MACHINE LEARNING

MEI/1

University of Beira Interior,
Department of Informatics

Hugo Pedro Proença,
hugomcp@di.ubi.pt, 2024/2025

Machine Learning

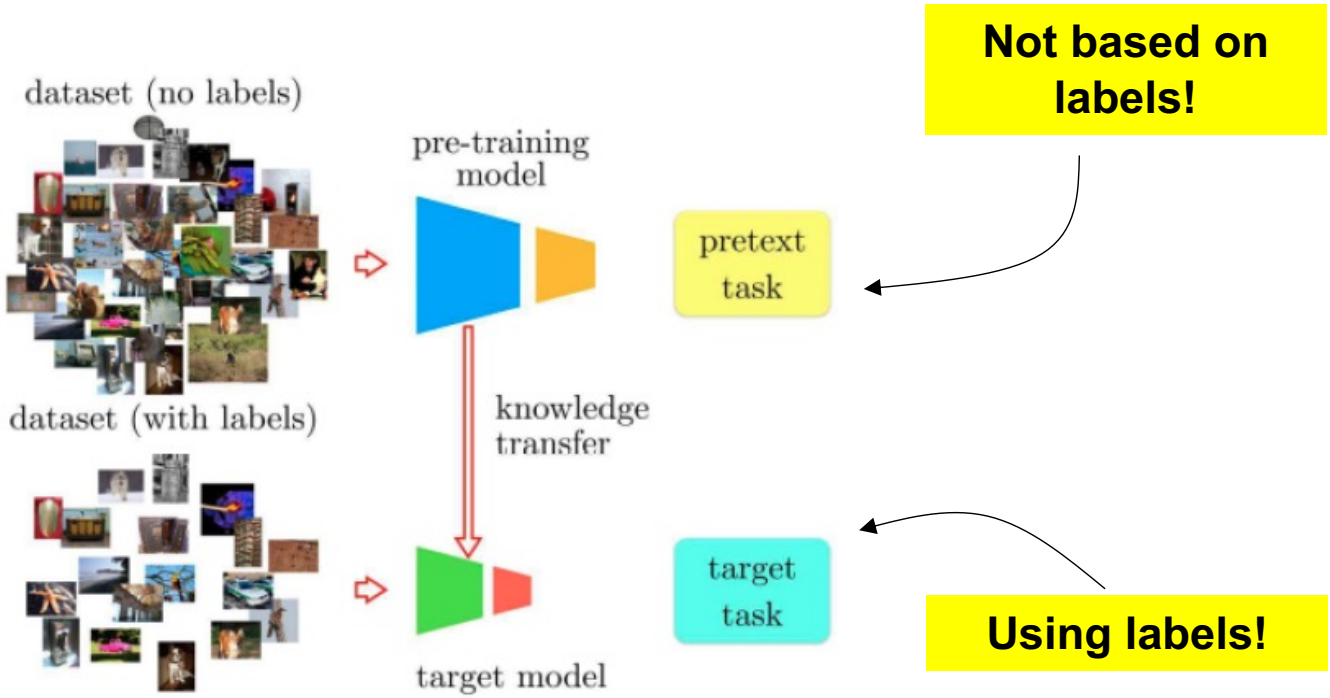
[06]

Syllabus

- Self-Supervised Learning

Self-Supervised Learning

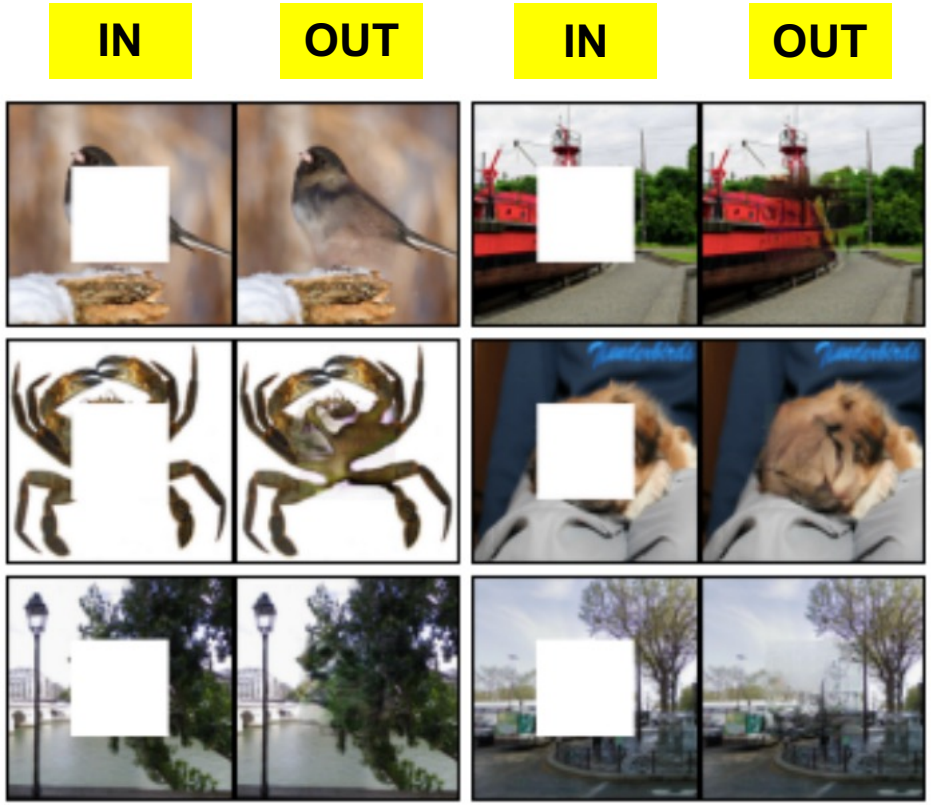
- Self-supervised learning is a relativelly recent type of machine learning that can be regarded as a midle point between supervised and unsupervised learning.
- It is a form of unsupervised learning where the model is trained on unlabeled data, but the goal is to **learn good representations** of the data that can belater used in a downstream supervised learning task.



Source: https://neptune.ai/blog/self-supervised-learning

Self-Supervised Learning

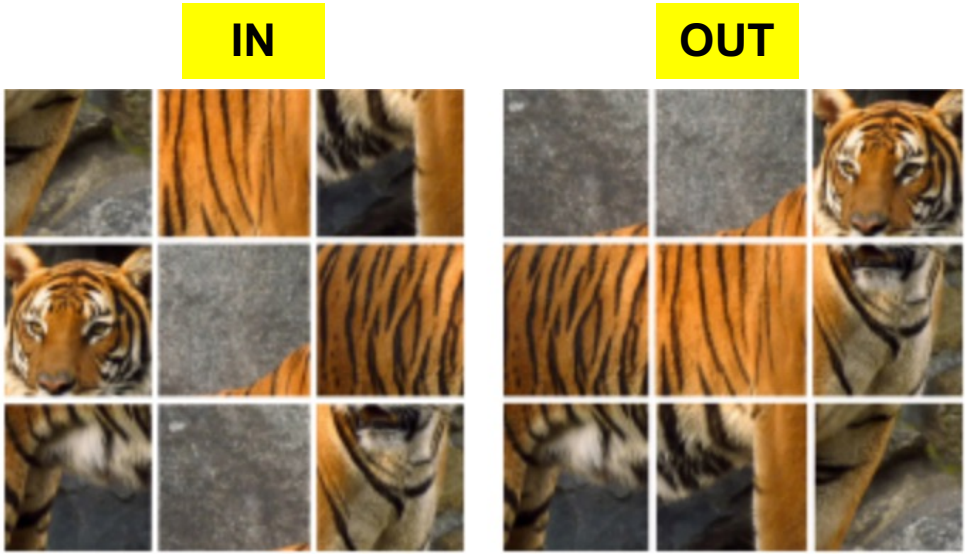
- At first, Self-supervised learning starts by training a model itself to learn one part of the input from another part of the input.
- This is known as **pretext learning**, which can assume different forms:
- For example, using unstructured 2D data, predict any part of the input from any other part:



By doing this, we force the model to "understand" the data

Self-Supervised Learning

- Still for unstructured 2D data, another very popular pretext task is to learn by solving Jigsaw puzzles:

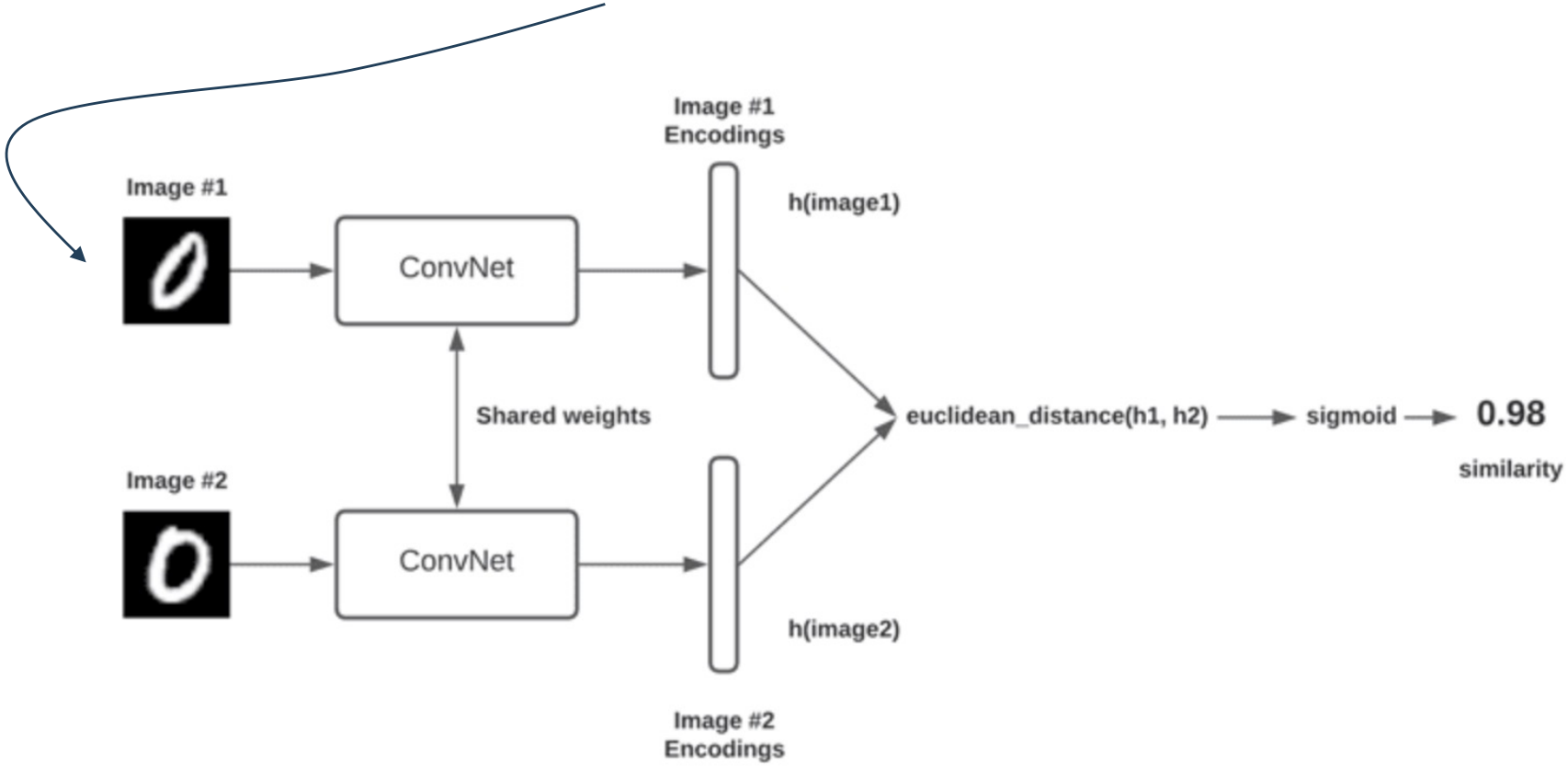


Again, the model is forced to understand each part of the input, in order to obtain a realistic output

Self-Supervised Learning

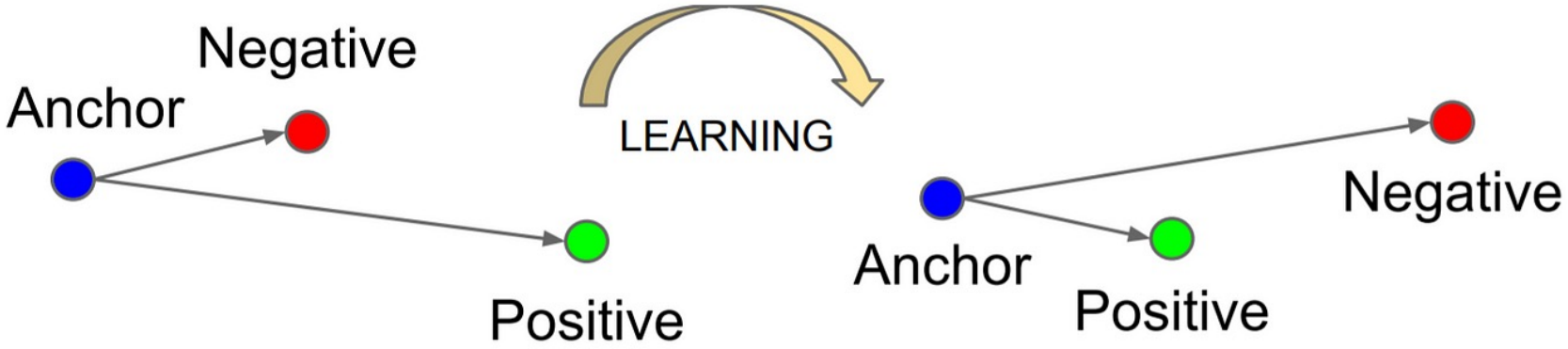
- It is also very common to use some Siamese architecture to obtain appropriate feature representations.

If both inputs are from the same image (not "class" in this case), the distance should be small. Otherwise, it should be large.



Self-Supervised Learning

- Another possibility is to use three images in the input: the Anchor (**A**) and the Positive (**P**) that are variations of the same image, and the negative (**N**), that regards a different image.



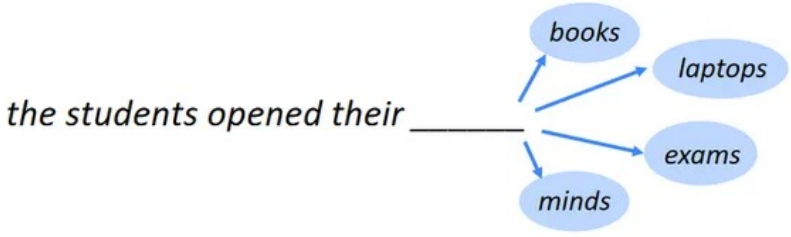
The Anchor and Positive should be near each other, while their distance to the Negative image should be large

$$\mathcal{L}(A, P, N) = \max(\| \mathrm{f}(A) - \mathrm{f}(P) \|_2 - \| \mathrm{f}(A) - \mathrm{f}(N) \|_2 + \alpha, 0)$$

Self-Supervised Learning

- In case of 3D unstructured data (video), one can predict the predict the future from the past/present, or predict the present from the future.

- In case of text data, the most obvious pretext task is to predict the next word, based in the last “k” words.



Self-Supervised Learning

- Once the pretext task is considered solved (i.e., the model stopped to learn), it is time to apply “Transfer Learning” techniques
- In practice, it consists in copying (and freezing ?) the weights from the earliest layers of the model into the new one.