Object Recognition using Self Taught Learning for Feature Discovery

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Problem

- Object Recognition
- Unavailability of training data for the task
- Learning a reliable model requires plenty of labeled data
  - Labeled Data : Scarce and Expensive
  - Unlabeled Data : Abundant and Cheap

Possible Solutions

- Collect more labeled data (Expensive)
- Use Semi-Supervised Learning techniques
- Use Transfer Learning
- Use **Self Taught Learning**

Supervised Classification

Semi-supervised Learning

Transfer Learning

Self-taught Learning

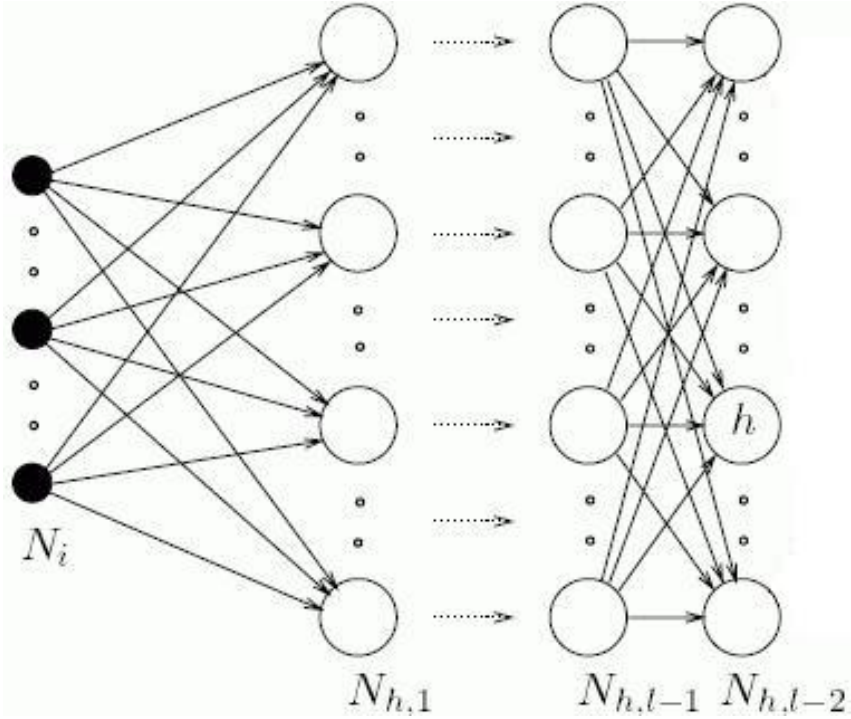
Self Taught Learning

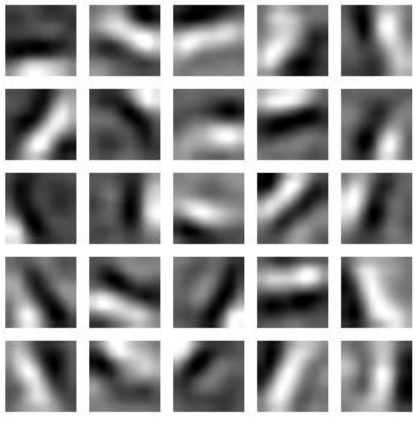
- Raina et al proposed the concept of self taught learning in 2007.

- Large unlabeled data can help in supervised learning tasks, even when the unlabeled data does not share the same generative distribution as the labeled data.

Algorithm

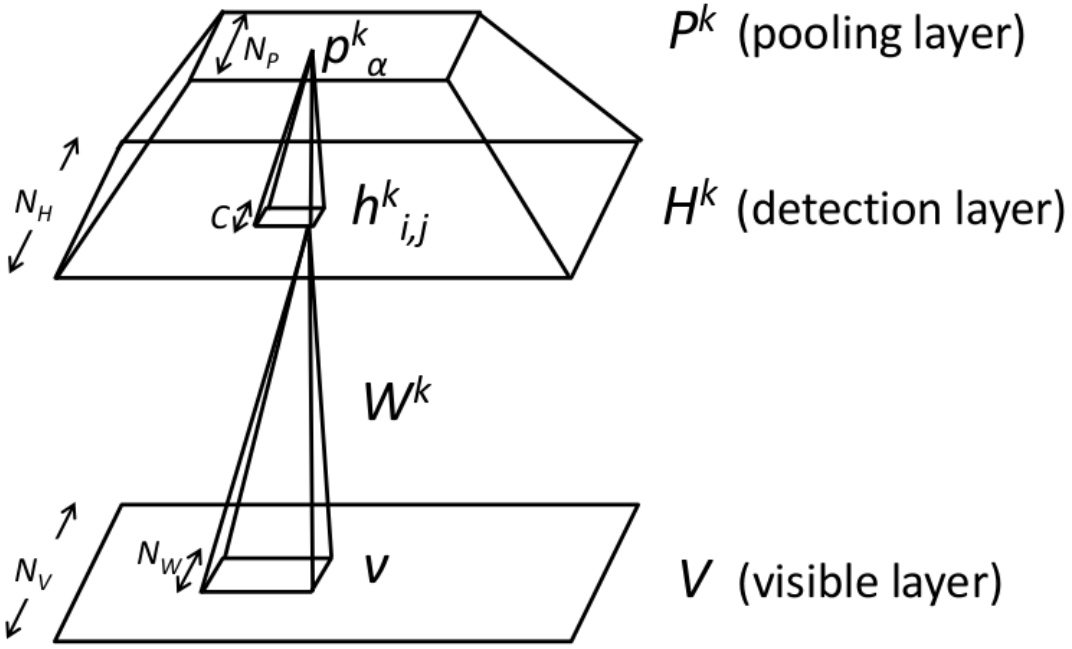
- Train a Deep Belief Network on the unlabeled data.
- Then use the trained Network to obtain features for the labeled images.
- Then train any supervised classification model on labeled data





First Layer Visualization

Convolutional Deep Belief Networks



Approach

- Train a Convolutional DBN with unlabeled images
- Obtain features for labeled images using the trained CDBN
- Then train an SVM using the images and their feature vectors
  - Possible kernels that have been used in the past
    - Fisher kernel
    - Spatial pyramid matching kernel
- Compare Performance without using unlabeled examples vs using Labeled examples

Data sets

- We plan to use CIFAR-10 and CIFAR-100 Image datasets
- CIFAR-100
  - Objects of 100 classes with 600 examples of each
- CIFAR-10
  - Objects with 10 classes with 6000 examples of each

Questions ?

References

- Raina R., Battle A., Lee H., Packer B., & Ng A. Y. Self-taught learning: Transfer learning from unlabeled data. International Conference on Machine Learning 2007
- H. Lee,R. Grosse, R. Ranganath and A. Ng. Convolutional Deep Belief Networks for scalable unsupervised learning of hierarchical representations. ICML 2009
- http://www.cs.toronto.edu/~kriz/cifar.html

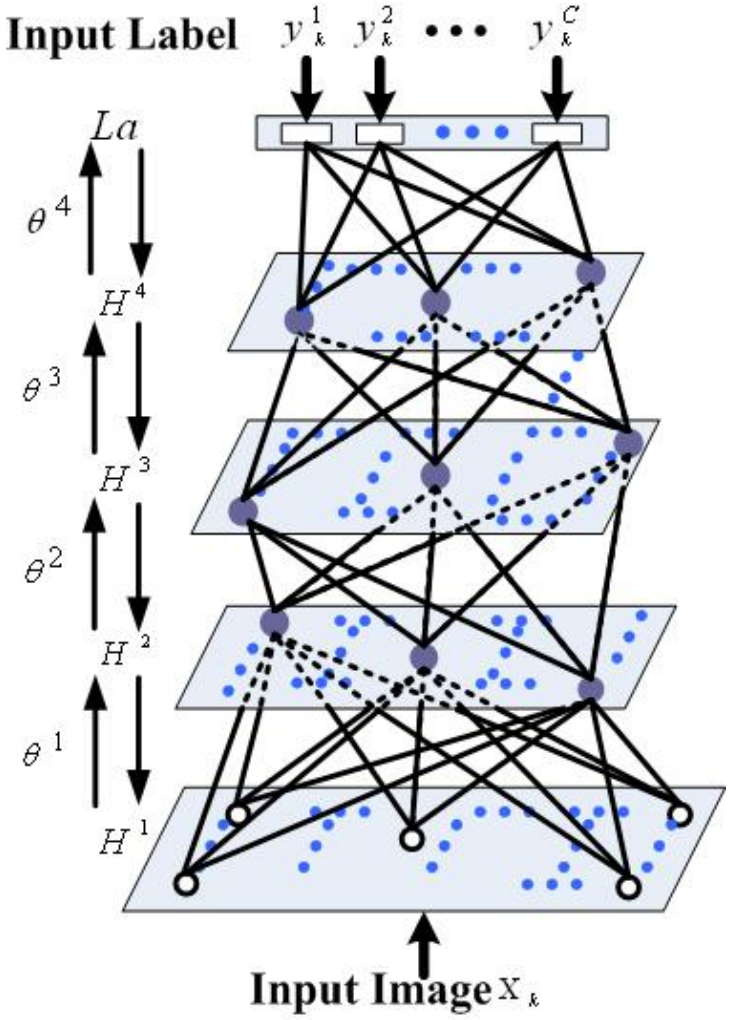
Semi-Supervised Learning

- General Idea: Learning from both labeled and unlabeled data
- Semi-supervised Classification/Regression
  - Given : Labeled training data $L = \{x_i , y_i \}^{L}_{i=1}$, unlabeled data $U=\{x_j \}^{L+U}_{j=L+1}$ (usually U $\gg$ L)
  - Goal: Learning a classifier f better than using labeled data alone
- One possible method to achieve this - Use clustering to relate the unlabeled data with the labeled data and then use it for training.

Transfer Learning

- Transfer learning is the improvement of learning in a new task through the transfer of knowledge from a related task that has already been learned.
- Consider a classification task in one domain of interest, but we only have sufficient training data in another domain of interest.
- Example-
  - Train a neural network for classification of handwritten digits
  - Now we can transfer this knowledge to improve performance on a task such as classifying handwritten alphabets (when there isn't sufficient training data for handwritten alphabets).

Convolutional Deep Belief Network



Structure of a CDBN