MIME
Master's degree ICT Internet Multimedia Engineering

HUMAN DATA ANALYTICS: LAB 3

Instructor

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Lab. classes

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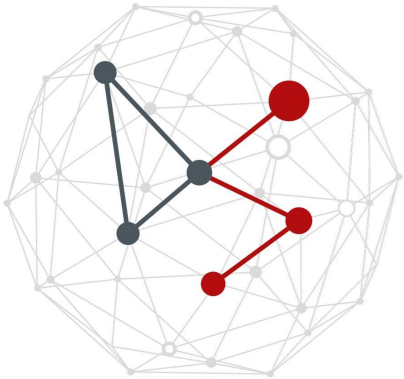

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DIPARTIMENTO MATEMATICA

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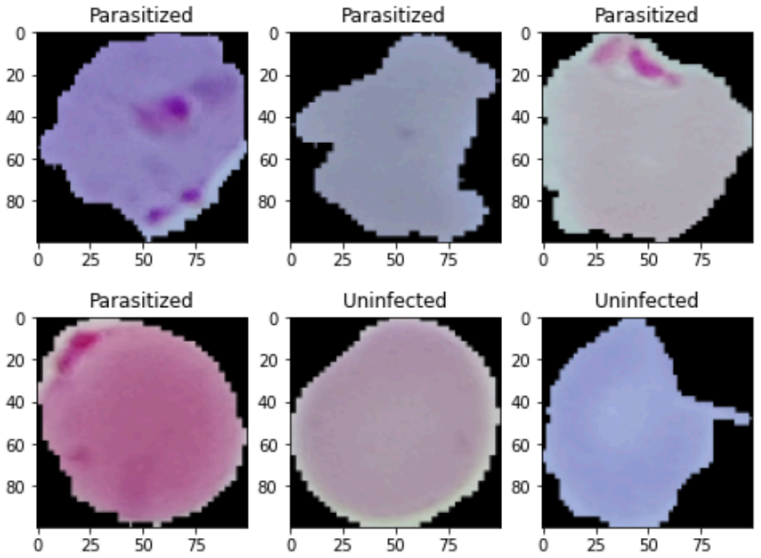
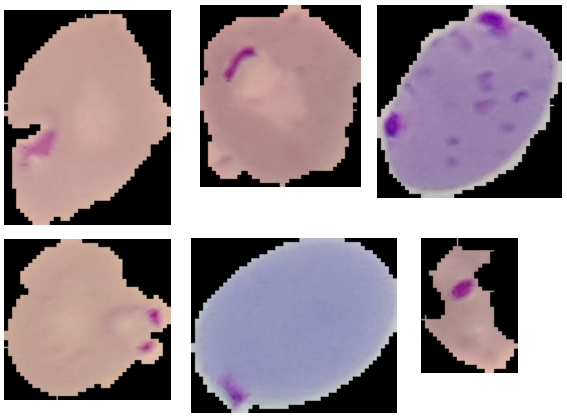
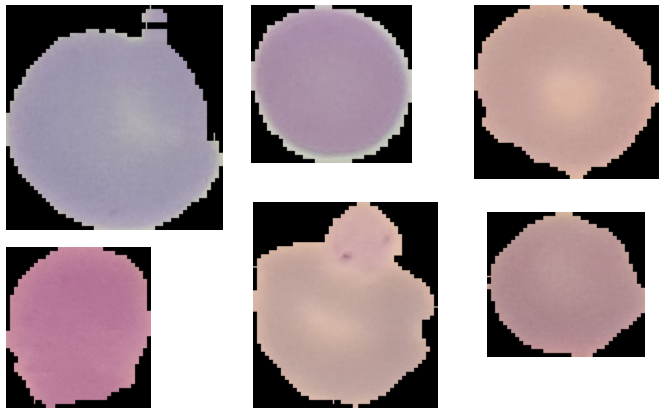
Lab 3



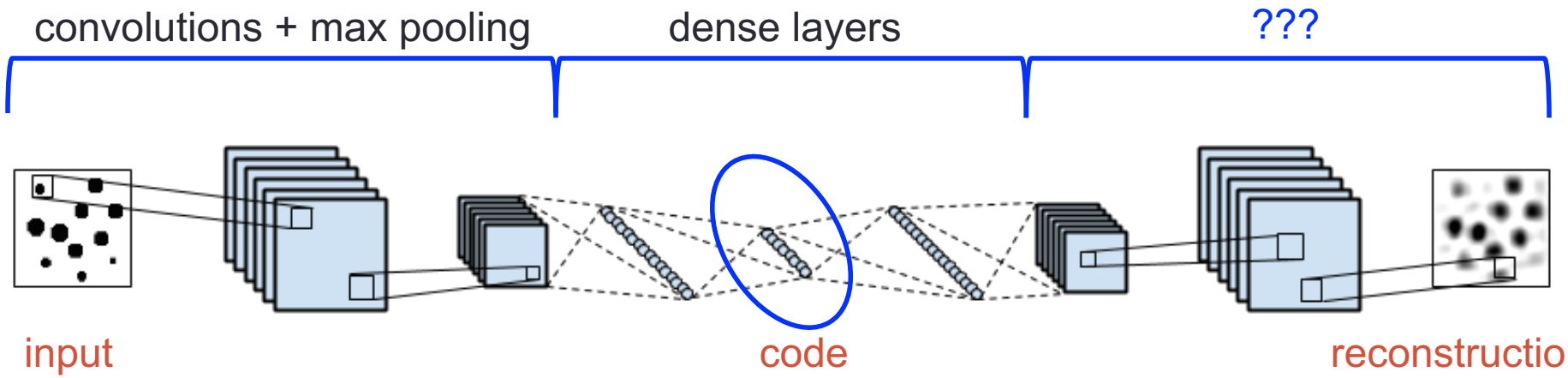
- CNN based autoencoder
  - TensorFlow
  - The challenge:
    - cell image dimensionality reduction
  - You will learn to:
    - implement a CNN based autoencoder using TensorFlow
    - use the autoencoder to denoise noisy images





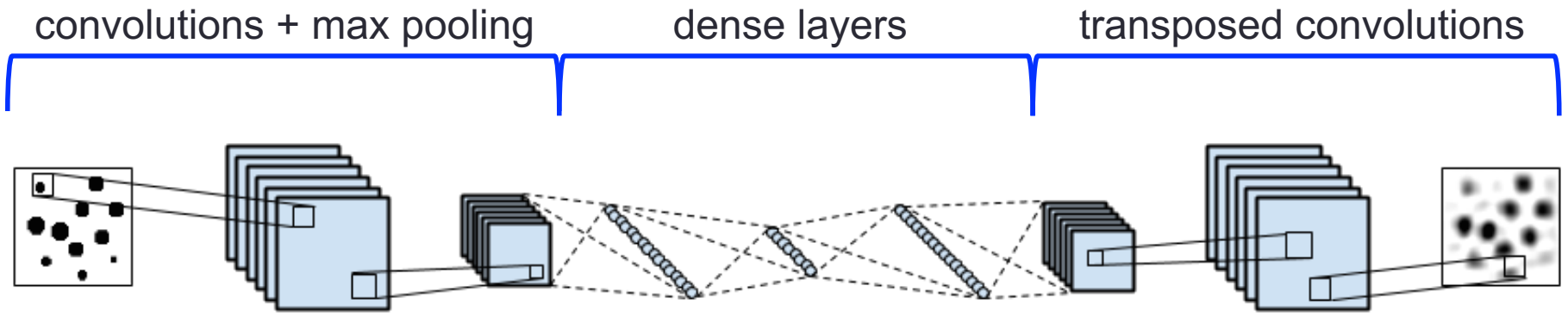
CNN-based autoencoders

- autoencoder = encoder + decoder networks
- in a CNN autoencoder, the encoder and the decoder are composed of convolutional layers
- useful when dealing with images
- applications: image denoising, image coloring, semantic segmentation, similarity assessment and many others!
- problem:



Transposed convolutions 1/4

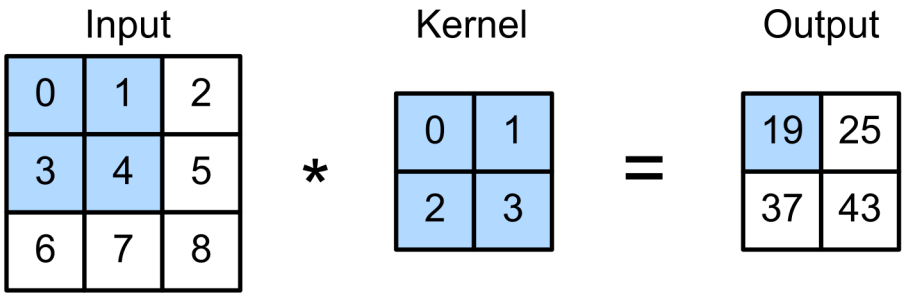
- convolution + max pooling layers -> reduce the dimensionality of the input
- how to reconstruct the input image at the output?
- with transposed convolutions



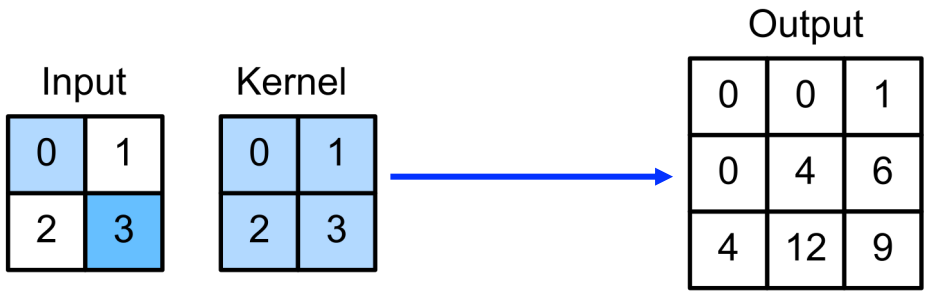
- TensorFlow Keras layer https://www.tensorflow.org/api_docs/python/tf/keras/layers/Conv2DTranspose

Transposed convolutions 2/4

- convolution:



- transposed convolution: allows recovering the shape of the initial feature map



[Dumoulin2016] A guide to convolution arithmetic for deep learning
https://arxiv.org/abs/1603.07285

Transposed convolutions 3/4

1. Take a kernel -> learnable parameters

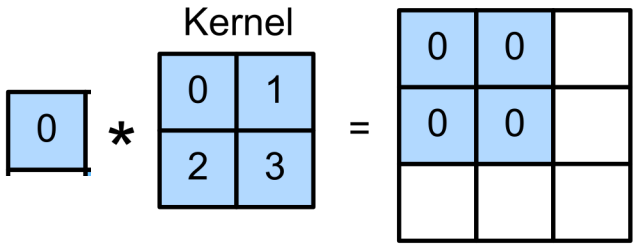
Kernel

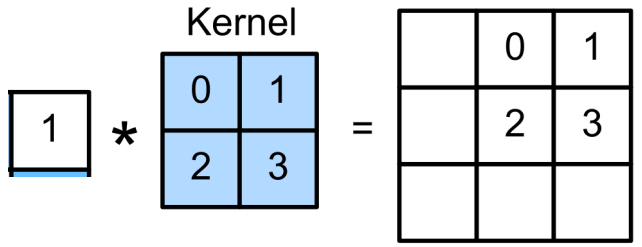
0	1
2	3

Input

0	1
2	3

2. Multiply the kernel by each element in the input and place the results in the output matrix using strides





The kernel shape and the stride parameter are selected by considering

- the shape of the input
- the desired shape of the output

Input

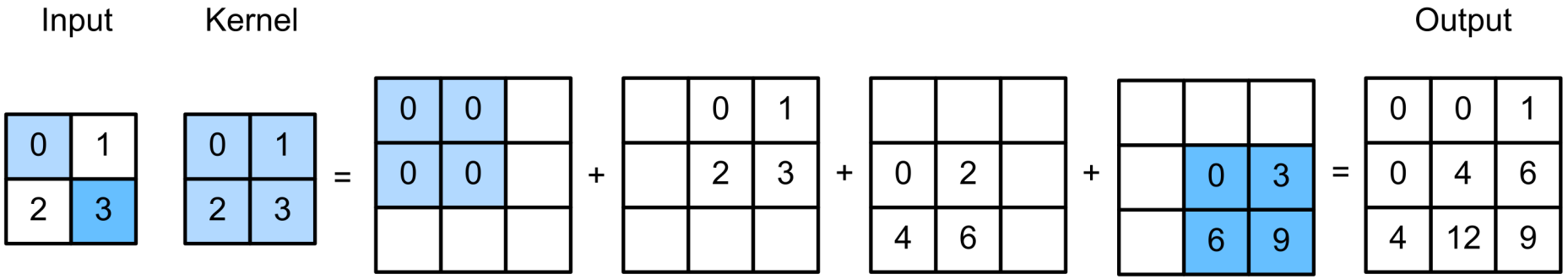
0	1
2	3

Output

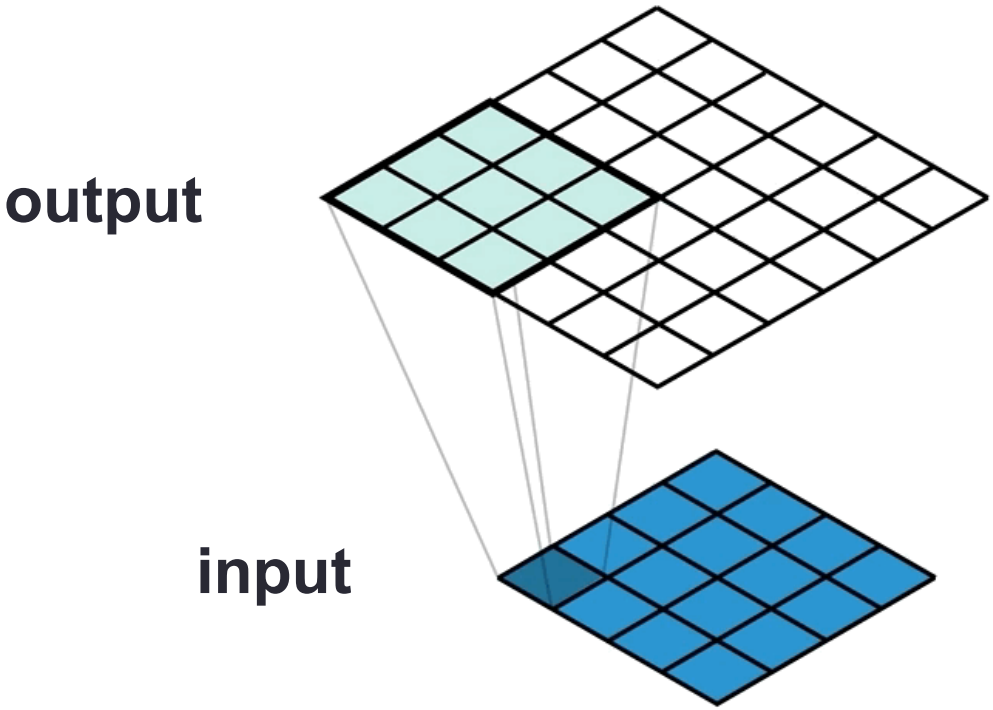
0	0	1
0	4	6
4	12	9

Transposed convolutions 4/4

3. Sum all the outputs in the same position to obtain the result of the transposed convolution

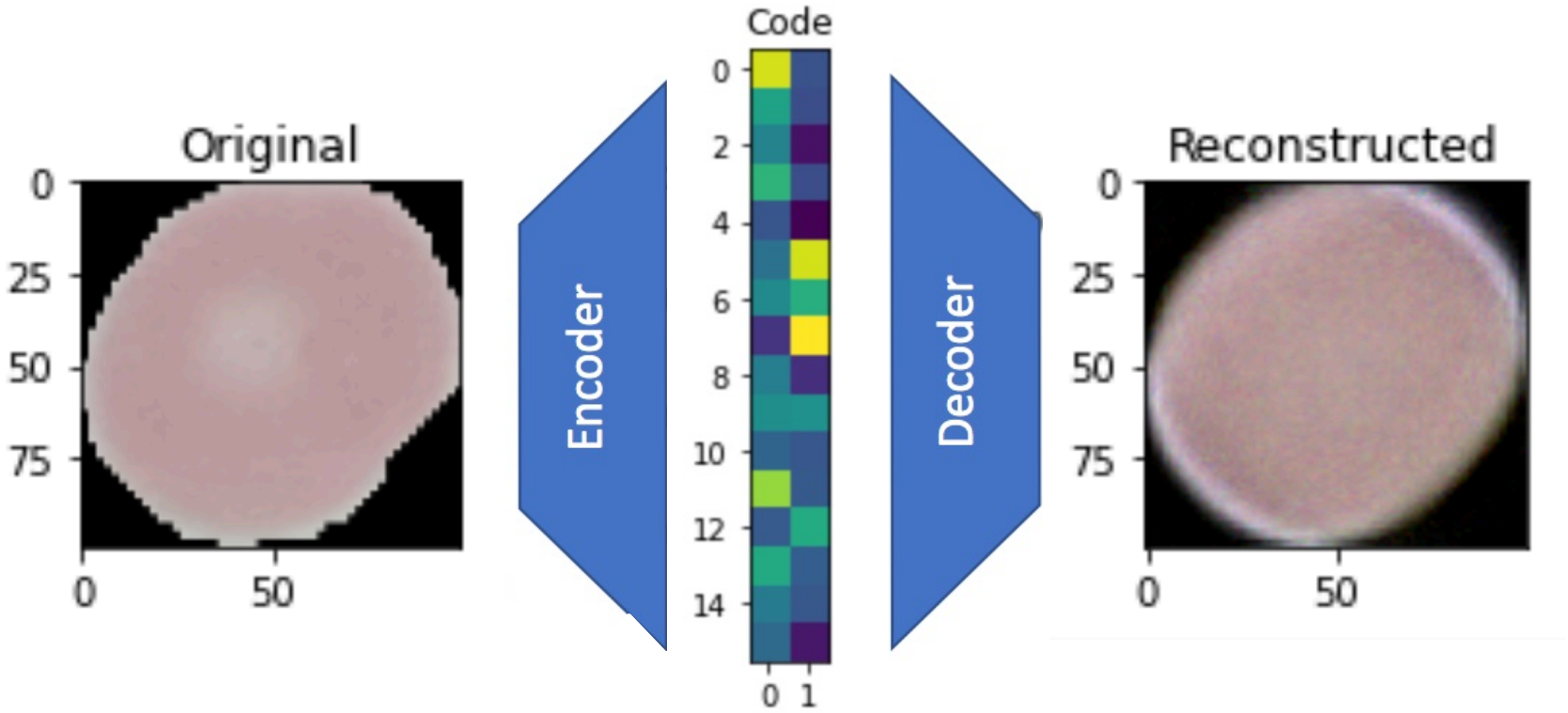


Transposed convolutions



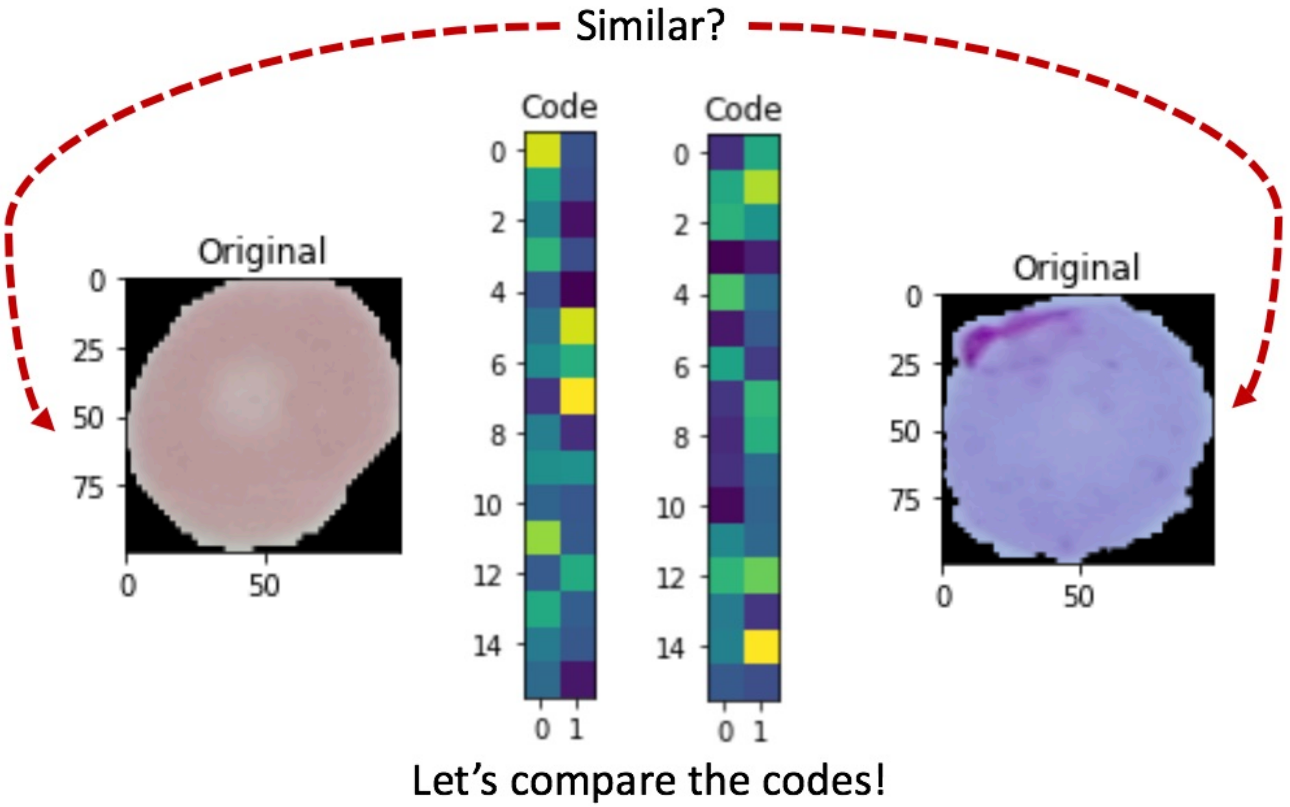
Part I – CNN-autoencoder design

- design a CNN-based autoencoder (encoder + decoder)
- train the network to reconstruct cell images



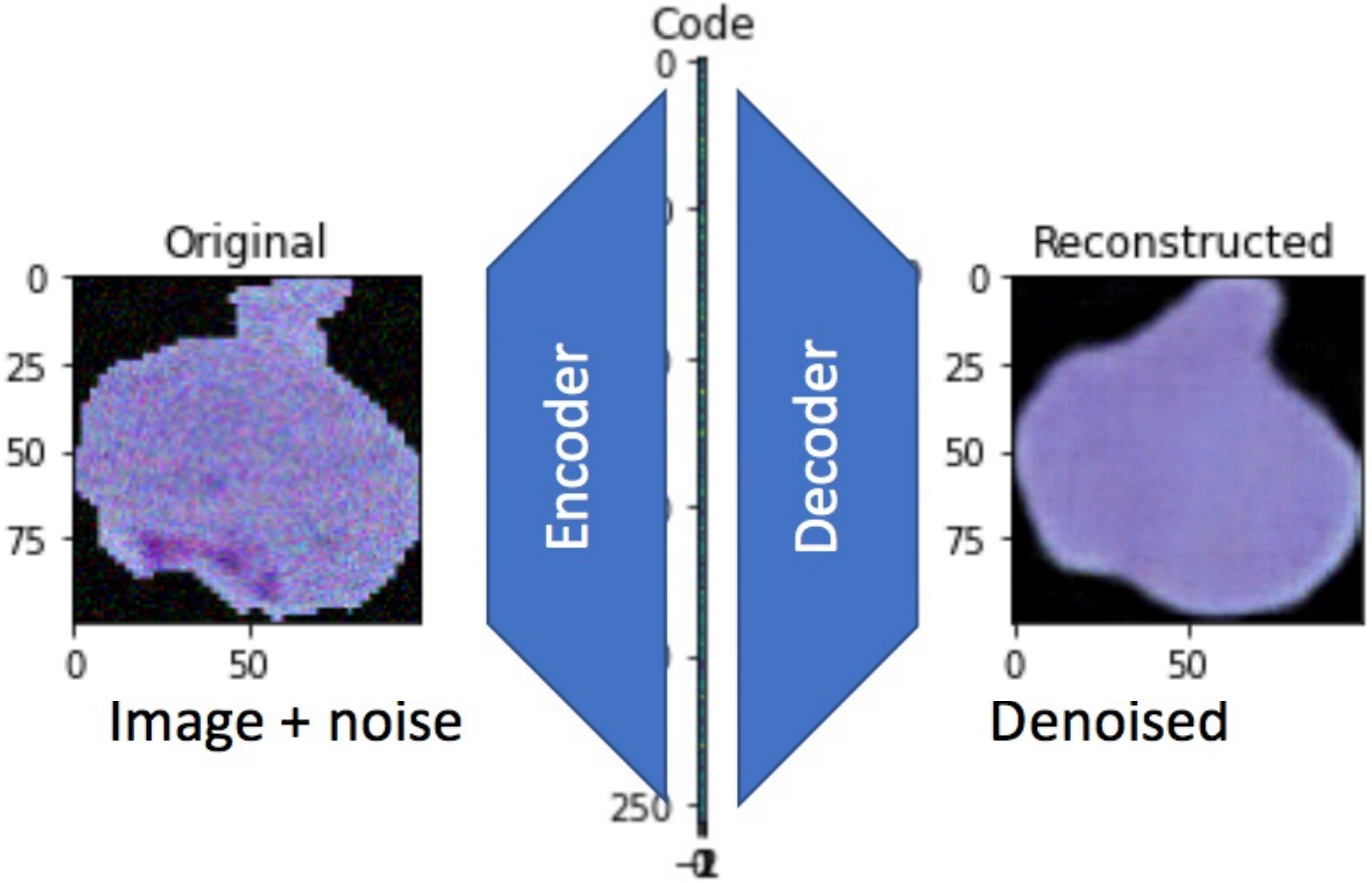
Part II – application: image search

- use the encoder to extract internal codes
- use the codes to compare the images and search for similar images in the dataset



Part II – application: denoising

- use the CNN-autoencoder as a denoising autoencoder
- obtain as output a denoised version of the input



New package to install for this lab

- `conda install -c conda-forge opencv`

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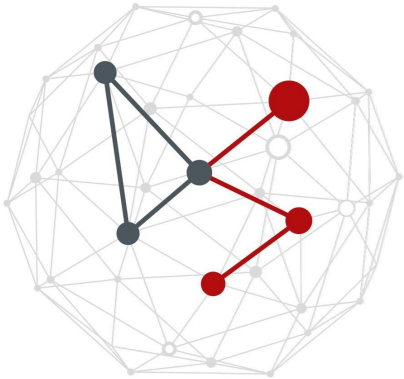

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