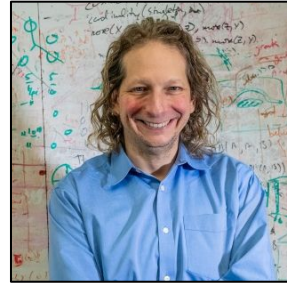


Infinite Mixture Prototypes for Few-Shot Learning

Adaptively inferring model capacity for simple and complex tasks

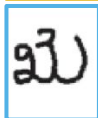
Kelsey Allen, Evan Shelhamer*, Hanul Shin*, Josh Tenenbaum



Few-Shot Learning by Deep Metric Learning

Given few instances of a few classes, recognize a new instance:

Labeled
support



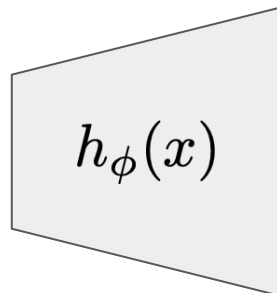
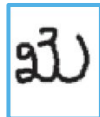
Query



Few-Shot Learning by Deep Metric Learning

Given few instances of a few classes, recognize a new instance:

Labeled
support



deep net

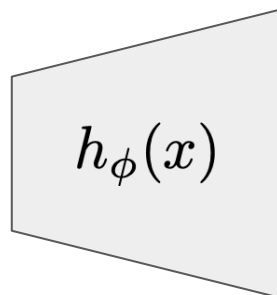
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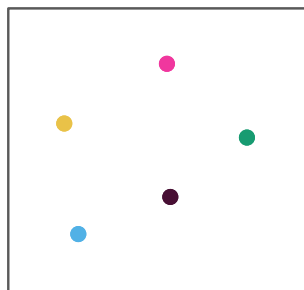
Few-Shot Learning by Deep Metric Learning

Given few instances of a few classes, recognize a new instance:

Labeled
support



deep net



embedding

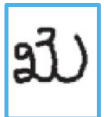
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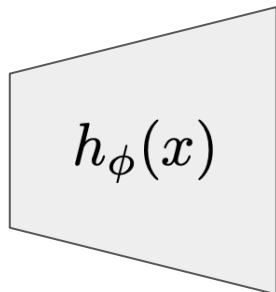
Few-Shot Learning by Deep Metric Learning

Given few instances of a few classes, recognize a new instance:

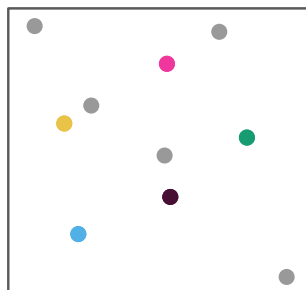
Labeled
support



Unlabeled
support



deep net



embedding

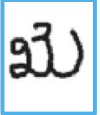
Query



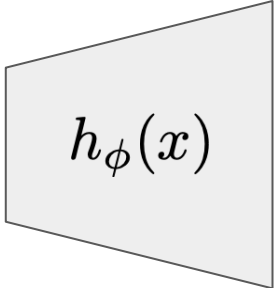
Few-Shot Learning by Deep Metric Learning

Given few instances of a few classes, recognize a new instance:

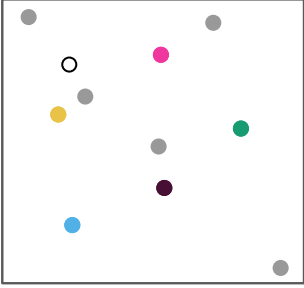
Labeled support



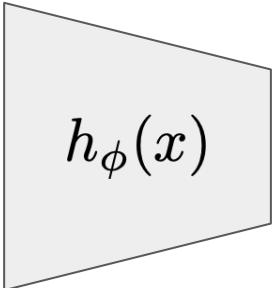
Unlabeled support



deep net



embedding



deep net

Query

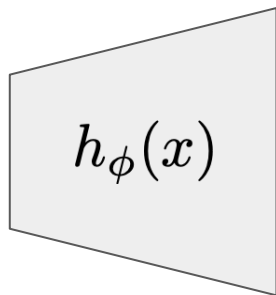
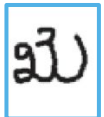


Few-Shot Learning by Deep Metric Learning

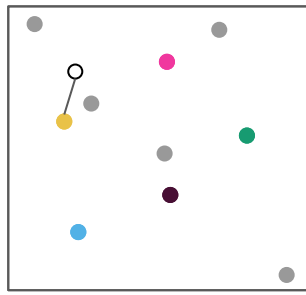
Given few instances of a few classes, recognize a new instance:

Labeled support

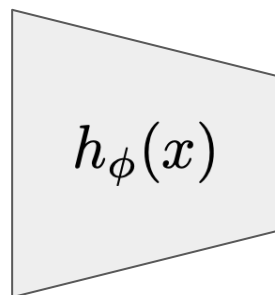
Unlabeled support



deep net



embedding



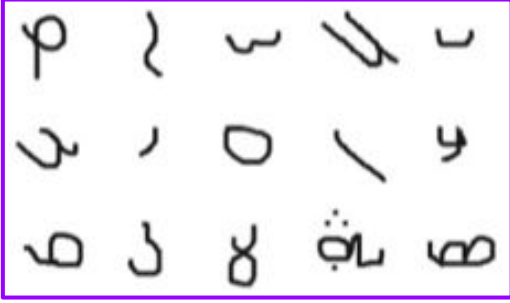
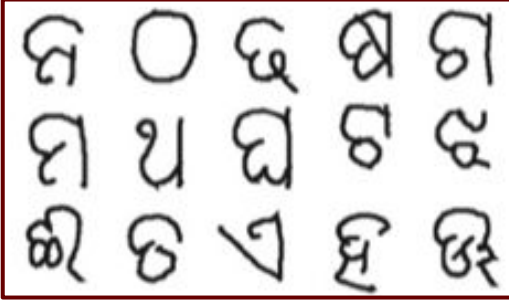
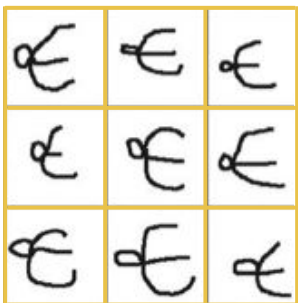
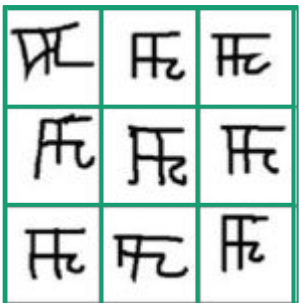
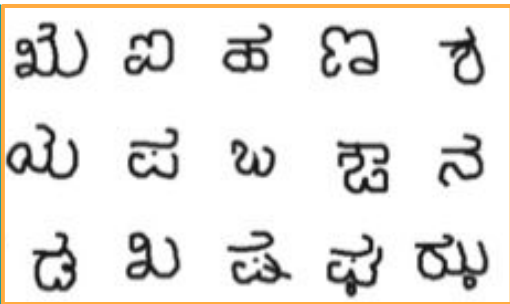
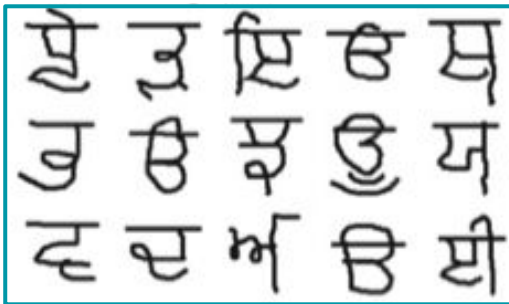
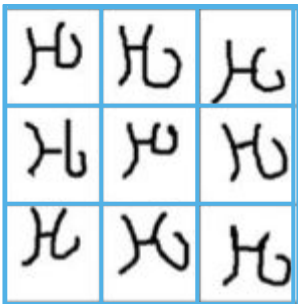
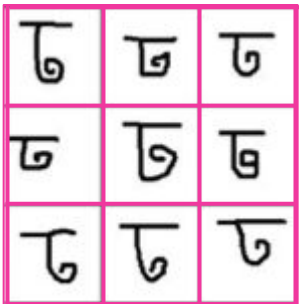
deep net

Query



Simple and Complex Tasks

- Simple tasks might be accurately represented as uni-modal clusters
- Complex tasks might require a more sophisticated clustering
- A deeper/wider network may not solve both kinds of task simultaneously

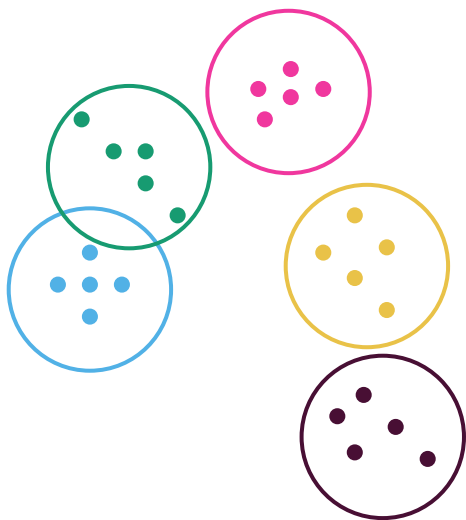


Omniglot character task

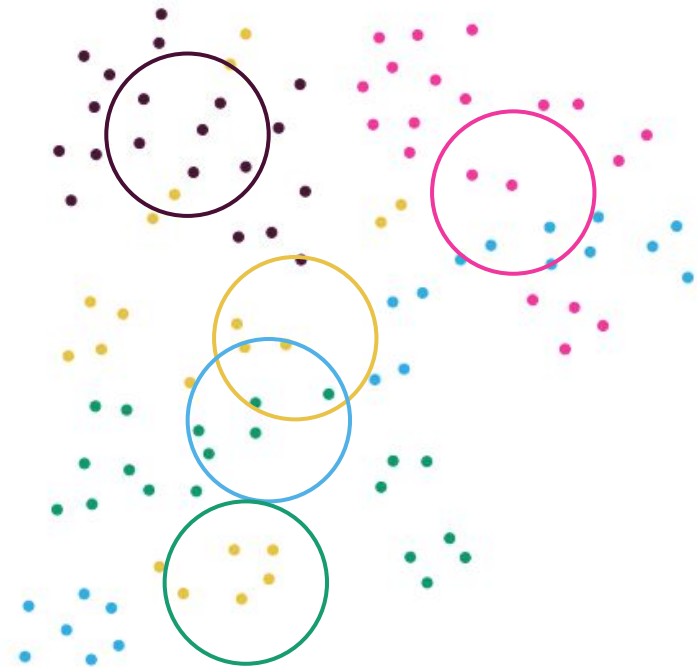
Omniglot super category task

Simple and Complex Tasks

- Simple tasks might be accurately represented as uni-modal clusters
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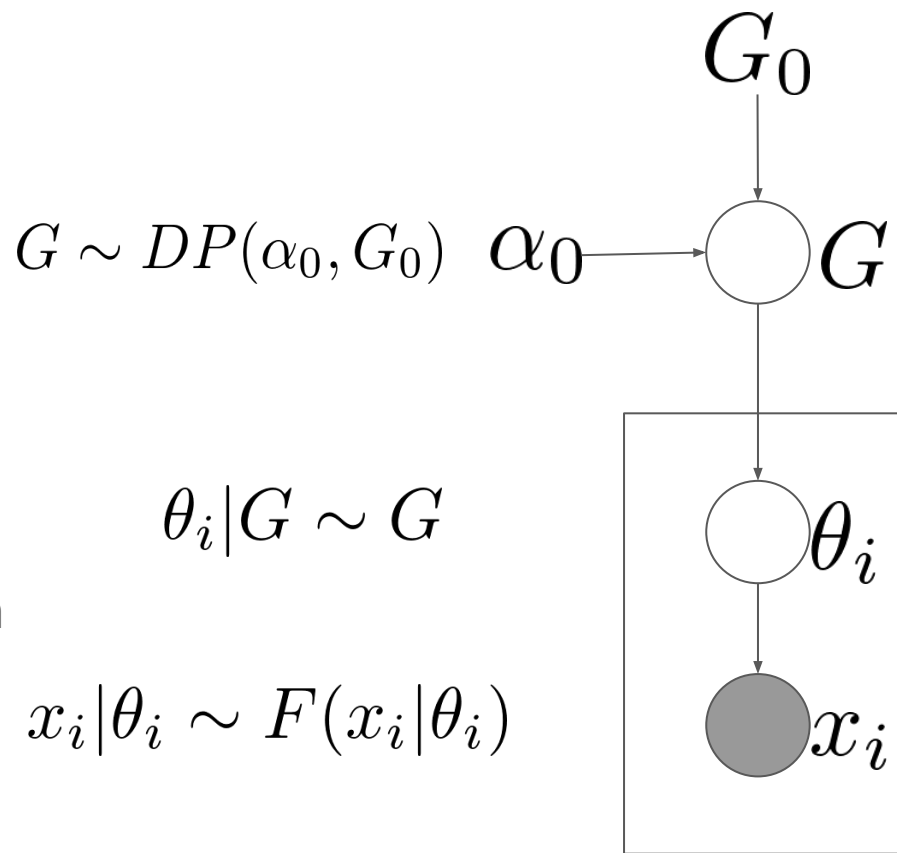
Omniglot character embeddings



Omniglot super category embeddings

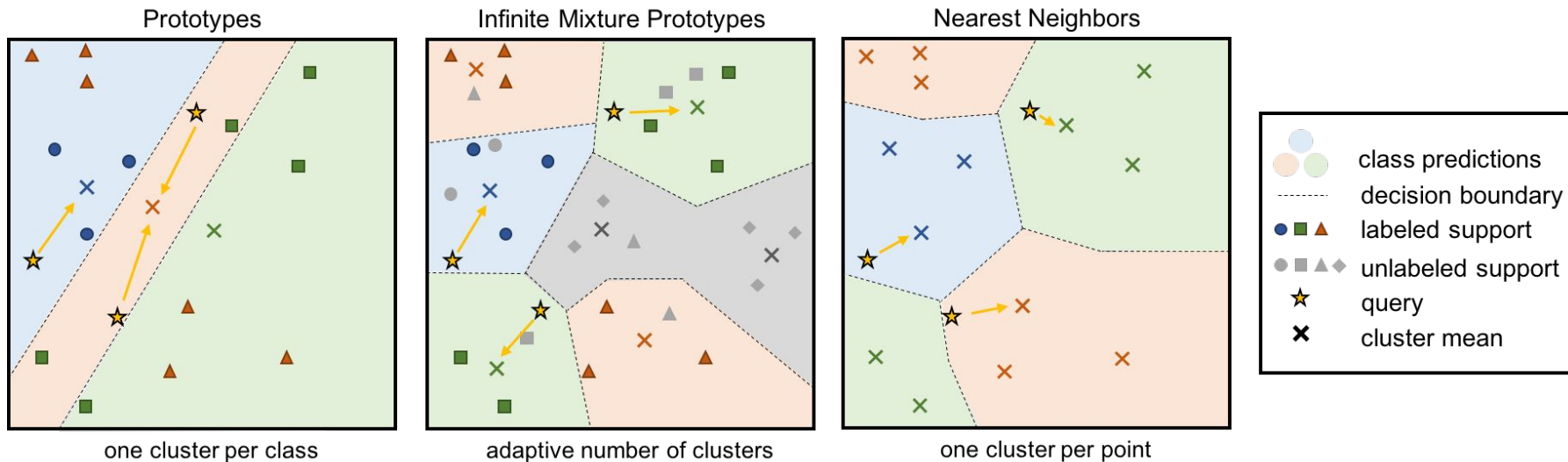
Infinite Mixture Modeling

- Represent clustering process using Dirichlet Process mixture model
- Unbounded number of clusters in mixture - let data determine for itself
- Naturally interpolates between nearest neighbors (each data point its own cluster) and prototypes (each cluster is uni-modal Gaussian)
- Semi-supervised and unsupervised possible



Adaptive Capacity for Simple and Complex Tasks

- Adapt between simple and complex data distributions by learning deep representation and inferring the number of clusters
- Efficient inference based on DP-means



Results

Poster 87

- **25% absolute improvement** over prototypical nets (Snell et al. 2017) for alphabet/super-class recognition on Omniglot
- **10% absolute improvement** for super-class to sub-class transfer on tiered-ImageNet
- equal or better to fully-supervised and semi-supervised prototypical nets on Omniglot and mini-ImageNet benchmarks
- **7% absolute improvement** over deep nearest neighbors on mini-ImageNet
- **20% absolute improvement** in unsupervised clustering AMI