



Unsupervised Deep Learning by Neighbourhood Discovery

ICML-2019

Jiabo Huang¹ Qi Dong¹ Shaogang Gong¹ Xiatian Zhu²

¹Queen Mary University of London

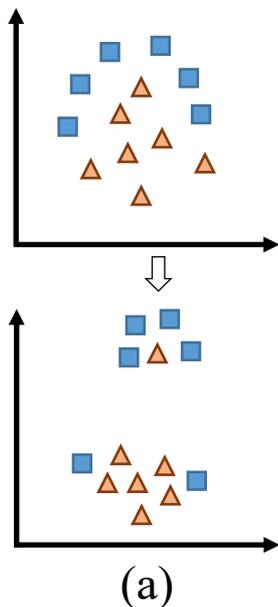
²Vision Semantic Ltd.

Related Works & Motivation

➤ Related Works

- Clustering Analysis: Caron *et al.*, ECCV, 2018
- Sample (Instance) Specificity Learning: Wu *et al.*, CVPR, 2018
- Self-supervised Learning: Zhang *et al.*, CVPR, 2017
- Generative Model: Donahue *et al.*, ICLR, 2016

➤ Motivation



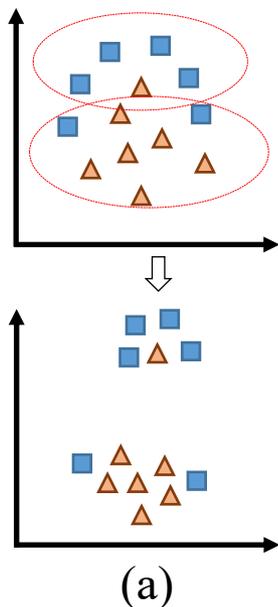
(a) Clustering analysis:

Related Works & Motivation

➤ Related Works

- Clustering Analysis: Caron *et al.*, ECCV, 2018
- Sample (Instance) Specificity Learning: Wu *et al.*, CVPR, 2018
- Self-supervised Learning: Zhang *et al.*, CVPR, 2017
- Generative Model: Donahue *et al.*, ICLR, 2016

➤ Motivation



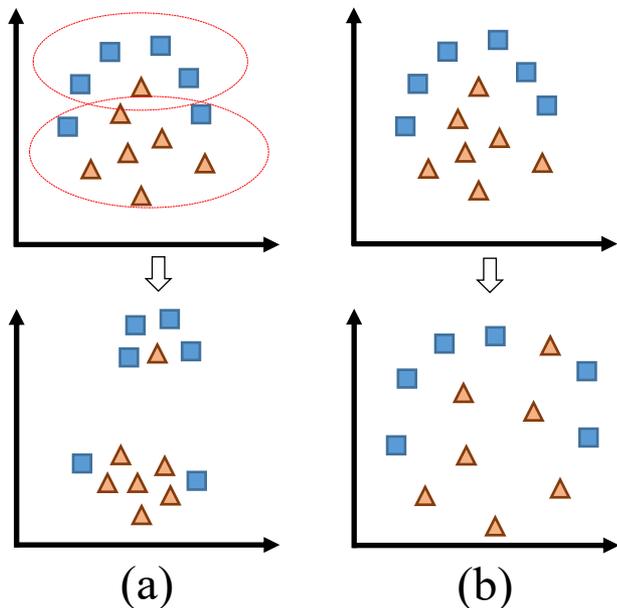
(a) Clustering analysis:
class-consistent boundaries?

Related Works & Motivation

➤ Related Works

- Clustering Analysis: Caron *et al.*, ECCV, 2018
- Sample (Instance) Specificity Learning: Wu *et al.*, CVPR, 2018
- Self-supervised Learning: Zhang *et al.*, CVPR, 2017
- Generative Model: Donahue *et al.*, ICLR, 2016

➤ Motivation



(a) Clustering analysis:
class-consistent boundaries?

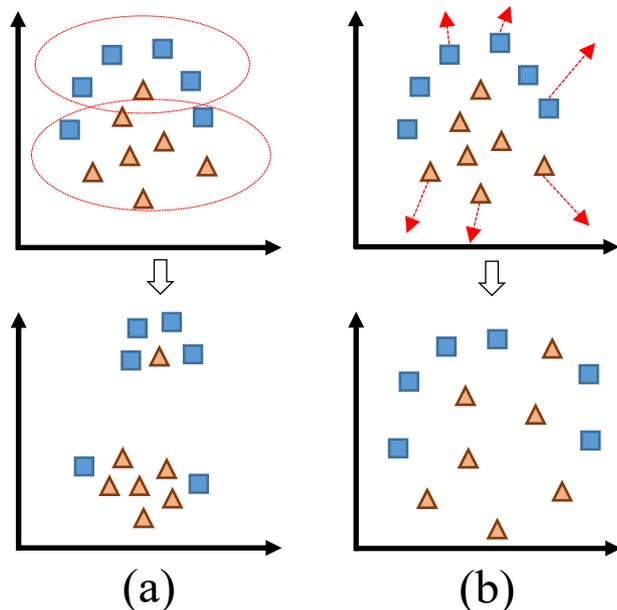
(b) Sample specificity learning:

Related Works & Motivation

➤ Related Works

- Clustering Analysis: Caron *et al.*, ECCV, 2018
- Sample (Instance) Specificity Learning: Wu *et al.*, CVPR, 2018
- Self-supervised Learning: Zhang *et al.*, CVPR, 2017
- Generative Model: Donahue *et al.*, ICLR, 2016

➤ Motivation



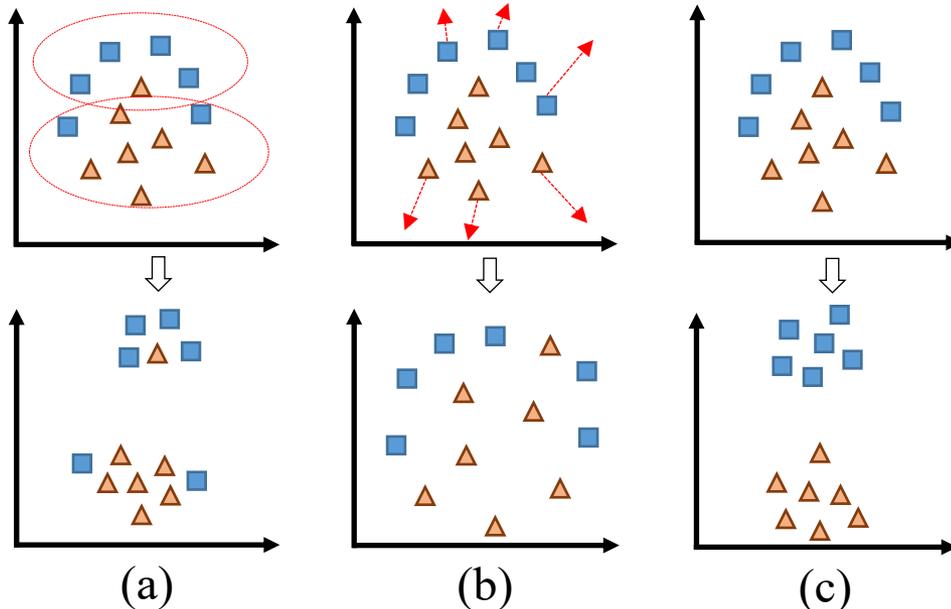
- (a) Clustering analysis:
class-consistent boundaries?
- (b) Sample specificity learning:
correlation between samples?

Related Works & Motivation

➤ Related Works

- Clustering Analysis: Caron *et al.*, ECCV, 2018
- Sample (Instance) Specificity Learning: Wu *et al.*, CVPR, 2018
- Self-supervised Learning: Zhang *et al.*, CVPR, 2017
- Generative Model: Donahue *et al.*, ICLR, 2016

➤ Motivation

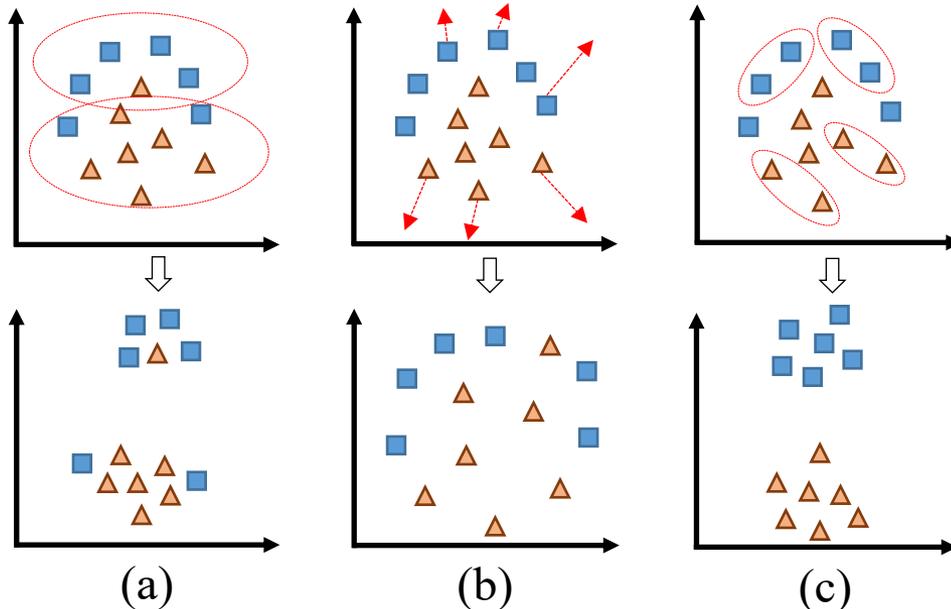


Related Works & Motivation

➤ Related Works

- Clustering Analysis: Caron *et al.*, ECCV, 2018
- Sample (Instance) Specificity Learning: Wu *et al.*, CVPR, 2018
- Self-supervised Learning: Zhang *et al.*, CVPR, 2017
- Generative Model: Donahue *et al.*, ICLR, 2016

➤ Motivation

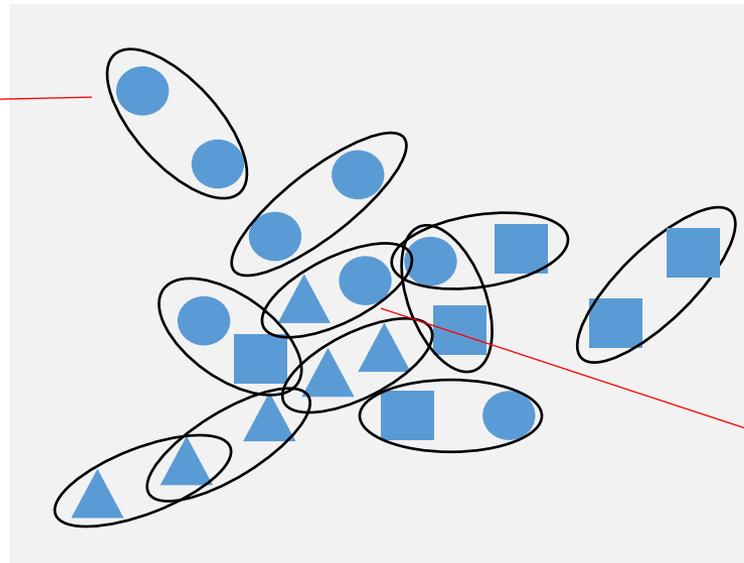


Neighbourhood Discovery & Selection

Without ground-truth labels

k -Nearest neighbour structure

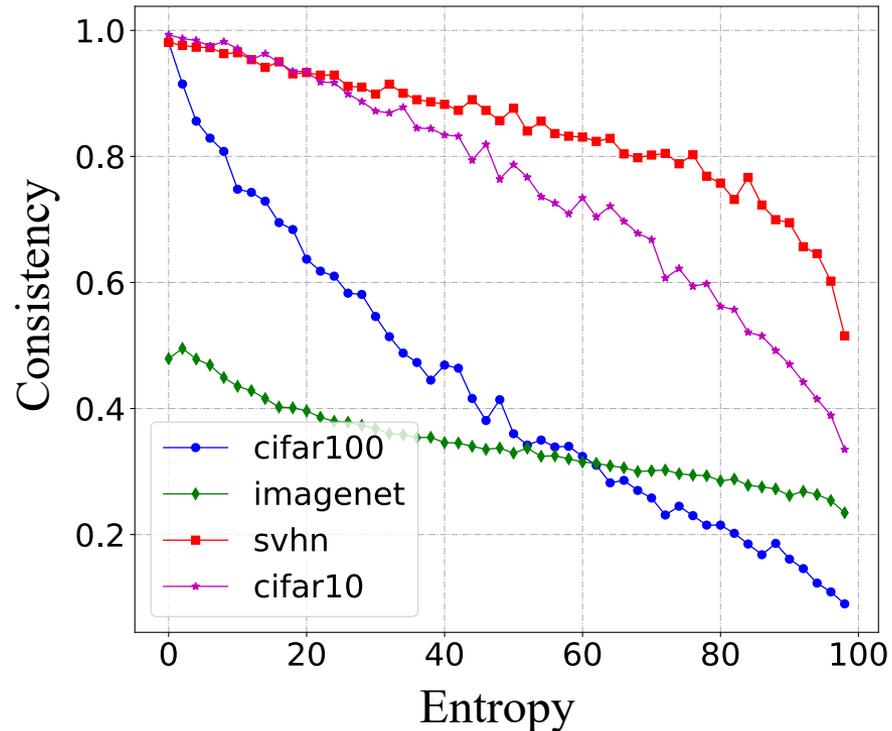
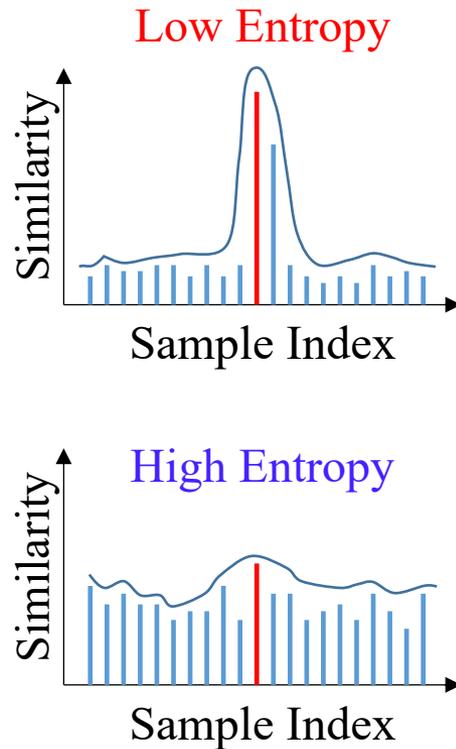
Consistent? ←



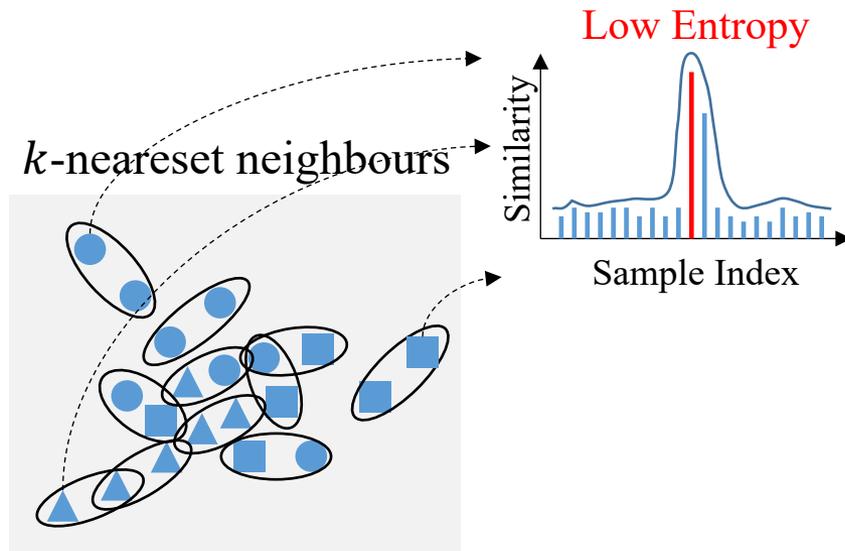
Consistent?

Neighbourhood Discovery & Selection

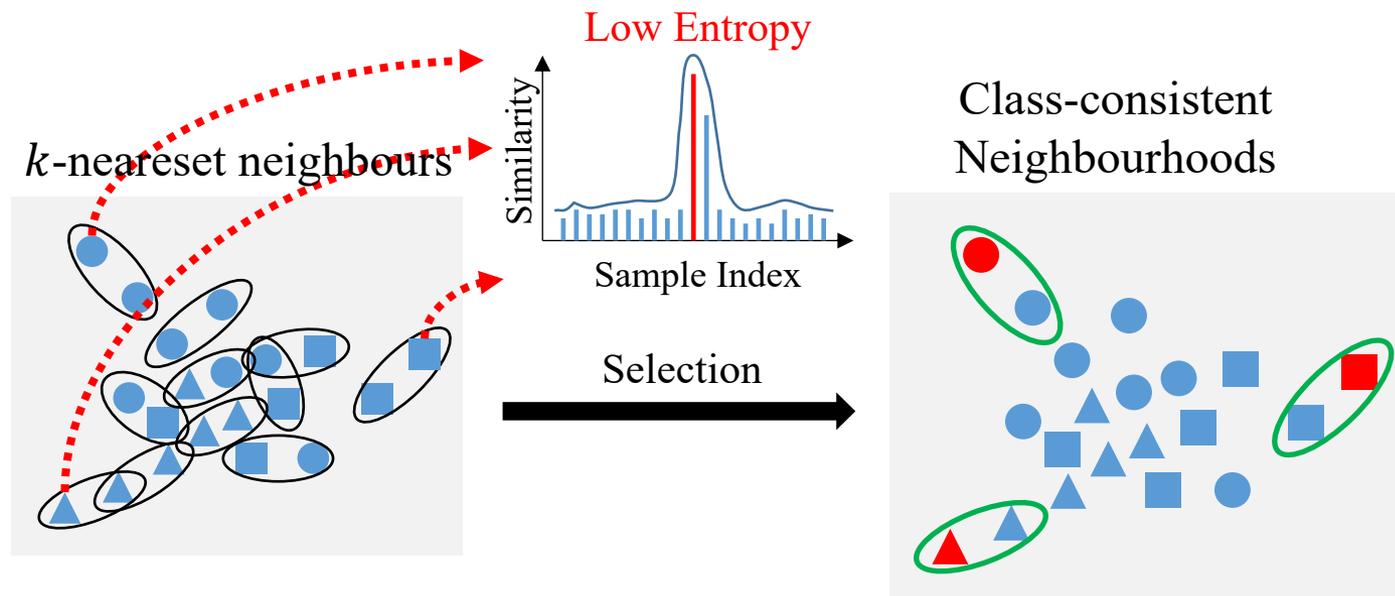
- Observation: Consistency *v.s.* Similarity Distribution Entropy



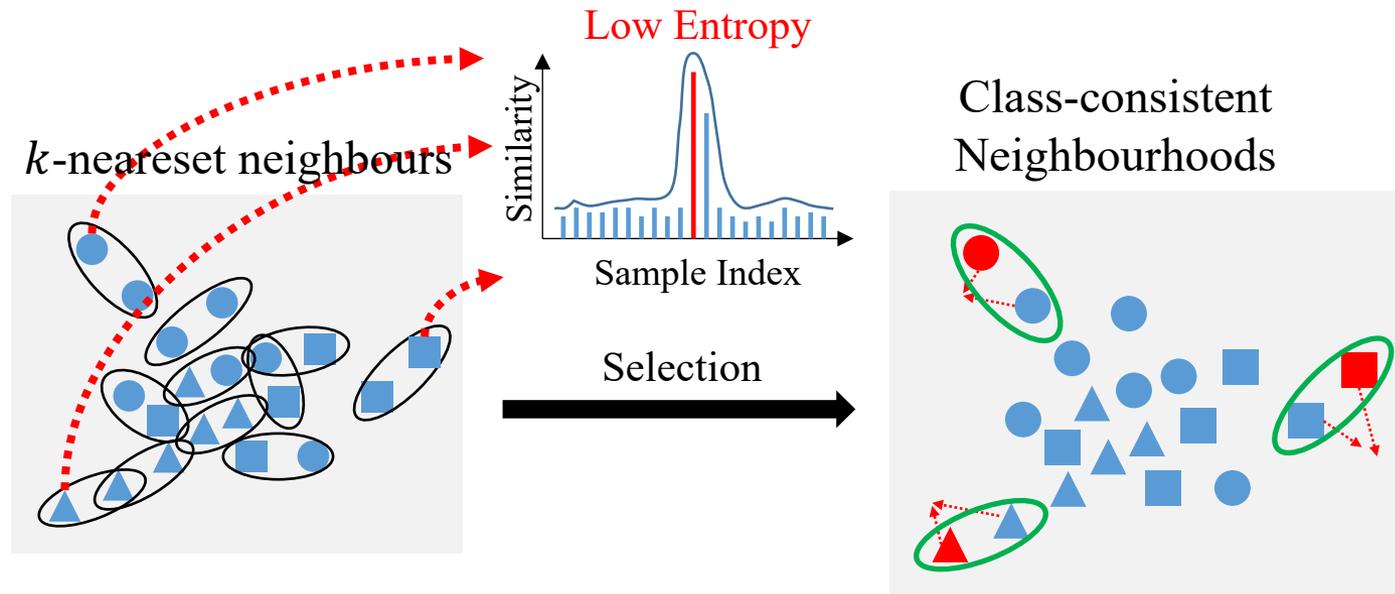
Neighbourhood Discovery & Selection



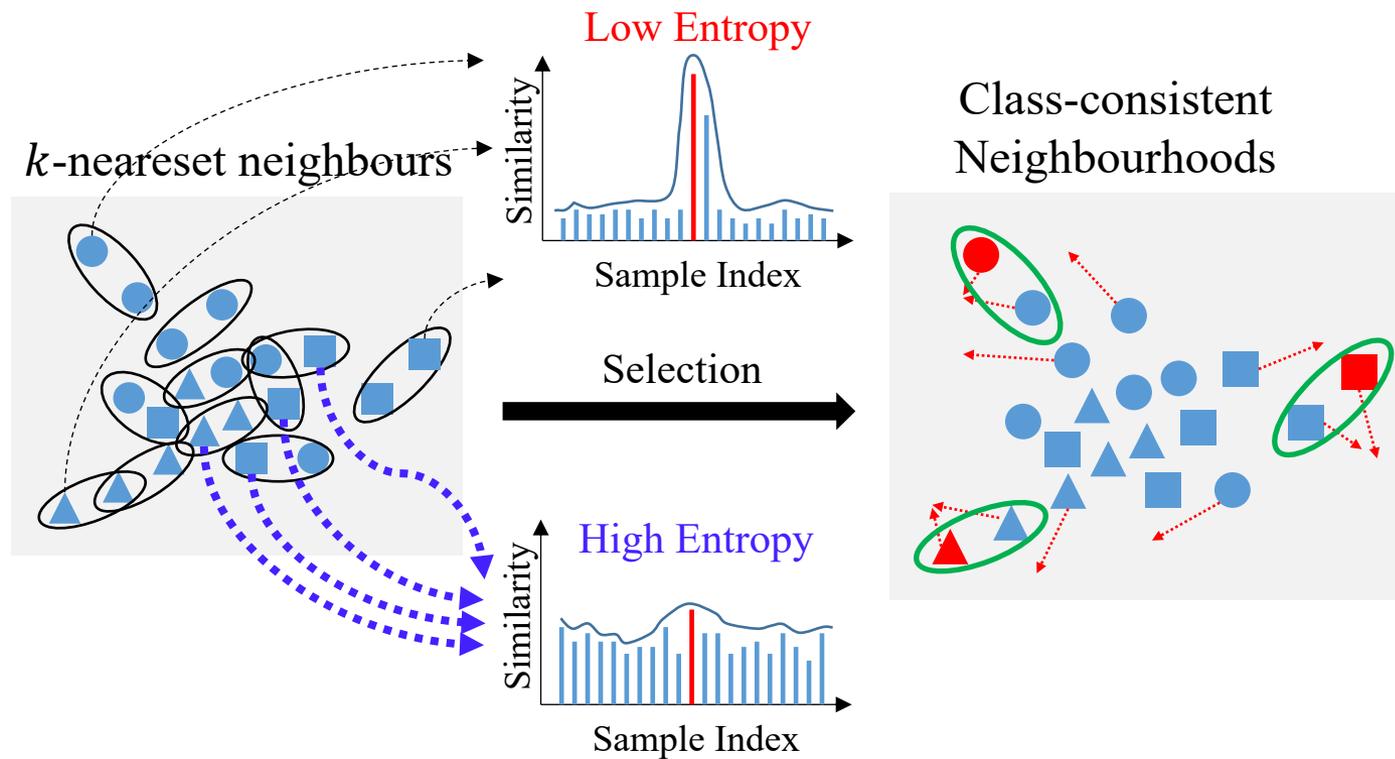
Neighbourhood Discovery & Selection



Neighbourhood Discovery & Selection

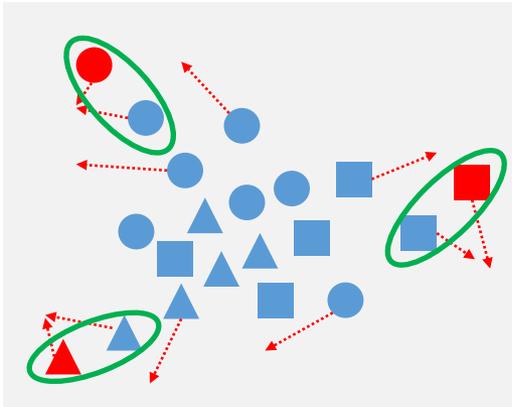


Neighbourhood Discovery & Selection

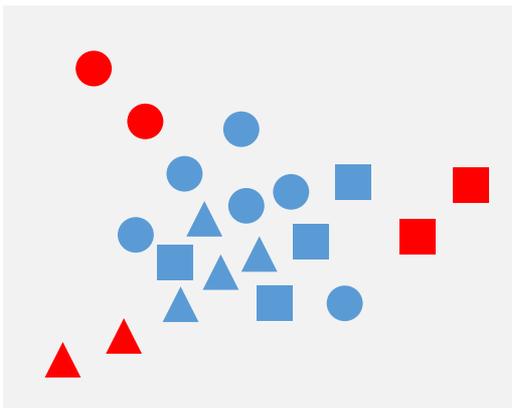


Training Objectives & Strategy

➤ Neighbourhood Supervision



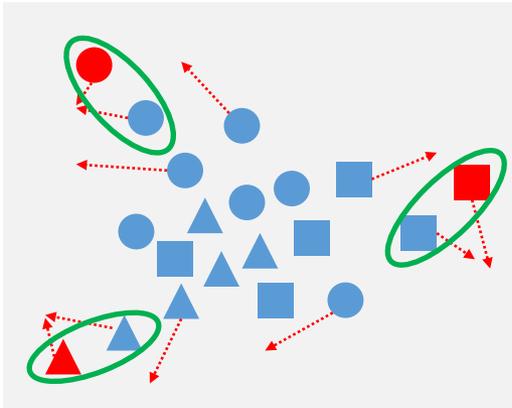
➤ Curriculum Learning



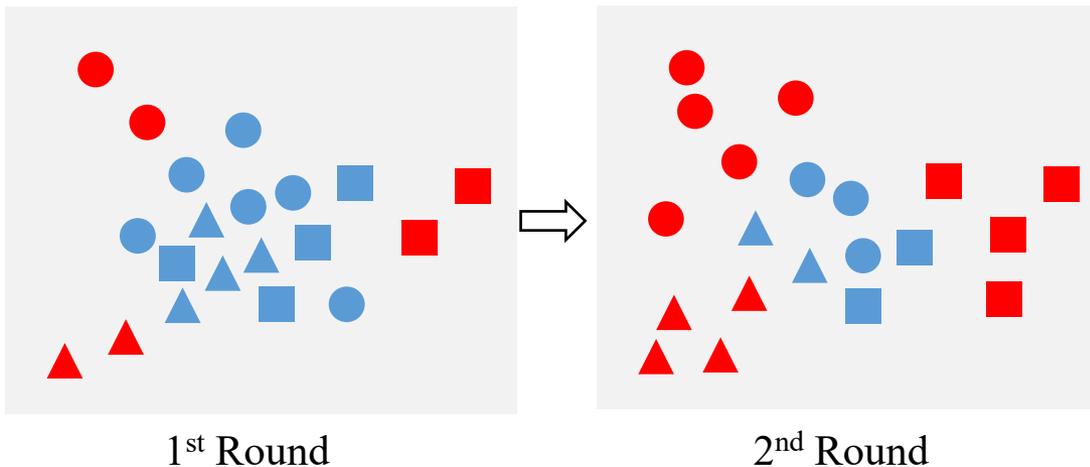
1st Round

Training Objectives & Strategy

➤ Neighbourhood Supervision

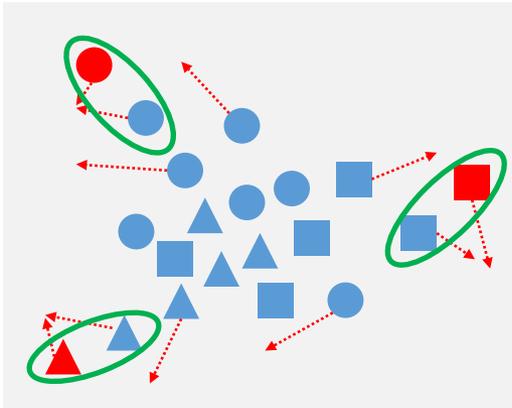


➤ Curriculum Learning

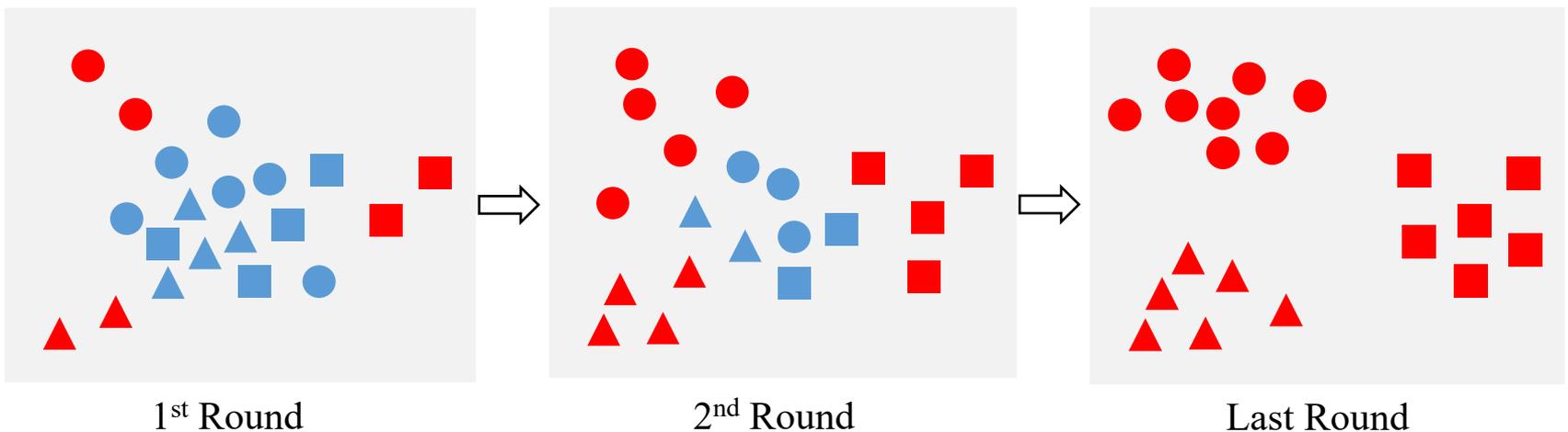


Training Objectives & Strategy

➤ Neighbourhood Supervision

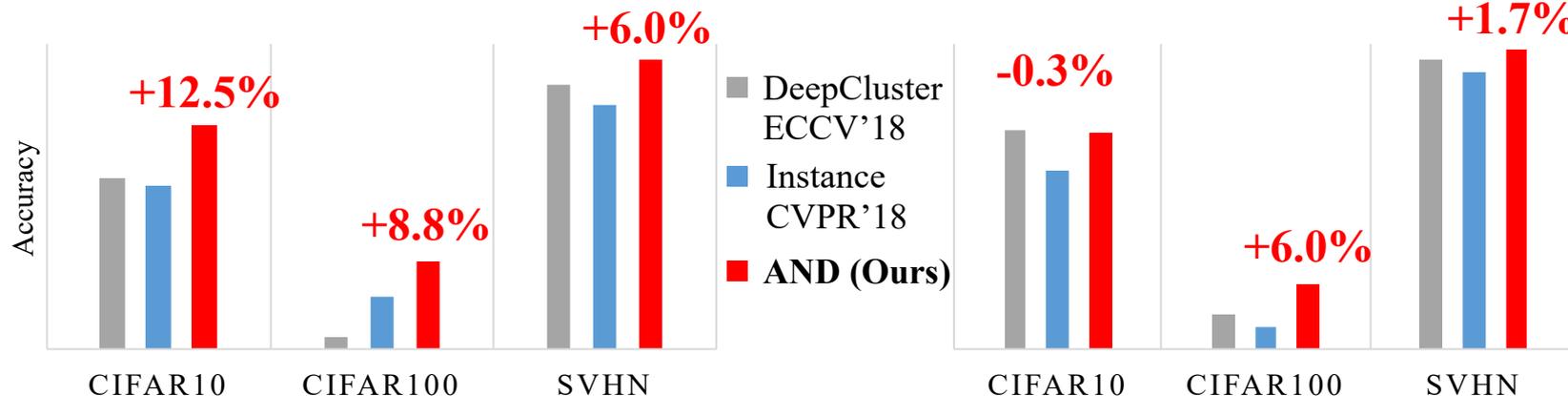


➤ Curriculum Learning



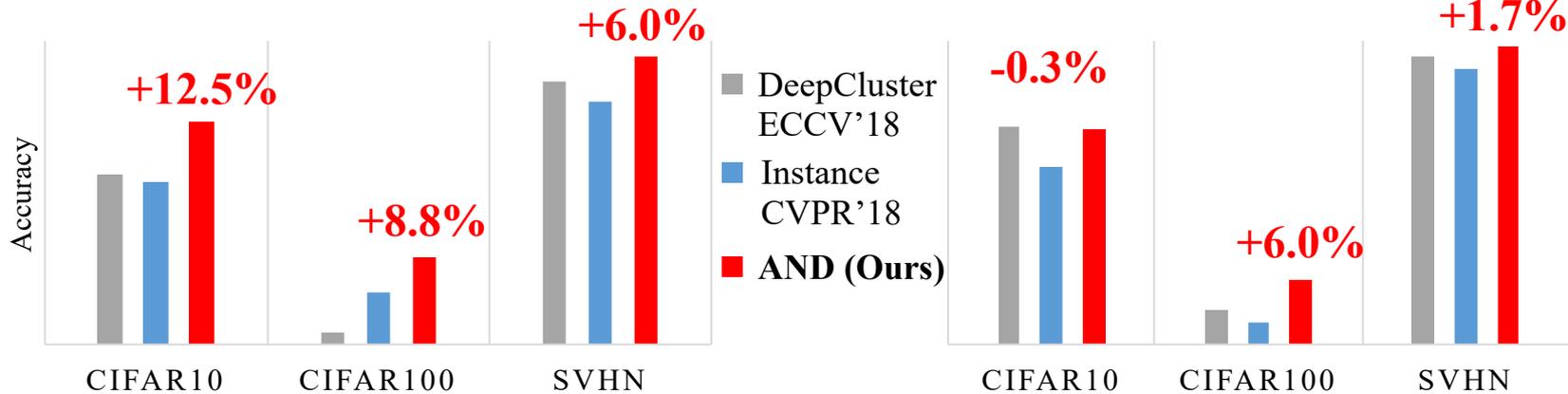
Experiments

- Small scale Image Classification (*k*NN) ➤ Small scale Image Classification (LC)

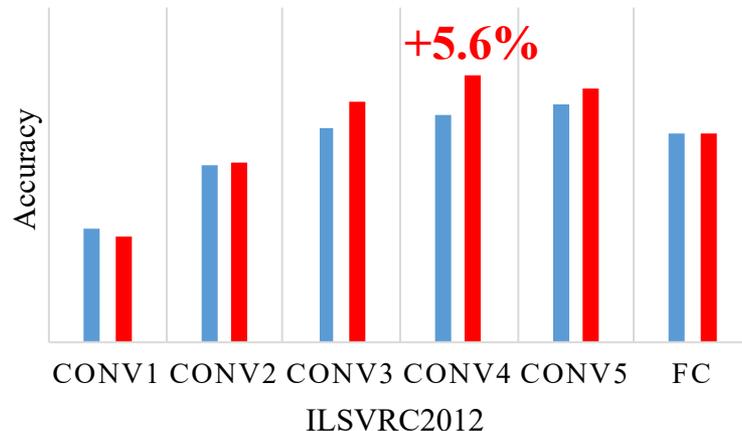


Experiments

- Small scale Image Classification (*k*NN) ➤ Small scale Image Classification (LC)

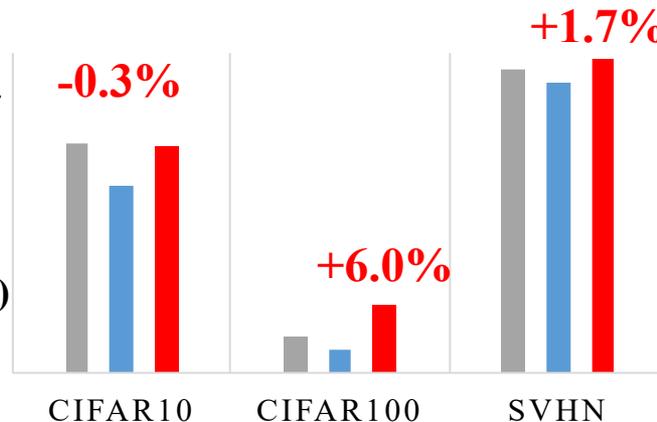
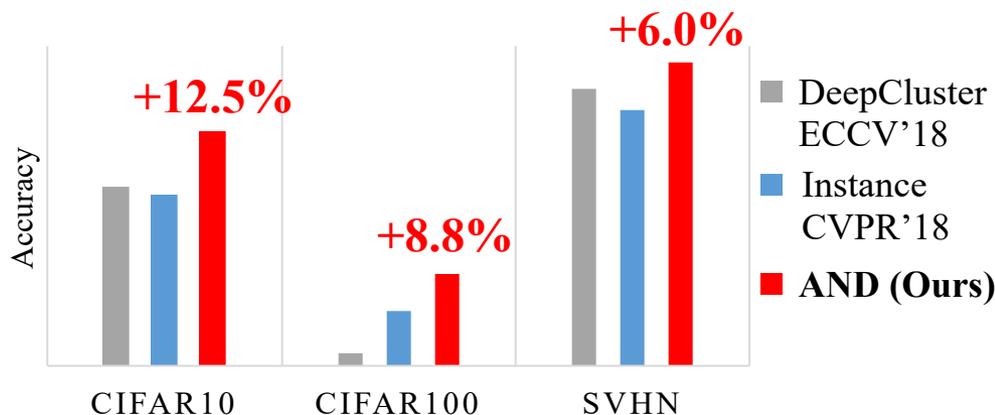


- Large scale Image Classification

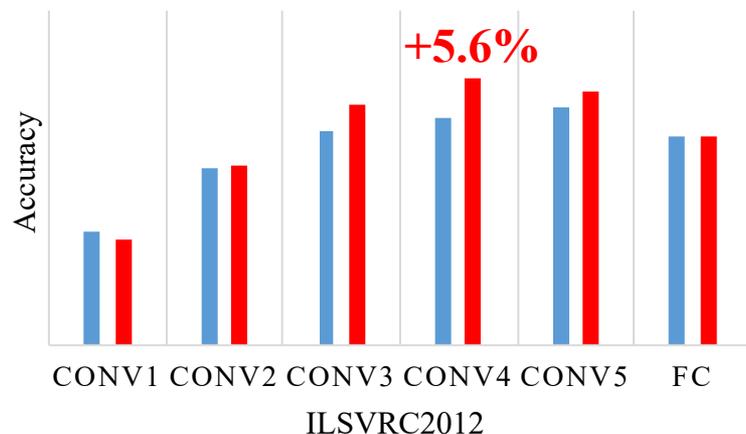


Experiments

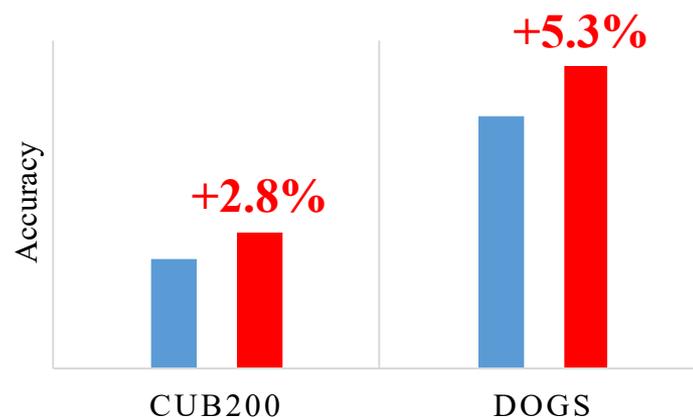
- Small scale Image Classification (*k*NN)
- Small scale Image Classification (LC)



- Large scale Image Classification



- Fine-grained Image Classification (*k*NN)





Unsupervised Deep Learning by Neighbourhood Discovery

Thank You!

Code: <https://github.com/Raymond-sci/AND>

Poster#115