A Study of the N-D-K Scalability Problem in Large-Scale Image Classification

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Image Classification

Image classification is a problem of central importance to computer vision.

Success has been achieved at small scales, but the main challenge remains to build systems to rival human visual system? Algorithms must scale up!

N-D-K Scalability Challenges:

- N = Number of images used to train model
- D = Dimensionality of feature vector space
- K= Number of classes in training problem
- N → Messy and huge data sets. How can we leverage them for maximum efficiency?
- D → Wealth of different feature vectors for images. Which one(s) to use? How can different information be incorporated for a better model?
- K → Classification challenge increases dramatically with number of classes. Semantically close classes (e.g., cat vs. dog) can be very difficult to distinguish.

Machine Learning Approach to Image Classification

- Several machine learning algorithms exist for general image classification.
- We used Linear Support Vector Machines (SVMs) that provide a powerful method for image classification, especially on big data sets.
- SVM can classify large data sets in both N (number of data points) and D (dimensionality of feature space) relatively fast.
- For scale up in K, SVM divides a multi-class problem into several instances of binary classifications.
- Several one vs. all models trained to distinguish a given class from the rest.

Software Implementation

A Library to Study N-D-K Scalability
- Developed a library of functions to study the scalability of LIBLINEAR [2] implementation of SVM classifiers on large image data sets.
- Built library on-top of LIBLINEAR package and provide functions to convert existing data.
- Used the whole NUS-WIDE data set to sample and construct different instances of image classification problems.
- Measured statistics on the data sets sampled and recorded performance of the SVM algorithm when applied to different image classification problems.

References
http://www.csie.ntu.edu.tw/~cjlin/liblinear/