



Object Recognition in Natural Images

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Motivation

- **Computer vision** is the study of how to extract and interpret data from images.
- **Object recognition** is detecting the presence of a particular object/type.
- Although there are many practical applications, it is difficult to achieve results near human ability.
- In order to encourage further development in this field, the **PASCAL VOC Challenge** was started.

The PASCAL VOC Challenge

- Three main contests comprise the challenge: classification, detection, and segmentation.
- We entered **classification**: the task of indicating whether an image contains an object of a given class
- There are twenty classes: train, person, potted plant, airplane, cow...
- Photographs taken from popular image website **flickr**

Baseline Method

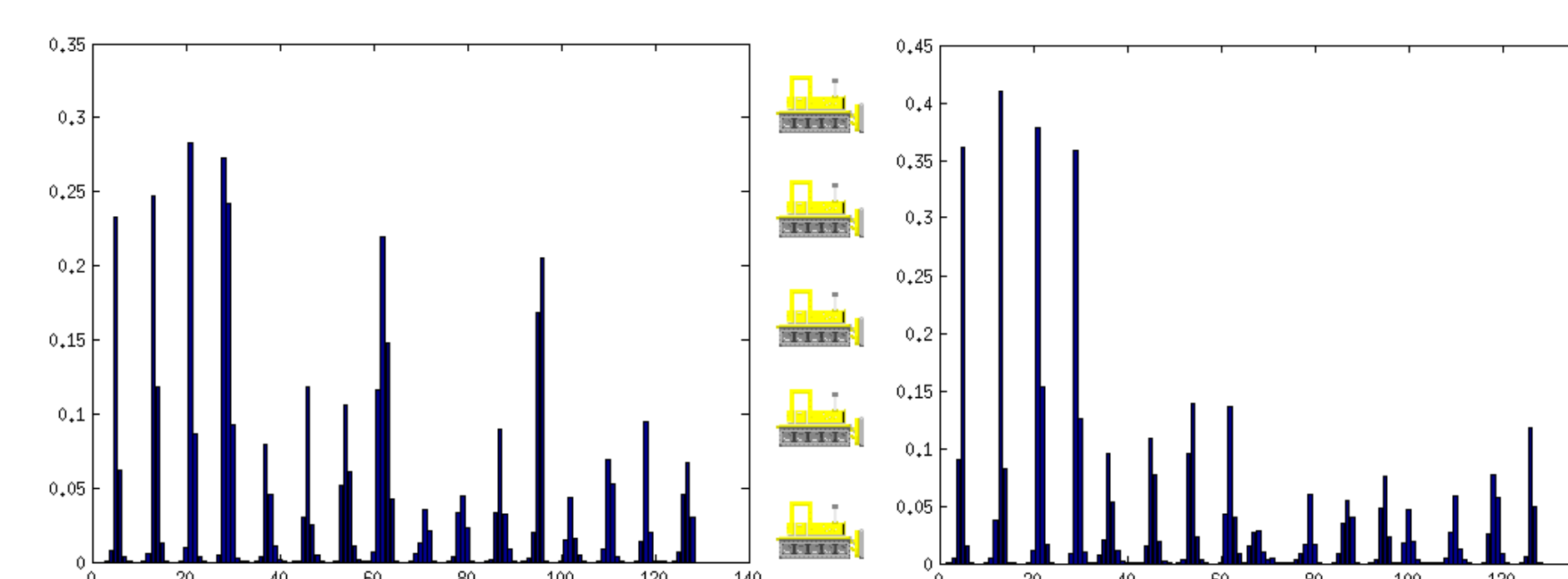
- 2009 winner, **Yang et al.**, University of Illinois Urbana-Champaign, provided their code freely
- **Extract SIFT Features** to describe local texture information
- **Cluster SIFTs** to generate SIFT types (think of clusters as object parts)
- **Spatial Pyramid Matching** encodes the spatial relation between SIFT descriptors in an image
- **Support Vector Machines (SVM)** discriminate between image groups based on different distributions of SIFT types



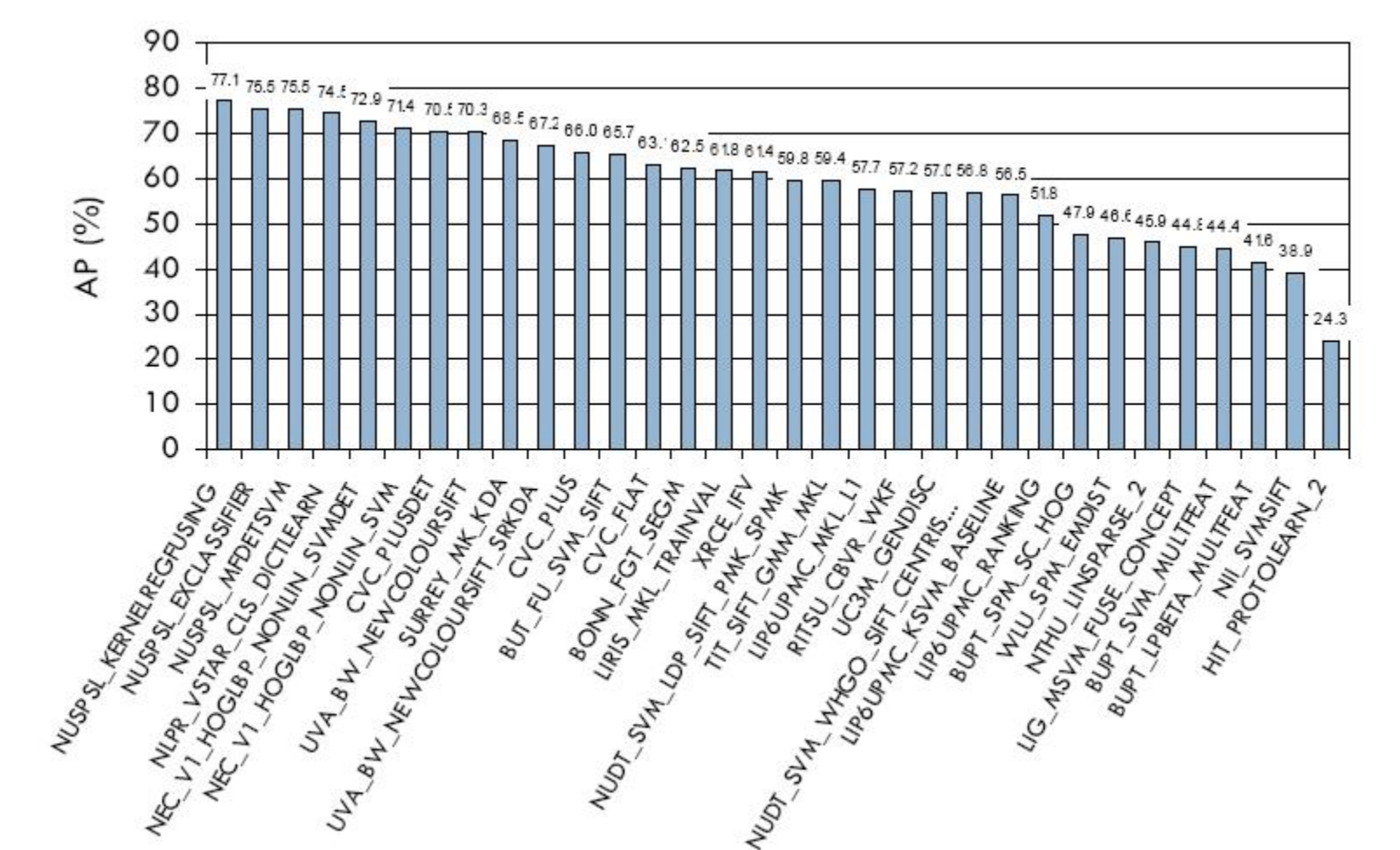
Twelve of the 10,000 images used to train the classifier

Our Improvements

- **Earth Mover's Distance (EMD)** as a distance metric for SIFT features
- Earth Mover's Distance works on the idea that reshaping one pattern into another involves both distance and quantity of change which comprise the work necessary.
- **Annotated sampling** allowed us to train on the SIFTs that comprised the object itself.
- Out of the thousands of SIFTs in an image, use only the ones around the object
- **Unique SVMs** at each level of the spatial pyramid
- Training support vector machines at multiple resolution levels allows the SVMs to be more precisely-suited to their respective tasks.



Earth Mover's Distance works by moving "mass" over "distance"



Ranked results from the 2010 PASCAL VOC Challenge

Results

- Each change improved the baseline method.
- At the competition, our performance was below average.
- We faced time and computation restraints: working for three months, and fewer possible clusters

Future Work

- Extract features at multiple scales
- Faster EMD computation
- Cluster in fewer dimensions

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