TA: Nikita Balabin

Anomaly detection using self-supervised point clouds

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Outline

1. Introduction
2. Related work
3. Methodology
4. Experiments and results
5. Conclusion and future work

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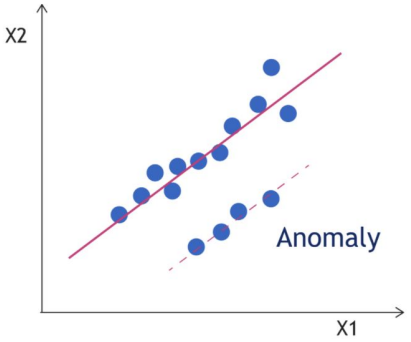
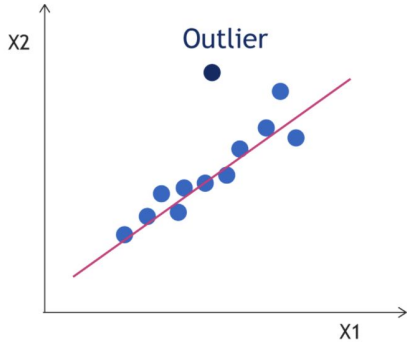
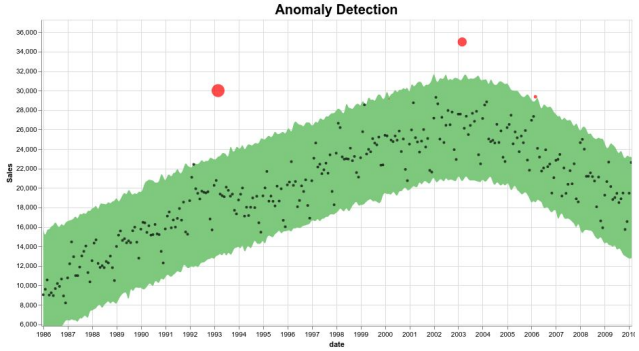
Introduction What is anomaly?

anomaly = outlier





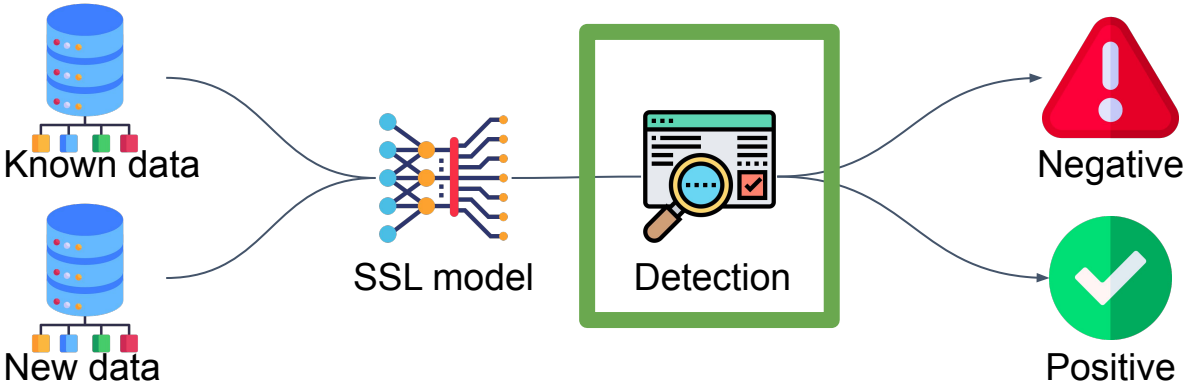


Introduction Why self-supervised learning?

You don't need labels/oracle

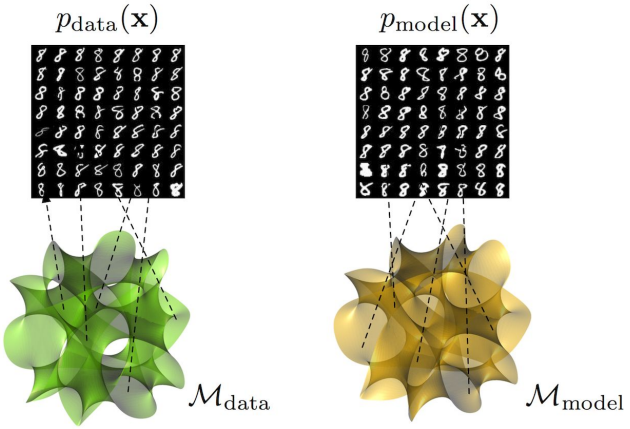
Yandex.Toloka

Google
Task Mate

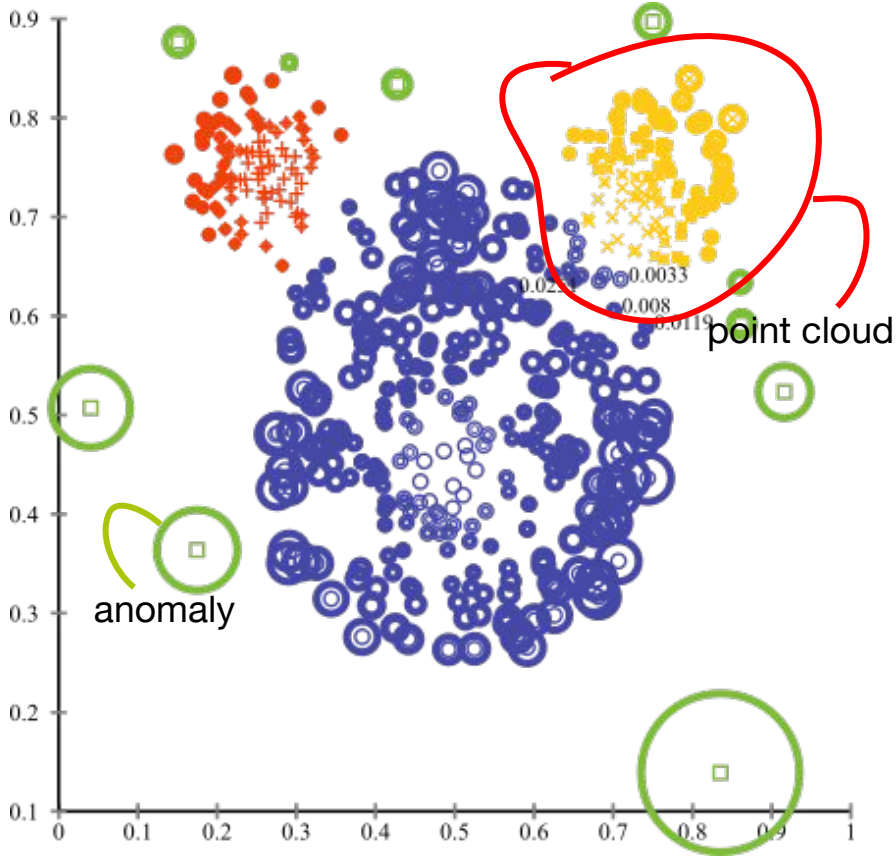


Introduction How to represent data for detection?

embeddings

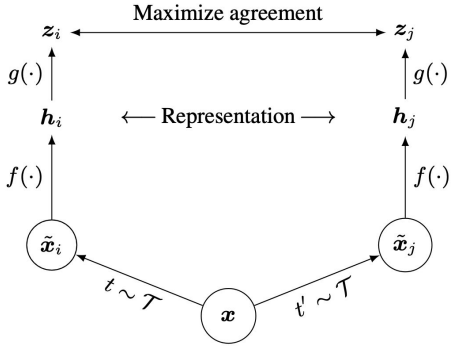


intrinsic data shape

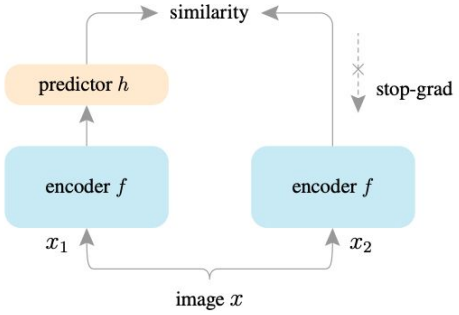


embedding space projection

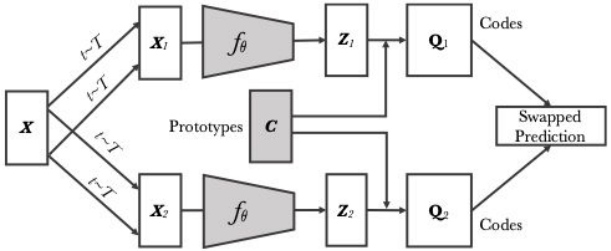
Related Work



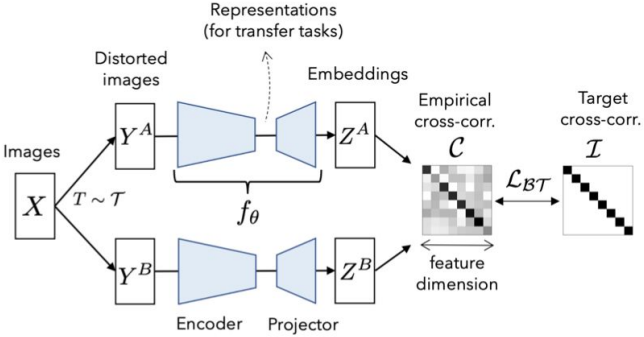
SimCLR



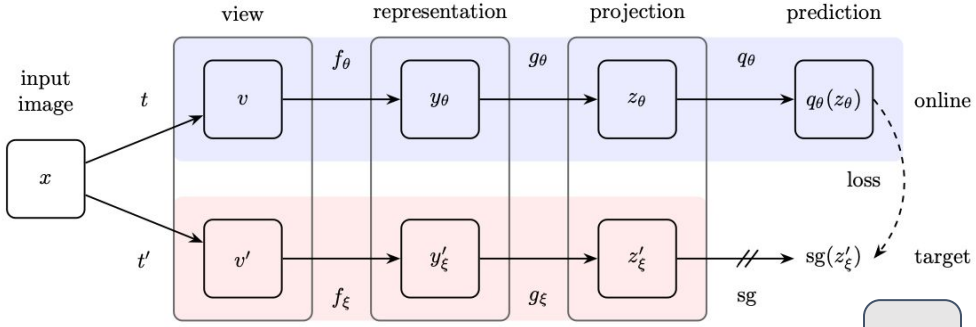
SimSiam



SwAV

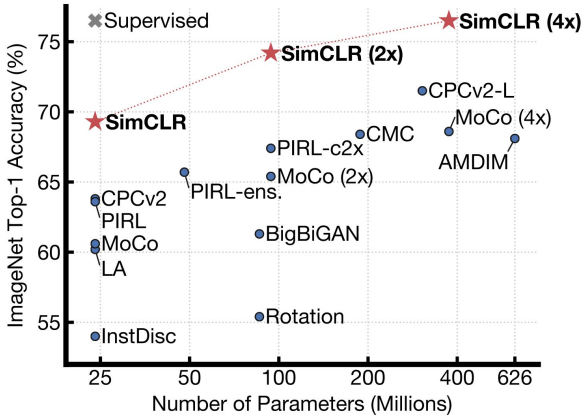


Barlow Twins

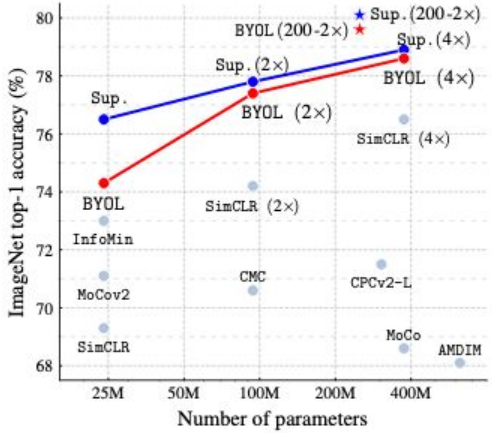


BYOL

Related work



Chen, 2020



Grill, 2020

Method	Top-1
Supervised	76.5
MoCo	60.6
PIRL	63.6
SimCLR	69.3
MoCo v2	71.1
SimSiam	71.3
SwAV (w/o multi-crop)	71.8
BYOL	74.3
SwAV	75.3
Barlow Twins	73.2

Zbontar, 2021

Top-1 accuracy under linear evaluation on ImageNet.
All models use a ResNet-50 encoder

Chen, T. et al.
A simple framework for contrastive learning of visual representations. CoRR, abs/2002.05709, 2020.
https://arxiv.org/abs/2002.05709

Grill, J., et al.
Bootstrap your own latent: A new approach to self-supervised learning. CoRR, abs/2006.07733, 2020
https://arxiv.org/abs/2006.07733

Zbontar, J. et al.
Barlow twins: Self-supervised learning via redundancy reduction. CoRR, abs/2103.03230, 2021
https://arxiv.org/abs/2103.03230

Methodology Pipeline

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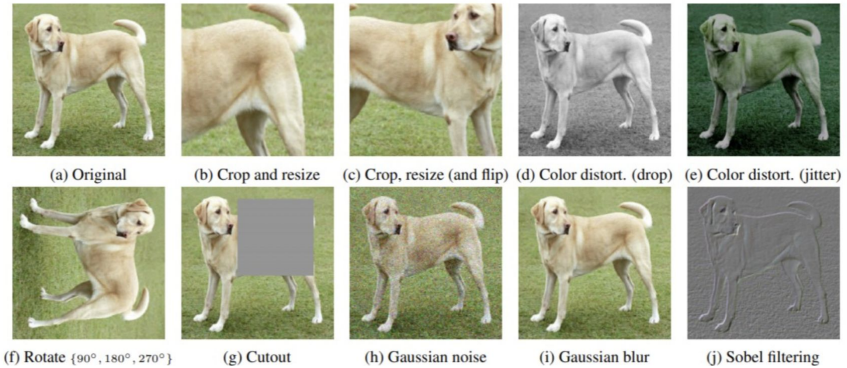
Methodology Model and augmentations

Why SimCLR and BarlowTwins?

- simple
- no predictor network
- do not use stop gradient operation
- no momentum encoder
- non-differential operations (clustering) free



Augmentations of CIFAR10

- SimCLR
- custom random non-rigid

Training results

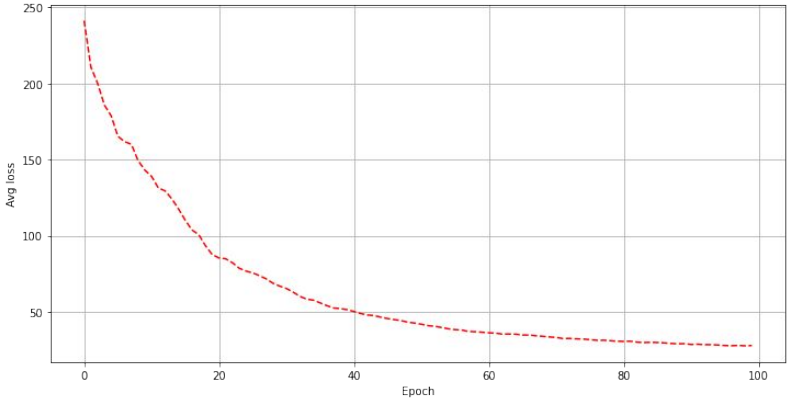
SimCLR
SGD optimizer
lr=6e-3
momentum=0.9
weight_decay=5e-4
CosineAnnealingLR

BarlowTwins
SGD optimizer
lr = 0.06
momentum=0.9

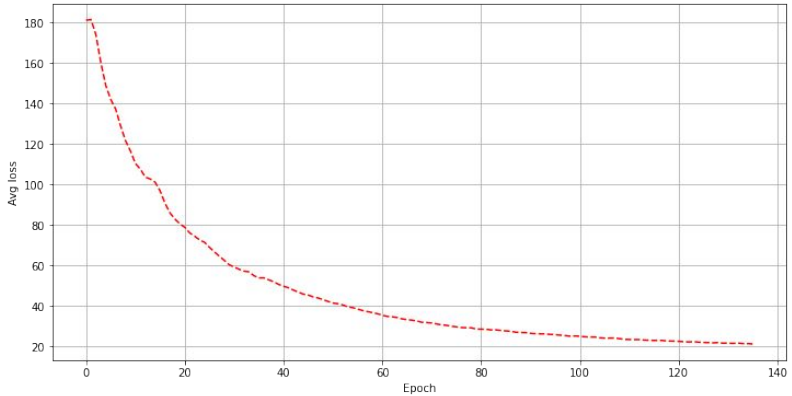
	SimCLR	BarlowTwins
backbone	ResNet20	ResNet20
training time	2h	2h
epochs	100	150
implementation	Lightly	Lightly

\+ custom **ResNet-20** backbone

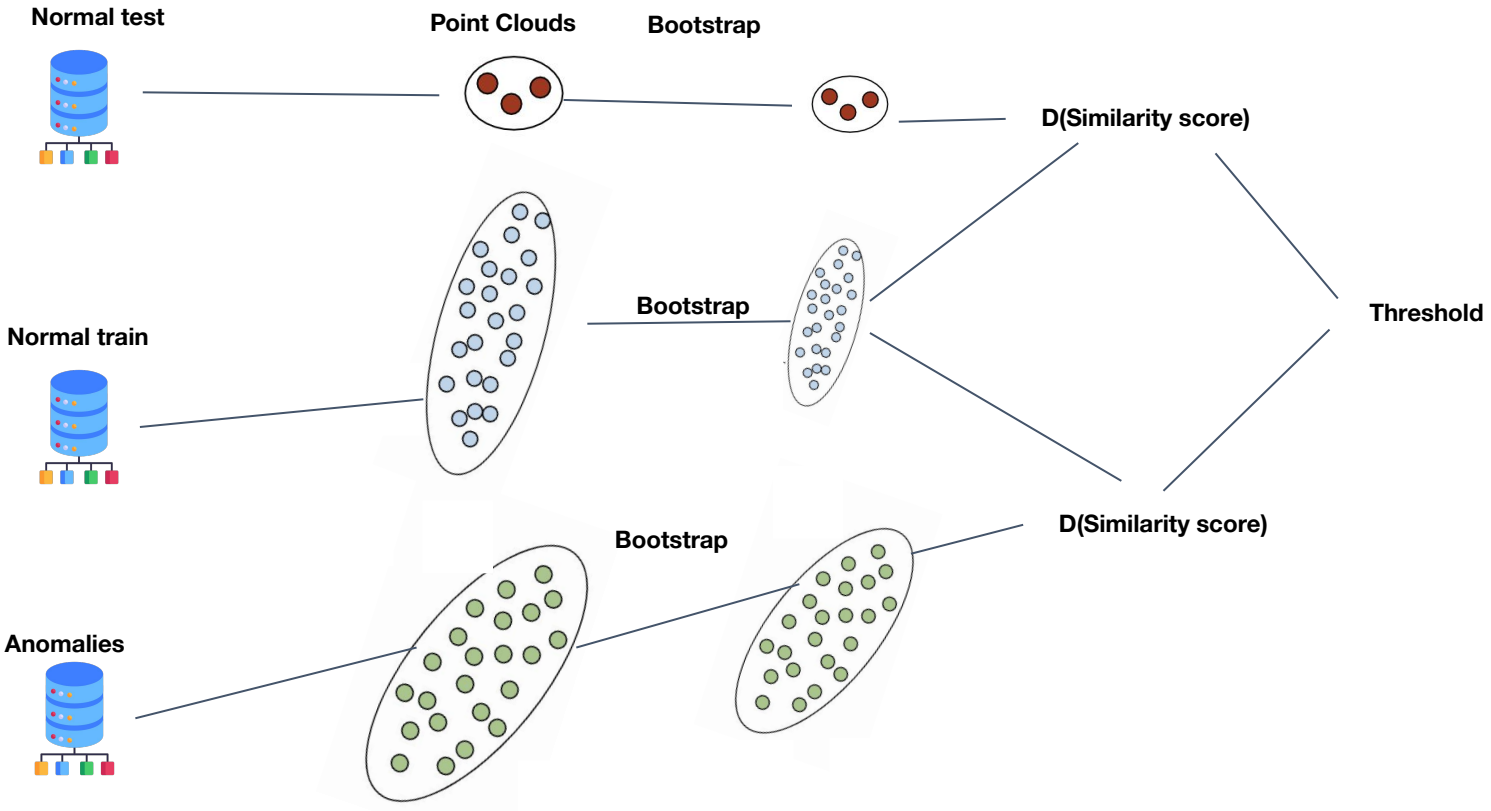
SimCLR



BarlowTwins



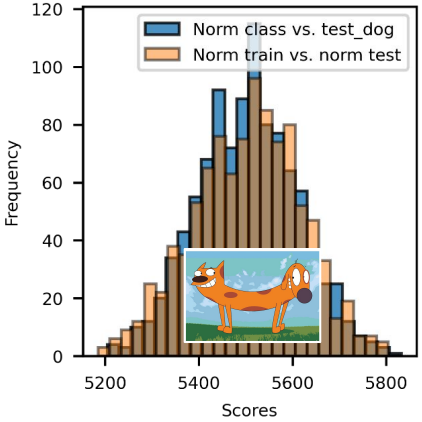
Methodology Scoring procedure



Metrics and results

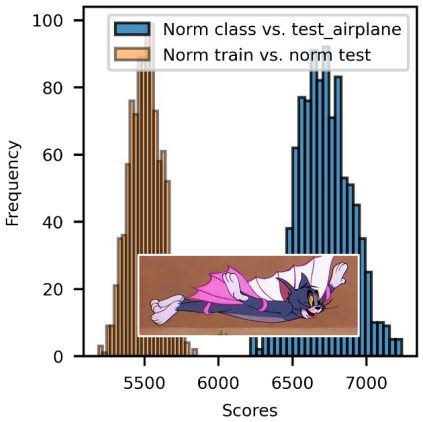
- Euclidean distance (scipy.distance.cdist)
  - Sum of point2point distances between clouds
- MTopDiv
  - Manifold Topology divergence
- Hausdorff distance

fail



cat vs dog

success



cat vs airplane

2-norm

Hausdorff

Classes	SimCLR	Twins
bird	349.2	537.1
horse	456.1	543.3
deer	483.6	279.4
ship	413.3	**790.2**
cat	423.0	205.6
truck	458.0	306.7
automobile	412.4	499.6
dog	**529.8**	162.7
frog	406.3	465.4
airplane	390.3	553.2

MTopDiv

Classes	SimCLR	Twins
dog	0.21	0.12
frog	0.12	0.48
automobile	0.21	0.44
deer	0.29	0.29
horse	0.32	0.25
cat	0.27	0.10
truck	0.14	0.44
ship	0.32	0.59
bird	0.15	0.24
airplane	**0.75**	**0.69**

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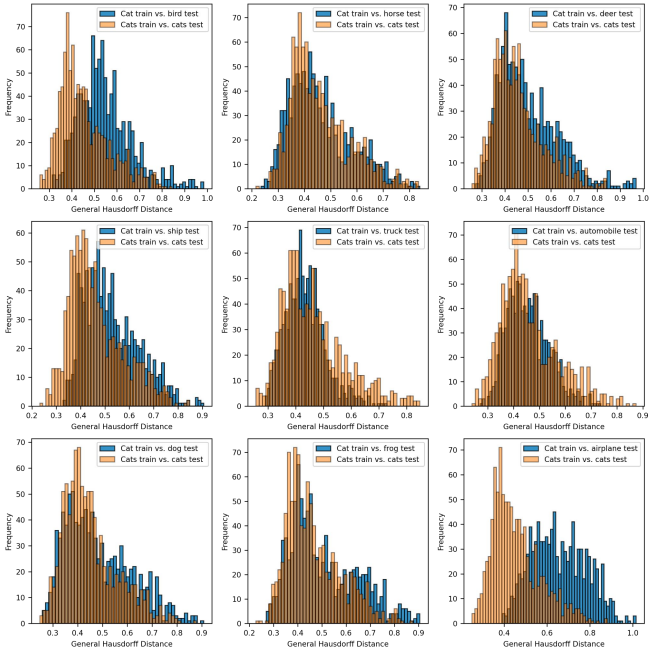
Conclusion and Future Work

1. Tried two contrastive models and two metrics on randomly augmented data
2. Proposed a pipeline for plausible data distinguishing
3. Two classes were confused
4. Barlow Twins outperform SimCLR



Next steps:

- Training on multiclass
- Extend on other datasets
- Try different augmentations

thx.

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Introduction