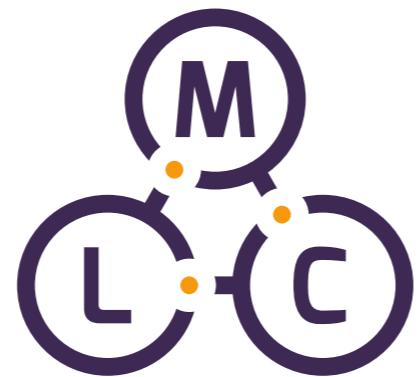


# Convolutional Neural Networks and Image Processing

Jiří Materna



Machine  
Learning  
College

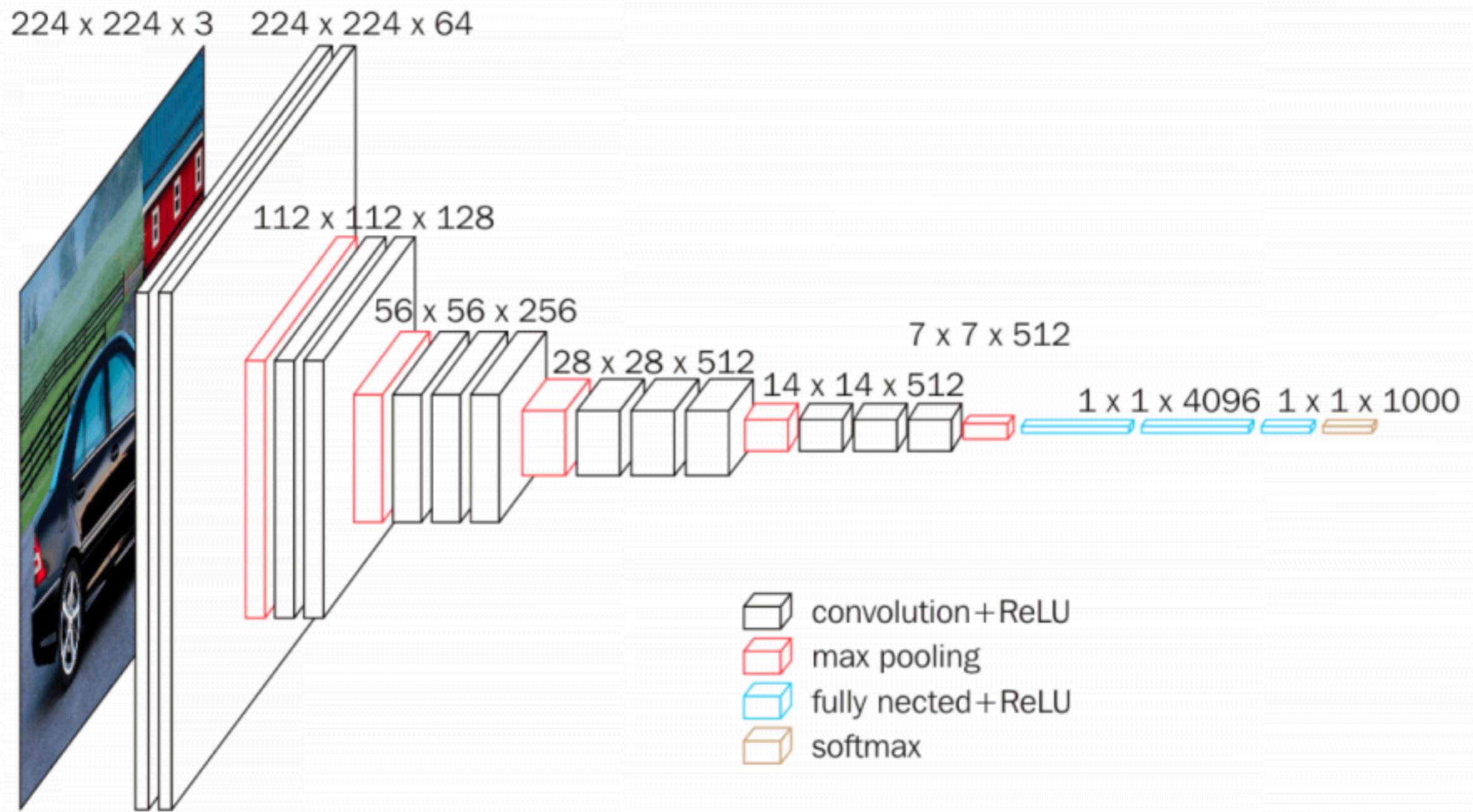
# About me

- Ph.D. in Natural Language Processing and Artificial Intelligence at Masaryk University
- 10 years at Seznam.cz (last 8 years as Head Of Research)
- Founder and lecturer at ML College
- Founder and co-organizer of ML Prague
- ML Freelance and consultant

# Image processing

- VGG 16 and ResNet
- Transfer learning and fine-tuning
- Image classification
- Batch normalization and data augmentation
- U-net and Image segmentation
- GANs and superresolution
- Neural network explainability
- Adversarial patch

# VGG 16



# ResNet



# Finetuning

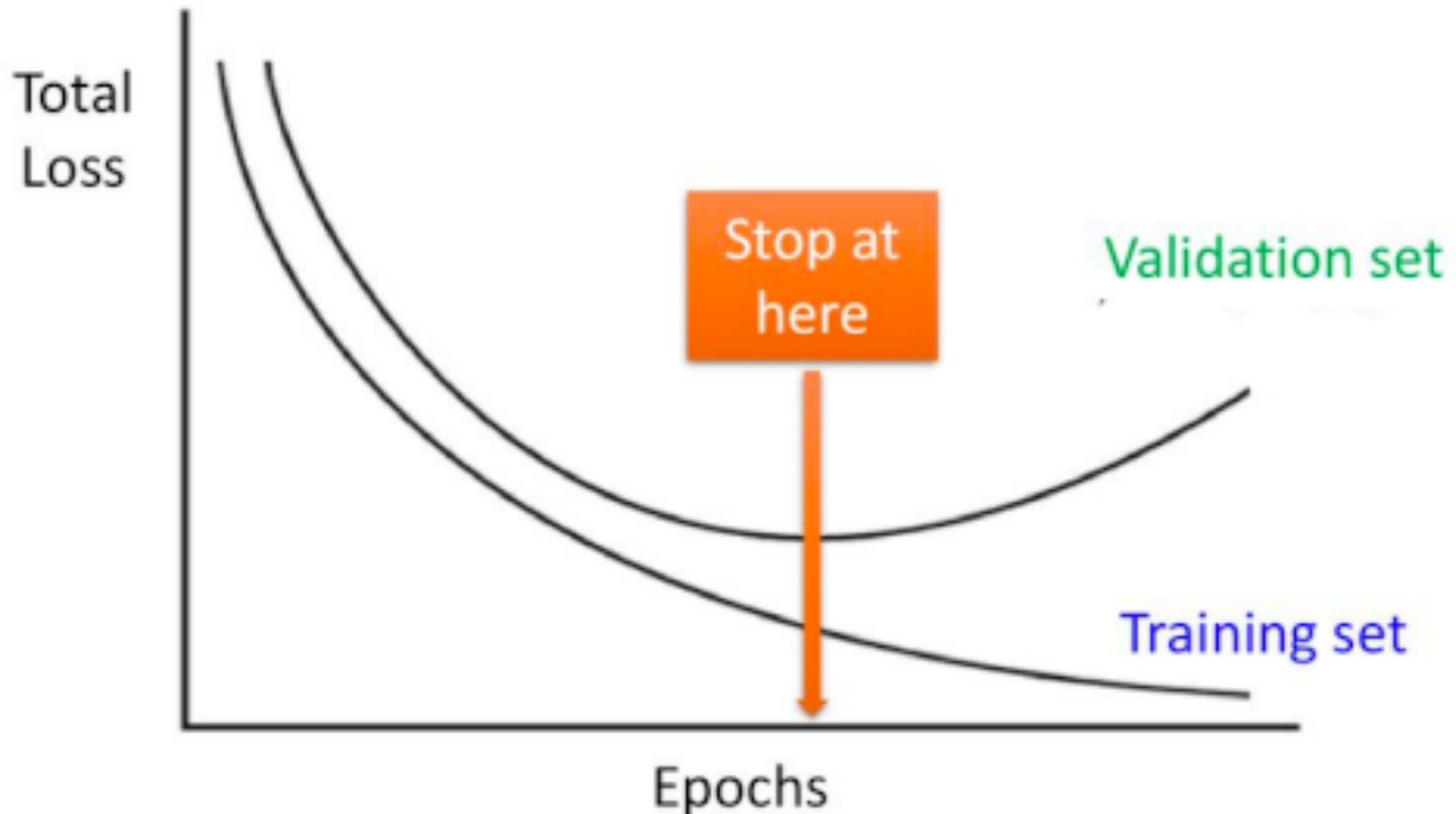
## Transfer Learning



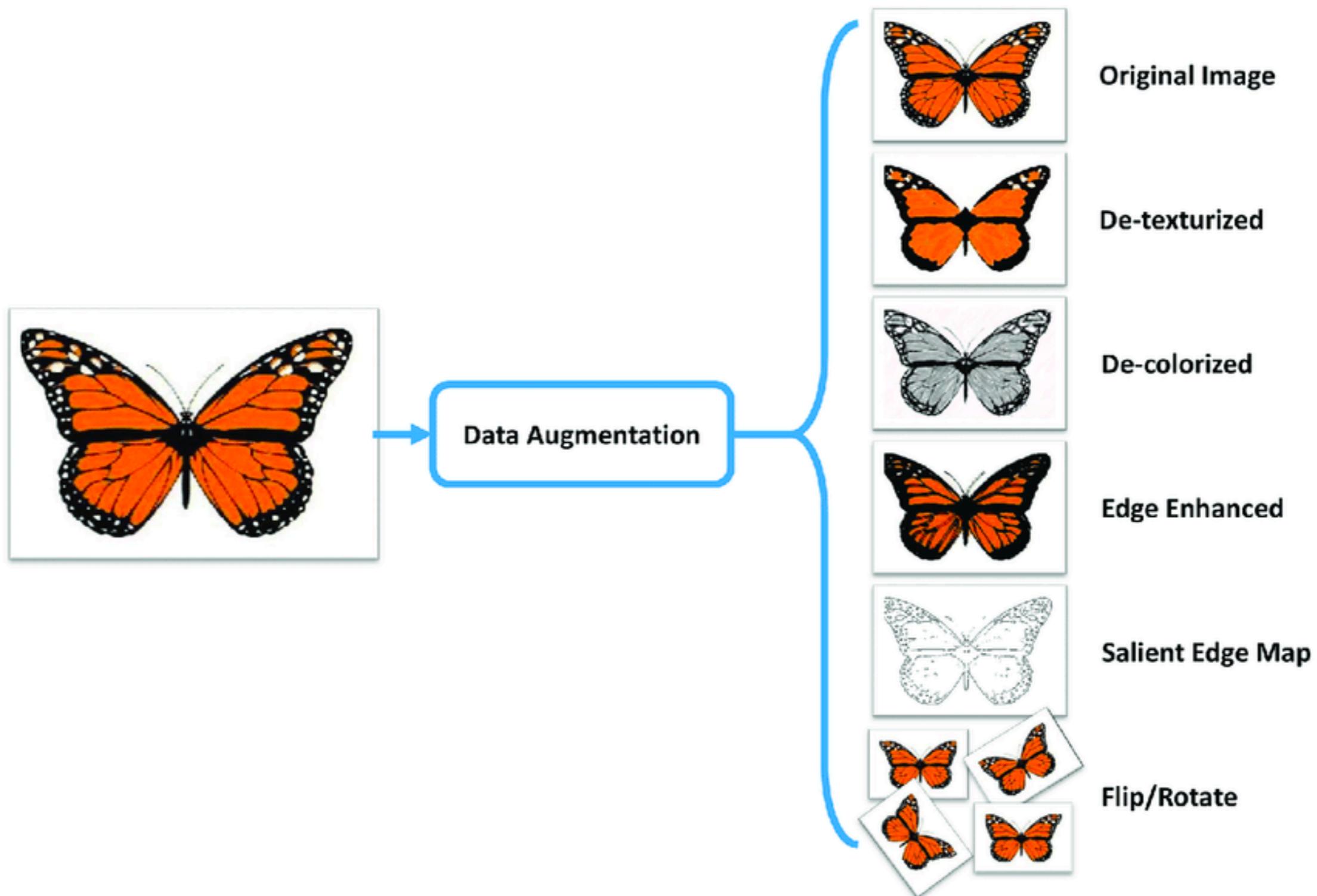
# **Transfer learning example**

**01-Transfer\_learning.ipynb**

# Early stopping



# Data augmentation



# Batch normalization

**Input:** Values of  $x$  over a mini-batch:  $\mathcal{B} = \{x_1 \dots m\}$ ;

Parameters to be learned:  $\gamma, \beta$

**Output:**  $\{y_i = \text{BN}_{\gamma, \beta}(x_i)\}$

$$\mu_{\mathcal{B}} \leftarrow \frac{1}{m} \sum_{i=1}^m x_i \quad // \text{mini-batch mean}$$

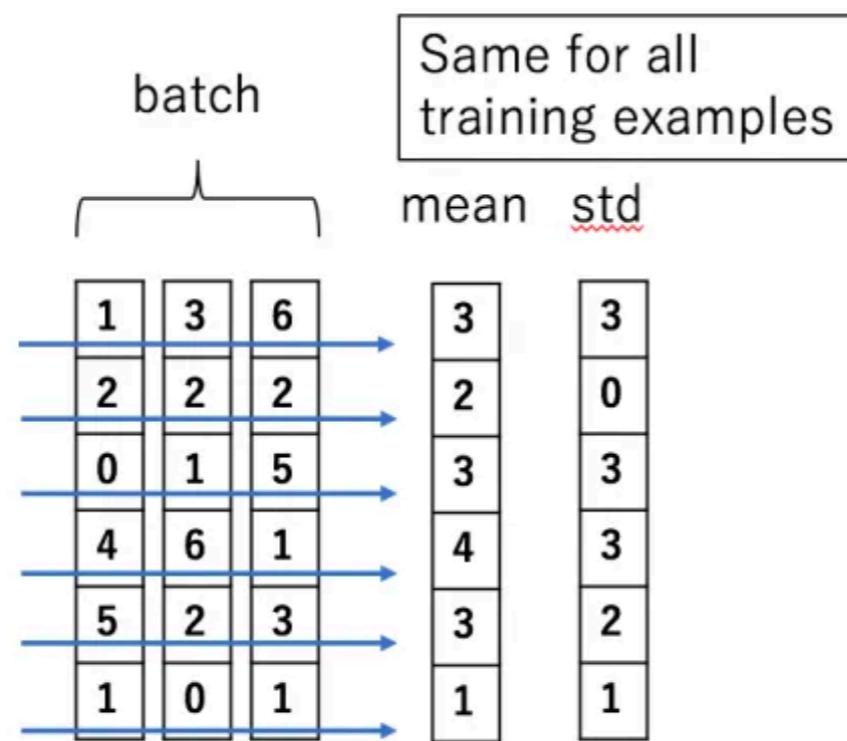
$$\sigma_{\mathcal{B}}^2 \leftarrow \frac{1}{m} \sum_{i=1}^m (x_i - \mu_{\mathcal{B}})^2 \quad // \text{mini-batch variance}$$

$$\hat{x}_i \leftarrow \frac{x_i - \mu_{\mathcal{B}}}{\sqrt{\sigma_{\mathcal{B}}^2 + \epsilon}} \quad // \text{normalize}$$

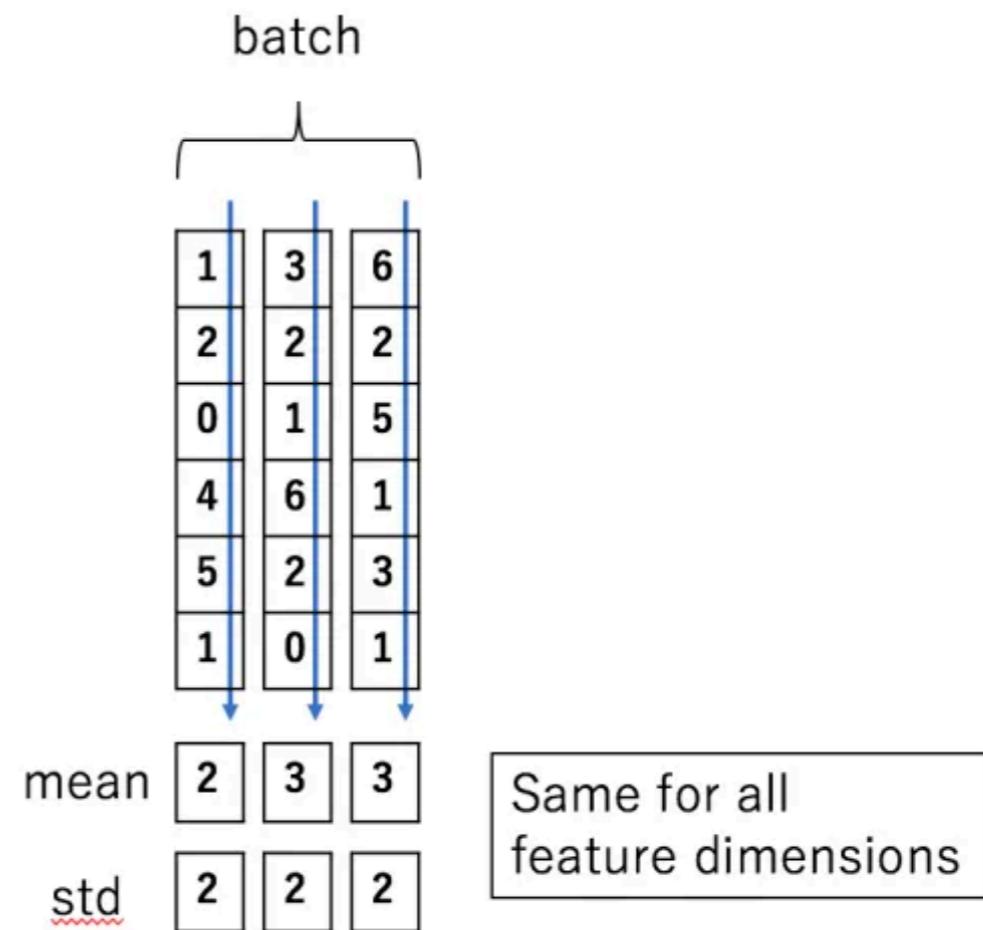
$$y_i \leftarrow \gamma \hat{x}_i + \beta \equiv \text{BN}_{\gamma, \beta}(x_i) \quad // \text{scale and shift}$$

# Layer normalization

Batch Normalization



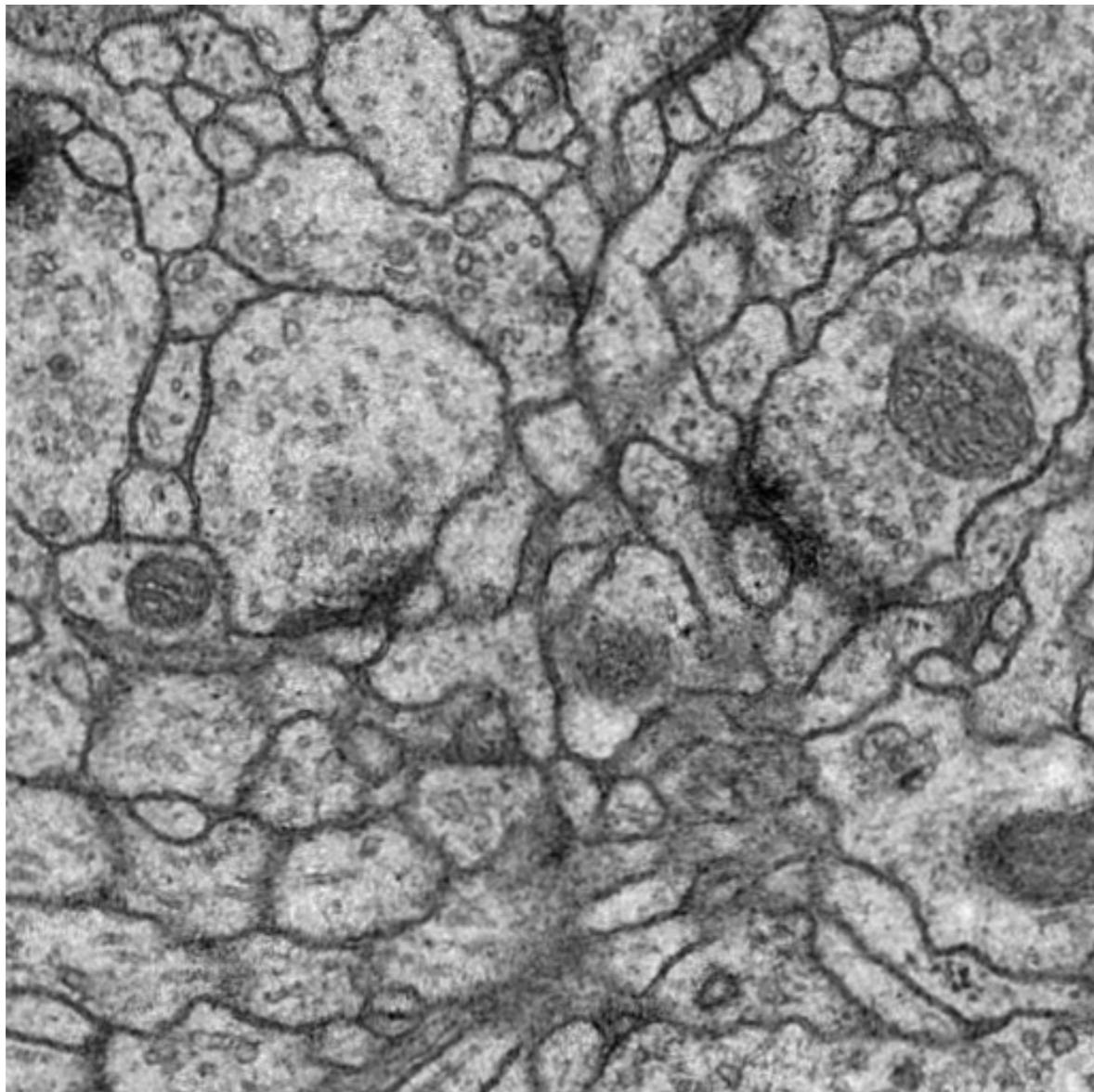
Layer Normalization



# Practical example on regularization and normalization

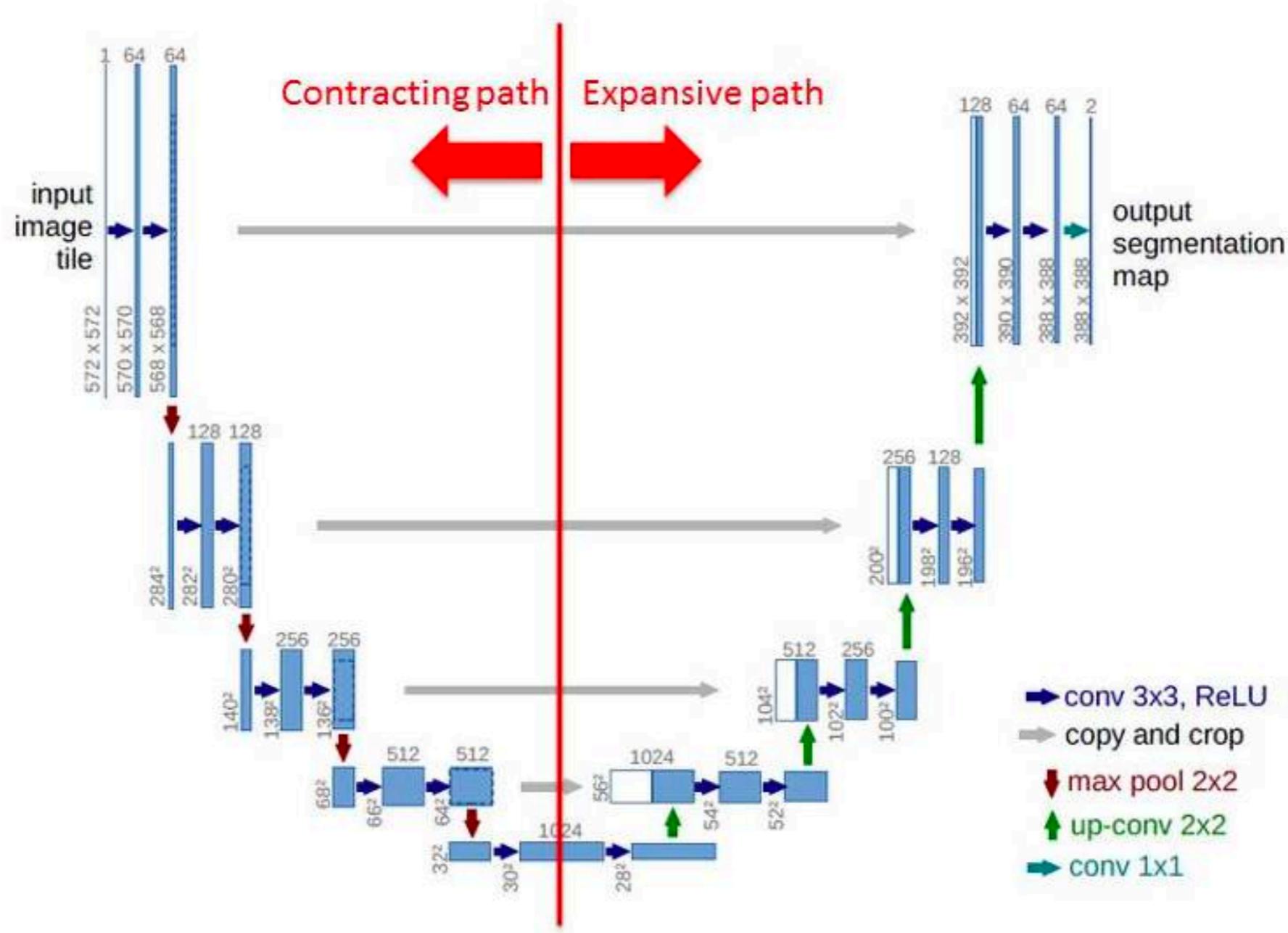
[\*\*05-Normalization-and-regularization-assignment.ipynb\*\*](#)

# Image segmentation



# U-Net

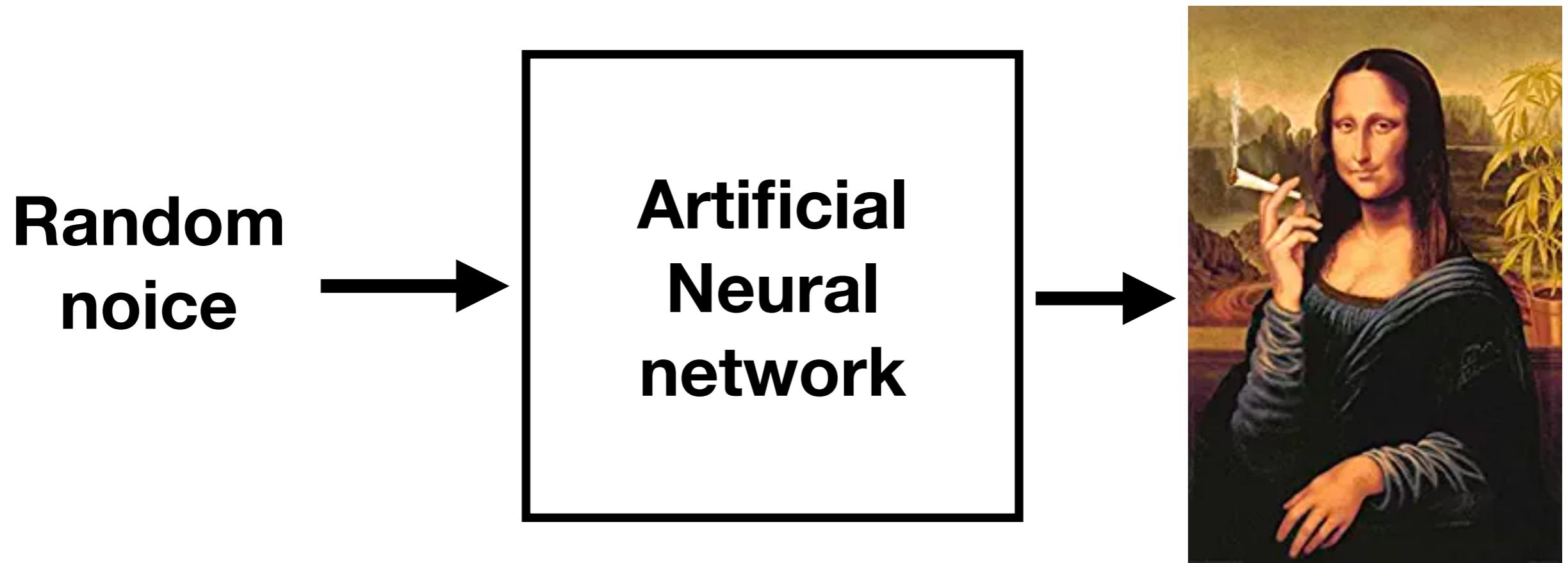
## Network Architecture



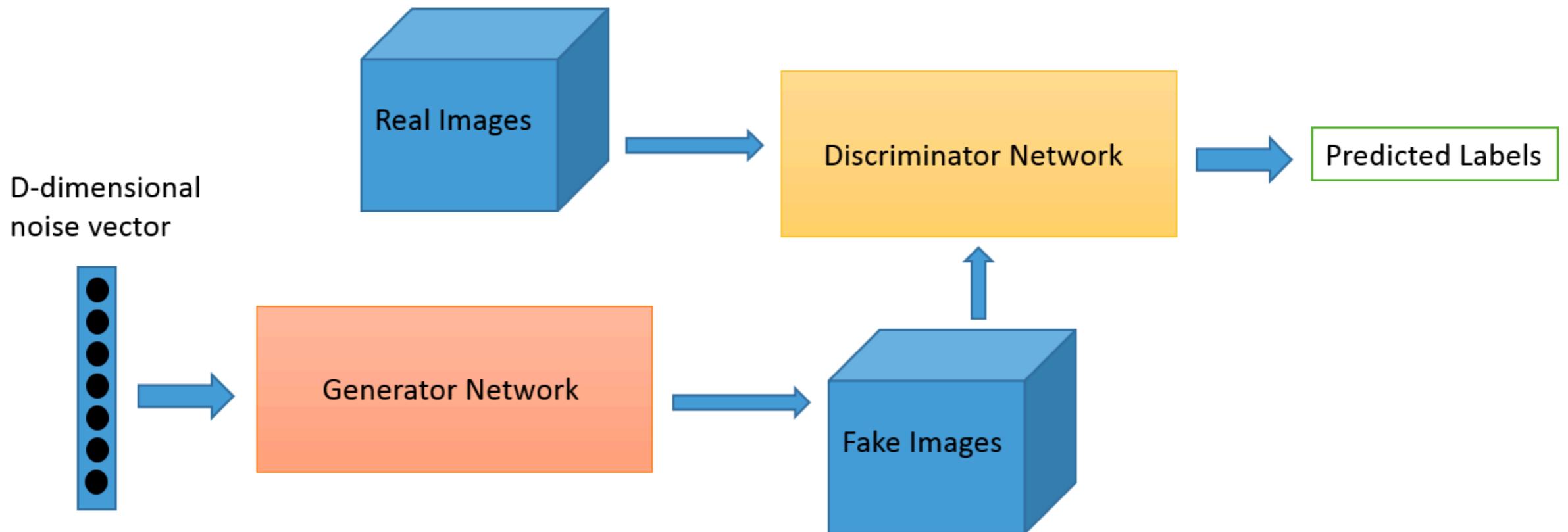
# **U-Net segmentation example**

**03-Segmentation.ipynb**

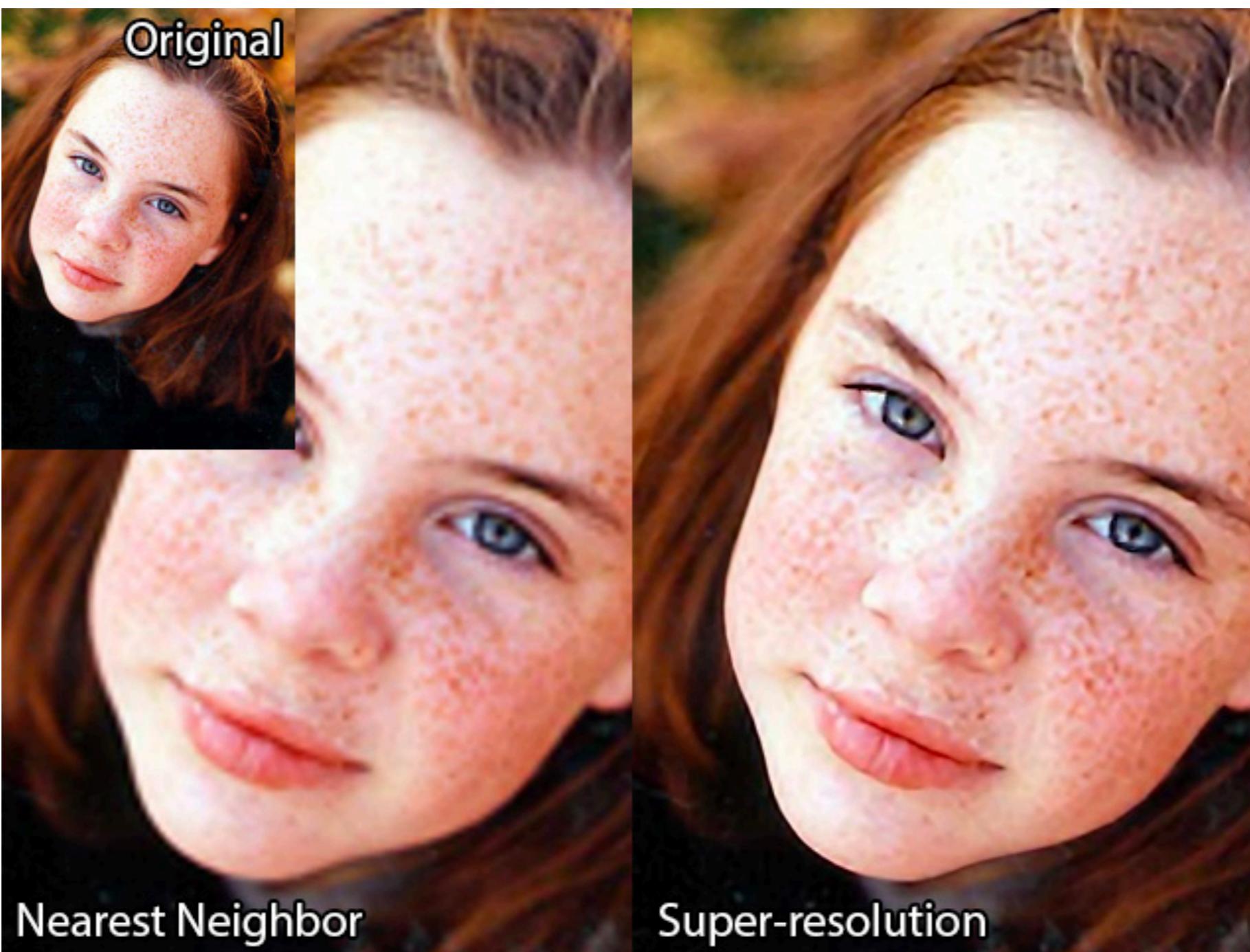
# Generative models with neural networks



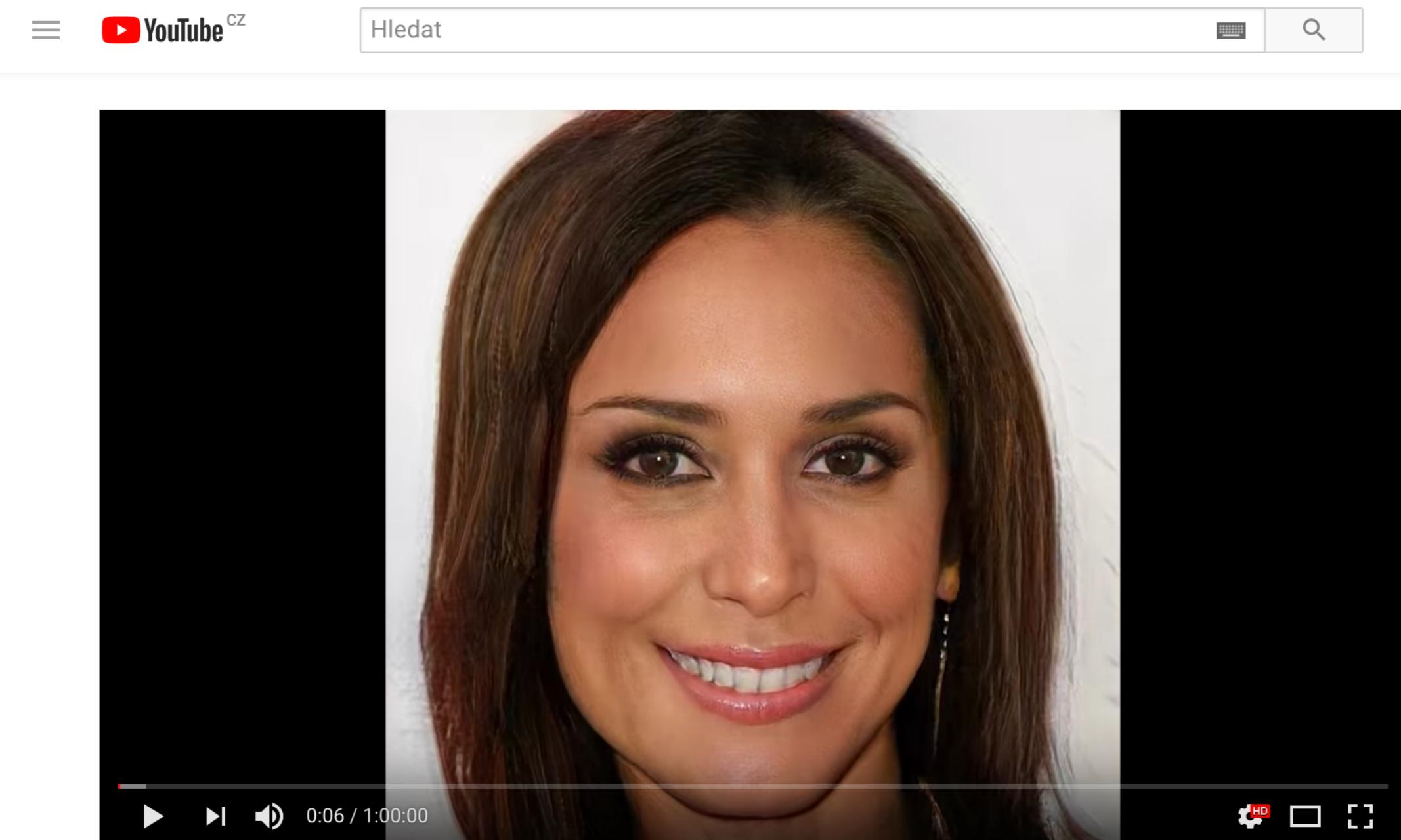
# Generative Adversarial Networks



# Superresolution



# Image synthesis



One hour of imaginary celebrities

95 832 zhlédnutí

TO SE MI LÍBÍ NELÍBÍ SE SDÍLET ...

# Which one is fake?



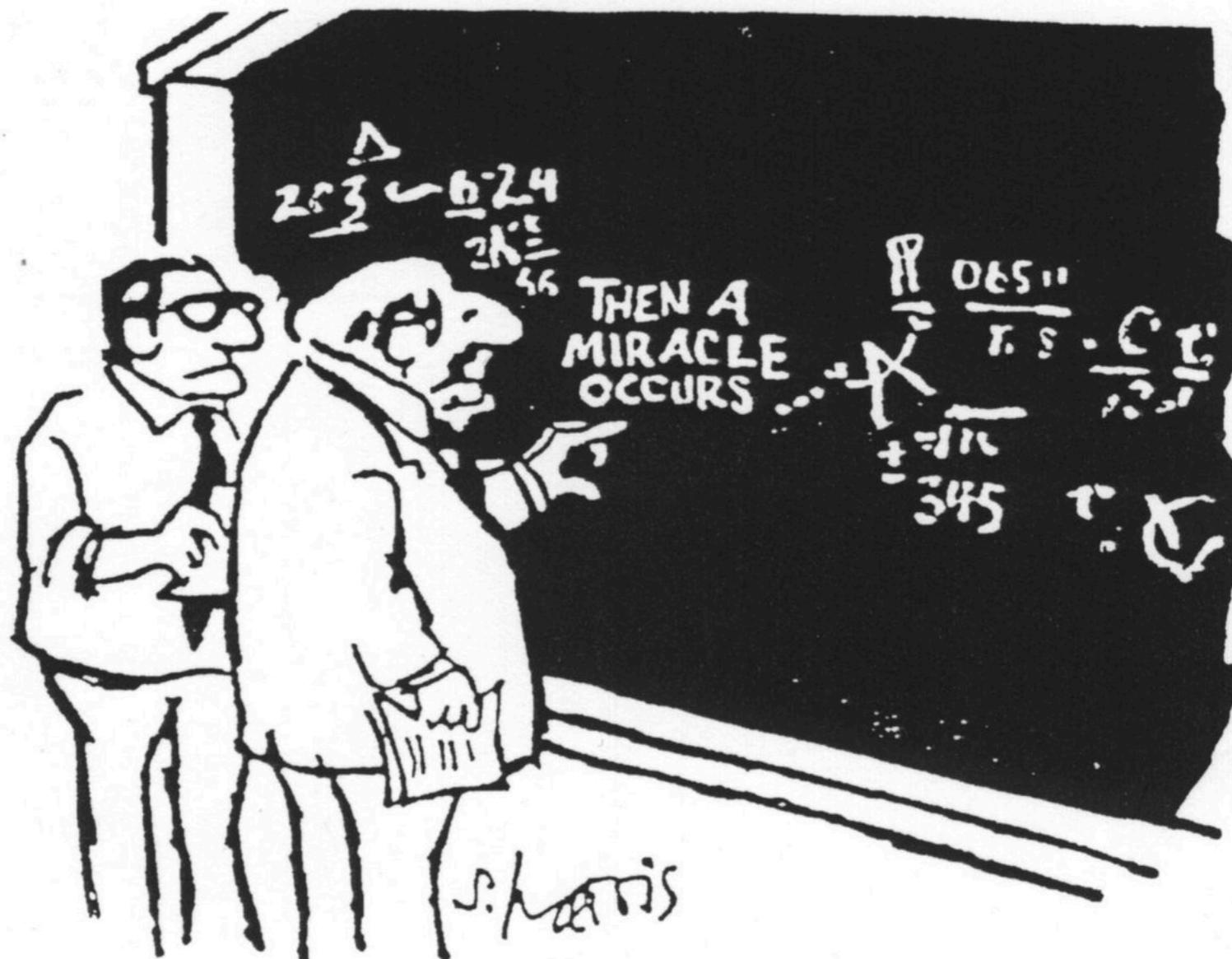
# Generative Adversarial Networks

**04\_GANs.ipynb**

# Image manipulation



# Neural network explainability



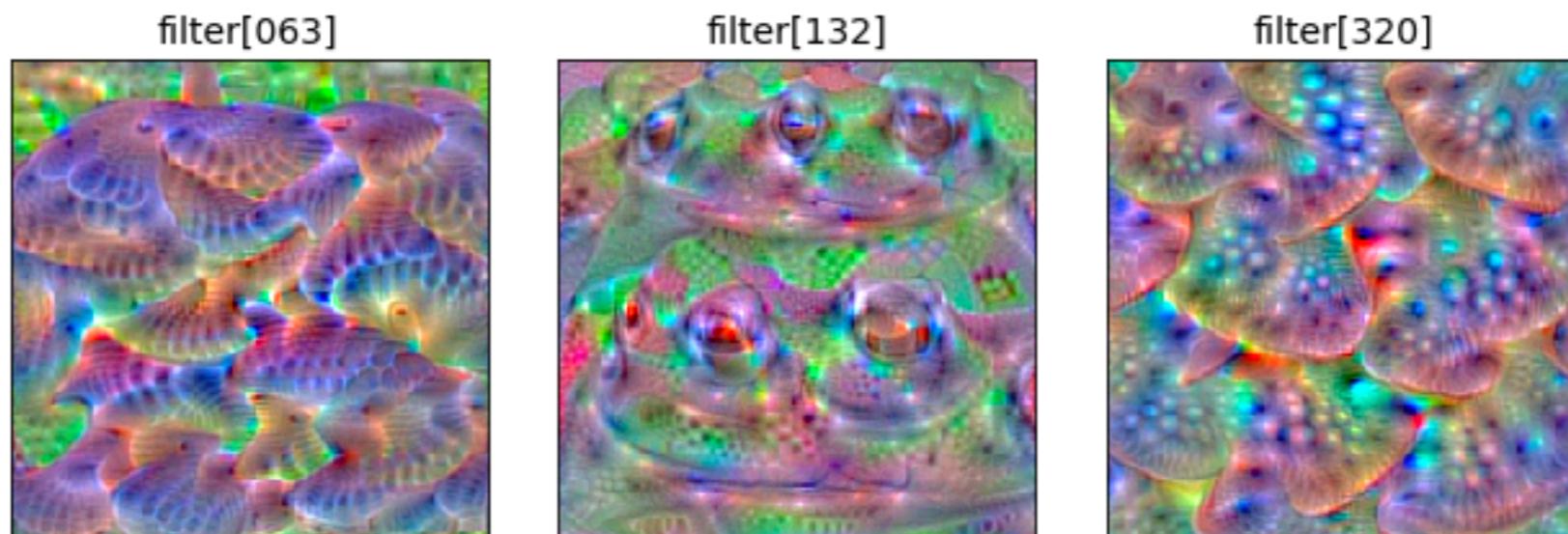
I think you should be a little  
more specific, here in Step 2

# Activation Maximization

## Visualized output classification Layer



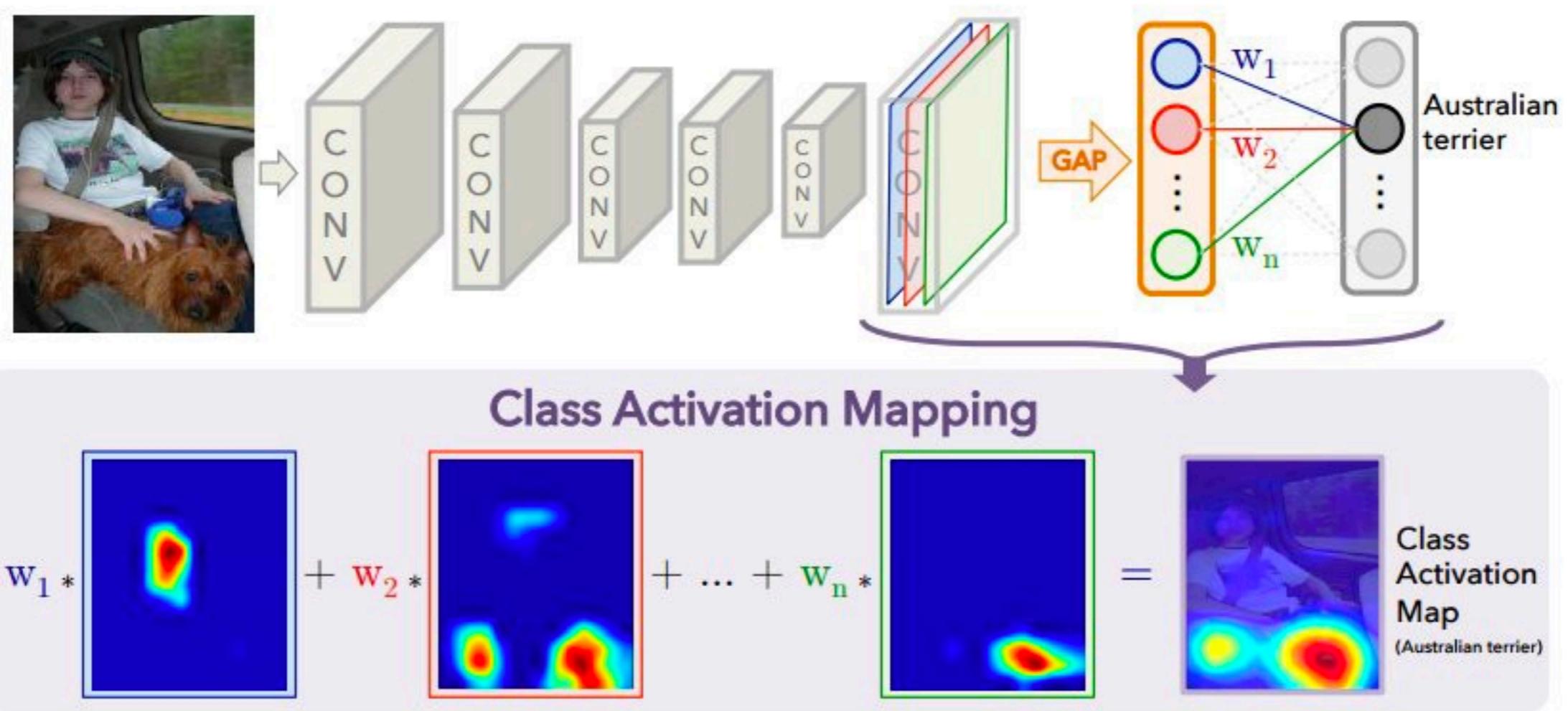
## Visualized hidden convolutional layers



# Grad-CAM heat maps



# CAM heat maps



# **Convolutional Neural Networks Explainability in Keras**

**5-Explainability.ipynb**

# Adversarial Patch

