Class-incremental Learning with Regular Polytope Networks





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Motivation

• We are interested in **learning features** that keep **stationary** while **learning** novel classes **incrementally**.

Practical advantages:

- Features can be used interchangeably in time,
- Visual search systems avoid re-computing features in the gallery when updating the model
- Along a similar vein, [Yantao et al. CVPR2020] introduces feature back-compatibility

Incremental Learning of a New Class

(2D internal feature representation, standard classifier)



- **MNIST** dataset, **5** classes learned:
- a **new class** (brown) is incorporated into the model.
- The **angle** between feature classes **changes** (i.e., $\varphi \neq \varphi'$)
 - The feature embedding changes

Class-Incremental Learning and Feature Representation

• Class Incremental Learning: training a single model on a sequence of disjoint classification problems without forgetting how to solve the previous ones.





 Even assuming no catastrophic forgetting, internal feature representation changes as new classes are incorporated into the learning model. To avoid this change we propose a preallocated fixed classifier (i.e., not undergoing learning).





 This keeps the features in a constant specific spatial configuration as novel classes are incorporated into the learning model.

The Effect of Class Pre-allocation

- Pre-allocation of the output nodes of future unseen classes allows to see **negative** samples since the **beginning** of learning.
 - The space of unseen classes is not occupied by the seen ones





 \mathbb{R}^d

- As no prior assumption about the semantic similarity between future classes can be made, the natural assumption is to consider the *d*-Simplex fixed classifier
 - All classes are nearest to all others (i.e., same cosine distance φ).

New class

MNIST (LeNet++ architecture, 2D feature dimension)





Thanks for Watching

