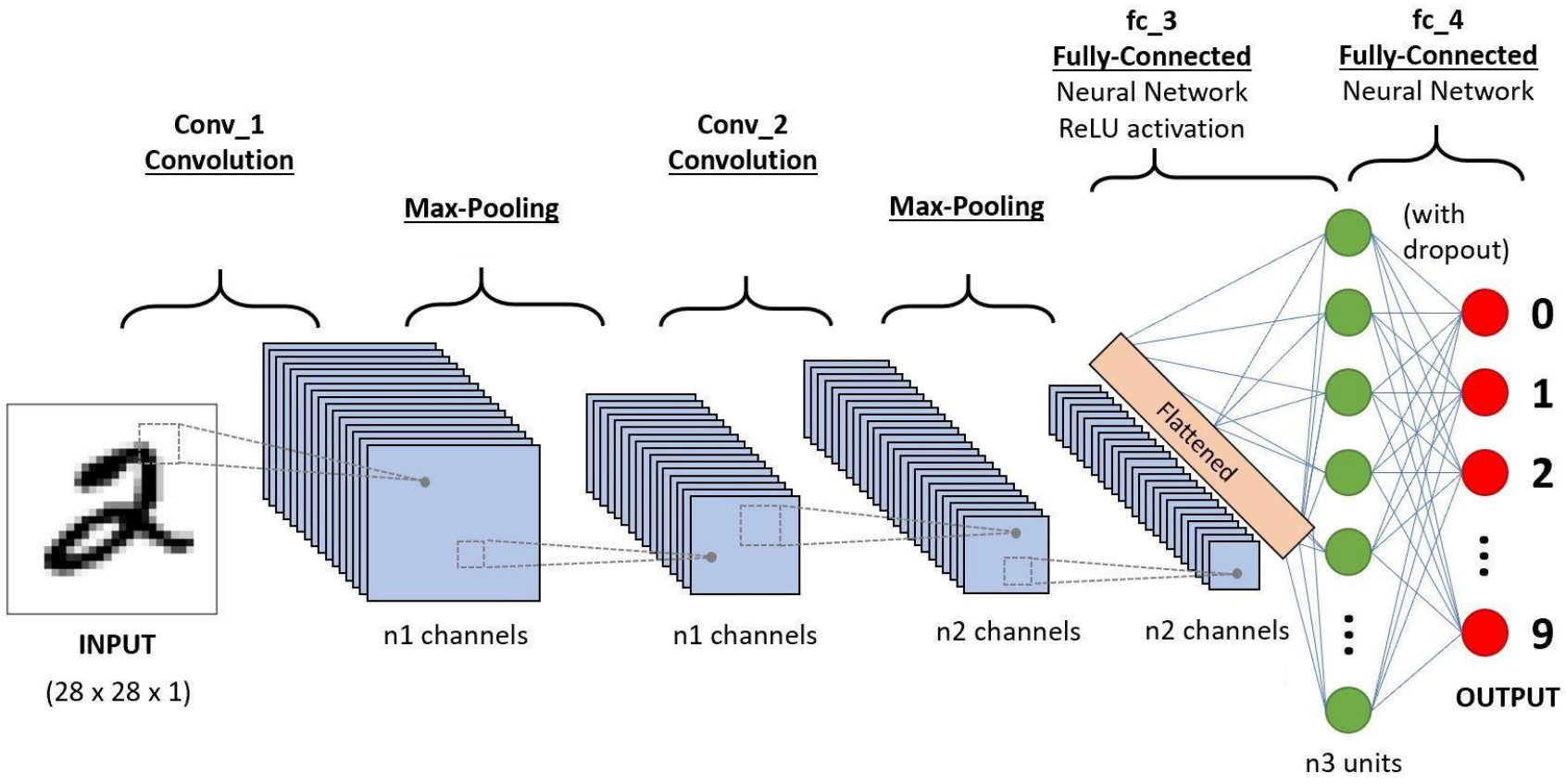
Neural Networks
11. Pytorch – Convolutional Network

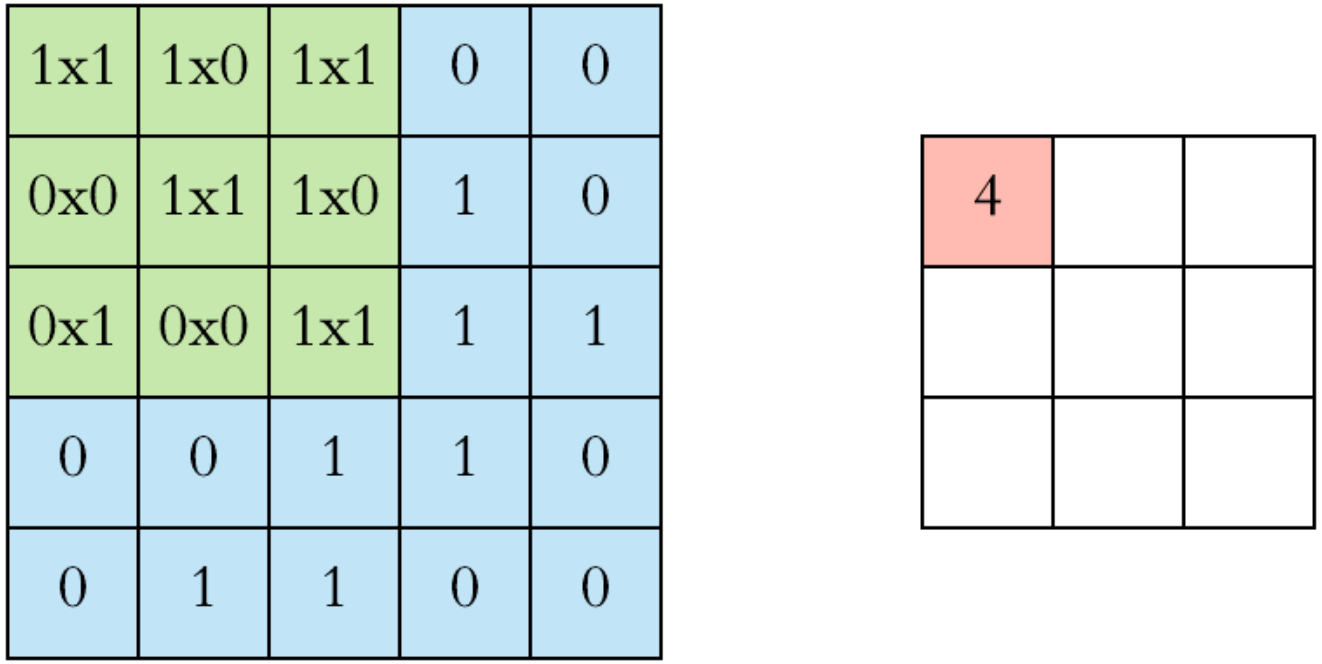
Center for Cognitive Science
Department of Applied Informatics
Faculty of Mathematics, Physics and Informatics
Comenius University in Bratislava

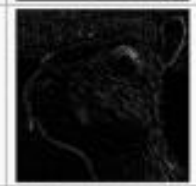
Thursday 2nd May, 2024

Convolutional Neural Networks (CNNs)

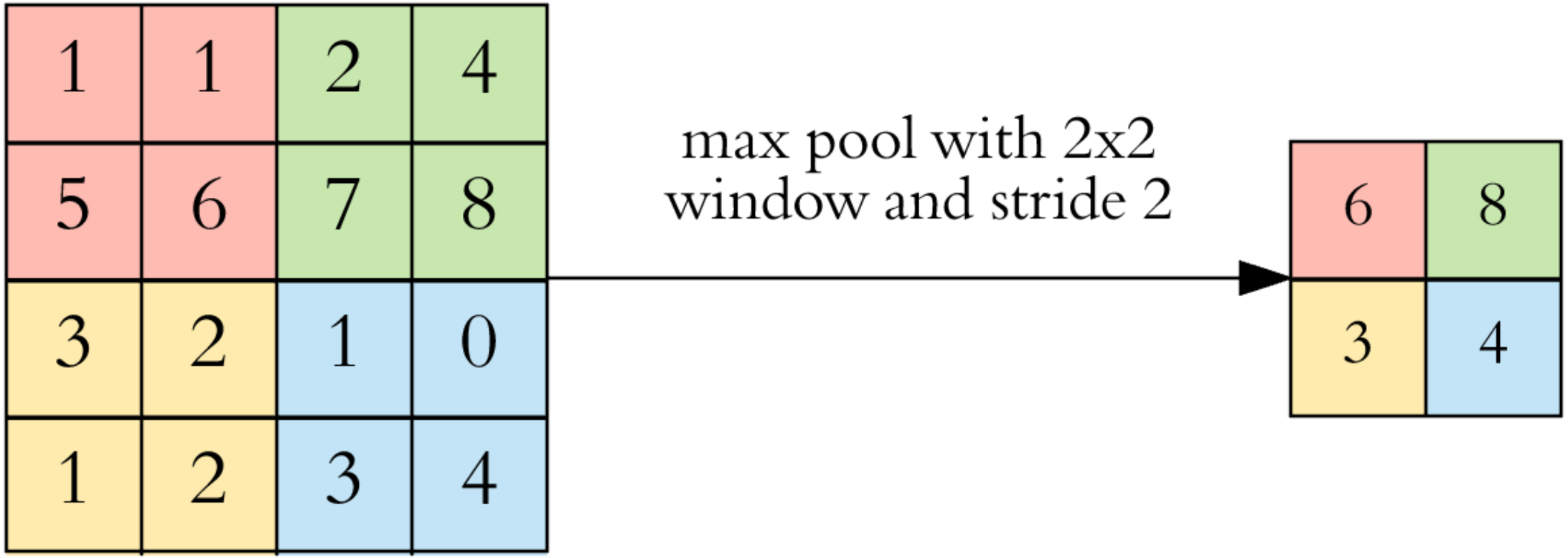


Convolutional filters

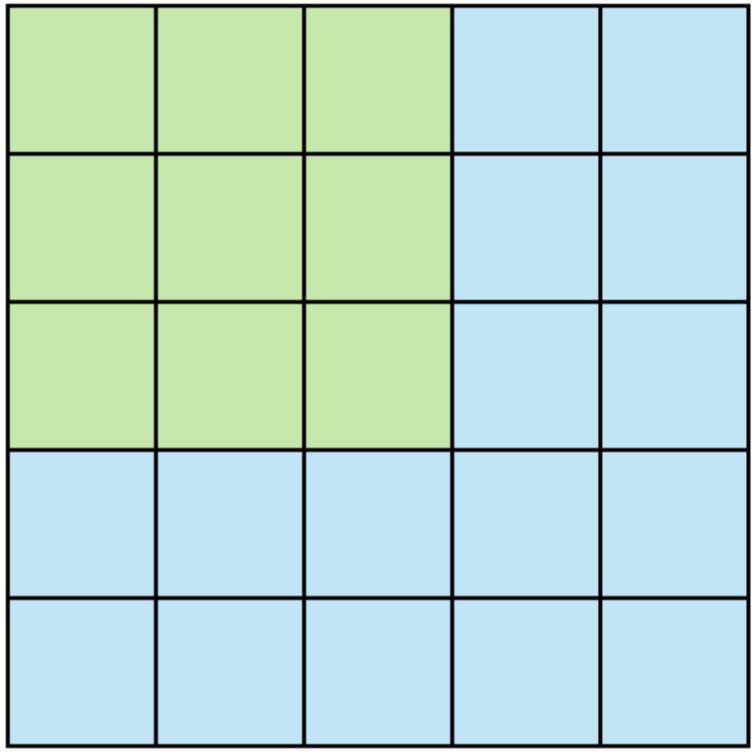


Operation	Filter	Convolved Image
Identity	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	
Edge detection	$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$	
	$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$	
	$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$	
Sharpen	$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$	
Box blur (normalized)	$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$	
Gaussian blur (approximation)	$\frac{1}{16}\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$	

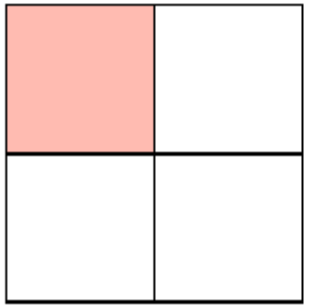
Convolutional pooling



Convolutional stride

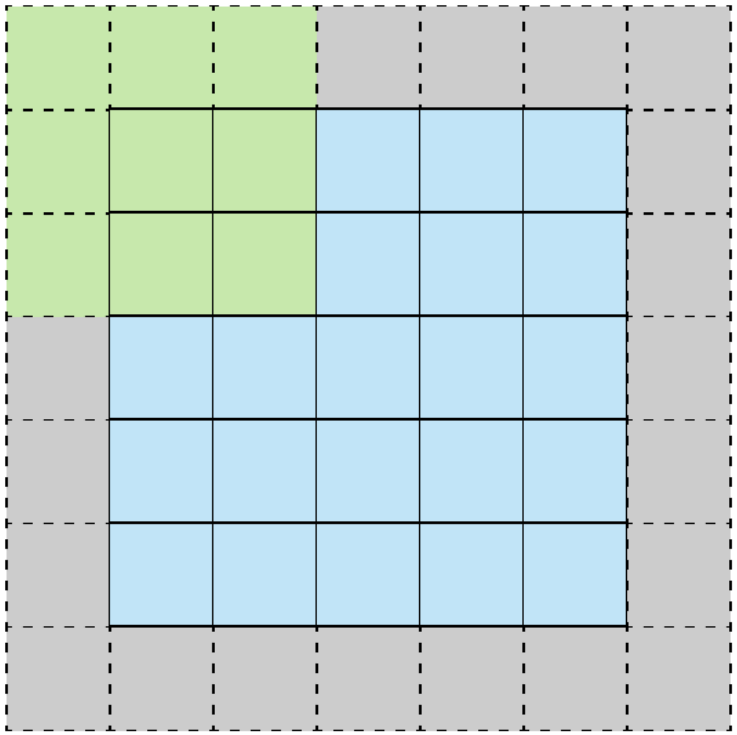


Stride 2

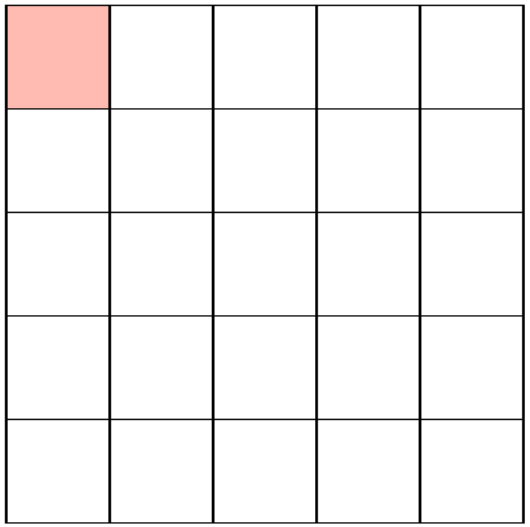


Feature Map

Padding



Stride 1 with Padding



Feature Map

https://towardsdatascience.com/pytorch-basics-how-to-train-your-neural-net-intro-to-cnn-26a14c2ea29

The only formula today:

$$n_{out} = \left\lfloor \frac{n_{in} + 2p - k}{s} \right\rfloor + 1$$

n_{in}: number of input features
n_{out}: number of output features
k: convolution kernel size
p: convolution padding size
s: convolution stride size

Task:

- Implement a convolutional network to classify Fashion MNIST
  - Define at least 2 convolutional layers (each having several filters, activation function and pooling)
  - For regularisation, use dropout (enough to use in the classifier part)
  - Compute by hand the number of neurons needed after last convolutional layer.
- Use learning rate decay to dynamically change the learning rate.
- Find two  in the code.