Large Scale Representation Learning In-the-wild

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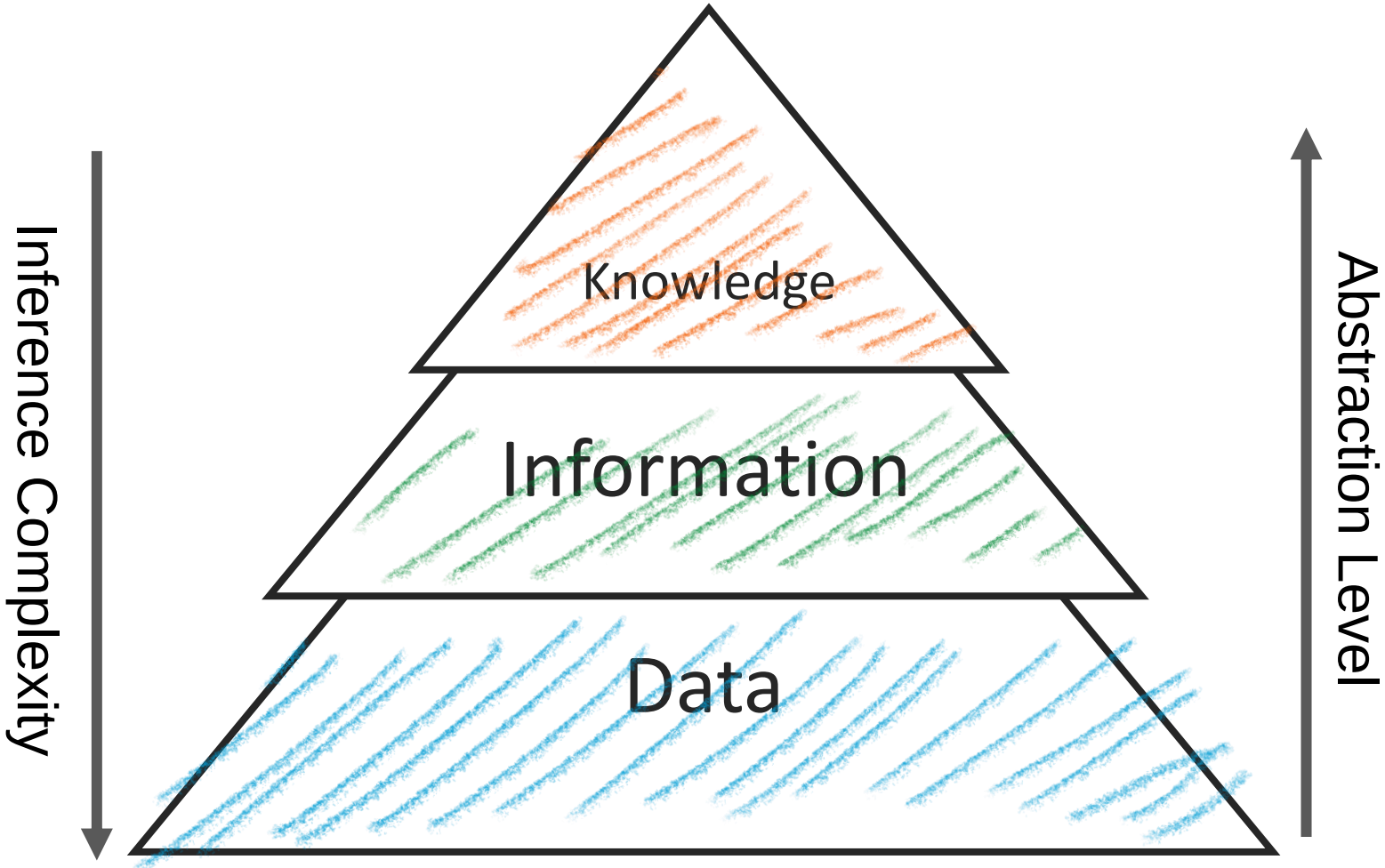
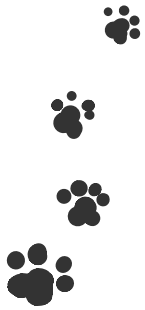
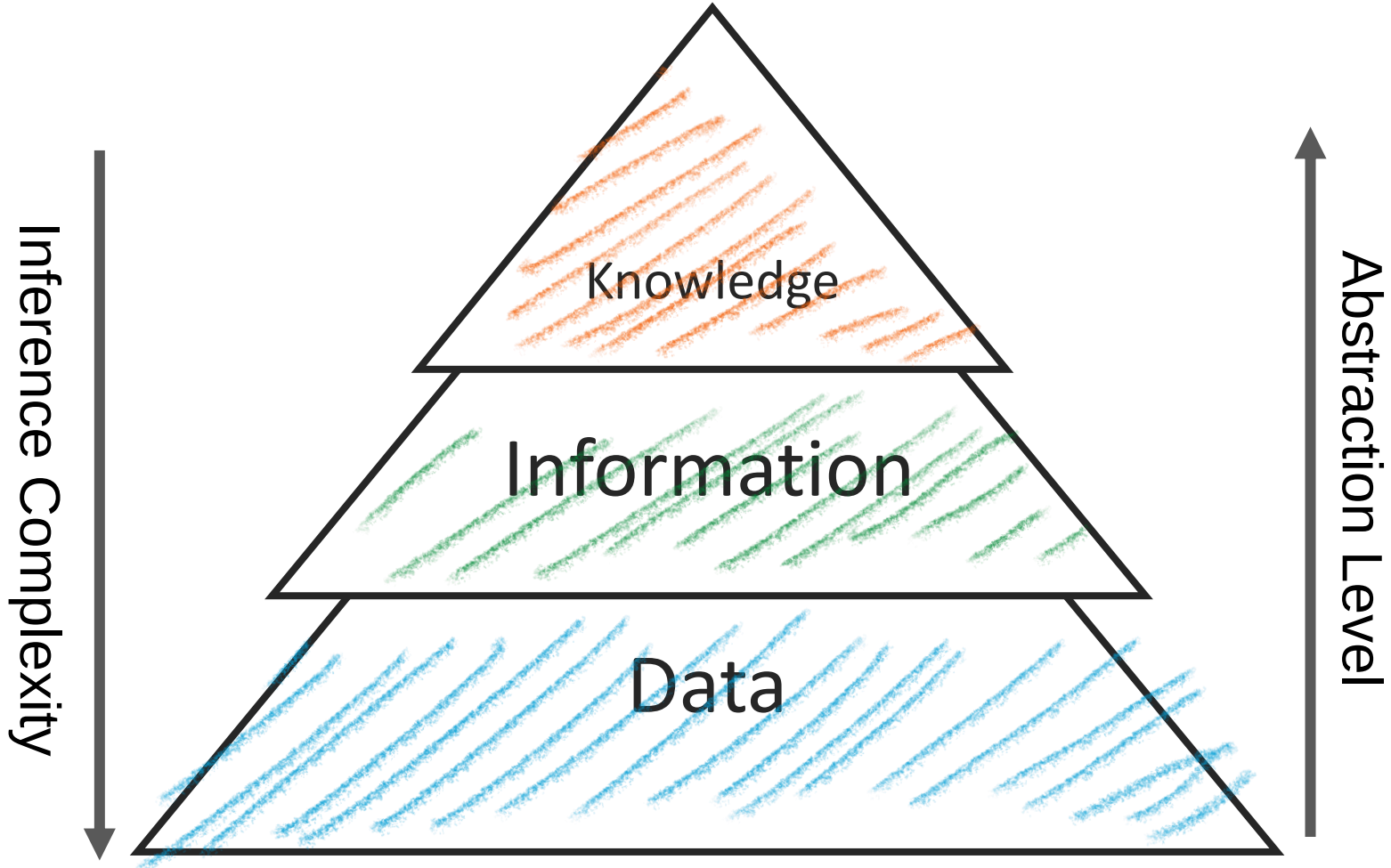
August 13th, 2022

Definition


Knowledge
Information
Data
Inference Complexity
Abstraction Level

Definition





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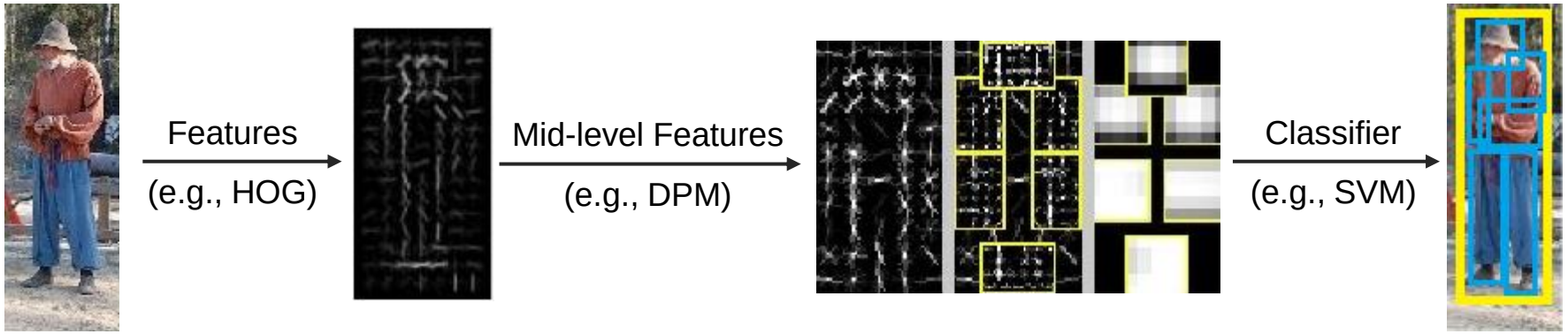
Deep Learning: End-to-end approach

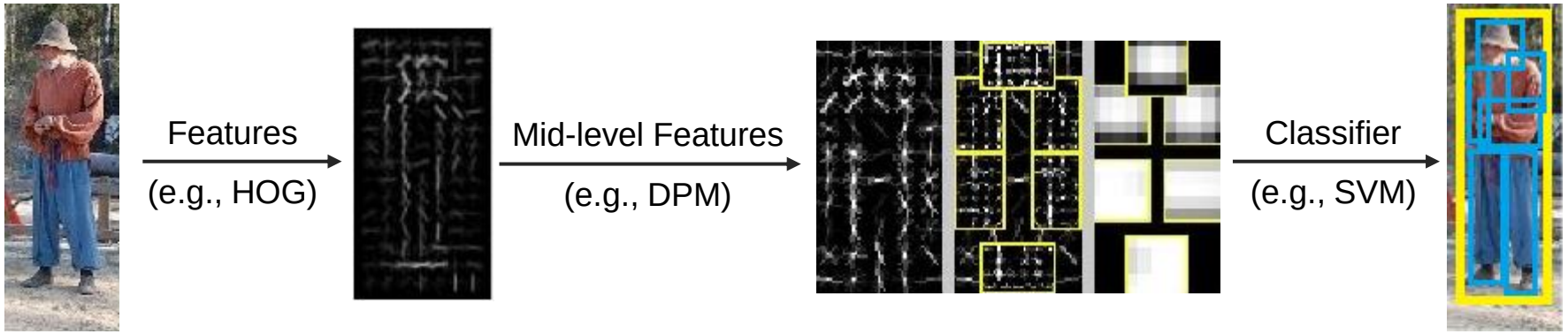
General Computer Vision



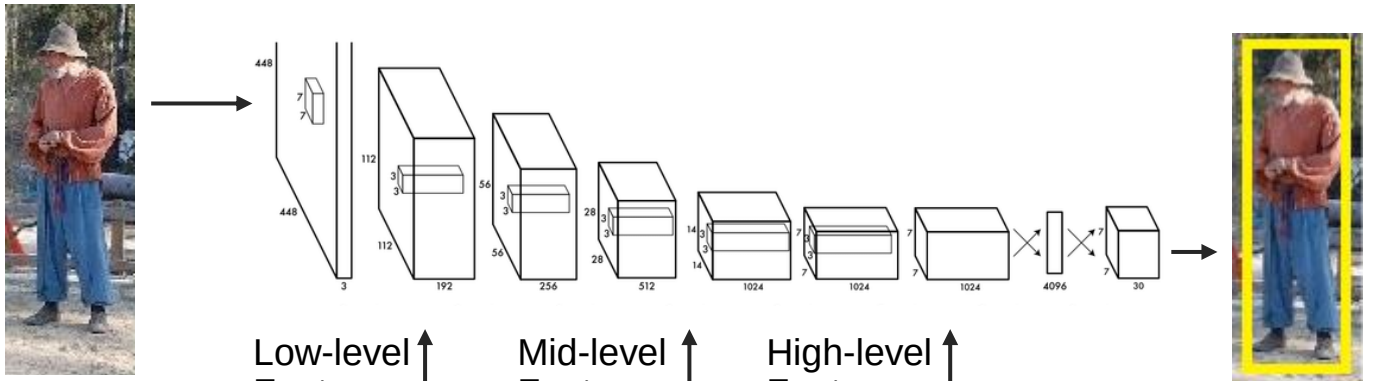
Learn More:
Object Detection with Discriminatively Trained Part-Based Models, Felzenszwalb et al (2010)

Deep Learning: End-to-end approach

General Computer Vision



Deep Learning



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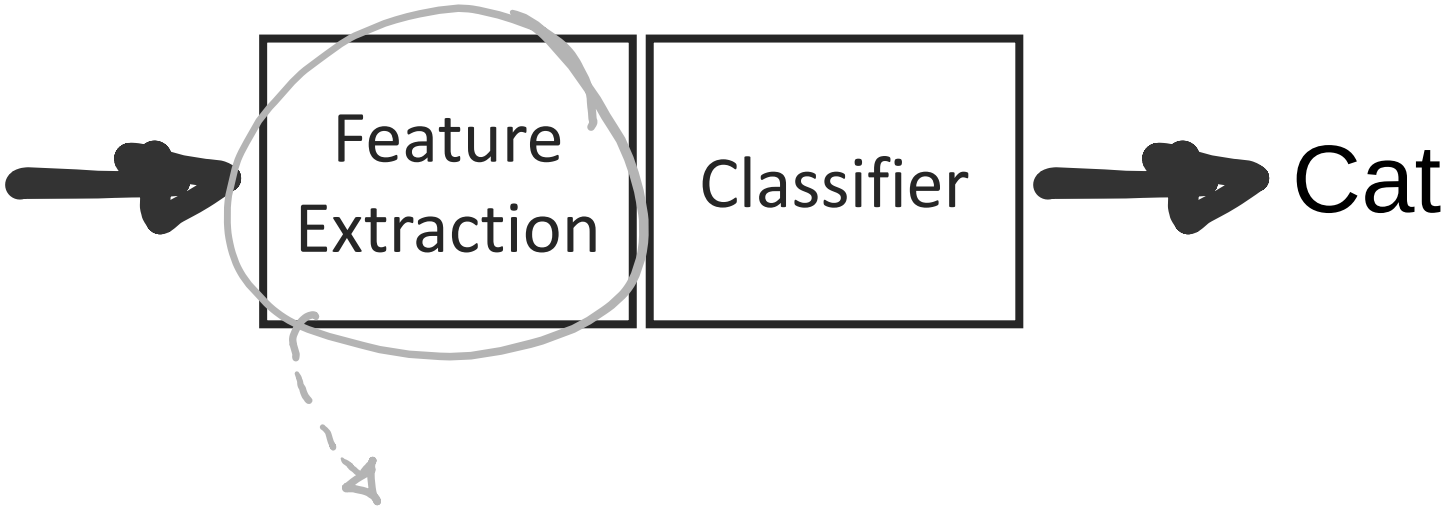
Supervised Representation Learning

Repurpose

Supervised Representation Learning

Repurpose



Object Detection

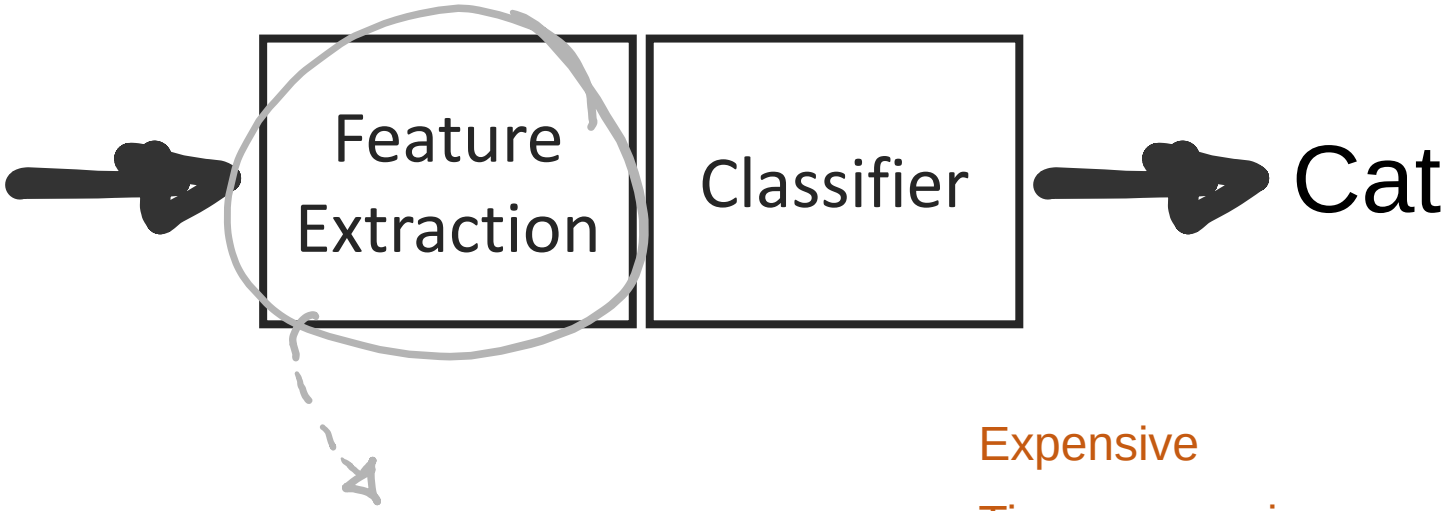
Semantic Segmentation

Visual Question Answering

…

Supervised Representation Learning

Repurpose



Object Detection

Semantic Segmentation

Visual Question Answering

…

Expensive

Time-consuming

Prone to error

Why unsupervised/self-supervised learning?

- Nature dose not use supervised learning most of the time

- Taking advantage of huge unlabeled data

- Answer new questions

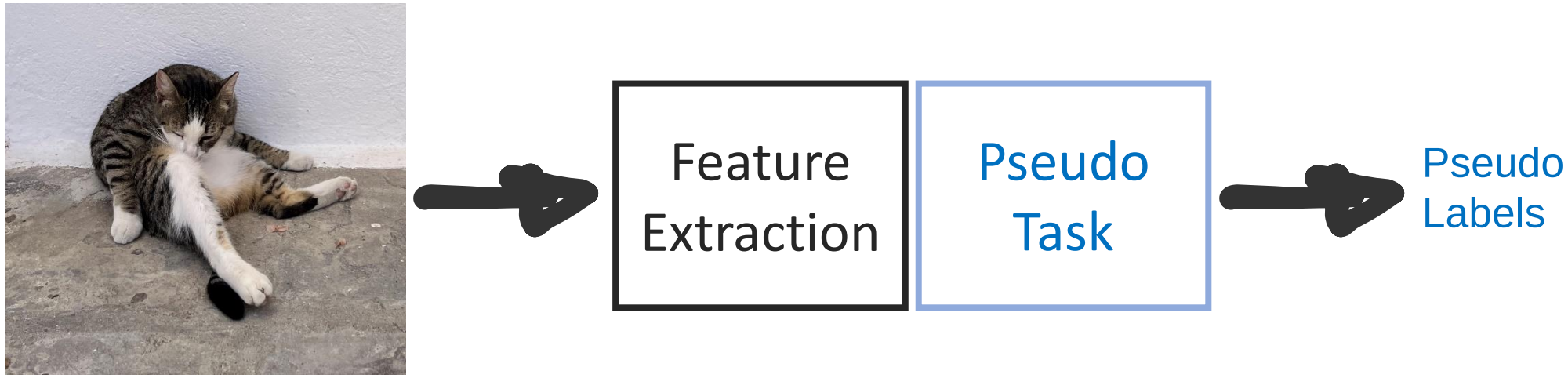
Learning how the world ticks

- Objective is to learn distribution that data comes from

Supervised: $p(y|x)$
Unsupervised: $p(x)$

- So long as our machine learning models “cheat” by relying only on surface statistical regularities

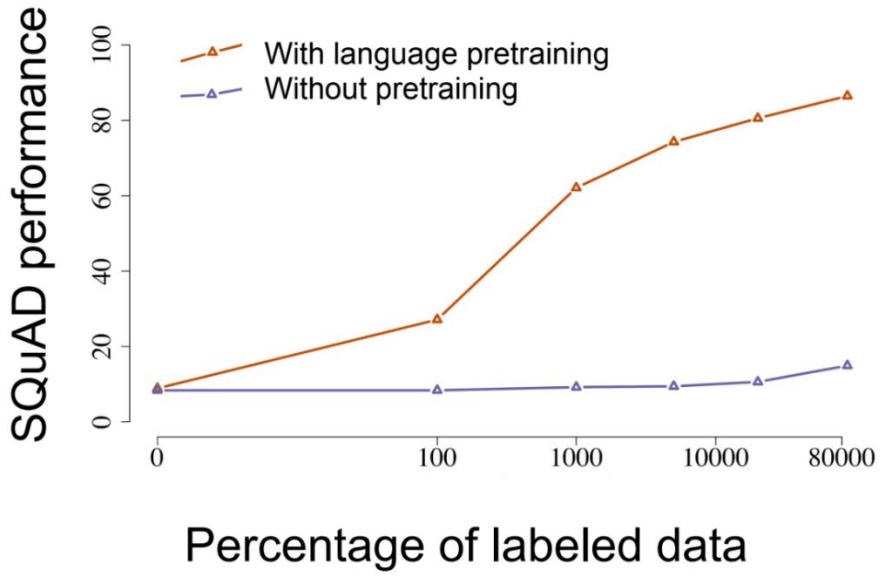
Self-supervised Representation Learning

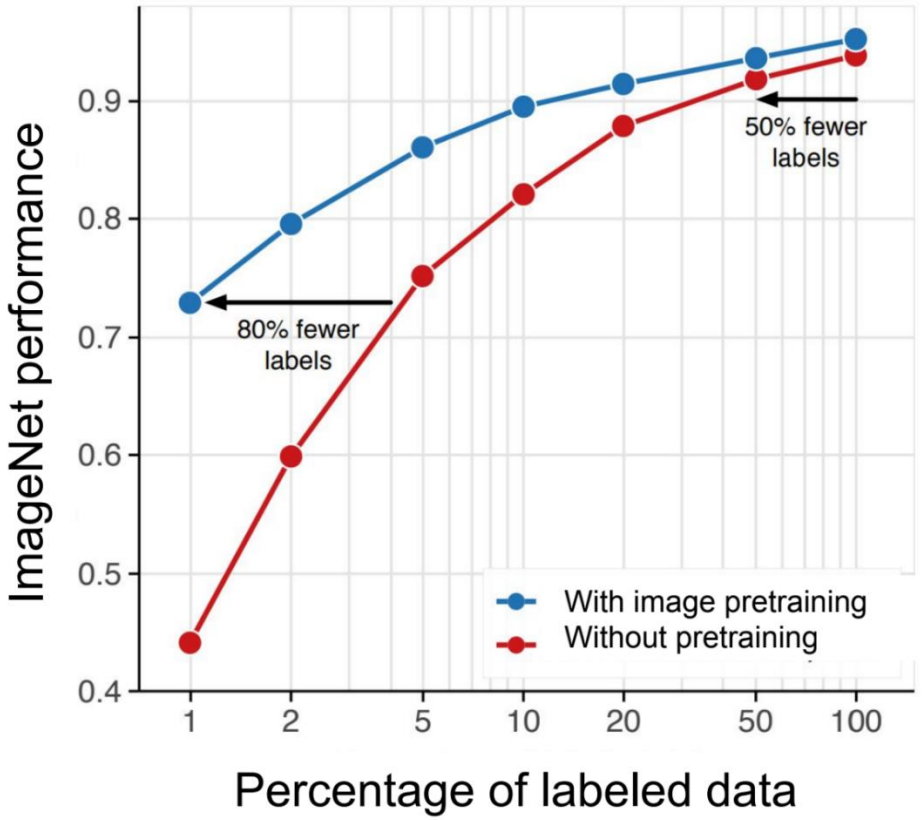


Self-supervised: pseudo labels

- Low cost
- More scalable
- Flexible

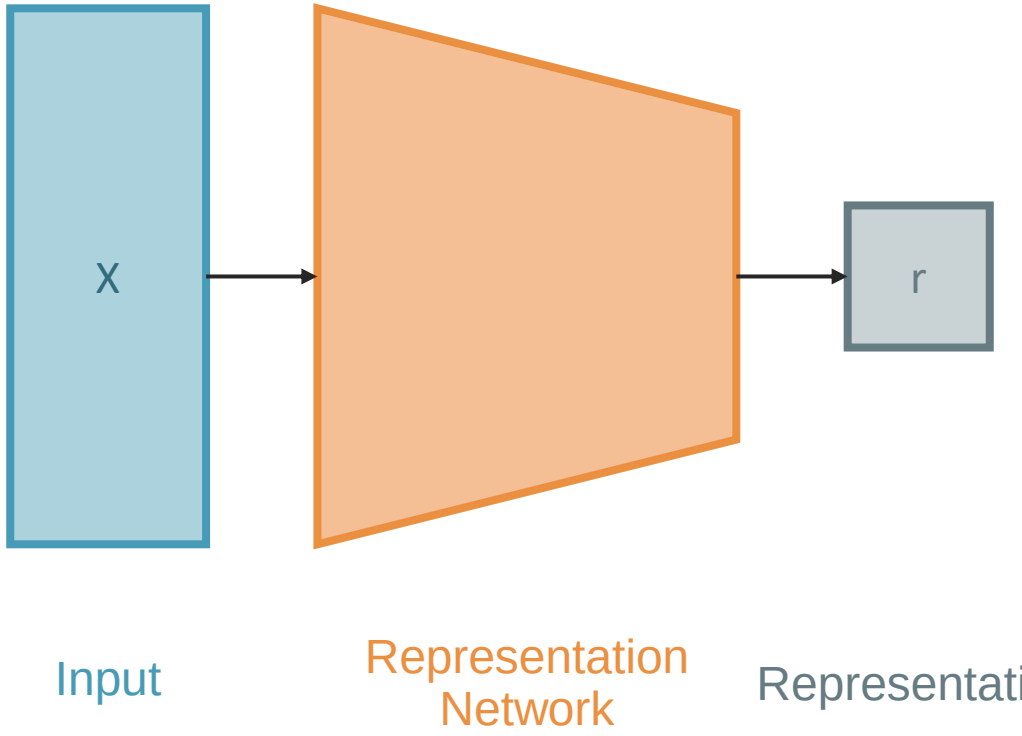
Recent Progress





Learn More:
Learning and Evaluating General Linguistic Intelligence, Yogatama et al
Data-Efficient Image Recognition with Contrastive Predictive Coding, Olivier J. Hénaff et al, ICML

(Representation / Encoder / Inference) Networks



Size: Smaller or larger than x

Structure: Flat or interpretable

Type: Continuous or discrete

Shape: Fixed or variable

Disentangled or not

- Multi-layer perceptron
- ConvNet
- Transformer
- Recurrent neural net

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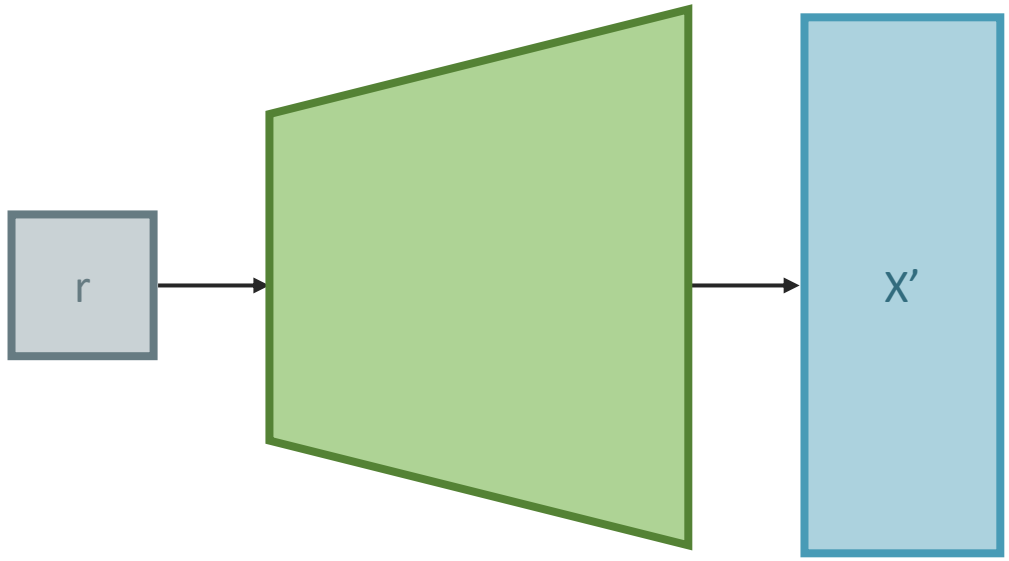
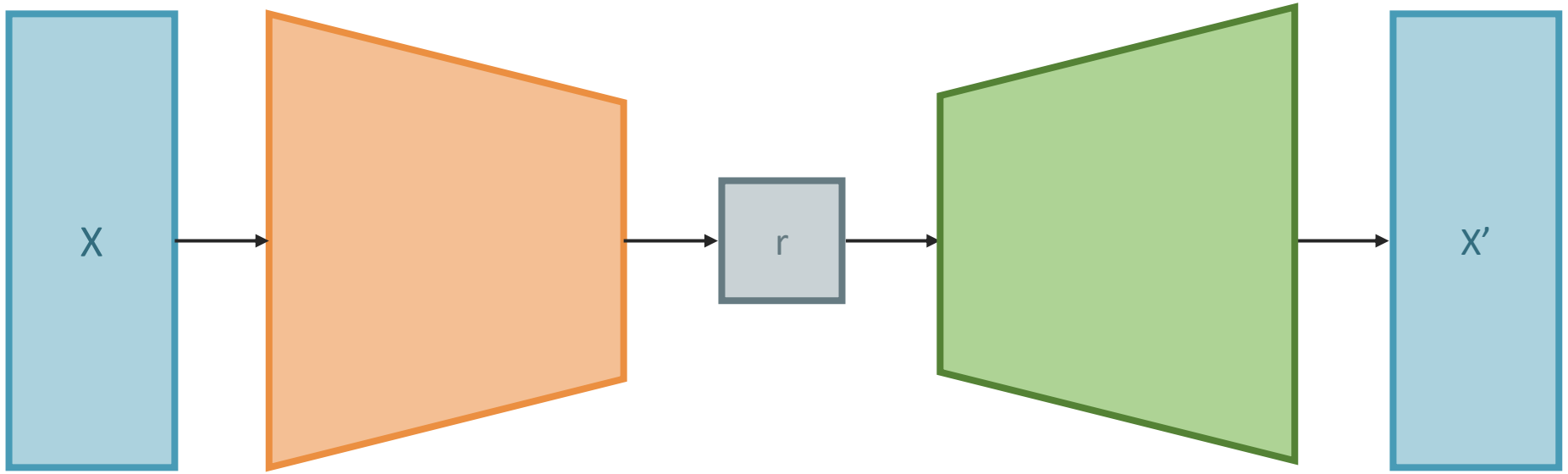
(Generation / Generator / Decoder) Networks



- Multi-layer perceptron
- DeconvNet
- Transformer
- Recurrent neural net

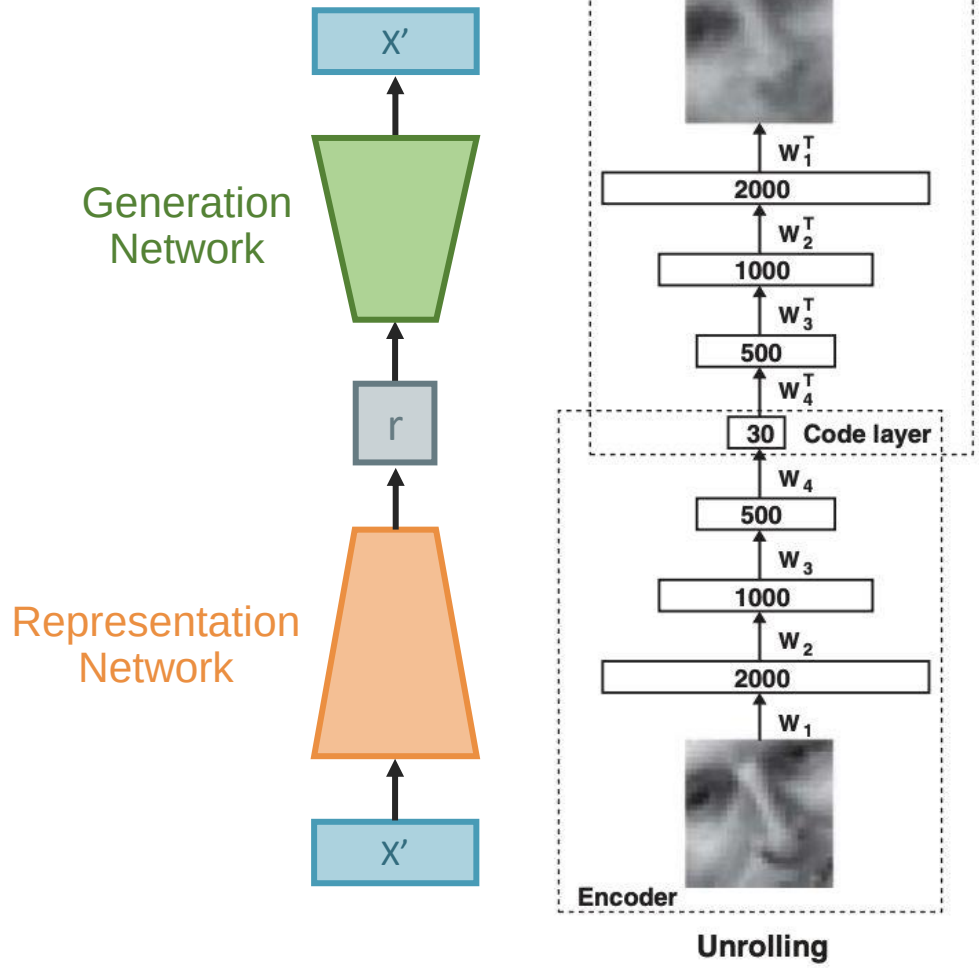
Autoencoders



Learn More:
Auto-Encoding Variational Bayes, Kingma et al, ICLR (2014)
Stochastic backpropagation and approximate inference in deep generative models, Rezende et al, ICML (2014)

Autoencoders: What are they for?

- Density estimation
- Dimensionality reduction
- Image generation
- Denoising
- **Representation learning**



Learn More:
Reducing the Dimensionality of Data with Neural Networks, Hinton et al, Science (2006)

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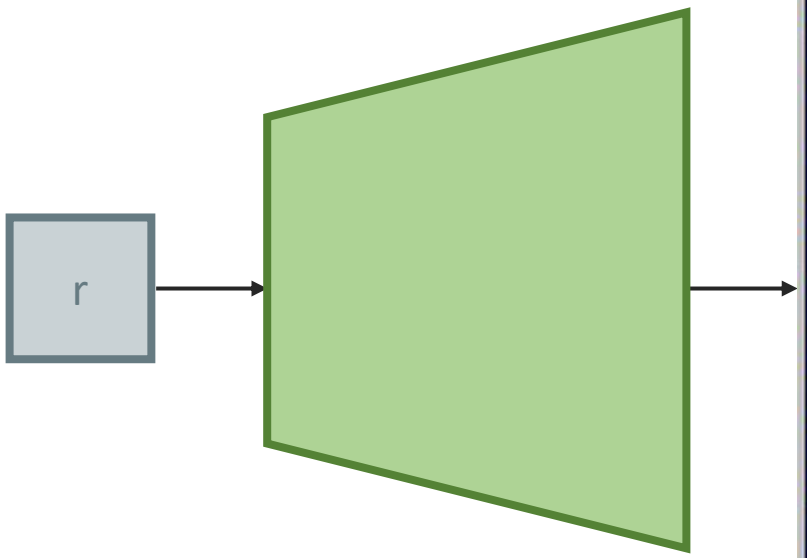
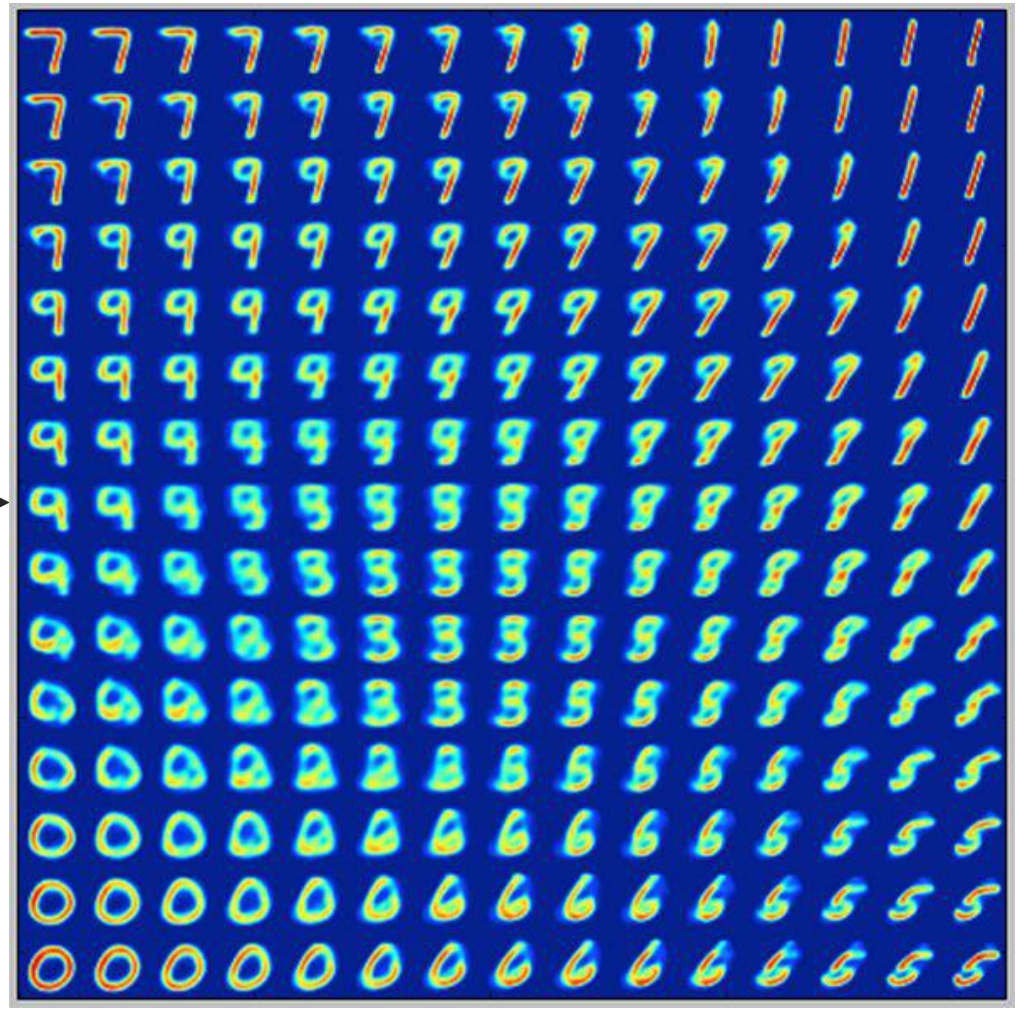
Autoencoders



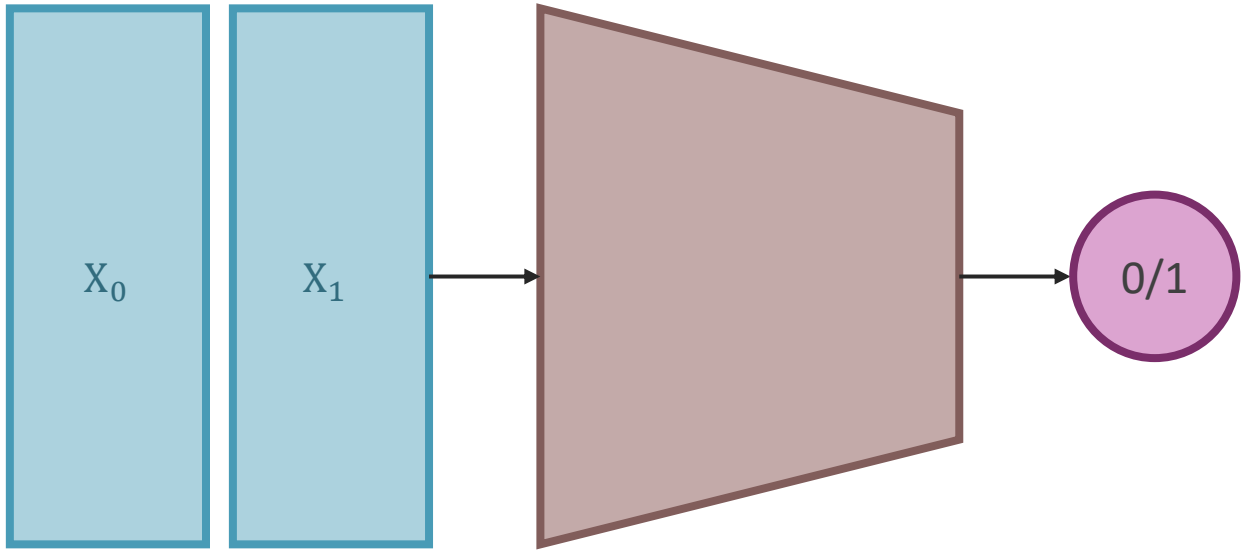


Representation

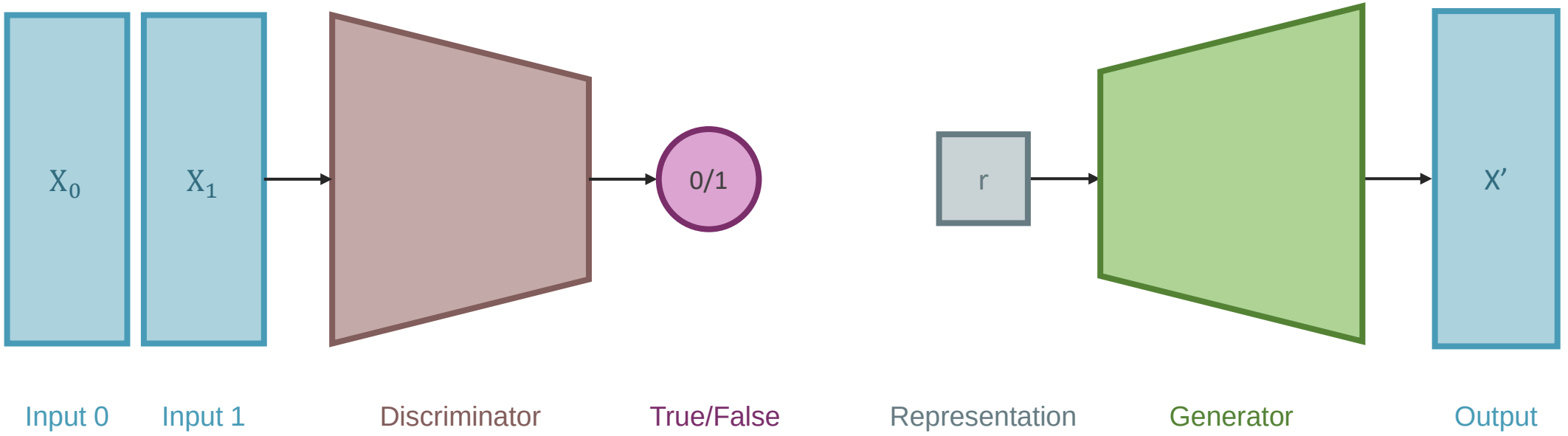
Generation Network

Learn More:
Building Autoencoders in Keras, Chollet (2016)

Discriminators / Contrastive Networks



Generative adversarial networks



Learn More:
Generative adversarial networks, Goodfellow, et al. NeurIPS (2014)

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Generative adversarial networks

Learn More:
A Style-Based Generator for GANs, Karras et al (2018)
Large Scale GAN Training for High Fidelity Natural Image Synthesis, Brock et al (2018)

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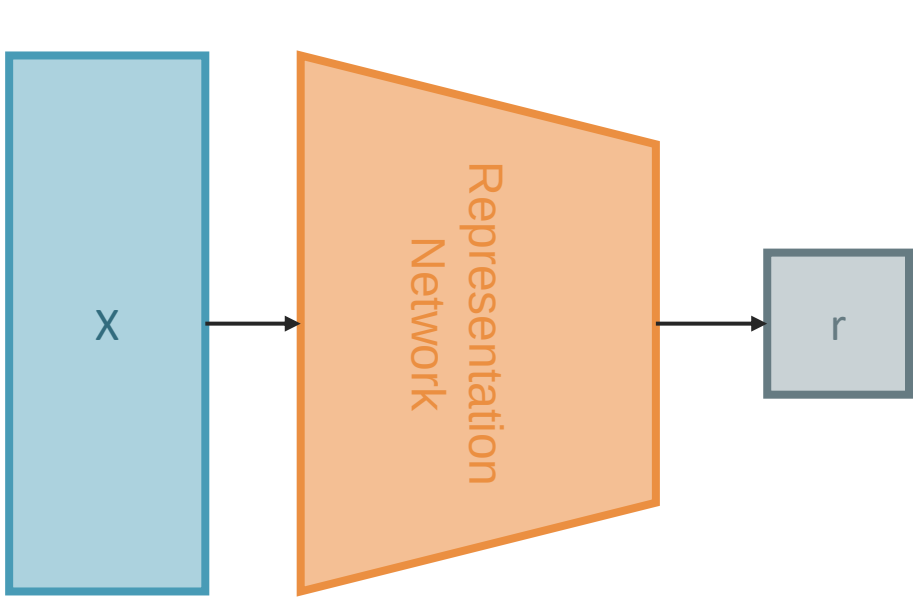
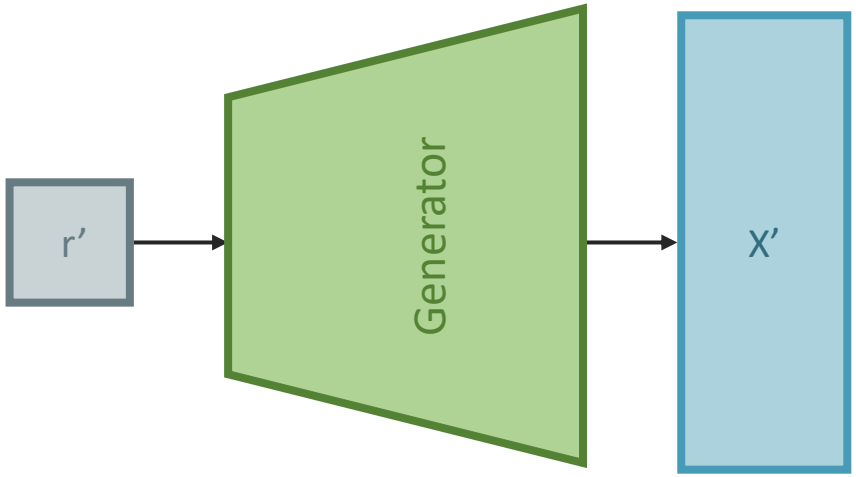
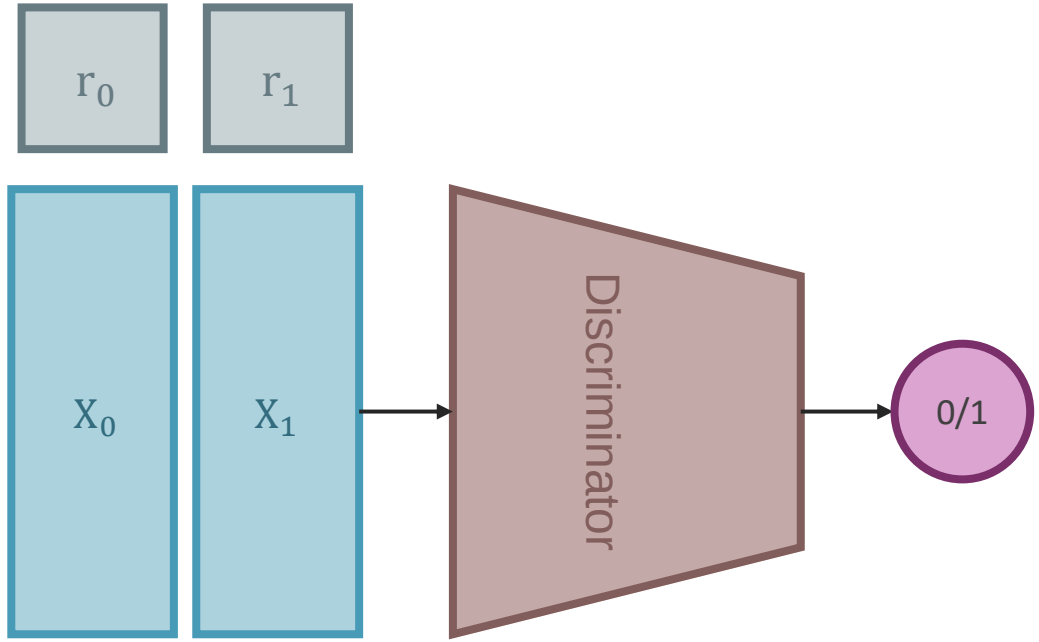
BiGAN







Learn More:
Adversarial Feature Learning, Donahue, et al. ICLR (2017)

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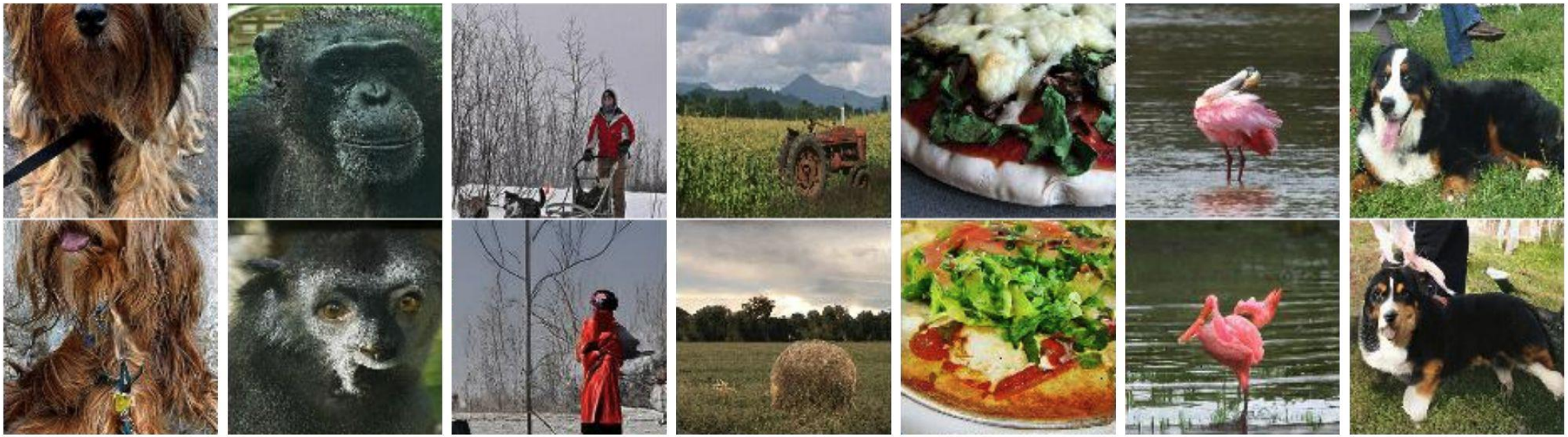
BigBiGAN



Learn More:
Large Scale Adversarial Representation Learning. Donahue, et al. NeurIP (2019)

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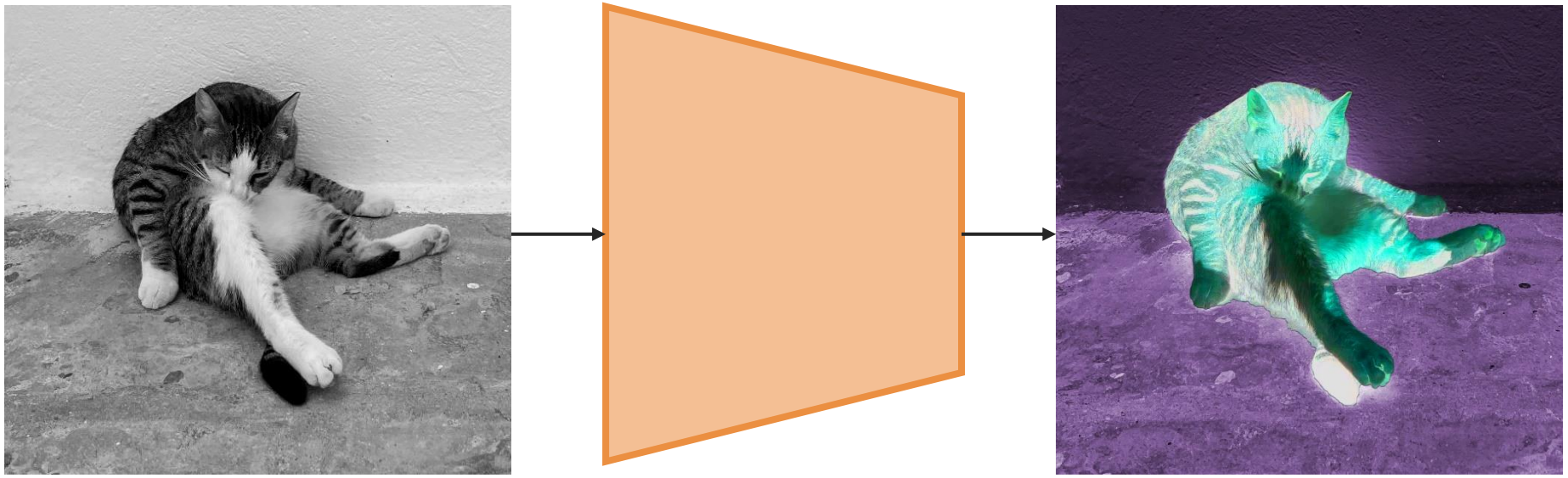
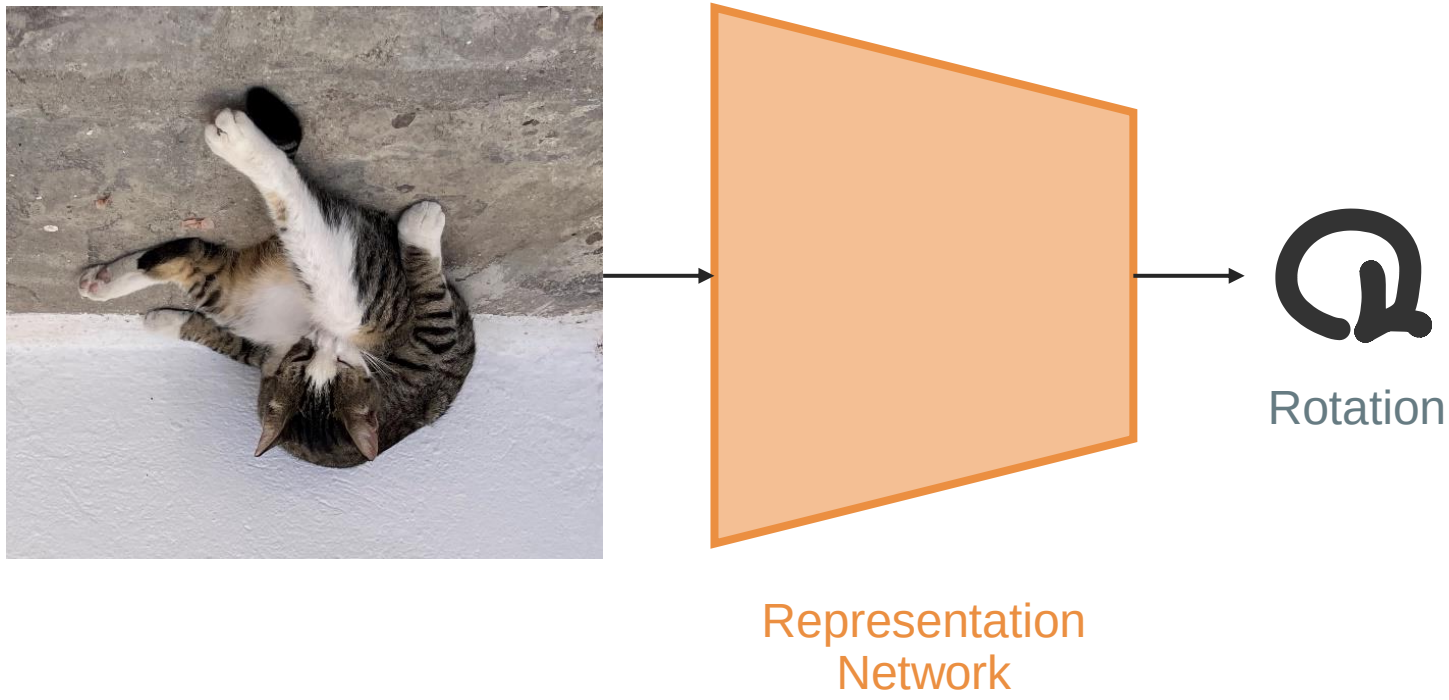
Generative Adversarial Networks: Colorization



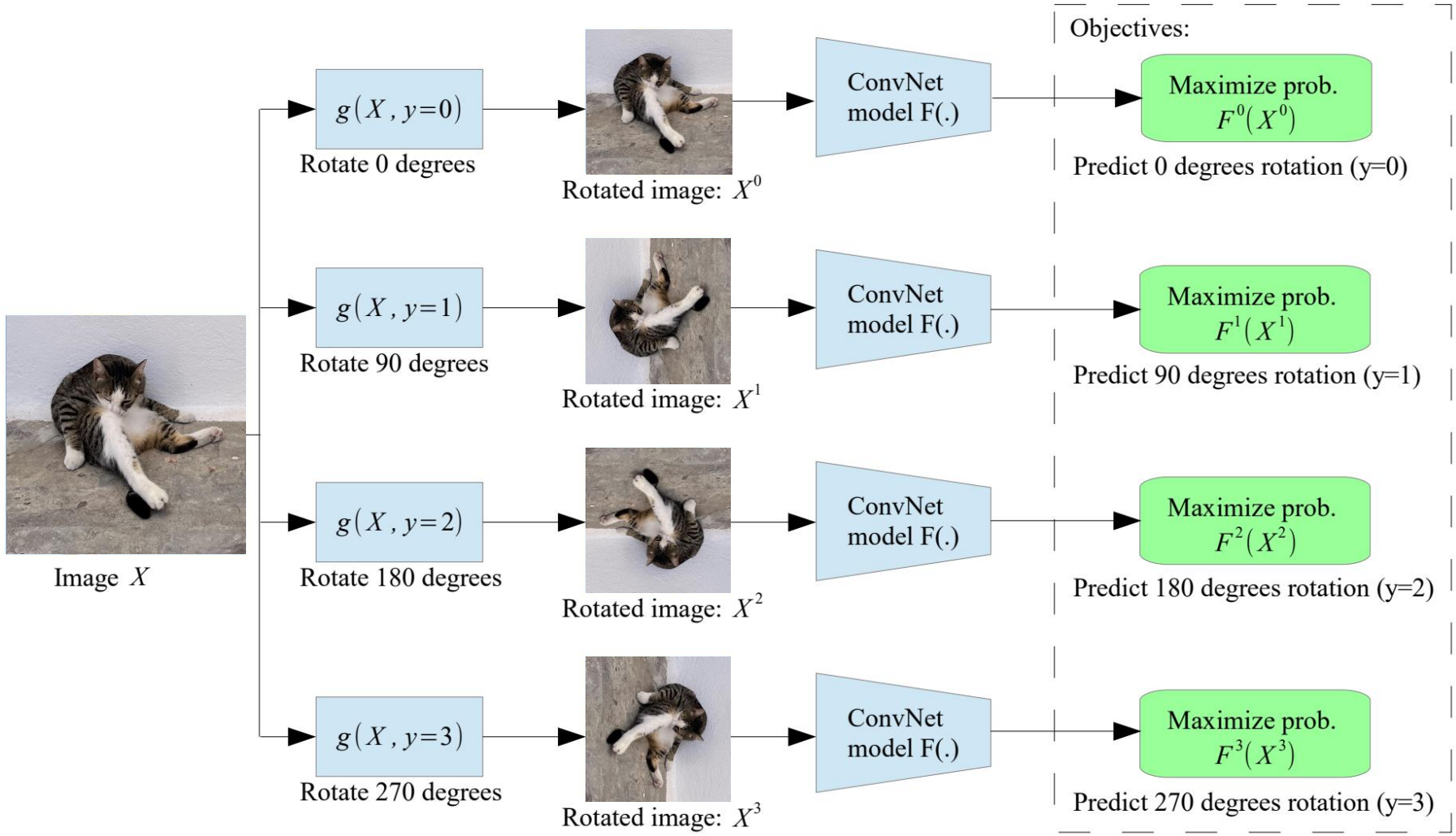
Learn More:
Colorization as a proxy task for visual understanding, Larsson et al, CVPR (2017)

Generative Adversarial Networks: Rotation Prediction



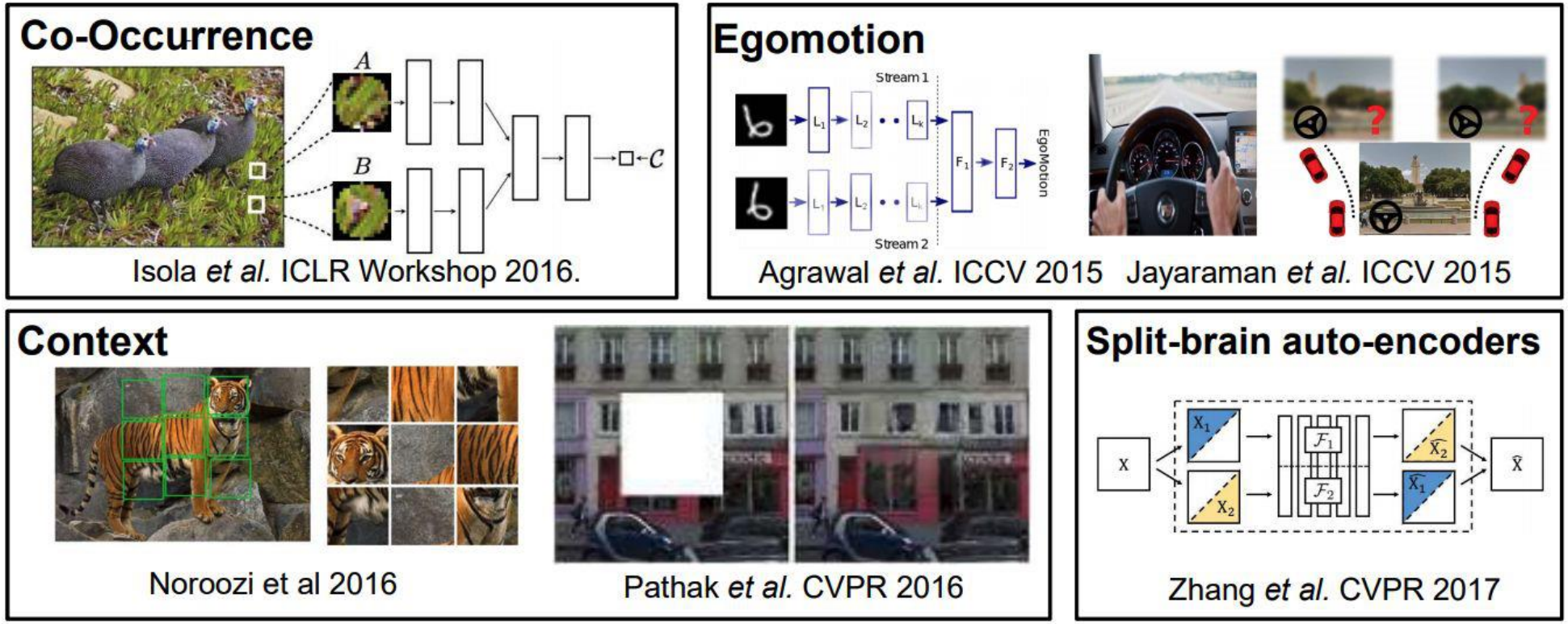
Learn More:
Unsupervised Representation Learning by Predicting Image Rotations, Gidaris et al, ICLR (2018)

Generative Adversarial Networks: Rotation Prediction



Learn More:
Unsupervised Representation Learning by Predicting Image Rotations, Gidaris et al, ICLR (2018)

Self-supervised learning



Learn More:
Self-Supervised Learning lecture, Andrew Zisserman, ICML (2018)

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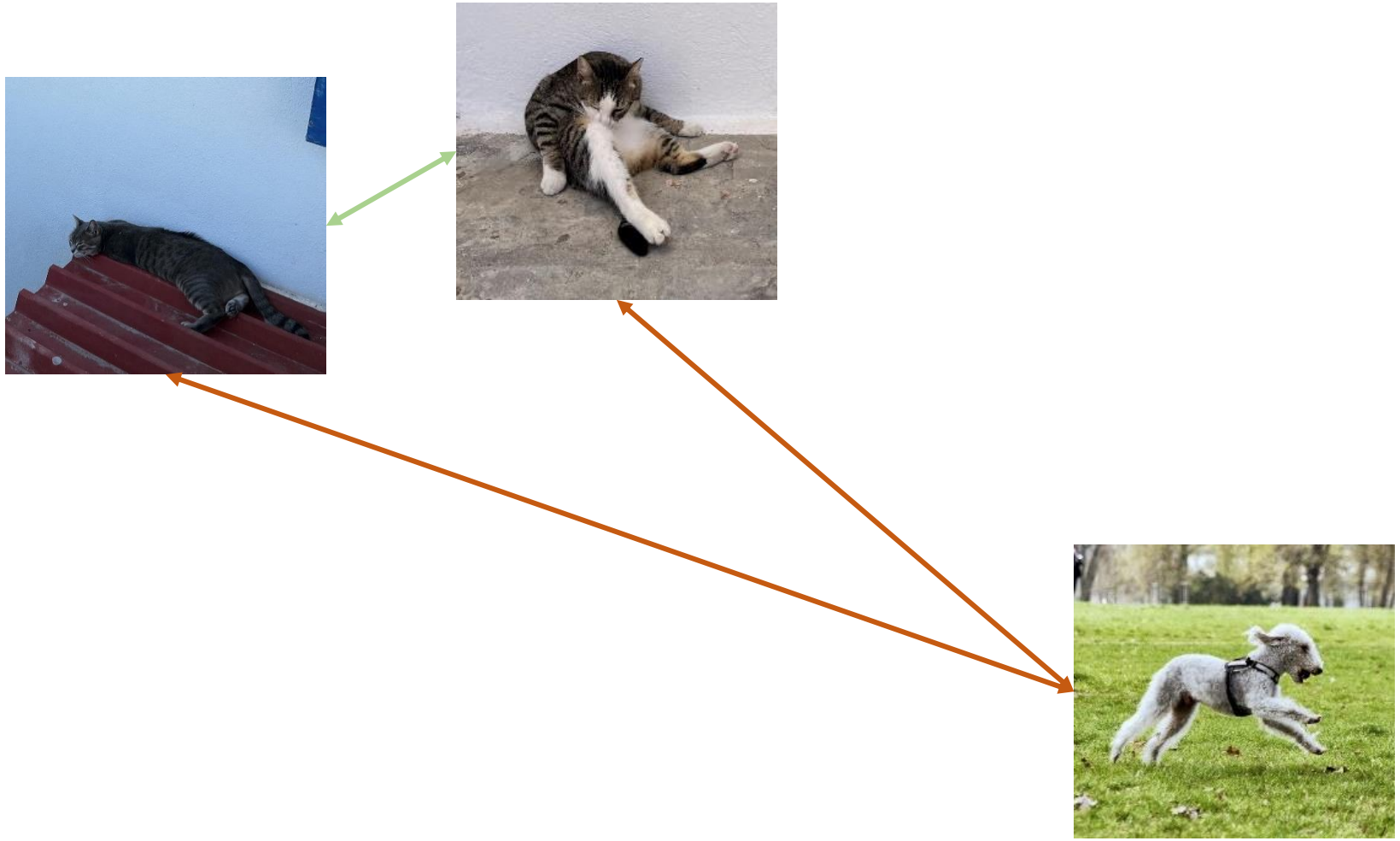
Contrastive learning



Contrastive learning

What data points are similar?


What data points are dissimilar?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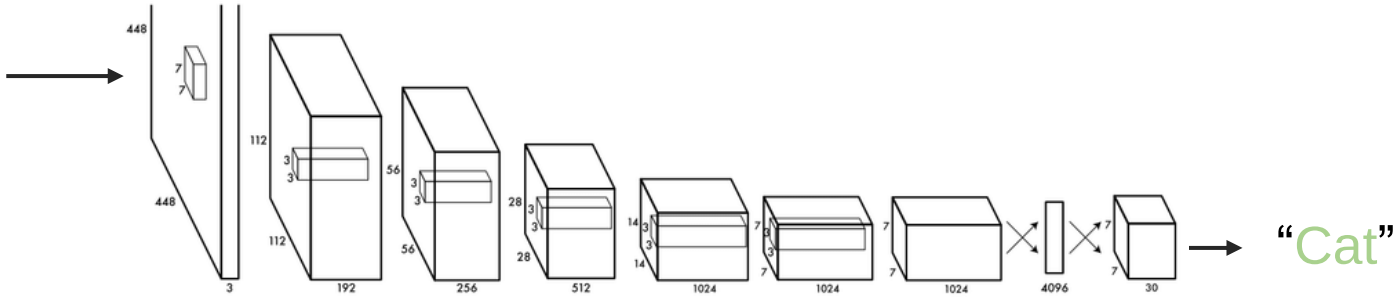
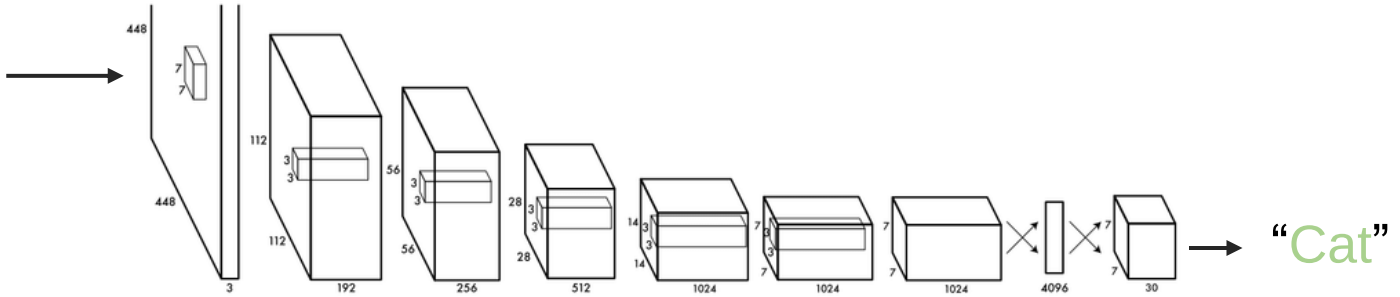
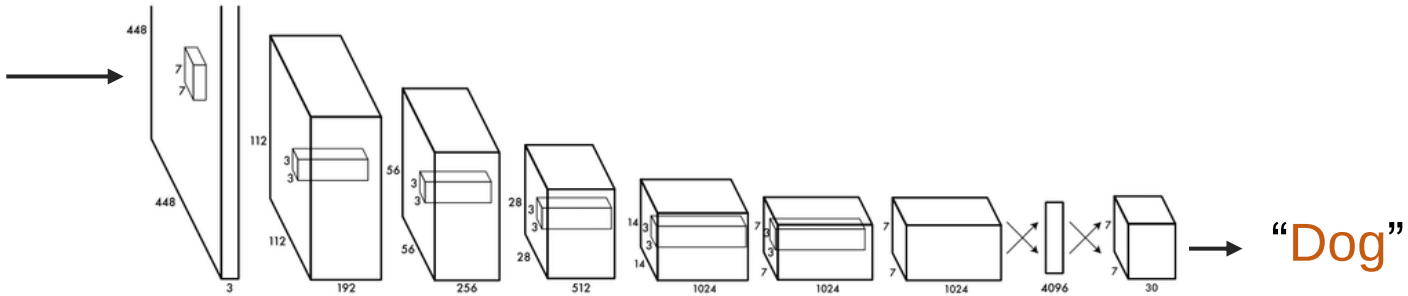
Supervised Representation Learning



"Cat"



"Cat"



"Dog"

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Contrastive learning

What data points are similar?


What data points are dissimilar? ⟶ Random Selection


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Contrastive learning

What data points are similar? ⟶ Multiple Views

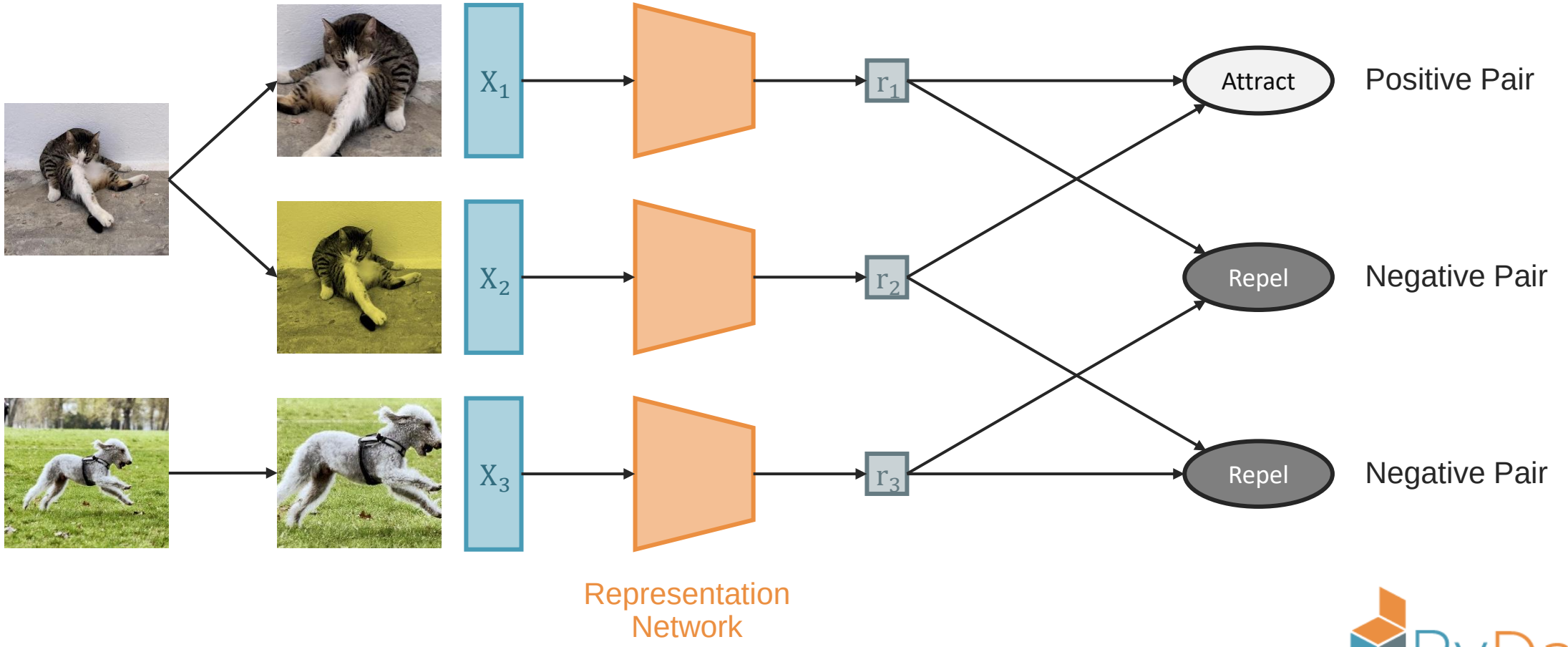

What data points are dissimilar? ⟶ Random Selection


How to obtain different views?

Learn More:
Unsupervised Learning of Visual Representations by Solving Jigsaw Puzzles, Noroozi et al, ICCV (2017)

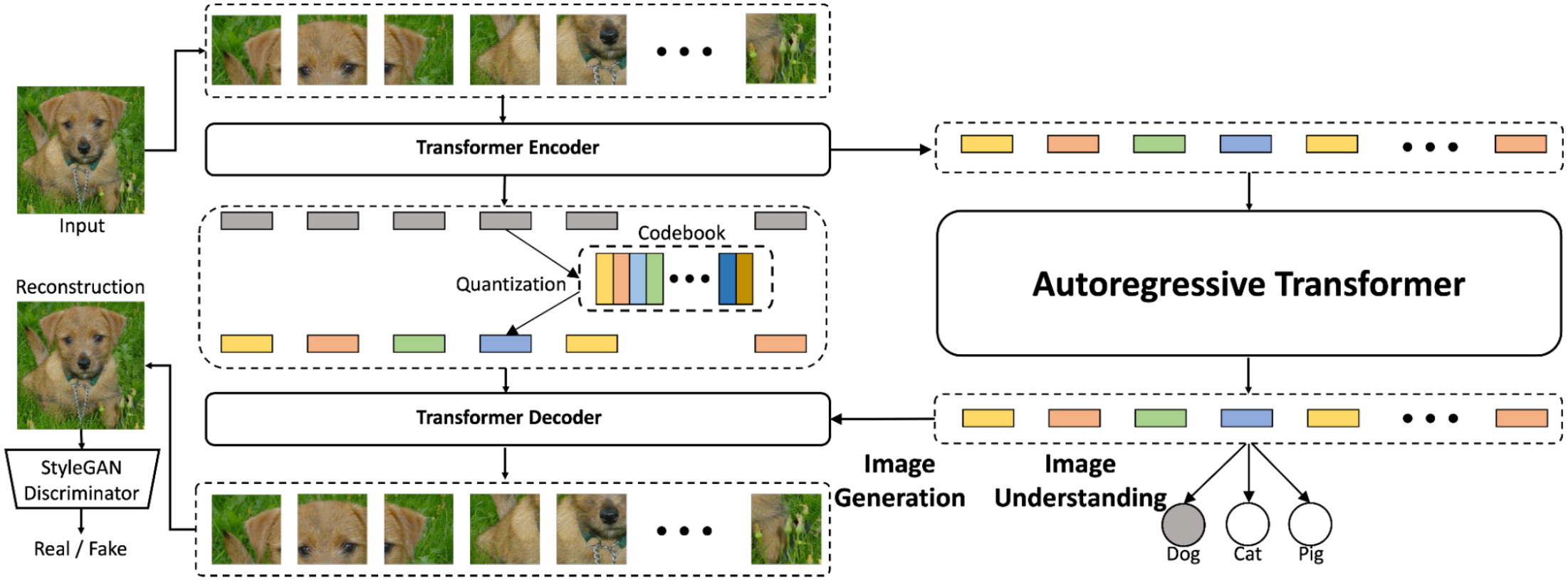
Learn More:
A Simple Framework for Contrastive Learning of Visual Representations, Chen et al, ICML (2020)

Contrastive learning



Learn More:
A Simple Framework for Contrastive Learning of Visual Representations, Chen et al, ICML (2020)

Vector-Quantized Image Modeling with Improved VQGAN



Learn More:
Vector-quantized Image Modeling with Improved VQGAN, Yu et al, ICLR (2022)

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* this photo was taken in Lindos on my last trip

Materials have been shared!

https://github.com/hkhojasteh/PyData-Yerevan

@hadiakhojasteh

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