Lecture: Deep Learning and Differential Programming

3.1 Computer Vision

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Semi-supervised learning

Goal: use **additional unlabeled** data for learning.

Example:

Dataset 1:
Industrial application: Crop growth stage
3000 images + labels
16 classes, annotated

For each image:
Label
(e.g. which class among 16)

Dataset 2:
Industrial application: Crop growth stage
100 000 images
No labels, **no** annotation

No manuel labeling
Easy / cheap data acquisition!

Self-supervised learning
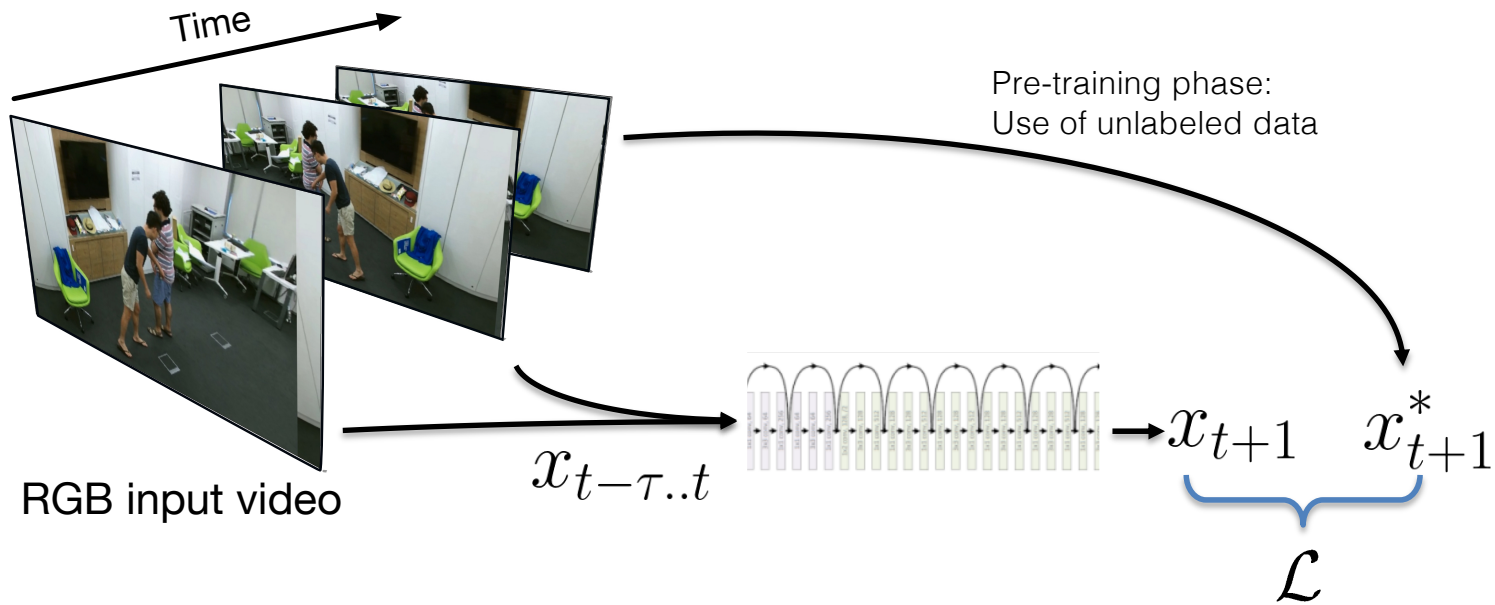
Humans can predict the future.

If we learn how to predict the future ... can this help us to train a model which better understands the data?

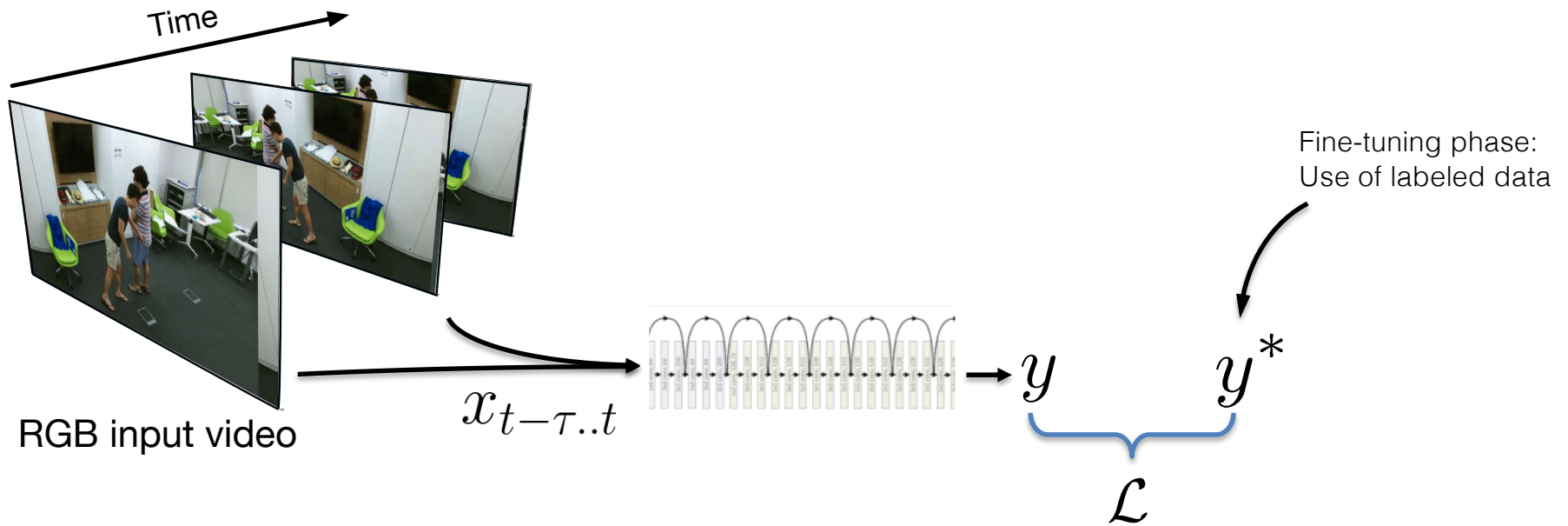<u>Self</u>-supervised learning is a vaiant of <u>semi</u>-supervised learning.

[T. Han, W. Xie, A. Zisserman, Video Representation Learning by Dense Predictive Coding, ICCV 2019]
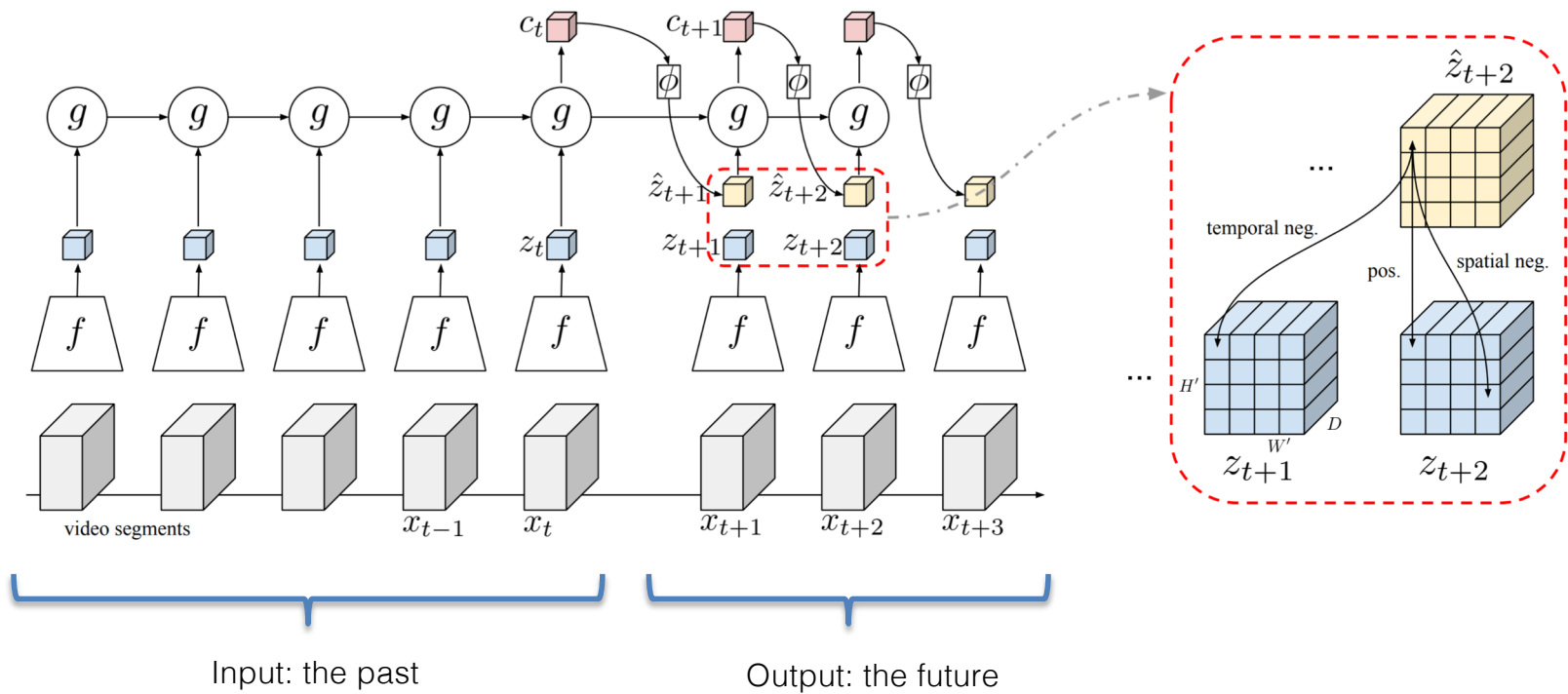
Self-supervised learning

Time

RGB input video

Pre-training phase:
Use of unlabeled data

$x_{t-\tau..t}$

x_{t+1} $\quad x_{t+1}^{*}$

$\mathcal{L}$

Self-supervised learning

Time

RGB input video

$x_{t-\tau..t}$

y $\qquad$ y^*

$\mathcal{L}$

Fine-tuning phase:
Use of labeled data

Self-supervised learning
Dense predictions

Input: the past

Output: the future

[T. Han, W. Xie, A. Zisserman, Video Representation Learning by Dense Predictive Coding, ICCV 2019]
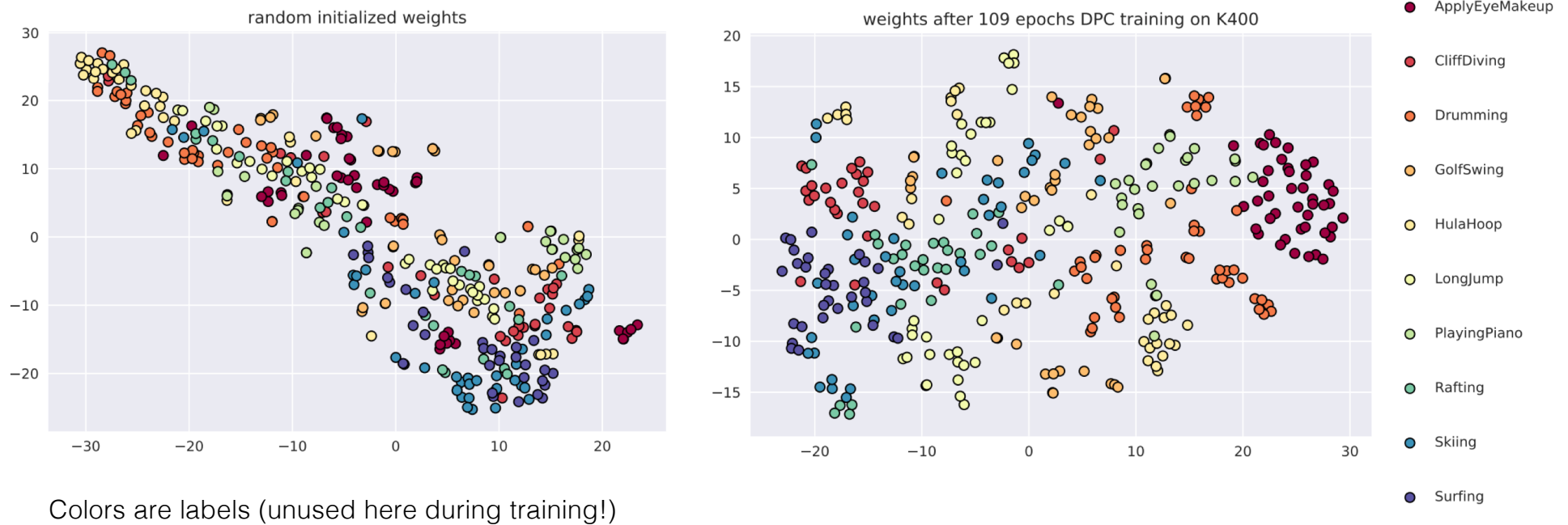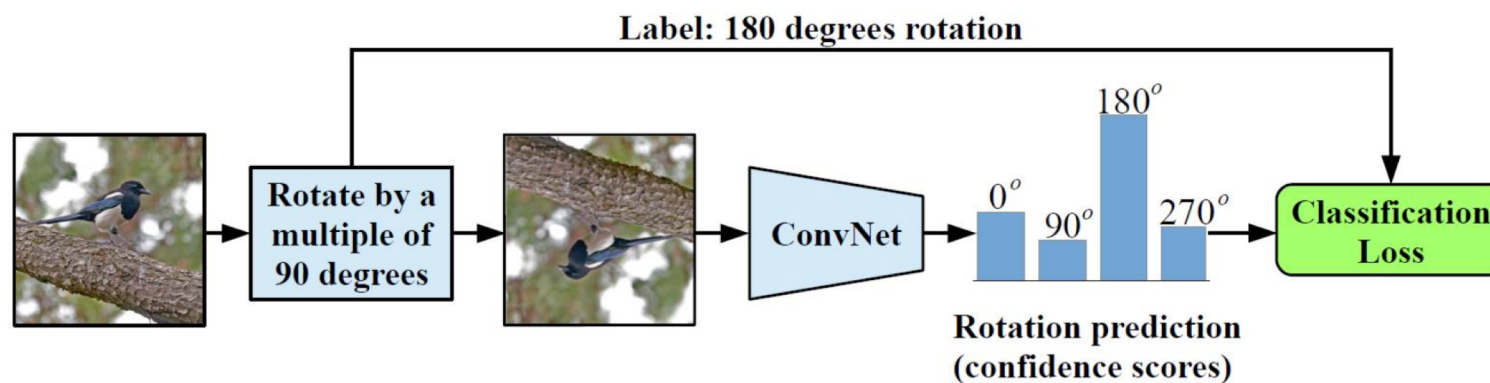
Self-supervised learning

random initialized weights

weights after 109 epochs DPC training on K400

- ApplyEyeMakeup
- CliffDiving
- Drumming
- GolfSwing
- HulaHoop
- LongJump
- PlayingPiano
- Rafting
- Skiing
- Surfing

Colors are labels (unused here during training!)

[T. Han, W. Xie, A. Zisserman, Video Representation
Learning by Dense Predictive Coding, ICCV 2019]

How about images?

[S. Gidaris, P. Singh, N. Komodakis, Unsupervised Representation Learning by Predicting Image Rotations, CVPR 2019]

Semi-supervised learning

The industrial perspective, by Varun Nair:

https://medium.com/@nairvarun18/from-research-to-production-with-deep-semi-supervised-learning-7caaedc39093

Can boost your performance.

Probably can't solve your problem if performance with labeled data alone is very low.