Mixture-based Feature Space Learning for Few-shot Image Classification

Arman Afrasiyabi, Jean-François Lalonde, Christian Gagné



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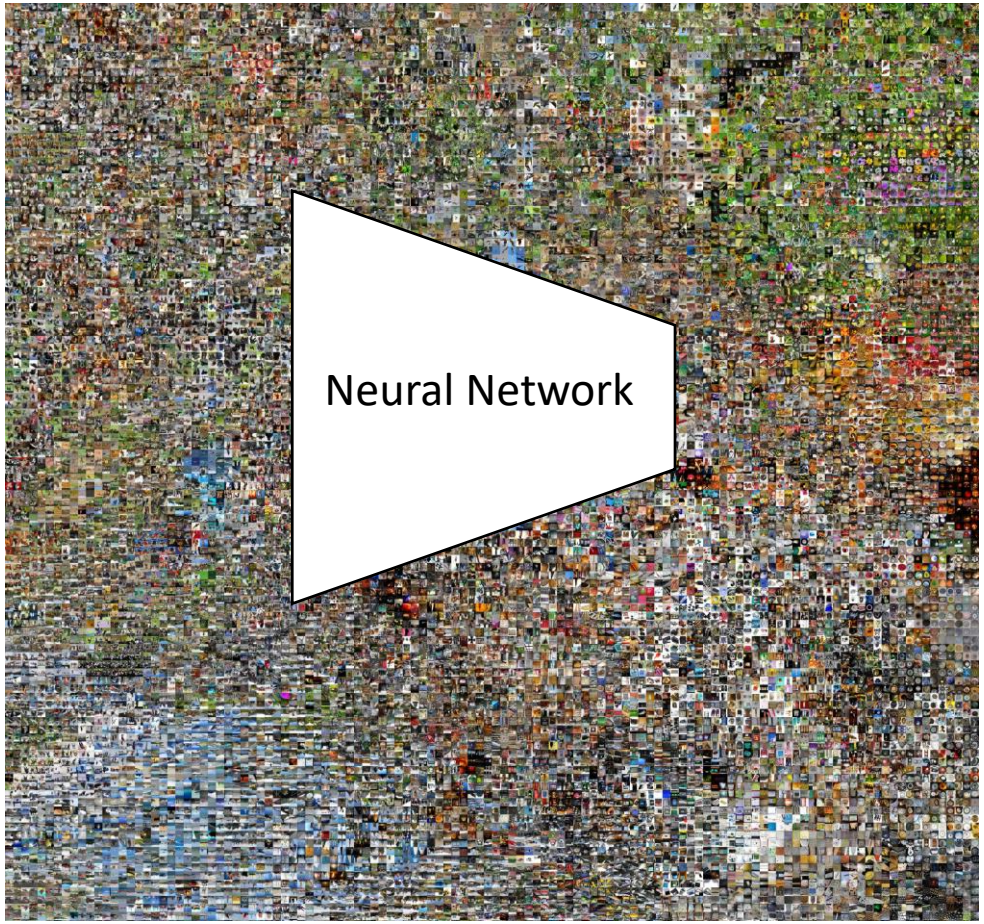
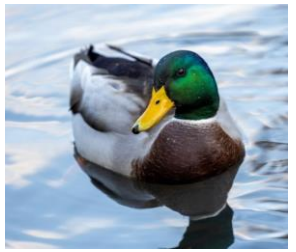
Few-shot image classification

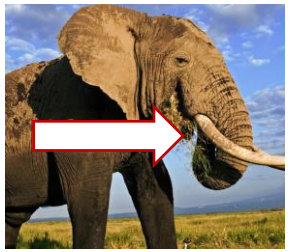


elephant



duck

wolf



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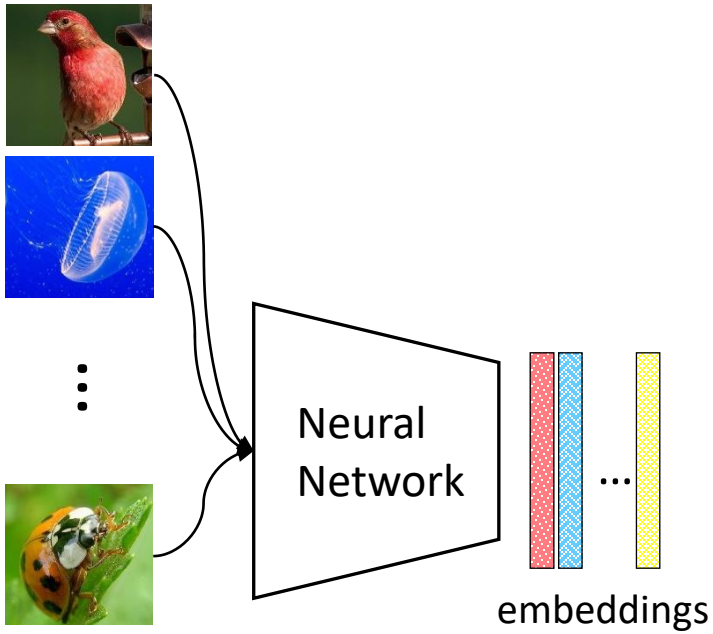
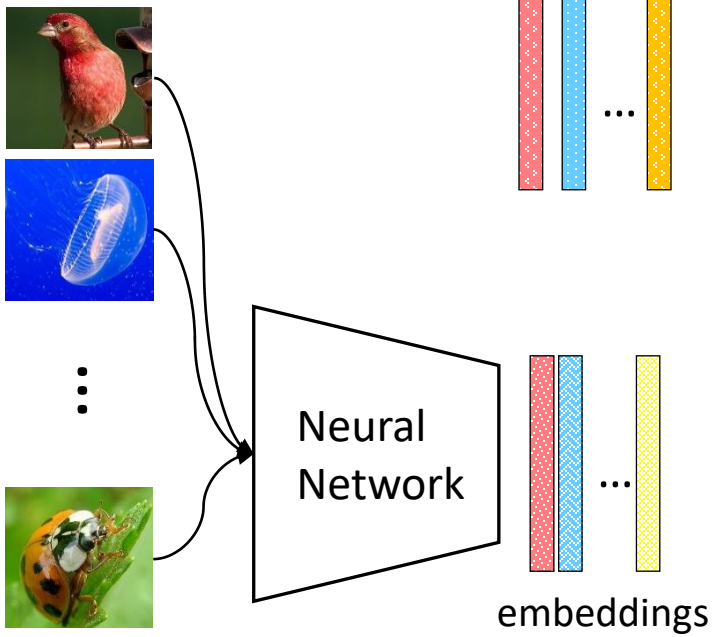
Typical pre-training

Typical pre-training

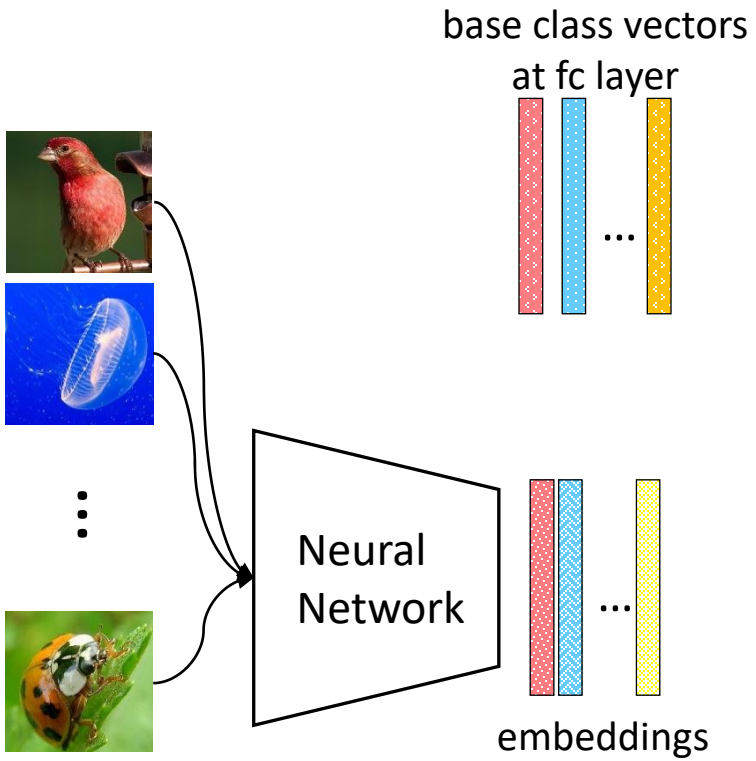


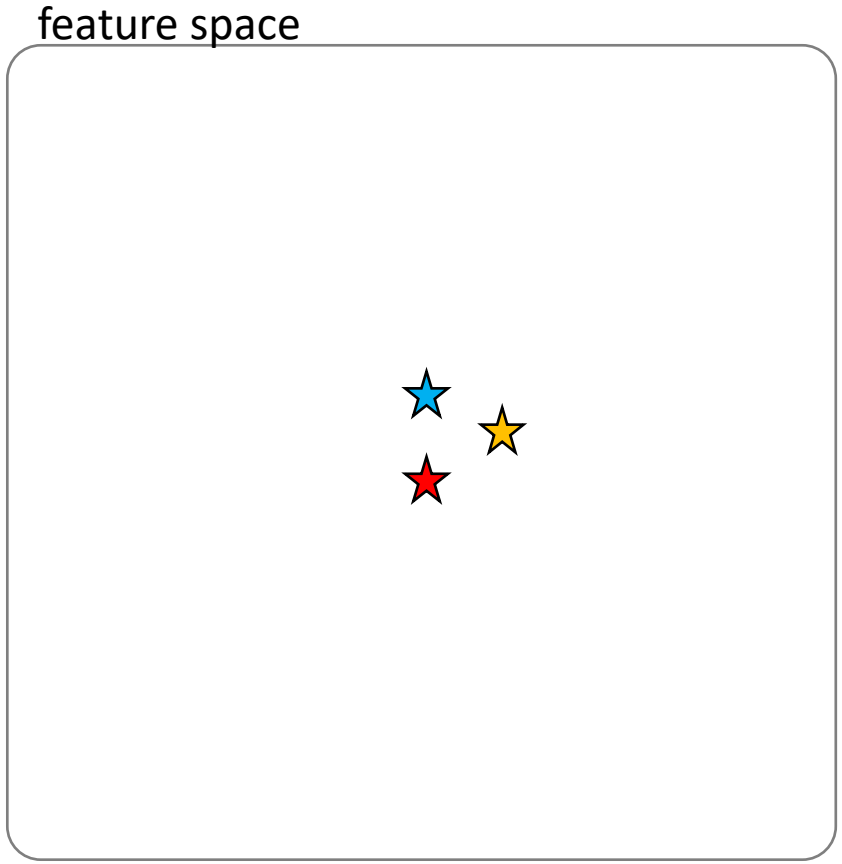
Typical pre-training



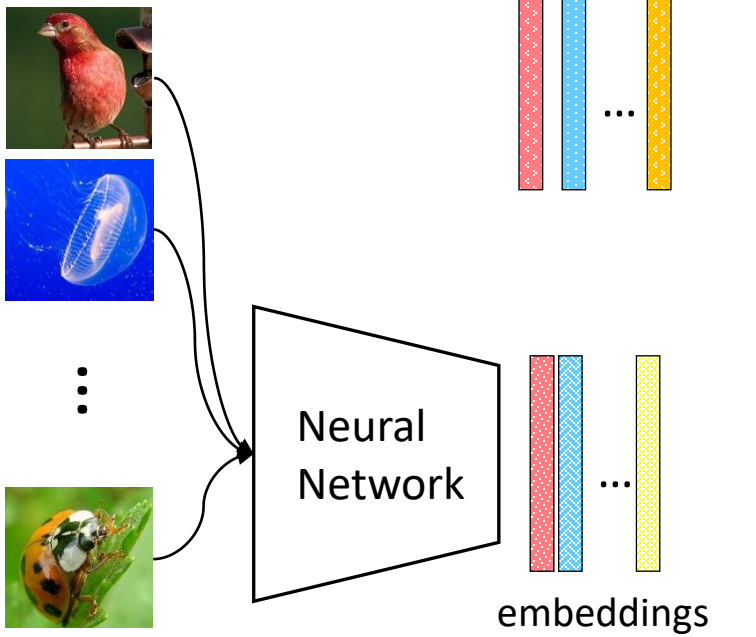
feature space

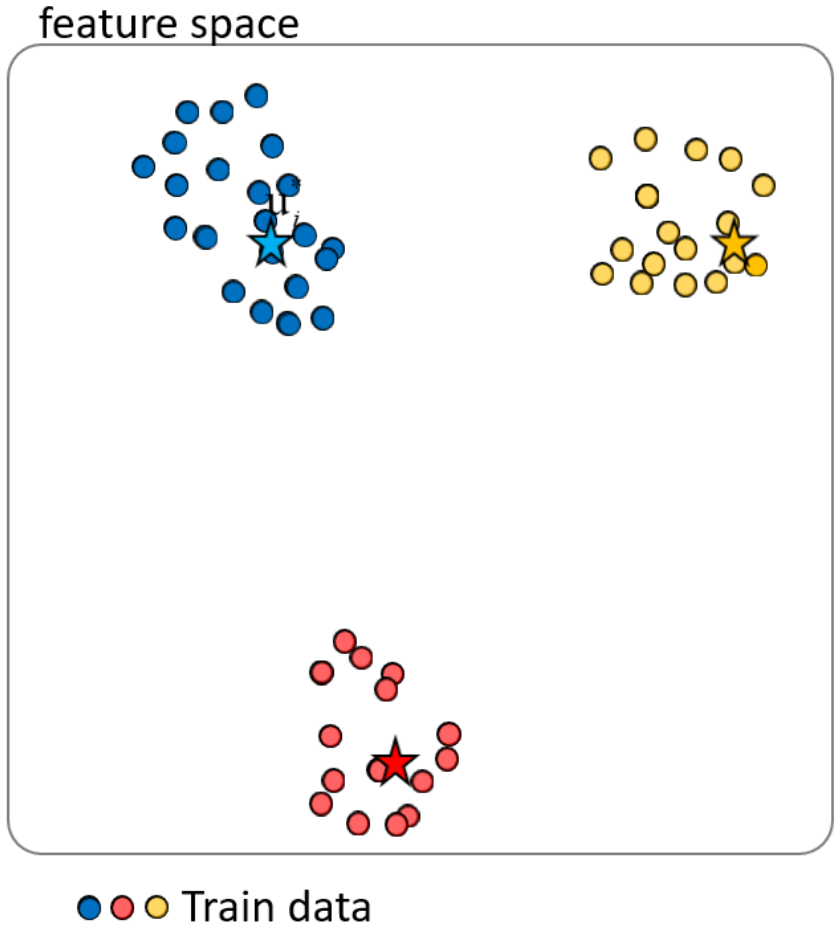
Typical pre-training





Typical pre-training

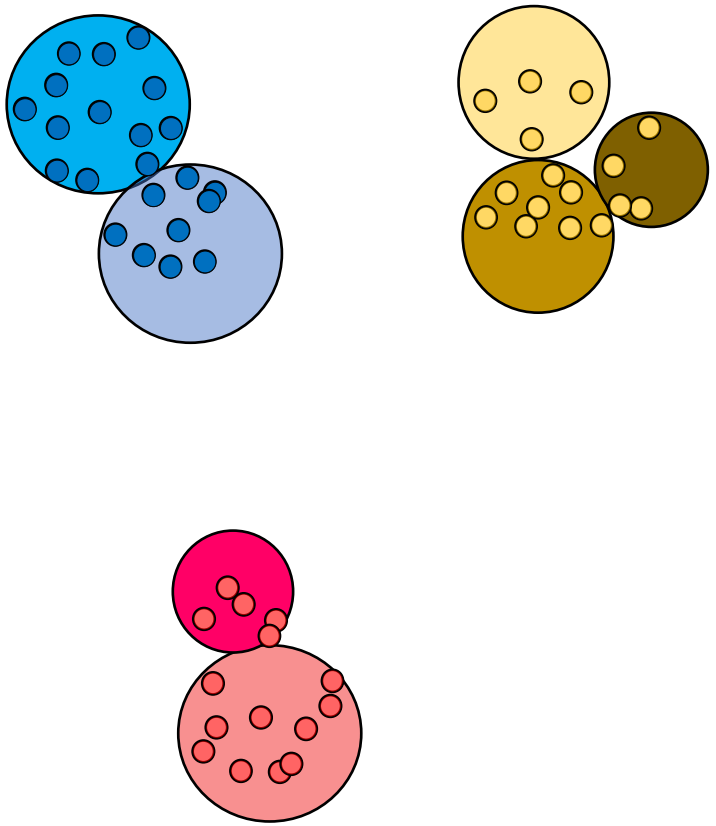




Infinite mixture prototypes

Kelsey R. Allen, Evan Shelhamer, Hanul Shin, Joshua B. Tenenbaum, ICML 2019.

- uses DP-means in **non-differentiable** way
- temporary clustering inside each batch in **offline manner**



We propose a multimodal method that is

- **fully differentiable**
- trainable in an **end-to-end** manner
- **without any clustering** algorithm

Mixture-based Feature Space Learning

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Mixture-based Feature Space Learning

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MixtFSL

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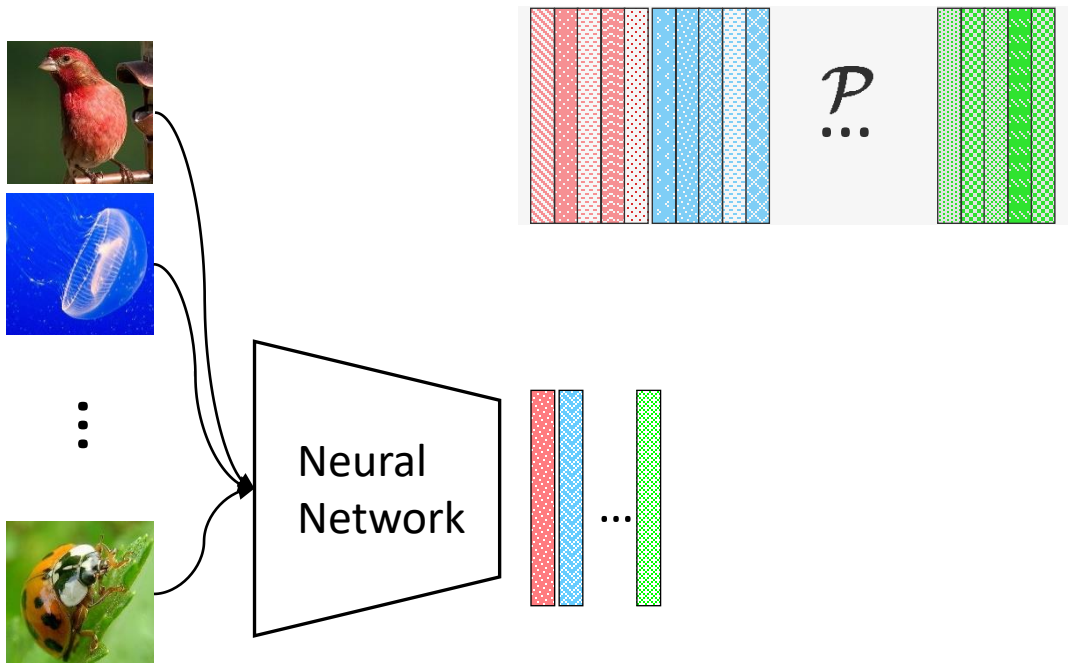
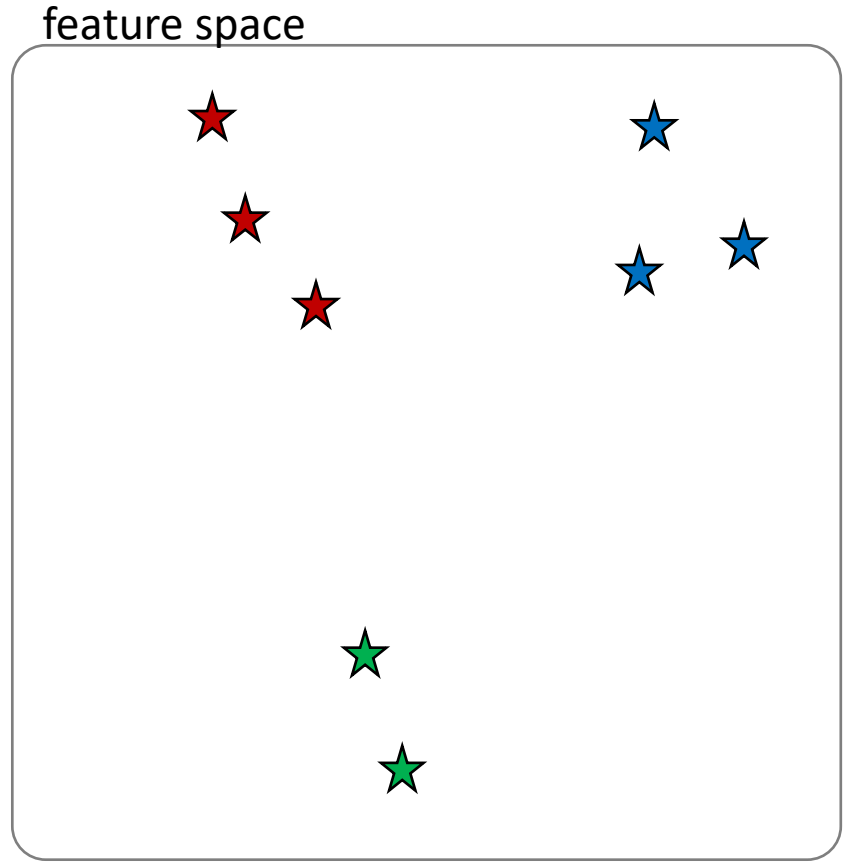
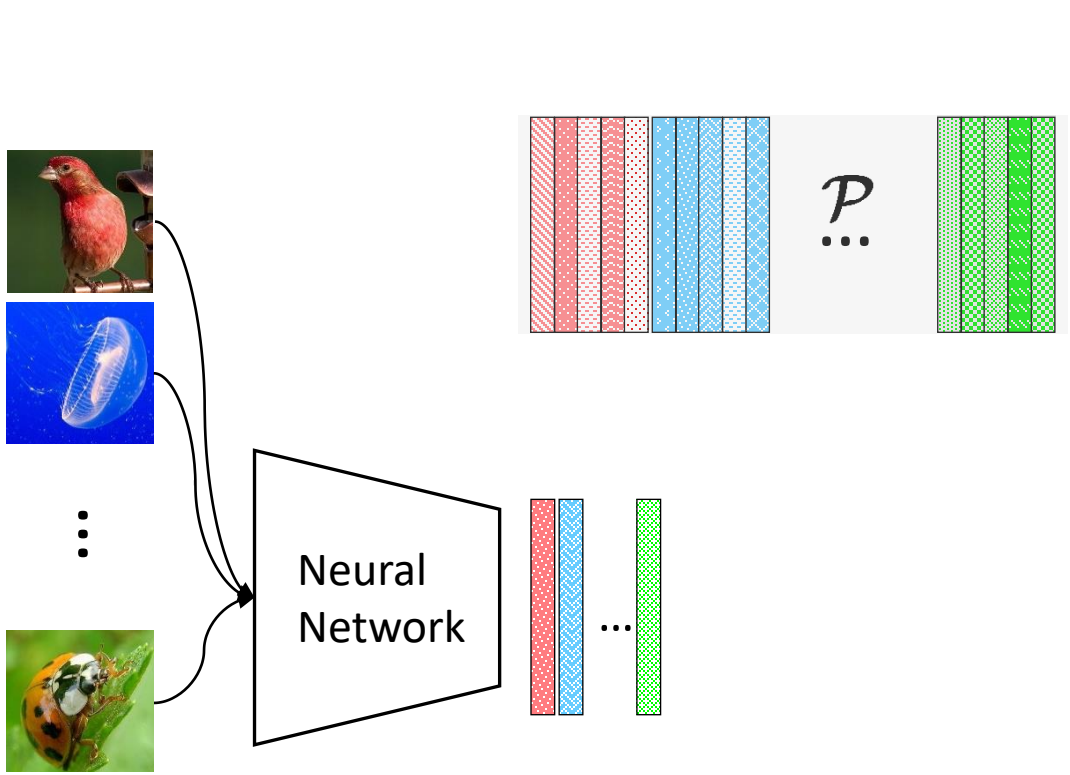
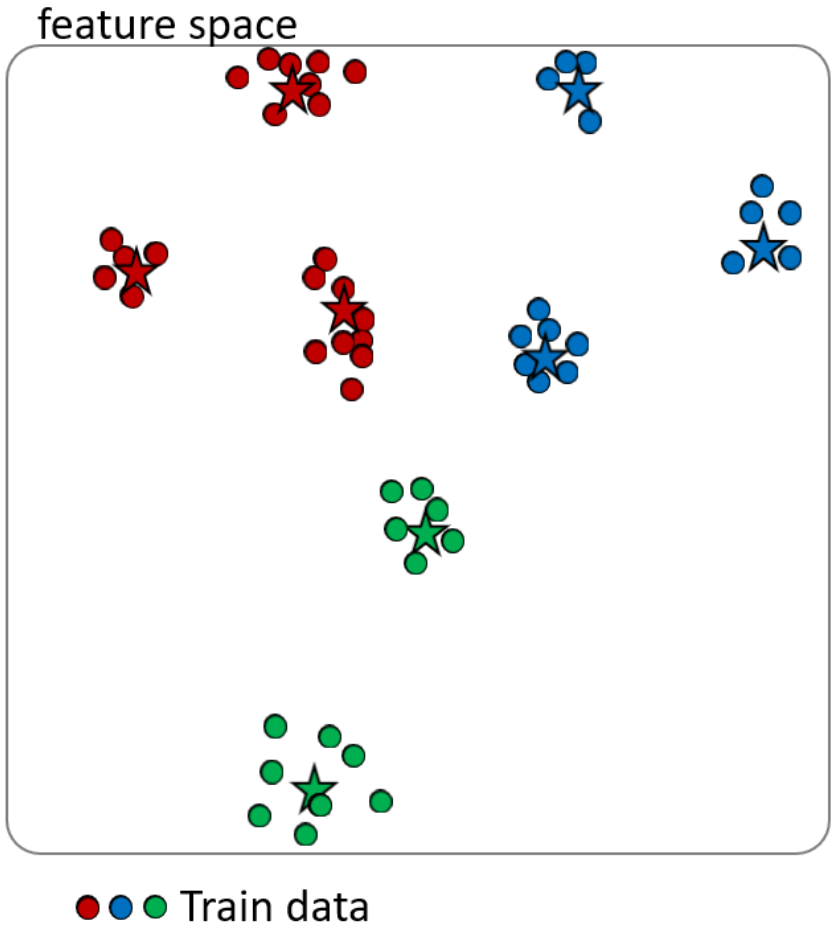
MixtFSL





MixtFSL





MixtFSL

Phase 1: Initial training

Phase 2: Progressive following

MixtFSL

Phase 1: Initial training

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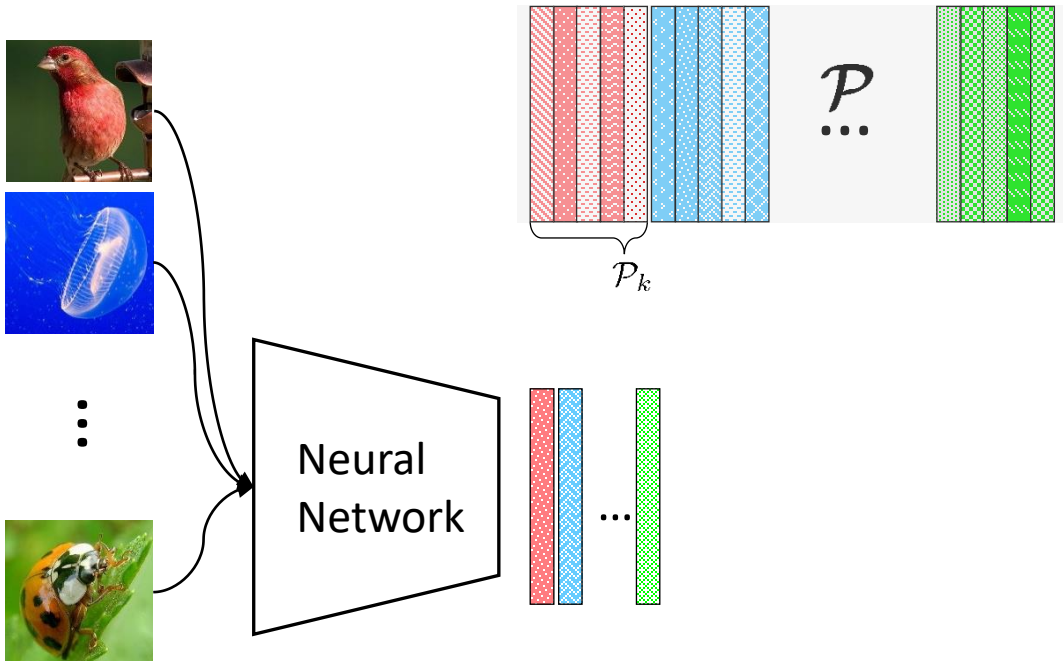
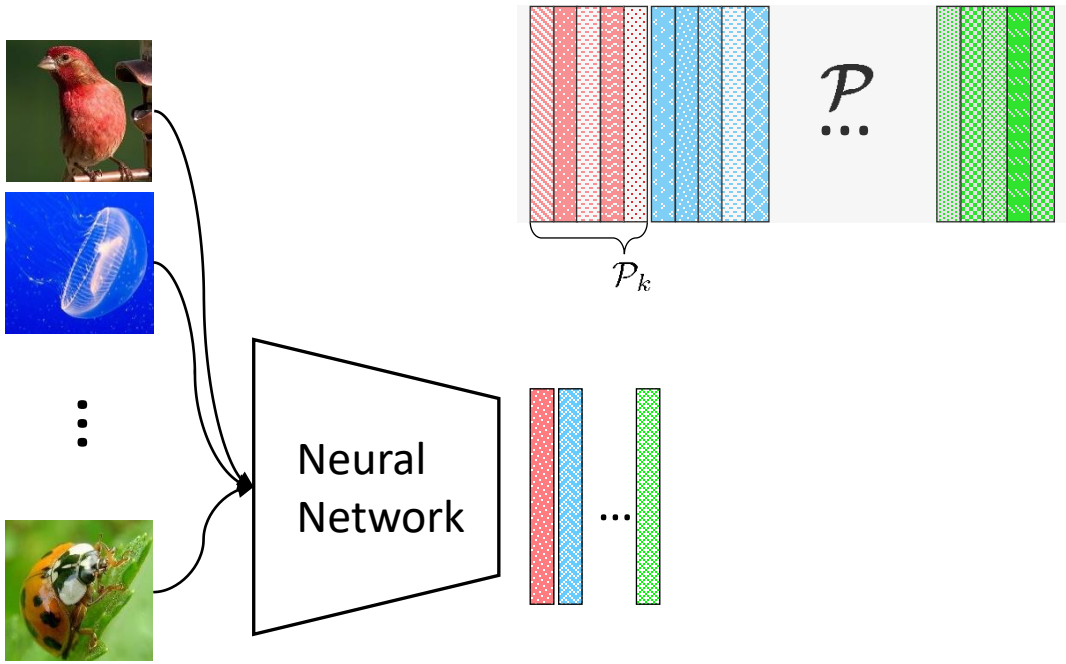
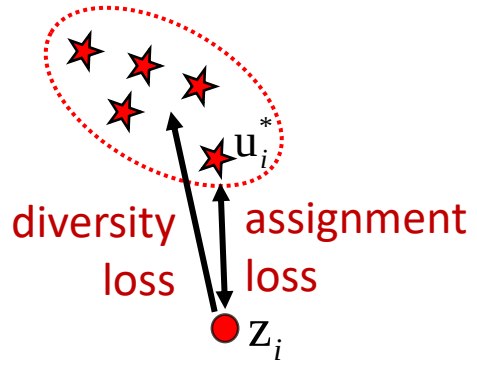
Phase 1: Initial training



Phase 1: Initial training

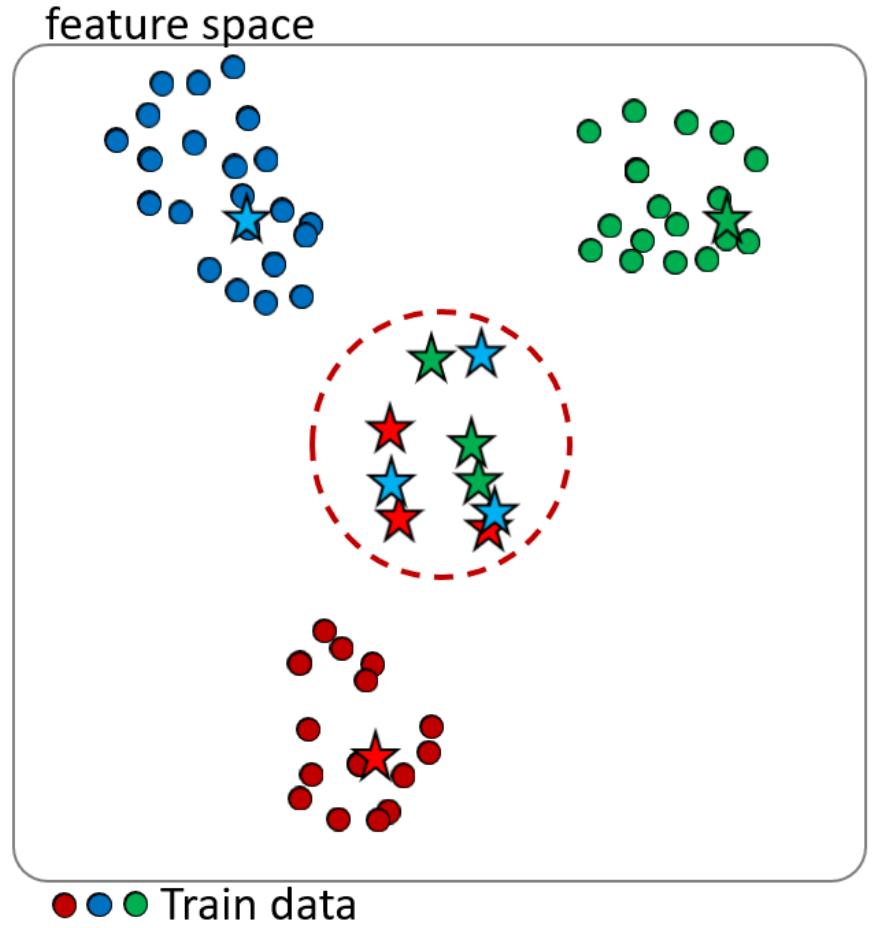


feature space



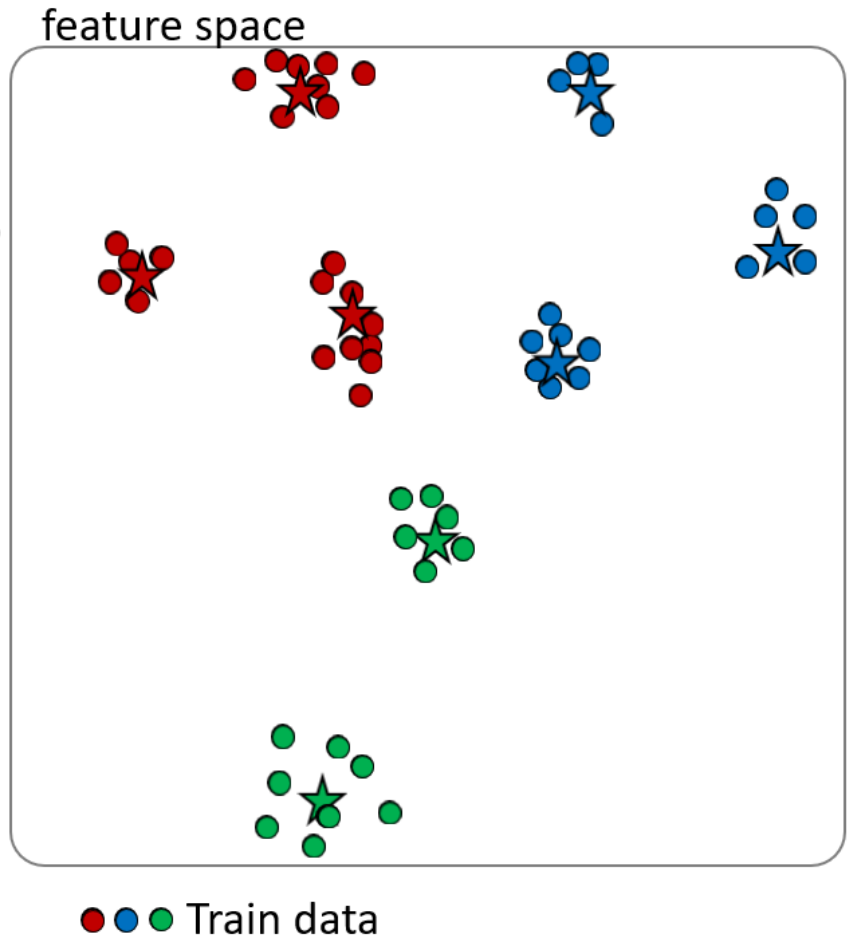
Phase 1: Initial training

Training **only** with assignment loss



Phase 1: Initial training

Training **with both** assignment and diversity losses:



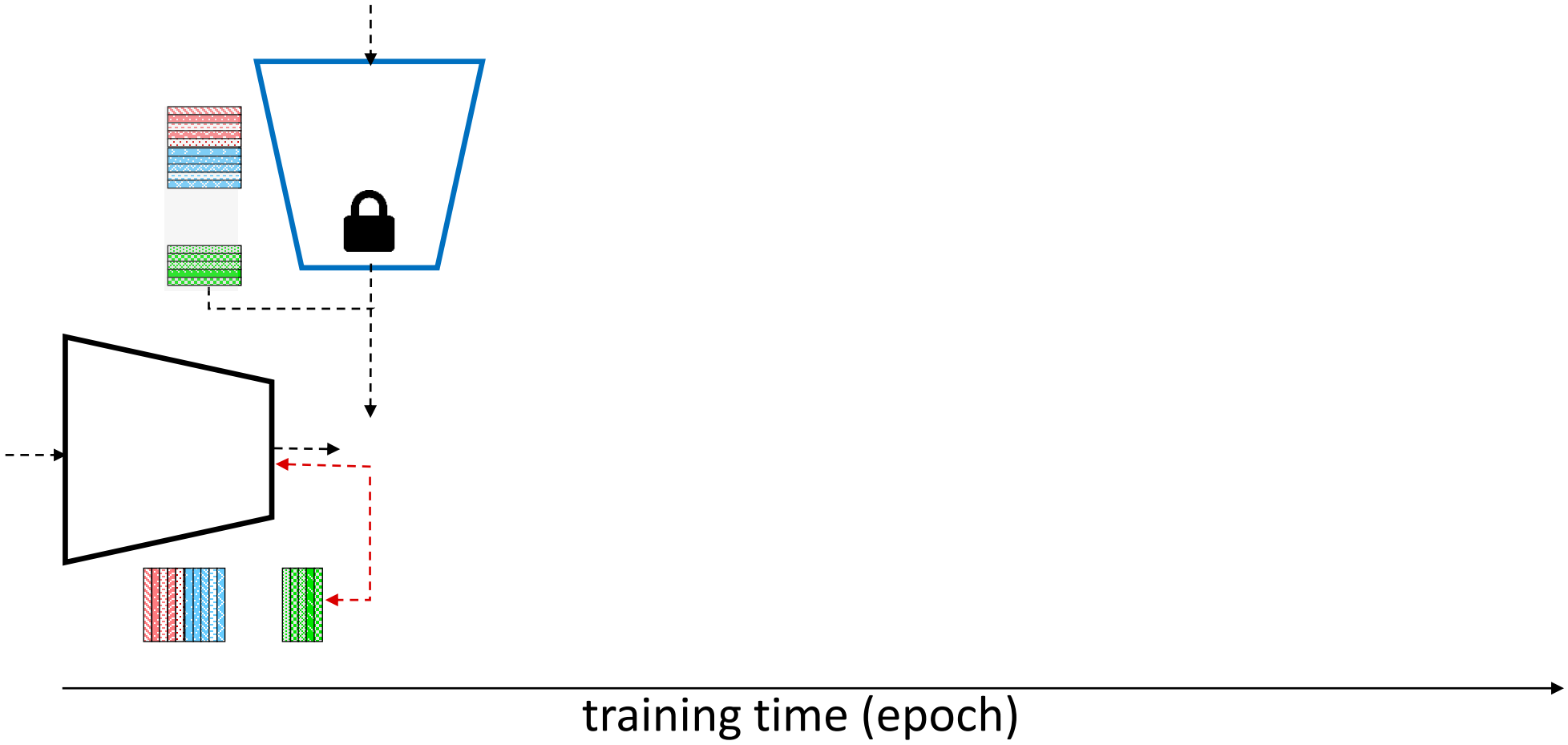
MixtFSL

Phase 1: Initial training

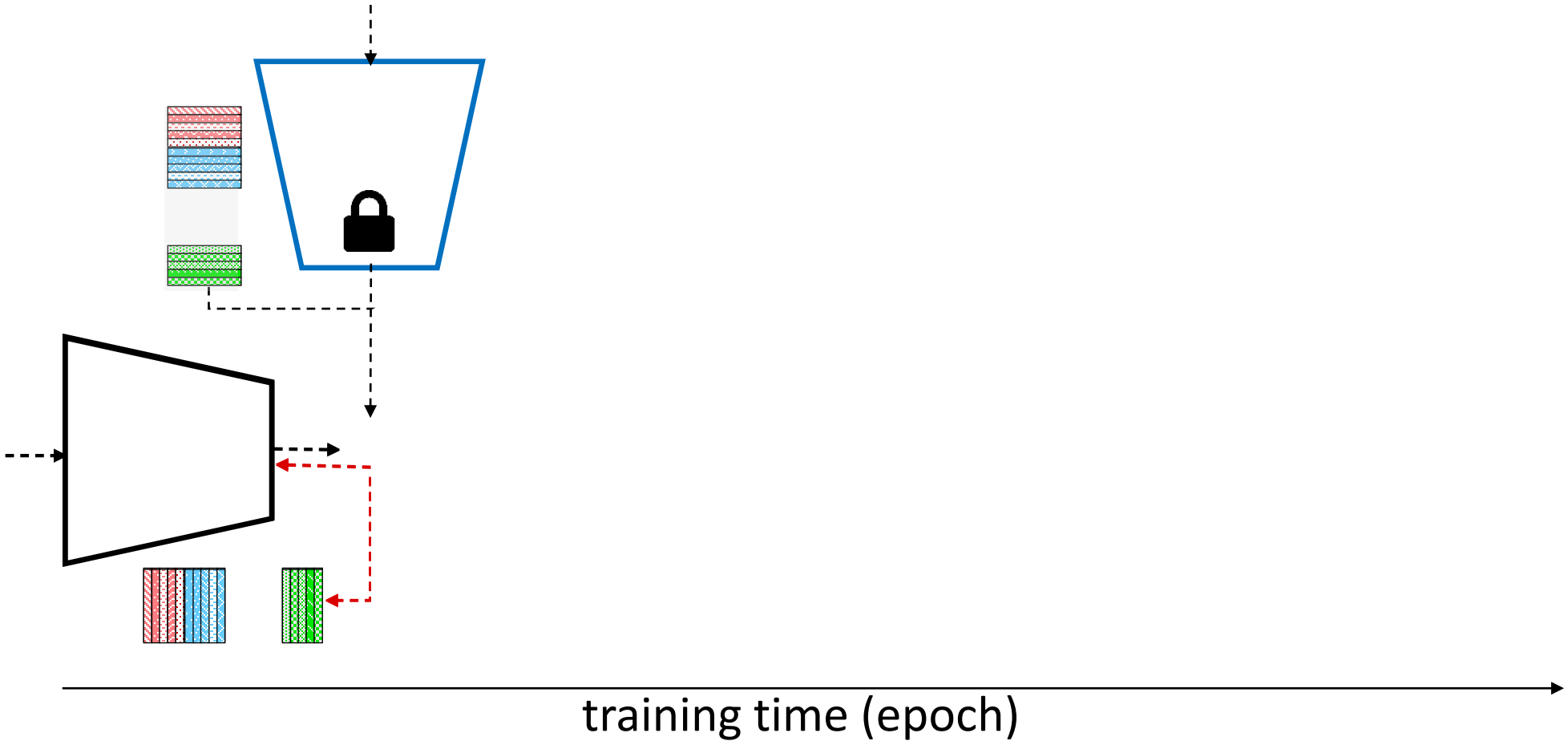
Phase 2: Progressive following

Phase 2: Progressive following

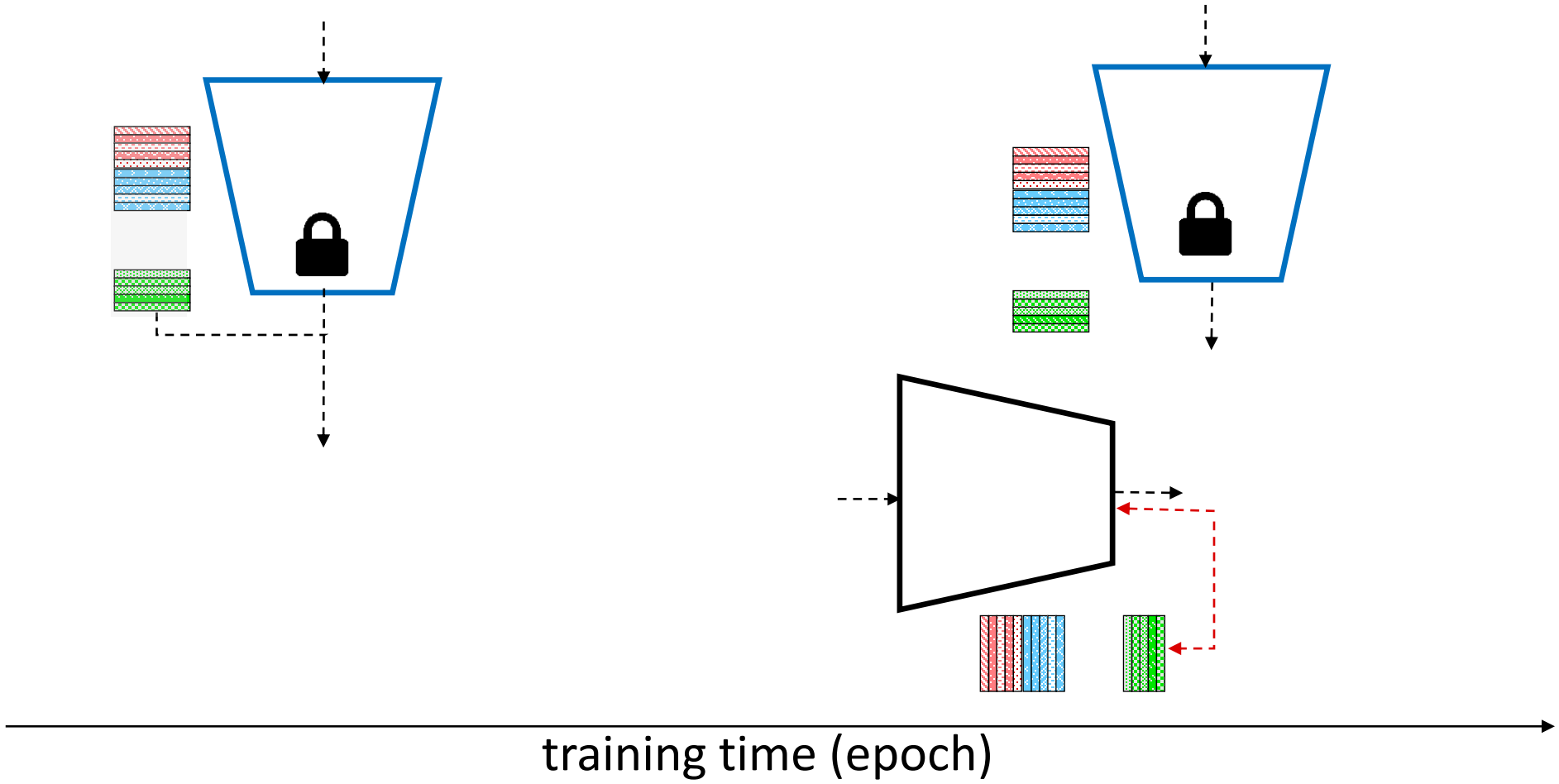
Phase 2: Progressive following



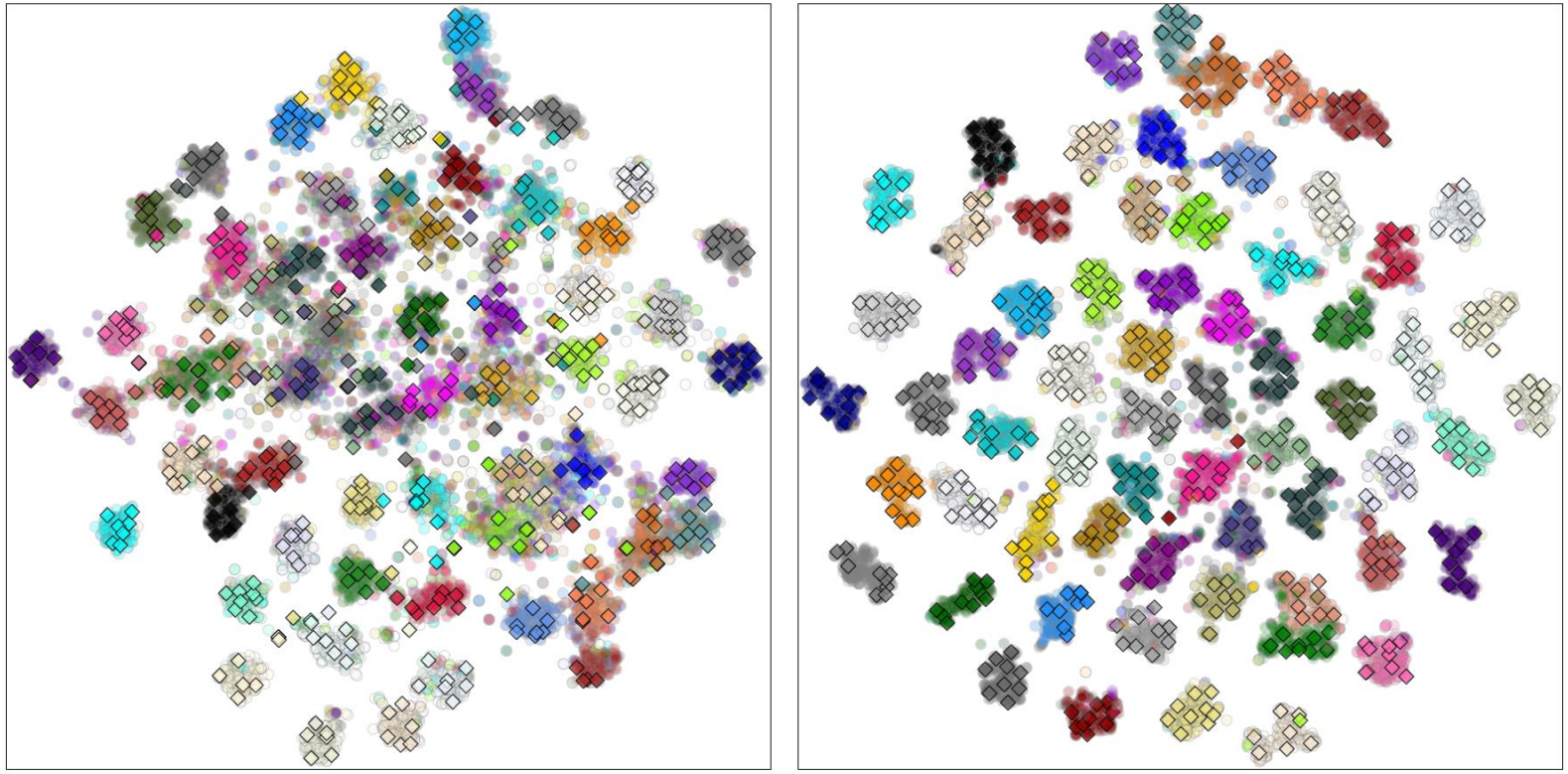
Phase 2: Progressive following



Phase 2: Progressive following



MixtFSL



(a) after initial training (b) after progressive following

Evaluations

Datasets	Backbones
MiniImageNet	Conv4
TieredImageNet	ResNet-12
FC100	WideResNet
CUB	ResNet-18

miniImageNet

ResNet-12

Method	1-shot	5-shot
DNS [62]	62.64	78.83
Var.FSL [87]	61.23	77.69
MTL [66]	61.20	75.50
SNAIL [46]	55.71	68.88
AdaResNet [48]	56.88	71.94
TADAM [49]	58.50	76.70
MetaOptNet [37]	62.64	78.63
Simple [69]	62.02	79.64
TapNet [83]	61.65	76.36
Neg-Margin [41]	63.85	81.57
MixtFSL (ours)	**63.98**	**82.04**

+ 0.47

tieredImageNet

Method	Backbone	1-shot	5-shot
DNS [62]	RN-12	66.22	82.79
MetaOptNet [37]	RN-12	65.99	81.56
Simple [69]	RN-12	69.74	84.41
TapNet [83]	RN-12	63.08	80.26
Arcmax* [1]	RN-12	68.02	83.99
MixtFSL (ours)	RN-12	**70.97**	**86.16**
Arcmax [1]	RN-18	65.08	83.67
ProtoNet [64]	RN-18	61.23	80.00
MixtFSL (ours)	RN-18	**68.61**	**84.08**

tieredImageNet

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MixtFSL (ours)	RN-18	**68.61**	**84.08**

+ 3.53

FC100

Method	Backbone	1-shot	5-shot
TADAM [49]	RN-12	40.1	56.1
MetaOptNet [37]	RN-12	41.1	55.5
ProtoNet† [64]	RN-12	37.5	52.5
MTL [66]	RN-12	43.6	55.4
MixtFSL (ours)	RN-12	**44.89**	**60.70**
Arcmax [1]	RN-18	40.84	57.02
MixtFSL (ours)	RN-18	**41.50**	**58.39**

+ 4.60

CUB and cross domain

Method	CUB 1-shot	CUB 5-shot	miniIN→CUB 5-shot
GNN-LFT$^{\diamond}$ [70]	51.51	73.11	–
Robust-20 [13]	58.67	75.62	–
RelationNet‡ [67]	67.59	82.75	57.71
MAML‡ [18]	68.42	83.47	51.34
ProtoNet‡ [64]	71.88	86.64	62.02
Baseline++ [8]	67.02	83.58	64.38
Arcmax [1]	71.37	85.74	64.93
Neg-Margin [41]	72.66	**89.40**	67.03
MixtFSL (ours)	**73.94**	86.01	**68.77**

+ 1.74

Extension with associative alignment

Afrasiyabi et al. ECCV 2020.

miniImageNet

Method	1-shot	5-shot
Cent. Align.* [1]	63.44	80.96
MixtFSL-Align. (ours)	**64.38**	**82.45**

tieredImageNet

Method	1-shot	5-shot
Cent. Align.* [1]	71.08	86.32
MixtFSL-Align. (ours)	**71.83**	**88.20**

MixtFSL in summary

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MixtFSL in summary

We introduce a **fully differentiable end-to-end** representation learning method

We present a **robust two-stage algorithm** for training such a model

Our method **achieves the state-of-the-art** results on four datasets with four backbones

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Thank you for your attention!

Visit our project webpage at https://lvsn.github.io/MixtFSL/

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