deeplearning.ai

# Convolutional Neural Networks

## Pooling layers

# Pooling layer: Max pooling (↓ size of o/p)

|   |   |   |   |
|---|---|---|---|
| 1 | 3 | 2 | 1 |
| 2 | 9 | 1 | 1 |
| 1 | 3 | 2 | 3 |
| 5 | 6 | 1 | 2 |

4 X 4

Say this is the O/p of some layer, ie, its an Activation of the NN

- Max pooling helps to extract & preserve the Strongest features of the Activation in the future layers

ie, that is why 9 was preserved

|   |   |
|---|---|
| 9 | 2 |
| 6 | 3 |

2 X 2

Hyper params

$f = 2$ (filter)

$s = 2$ (stride)

Its as if we took a filter & applied it to that Image & selected the max from the filtered region

- Then took a stride to Adjust new Filter position & did the same

The same formula we used for the o/p of the conv layer $(a^{[l]})$ Also works for max pooling

ie, 4x4 → 2x2

$$\frac{n+2p-f}{s}+1$$

$$=\frac{4+0-2}{2}+1$$

$$=2$$

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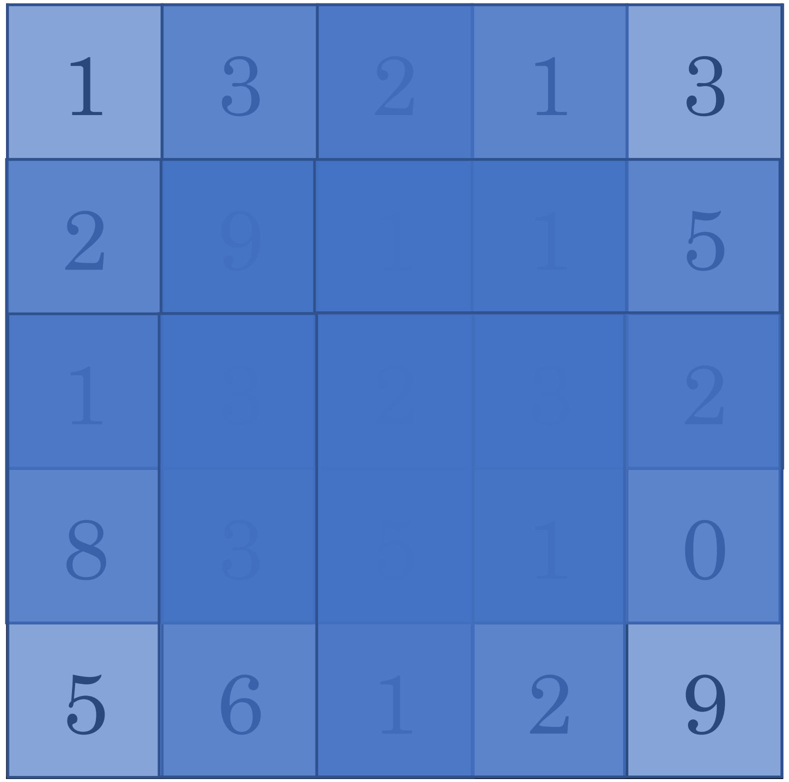
# Pooling layer: Max pooling



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

5 x 5

Say
$f=3$
$s=1$

| | | |
|---|---|---|
| 9 | 9 | 5 |
| 9 | 9 | 5 |
| 8 | 6 | 9 |

3 x 3

If there were more than 1 channels in the input, say 5 x 5 x 2 then max pooling output has dim 3 x 3 x 2 (we do max pooling channel by channel)

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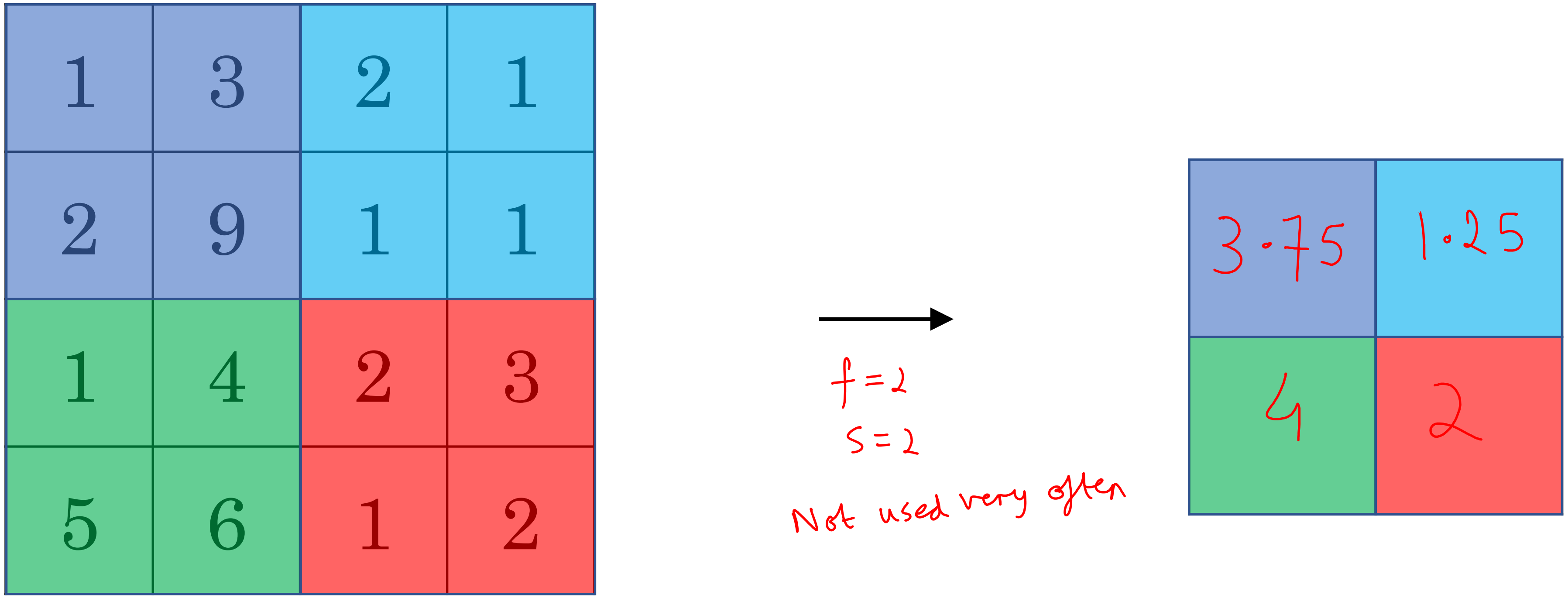
# Pooling layer: Average pooling



|  |  |  |  |
|---|---|---|---|
| 1 | 3 | 2 | 1 |
| 2 | 9 | 1 | 1 |
| 1 | 4 | 2 | 3 |
| 5 | 6 | 1 | 2 |

$$\longrightarrow$$

$f=2$

$s=2$

Not used very often

|  |  |
|---|---|
| 3.75 | 1.25 |
| 4 | 2 |

# Summary of pooling

$n_H \times n_W \times n_C$

$\downarrow$

$\left\lfloor \frac{n_H - f}{s} + 1 \right\rfloor \times \left\lfloor \frac{n_W - f}{s} + 1 \right\rfloor \times n_c$

Generally padding is 0 during pooling, so you dont see it above

Hyperparameters:

f : filter size

s : stride

Max or average pooling

There are no params to learn via (back prop) gradient descent in pooling