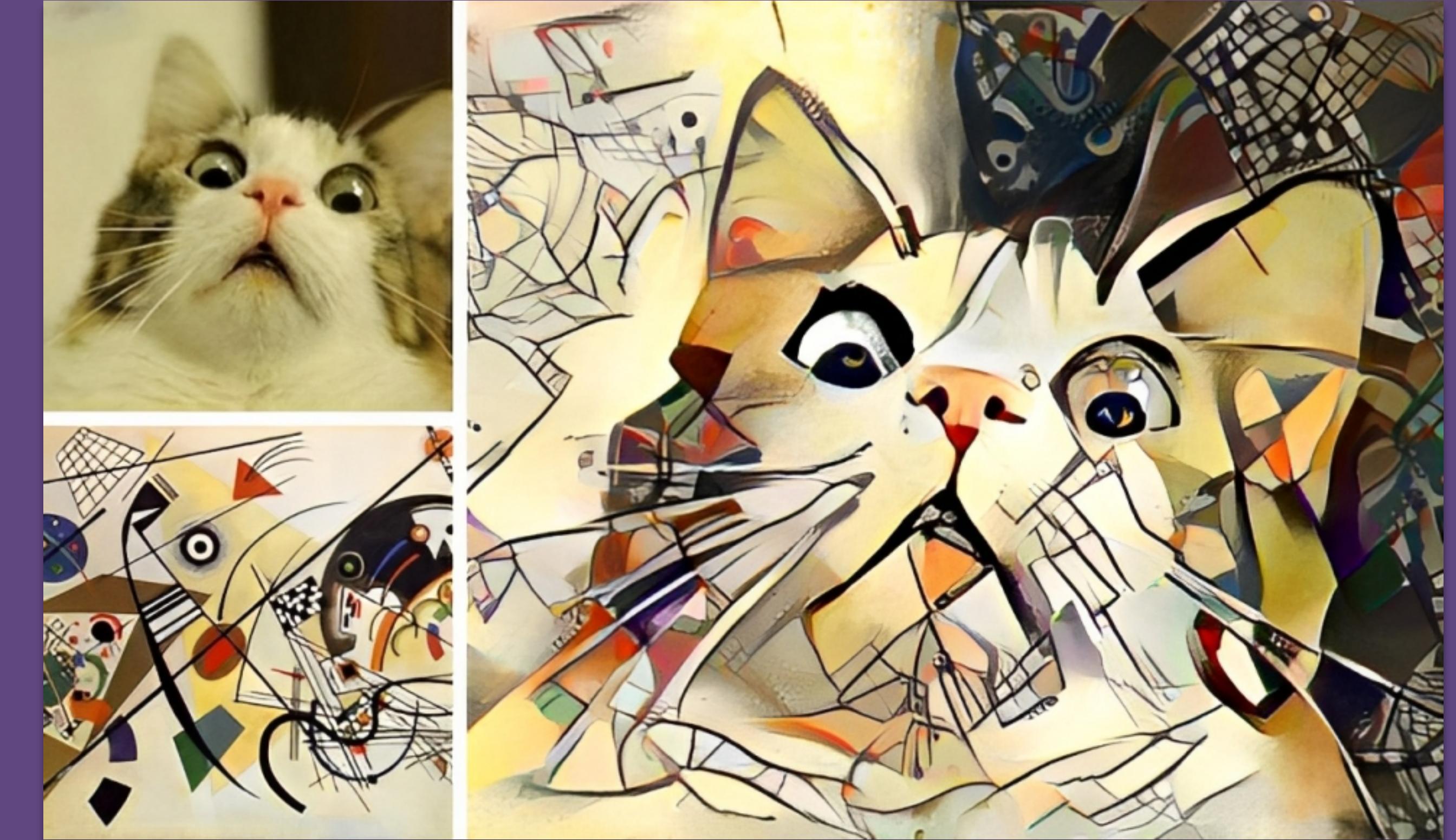


Tutorial 3: Convolutional Neural Networks

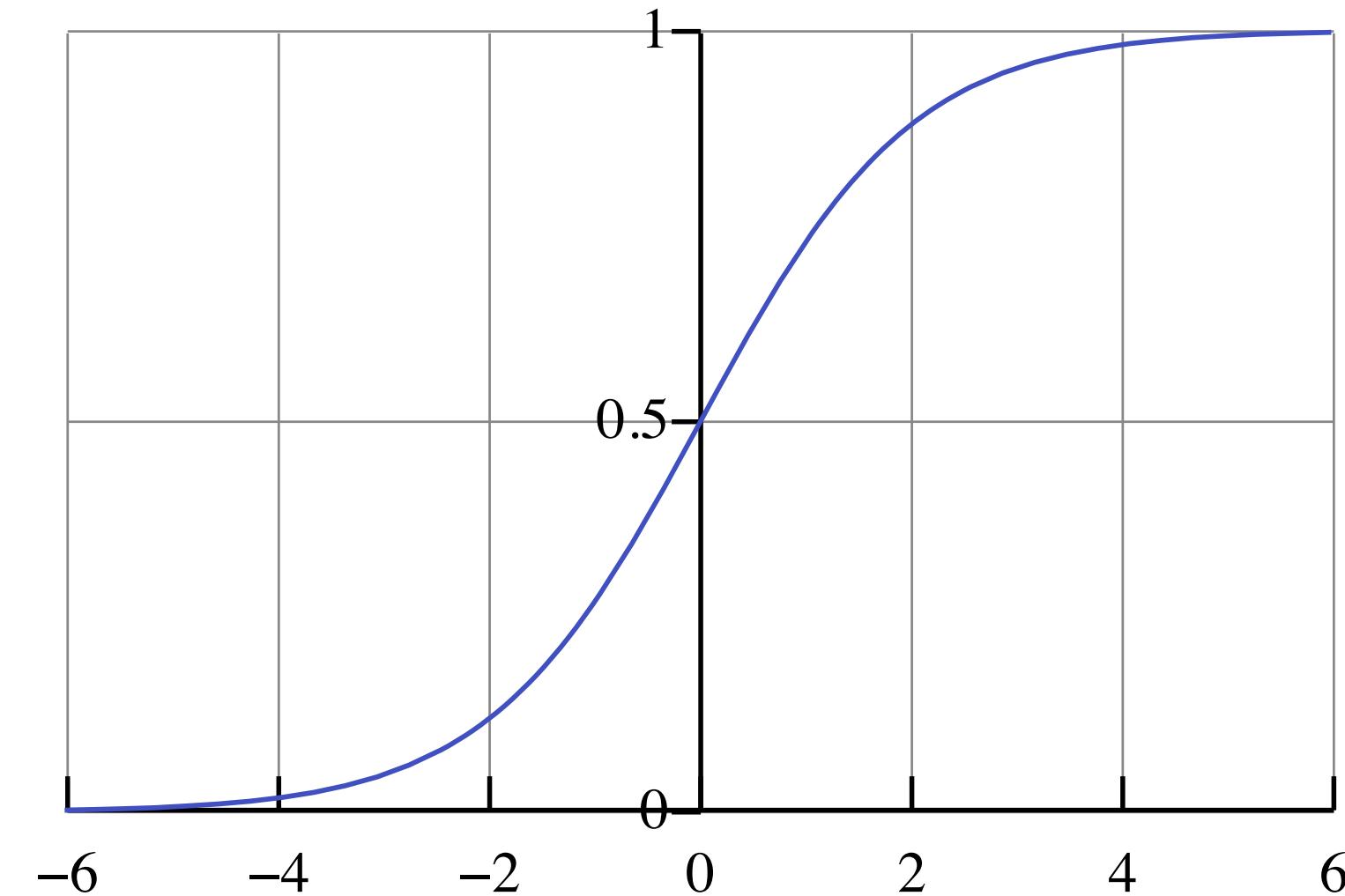


Practical Deep Learning for Science
09 May, 2024

Activations and losses

Binary classifications

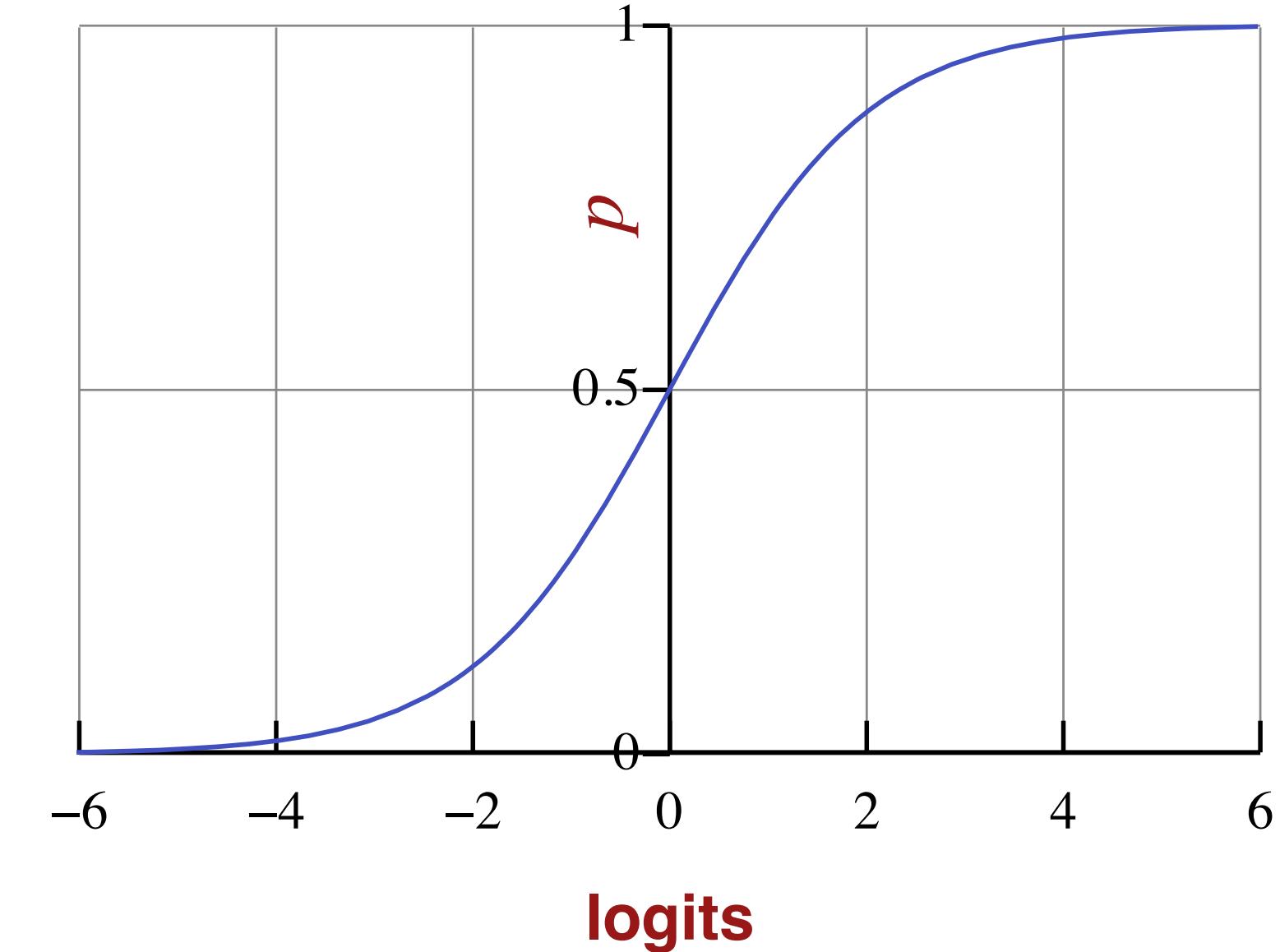
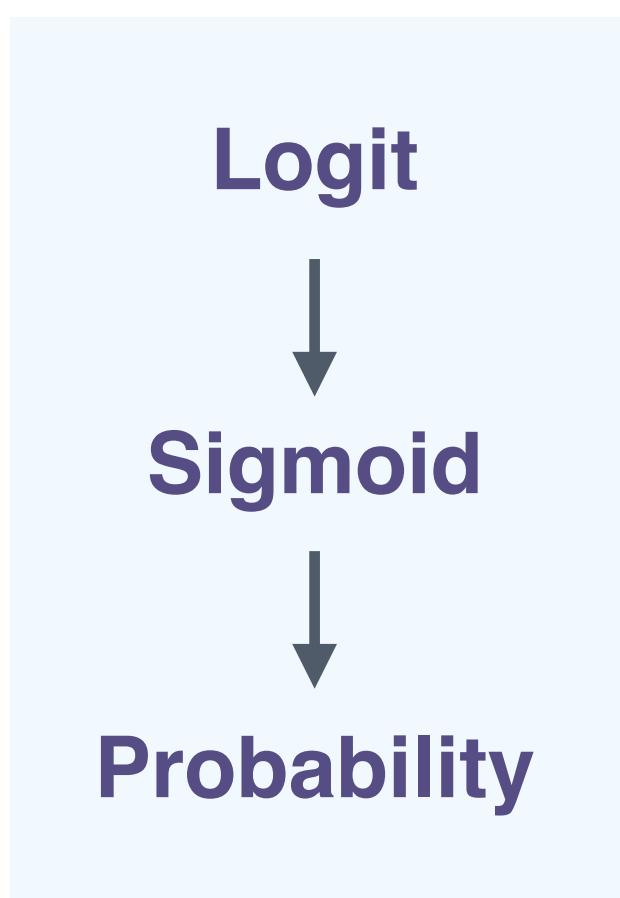
- **Class 0 vs Class 1**
 - NN Prediction = **probability of class 0** (p)
 - $\text{Probability of class 1} = 1 - p$
 - No need to predict this
 - Activation: `torch.nn.Sigmoid()`



Binary classifications: Loss

- **What we want -**

- End the network with `Linear() → Sigmoid()`
- Compute the loss using -
 - `torch.nn.BCELoss(pred_prob, target)`



- **More common practice -**

- End the network with `Linear()`
- Compute the loss using -
 - `torch.nn.BCEWithLogitLoss(pred_logit, target)`
 - Internally applies `Sigmoid()`
 - Numerically more stable

- **During inference -**

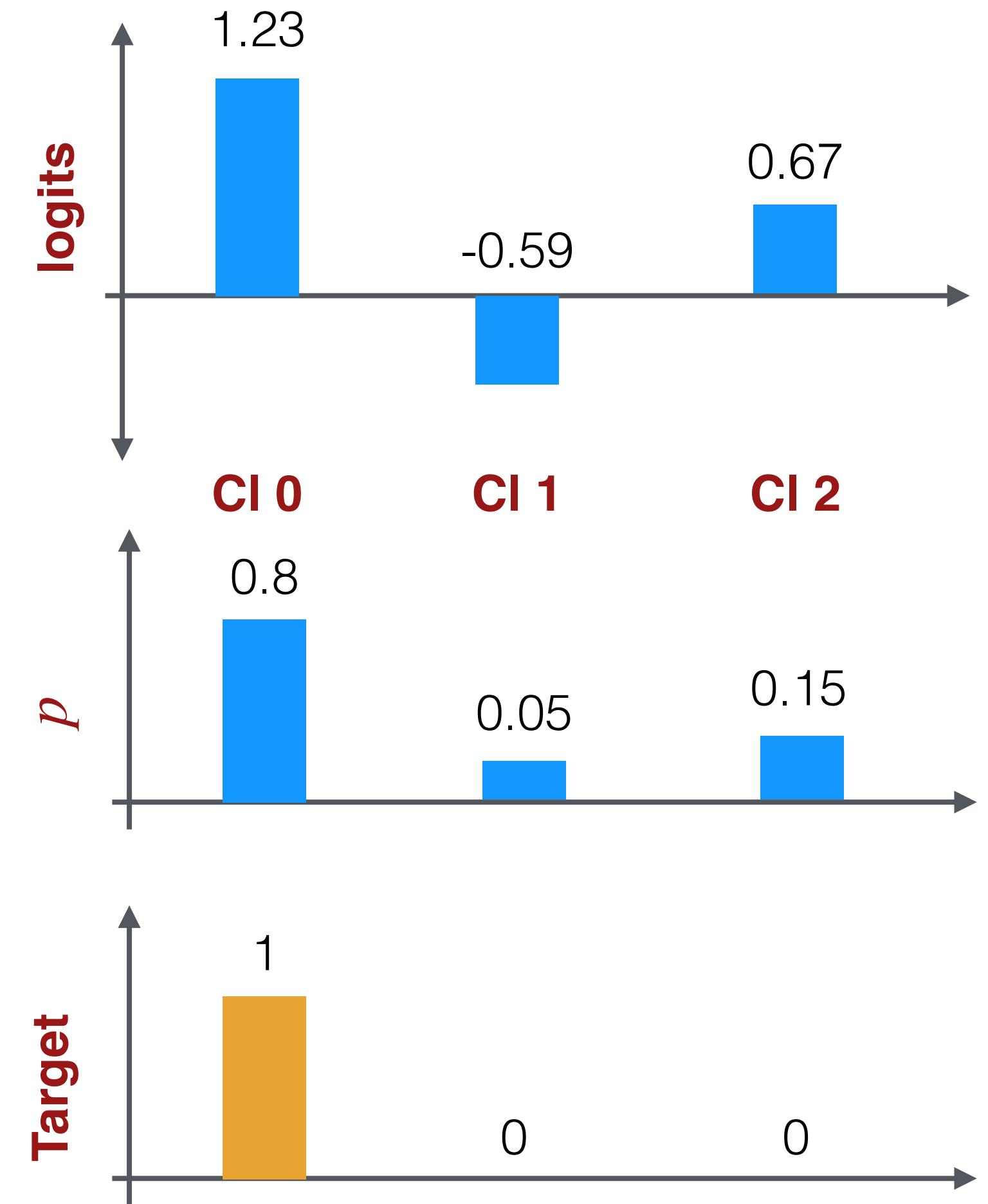
- $p > 0.5 \implies$ class 0
- $logit > 0 \implies$ class 0

Multi-class classifications

- **Option one -**

- End the network with `Linear() → Softmax()`
- Compute the loss using -
 - `torch.nn.NLLLoss(pred_prob, target)`

$$p_i = \frac{e^{x_i}}{\sum_i e^{x_i}}$$



- **More common practice -**

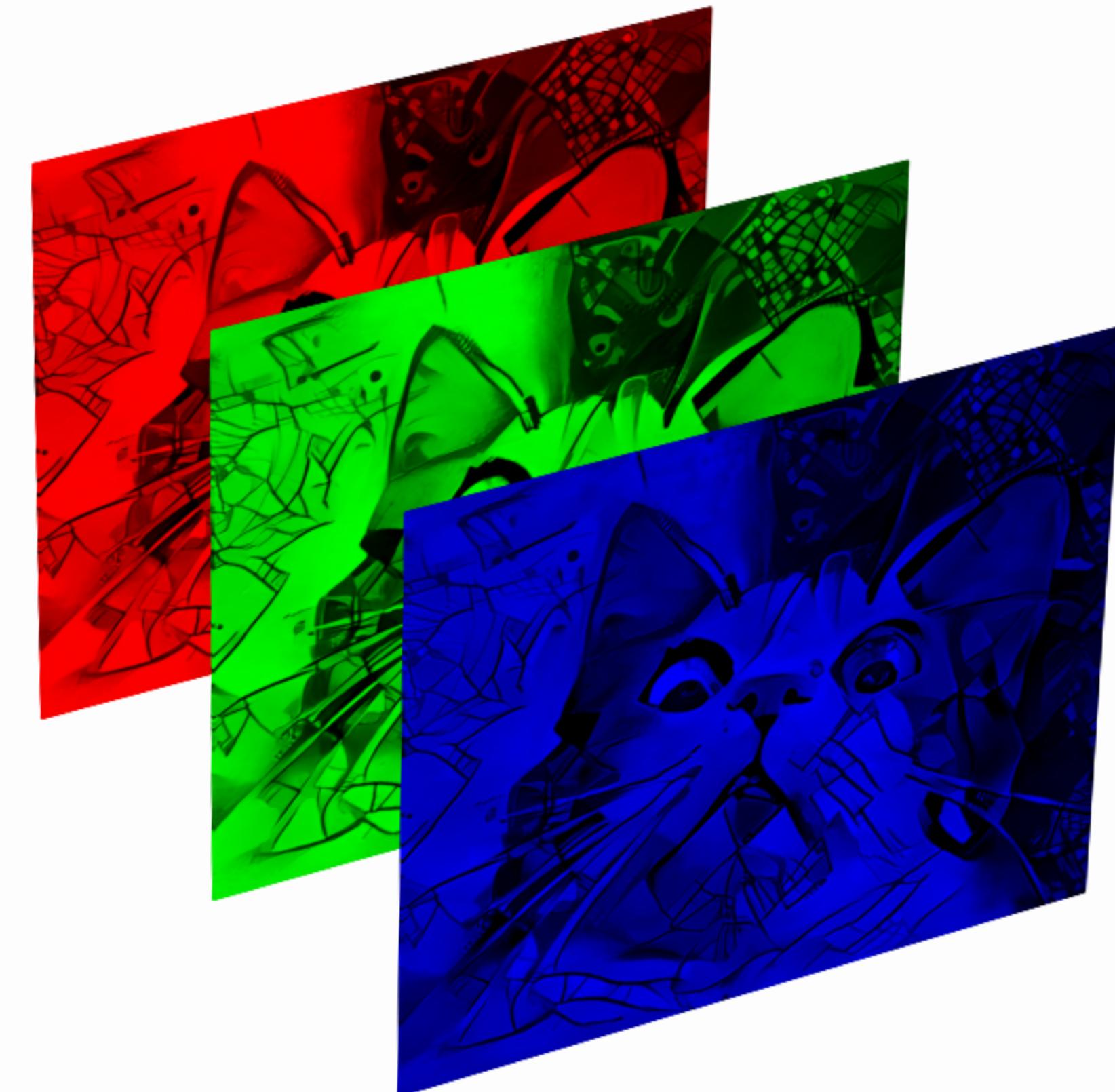
- End the network with `Linear()`
- Compute the loss using -
 - `torch.nn.CrossEntropy(pred_logit, target)`
 - Internally applies `Softmax()`
 - Numerically more stable

- **During inference -**

- Class = `argmax(prob)`
- Class = `argmax(logit)`

CNN Vocabulary

Channels



Not necessarily always 3

NCHW vs NHWC

- **N** - number of example in the batch
- **C** - channel number
- **H** - height
- **W** - width
- Torch expects data to be in **(N,C,H,W)** format

Permute and reshape are two completely different operations!

- An **RGB** image of size **100x50**

What we want

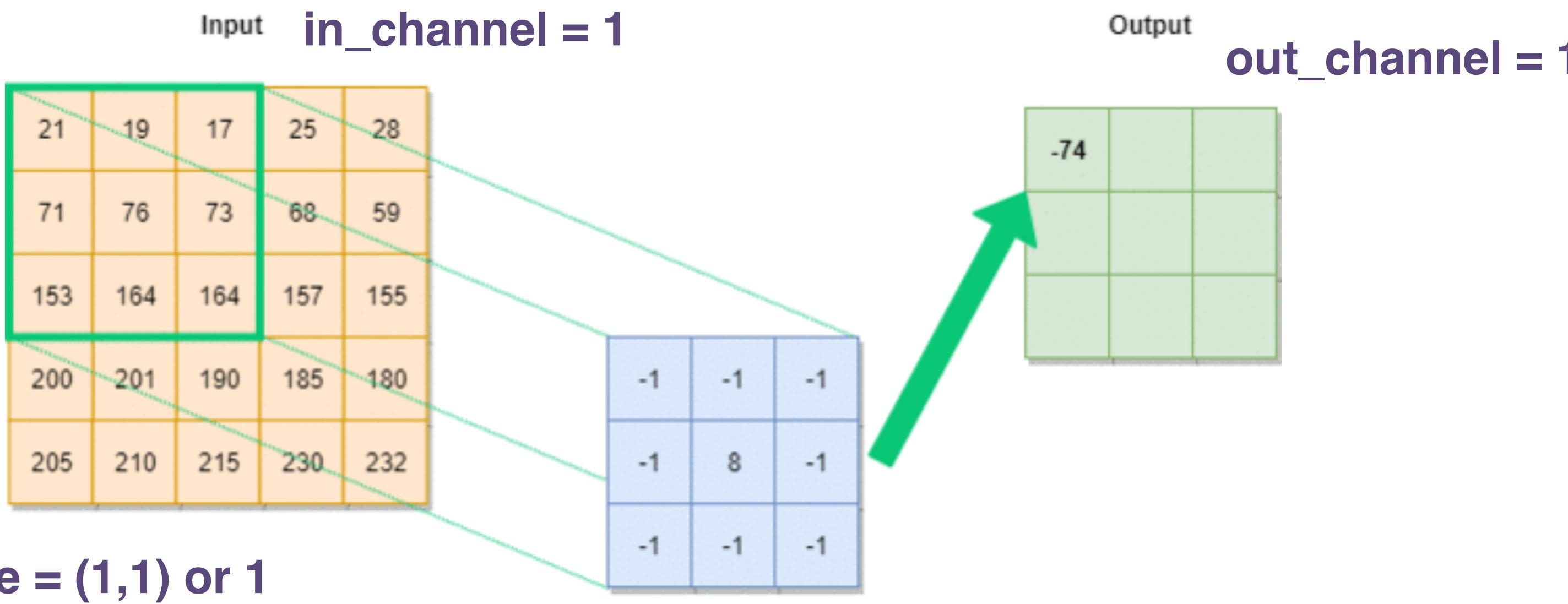
```
>>> img_tensor.shape  
torch.Size([1, 3, 100, 50])
```

What we do not want

```
>>> img_tensor.shape  
torch.Size([1, 100, 50, 3])
```

Fix

```
>>> img_tensor = img_tensor.permute(0,3,1,2)  
>>> img_tensor.shape  
torch.Size([1, 3, 100, 50])
```

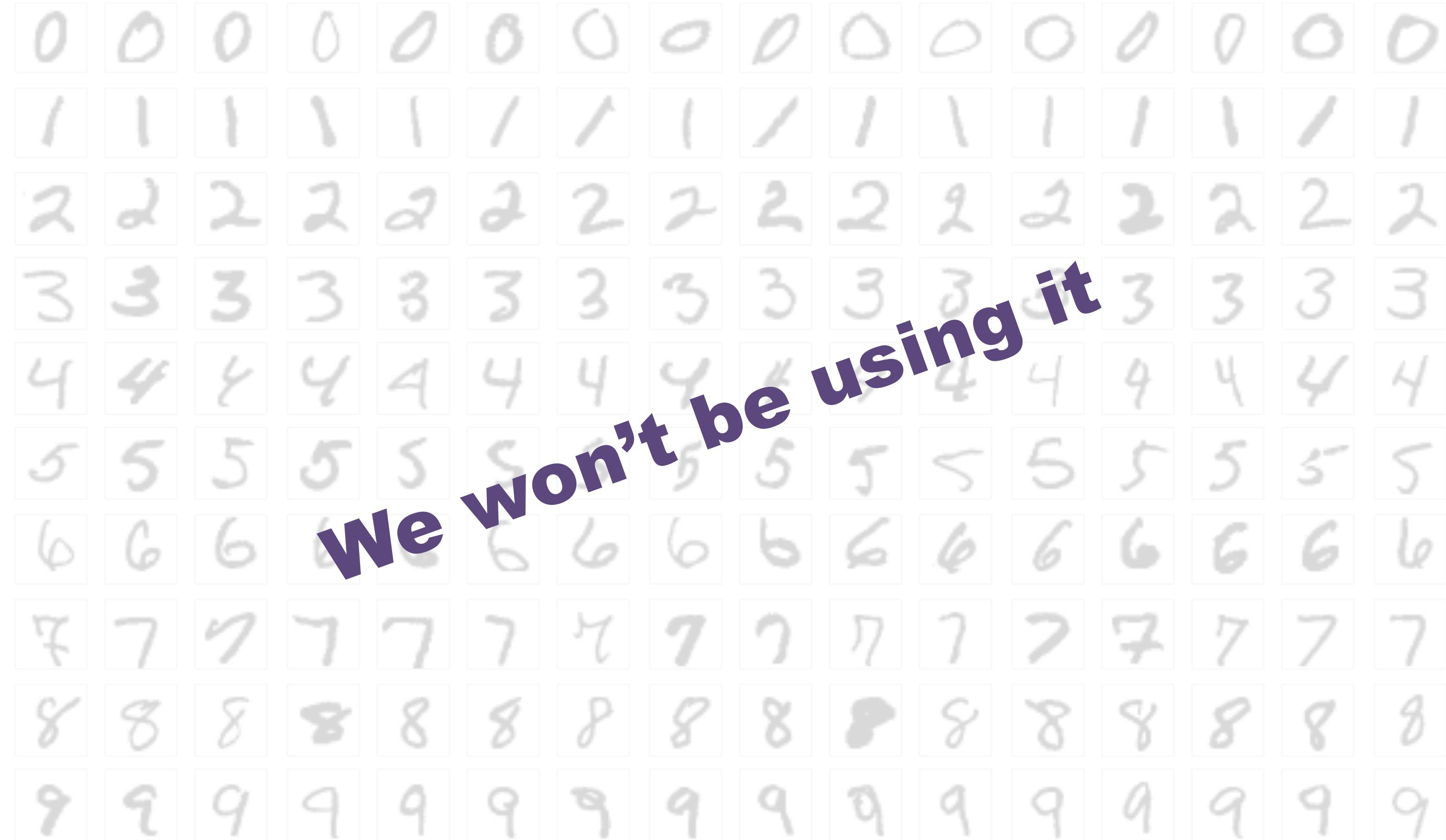


AIGeekProgrammer.com © 2019

padding = ‘valid’ or 0

- **in_channels**
- **out_channels**
- **kernel_size**
- **stride**
- **padding**

Dataset



MNIST

- Handwritten digits
- 28x28
- Grayscale (1 channel)
- Pretty old (1994)
- Quite simple

Fashion-MNIST

- 28 x 28
- grayscale images (1 channel)
- 10 classes
- Slightly more complex than MNIST

Before we wrap up...

Before we wrap up...

♦ Slack

- Your *primary* lifeguard
- https://join.slack.com/t/wis-ml-course-2024/shared_invite/zt-2hyndz2sm-xNJISa_T0t2HeXYdo4_ITA

♦ Final project

- Start (early) by creating a slack channel
- Keep it private (you don't wanna spam everyone)

♦ Feedback