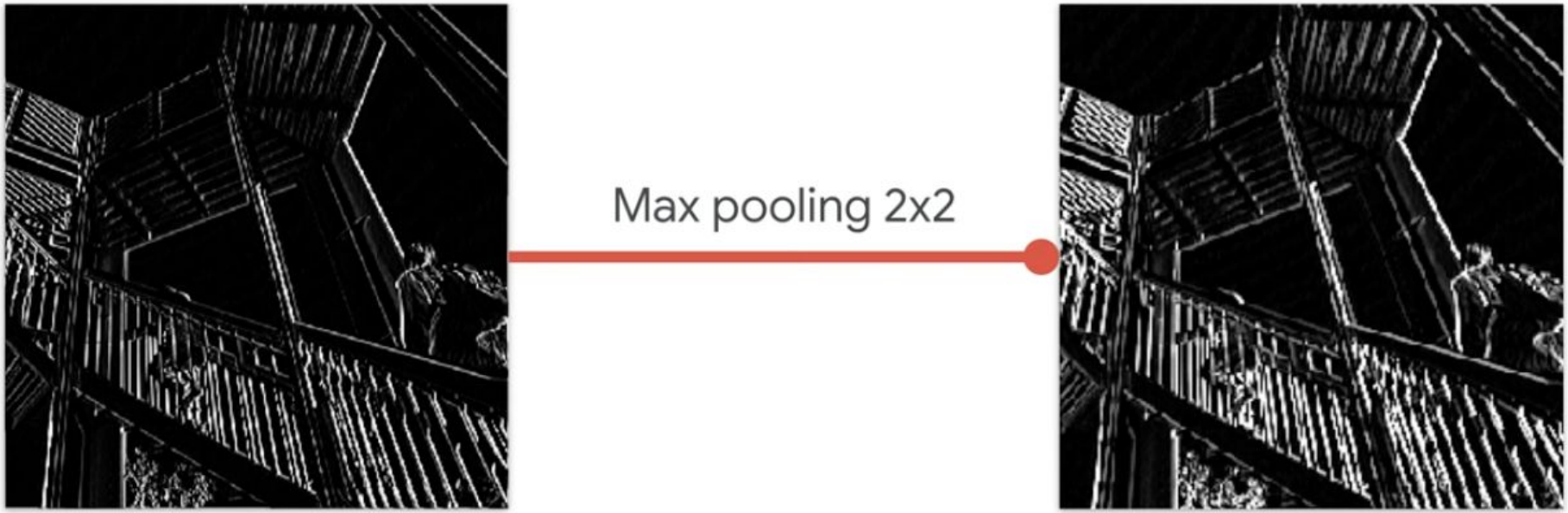
Source: Moroney (2019)

… and pick the largest



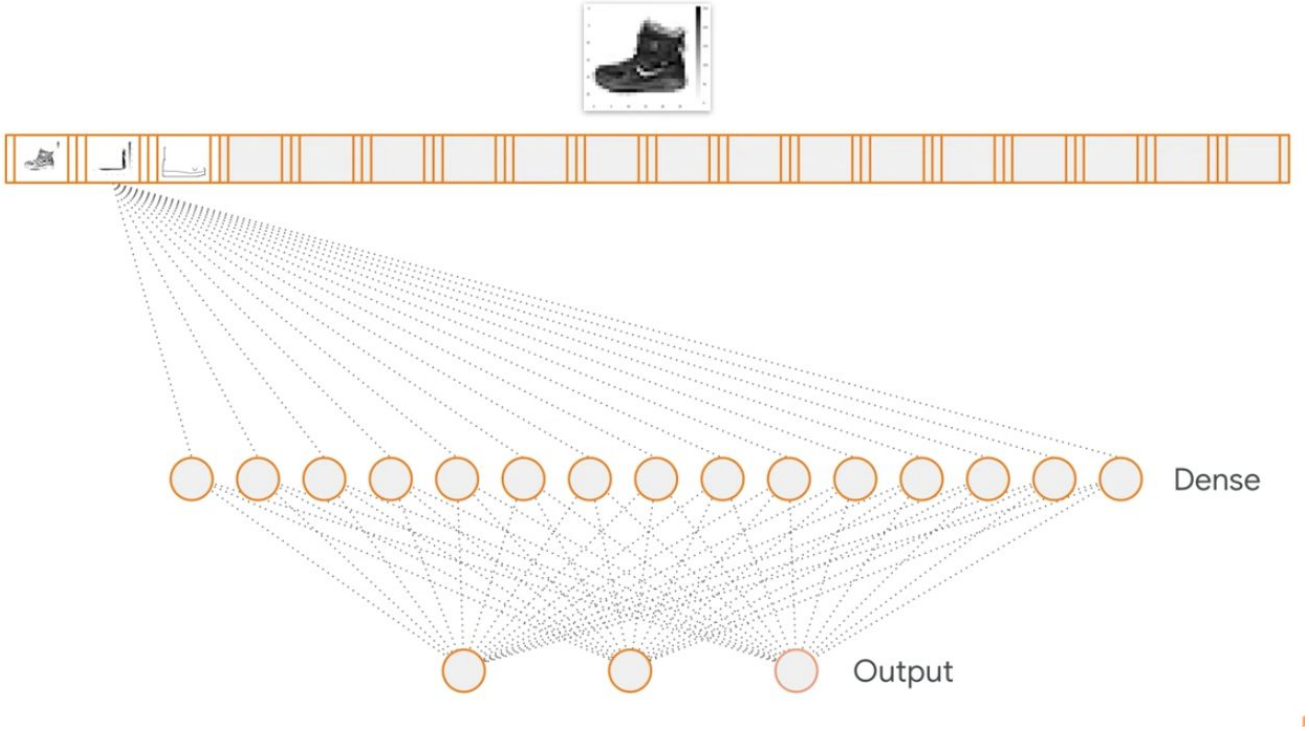
Source: Moroney (2019)

Result of Max pooling: vertical line features are maintained



Source: Moroney (2019)

The filters are learned - they are parameters!



this process is called f**eature extraction**

Source: Moroney

Resources

The slides are based on the excellent video tutorial “Introducing to convolutional neural networks (ML Zero to Hero - Part 3)” by Lawrence Moroney.