Self-Supervised Learning

AI Shot #4 @ VISUM

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01

The Learning Spectrum

AI shot

02

Embedding Domain Knowledge

AI shot

03

AI use case

04

Self-Supervised Learning

AI shot

01 What's Self-Supervised Learning?

Self-Supervised Learning

Fake it until you make it

- Dress up unsupervised learning as a supervised model.
- Supervision comes from a ***synthetic task***, that can be machine-derived from the data sample itself (+ some perturbation mechanisms).
- It lets you acquire some level of high-level understanding about the data.
- If your model understands the underlying concepts in the data, it will be able to extract more advanced conclusions easily (i.e., with less exposure to real labels).

... It's like vaccinating your model

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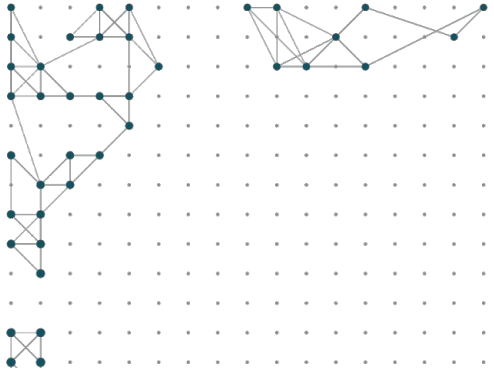
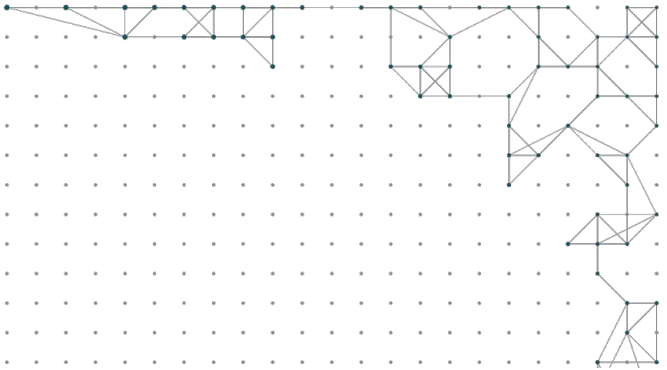
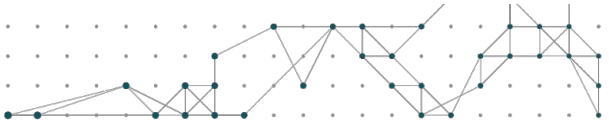



You're like Mr. Miyagi
teaching the Karate Kid
to dress/undress his jacket,
so he's ready
for the actual fight

you
your dumb model
self-supervised task

final supervised task

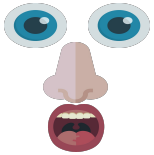
Self-Supervised Learning

Some intuition

Normal face

Swap order

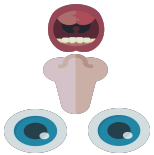
Swap order



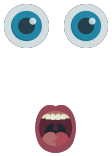
Stretched

Contracted

Rotated 45º



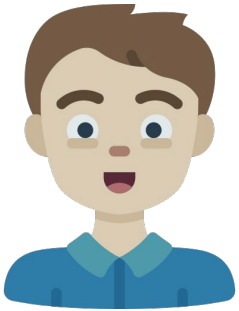
Upside down



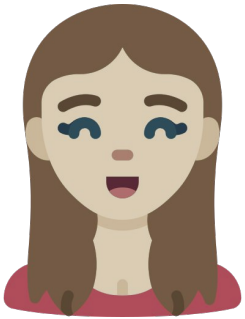
Missing part

Darkened

I already know faces, bring me those biometric tasks (e.g., face identification) to kick their...



Tom



Karen

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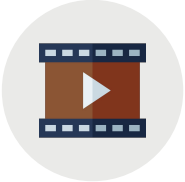
Self-Supervised Learning

Examples per Data Type

- **Image:**
  - Jigsaw puzzle reorganization.
  - Colorization.
  - Inpainting.
  - Rotation, perspective and flip detection.
  - Super-resolution.
  - Denoising.



- **Video:**
  - Sequence ordering.
  - Next-frame prediction.

- **Time Series:**
  - Outlier removal.
  - Forecast next step.
  - Sequence re-ordering.

- **Text:**
  - Word between context.
  - Next word.
  - Introduce punctuation.
  - Split sentences/paragraphs.
  - Remove missing words.

- **Graphs:**
  - Weight denoising.
  - Missing link detection.

- **Tabular:**
  - Missing value imputation.
  - Column re-ordering.
  - Super-resolution.
  - Next value per feature.

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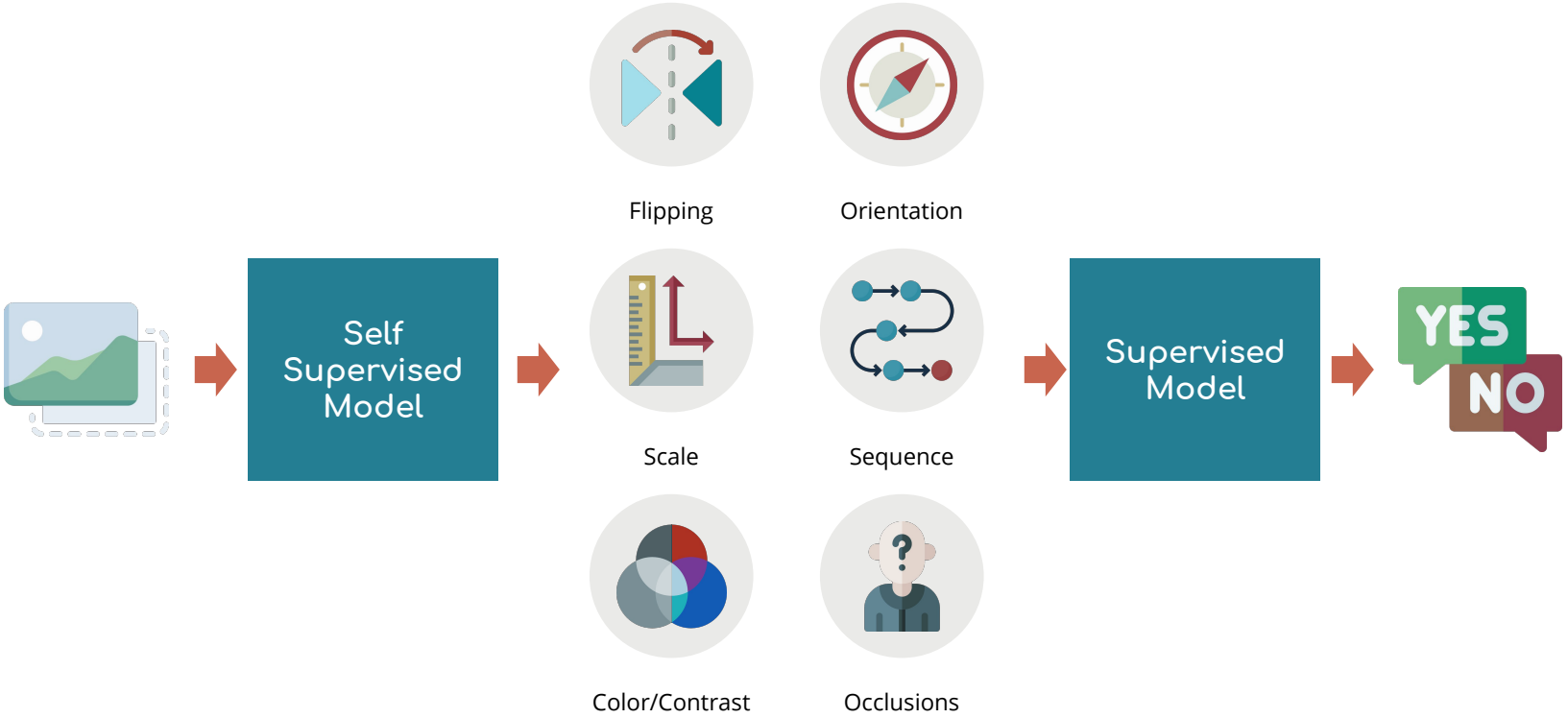
02 How to use it?

Transfer Learning (Pre-training)

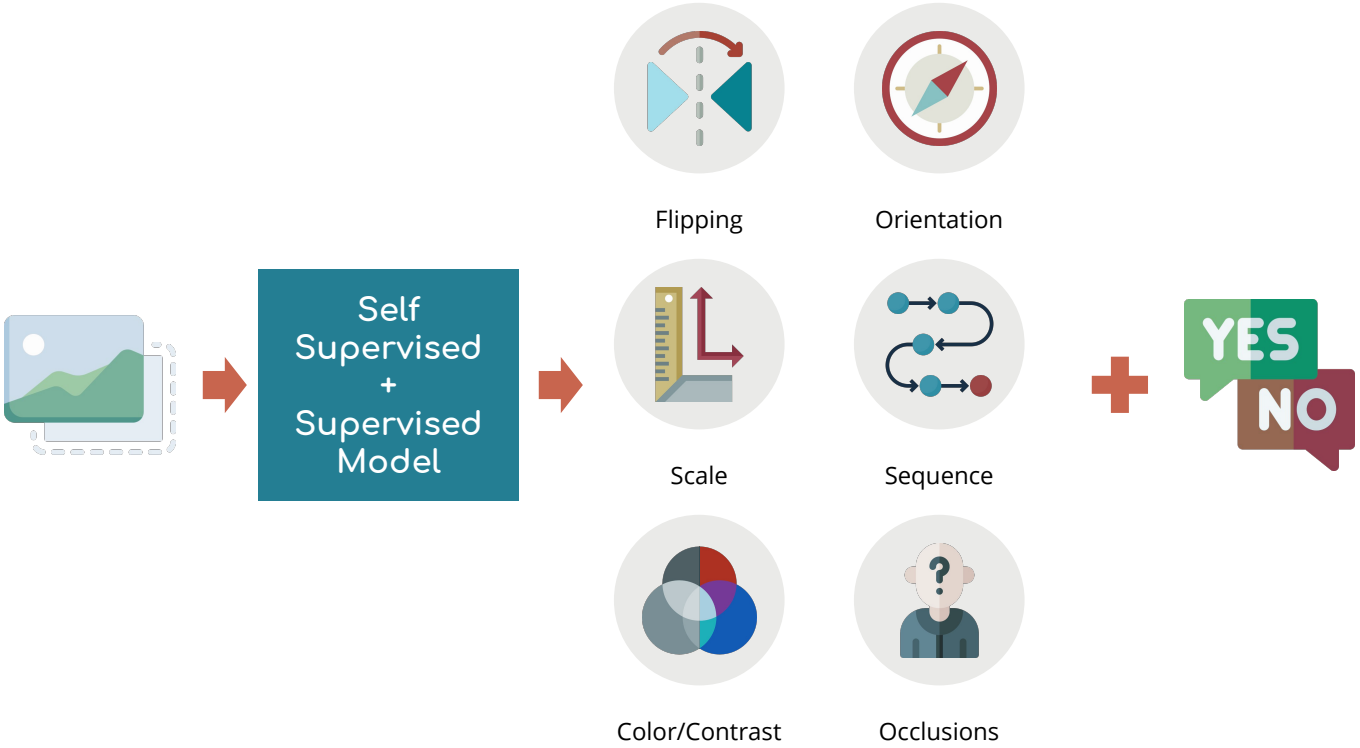
Train your model on the
synthetic tasks
(self-supervised)

Fine-tune it for your
target task
(supervised)

Feature Extraction

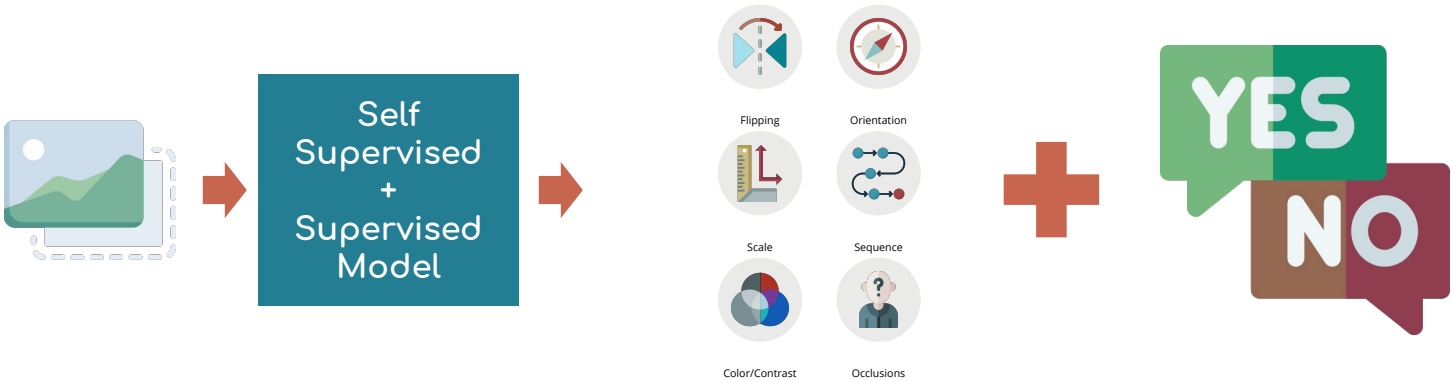


Multitask Learning

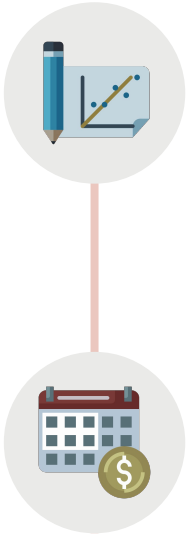


Multitask Learning

Multitask Learning



Proxy Model



Real vs. Synthetic task correlation

- It's not that common, but sometimes your self-supervised task is already correlated with the target task.
- So, why wasting time on a supervised model?

Bird in a hand

- You can shorten development time by coming up with a nice model.
- I know you can wait K months to have a marvelous supervised model.
- But businesses will prefer to have a weaker self-supervised model next week and start making profit.

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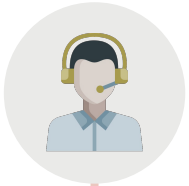
03 Examples from real-life projects

Sentiment Analysis in Call Centers

when labeling data isn't even a reliable option



Problem

- We had to provide an indicator of customer satisfaction through a customer support call using audio.
- Labeling data regarding sentiment is very subjective/ambiguous.

Self-Supervised Learning to the rescue: Proxy Model

- Trained a **proxy model** to predict:
  - Inbound vs. outbound calls: when the customer calls it's in general for complaining, when you call them, it's to offer stuff.
- There you go, you have a model that reached ~70% ROC AUC on identifying churners.
  - without labels.
  - in just a couple of days!

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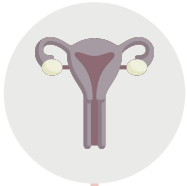
Cervical Cancer Detection

high-level features that are worth thousands of biopsies



Problem

- Models for the automated detection of cervical cancer.
- Data is extremely scarce, especially labeled data (with biopsies).

Self-Supervised Learning to the rescue: High-Level features

- Acetowhitening:
  - Sequence ordering as a proxy task. If you recognize the frame order, it's because you observed a response.
- Cervical cancer causes rough textures in the cervix:
  - Blur detection as a proxy task.
- Bleeding is visually different from lesions because gravity pulls it downwards.
  - Vertical flip detection as a proxy task to differentiate bleeding from lesions.

- Use those features to train your final model with a few labels, voilá!

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Thank you!
Questions?

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