Project 3 Results

Scene Classification Accuracy

base
pipeline

base pipeline
+ careful
parameter
choices

Spatial pyramids
and additional
features
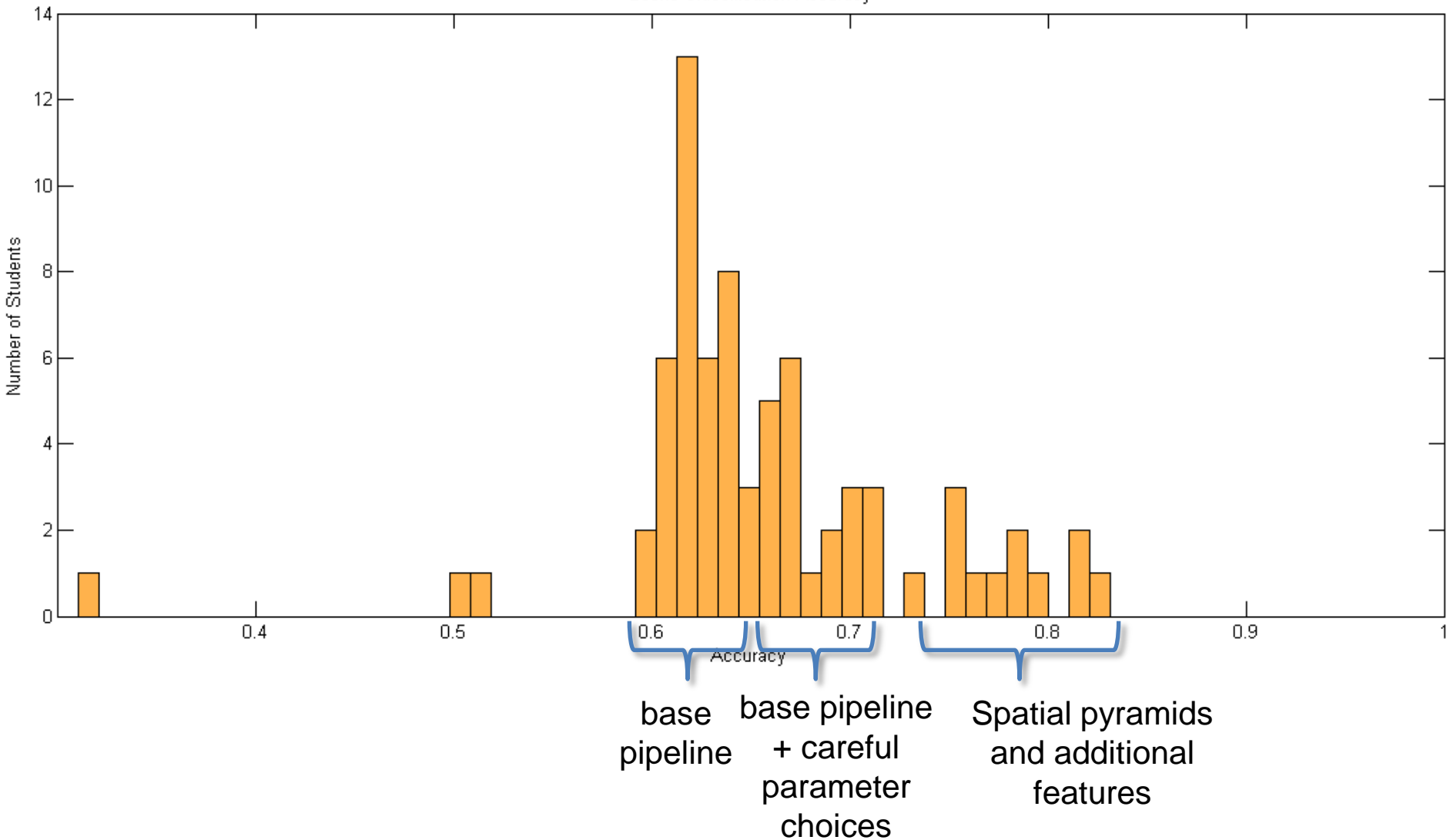
Example Results

- [Tala Huhe]
- [Betsy Hilliard]
- [Hang Su]
- [Yun Zhang]
- [Seth Goldenberg]
- [Paul Sastrasinh]
- [Andy Loomis]
- [Emanuel Zgraggen]

Object Category Detection: Sliding Windows (continued)

Computer Vision

CS 143, Brown

James Hays

Previously

- Category recognition (proj3)
  - Bag of words over *not-so-invariant* local features.

- Instance recognition
  - Local invariant features: interest point detection and feature description
  - Local feature matching, spatial verification
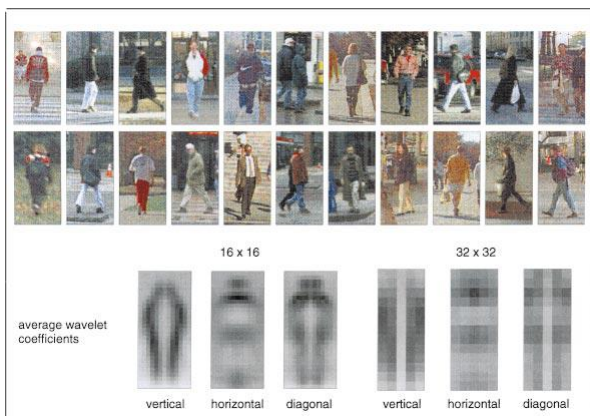 - Scalable indexing

Today (continued from Wed.)

- Window-based generic object detection
  - basic pipeline
  - boosting classifiers
  - face detection as case study

What other categories are amenable to *window-based representation*?
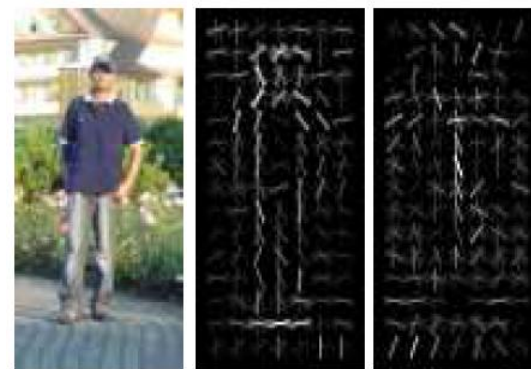
Pedestrian detection

- **Detecting upright, walking humans also possible using sliding window's appearance/texture; e.g.,**

SVM with Haar wavelets [Papageorgiou & Poggio, IJCV 2000]

Space-time rectangle features [Viola, Jones & Snow, ICCV 2003]

SVM with HoGs [Dalal & Triggs, CVPR 2005]

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Window-based detection: strengths

- **Sliding window detection and global appearance descriptors:**
  - ➢ **Simple detection protocol to implement**
  - ➢ **Good feature choices critical**
  - ➢ **Past successes for certain classes**

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Window-based detection: Limitations

- ## High computational complexity
  - For example: 250,000 locations x 30 orientations x 4 scales = 30,000,000 evaluations!
  - If training binary detectors independently, means cost increases linearly with number of classes
- ## With so many windows, false positive rate better be low

Limitations (continued)

- **Not all objects are "box" shaped**
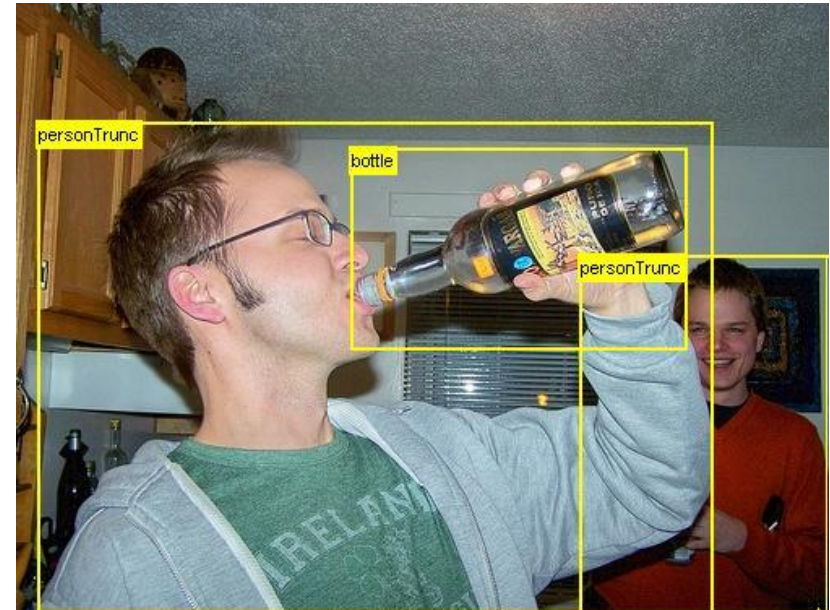
Limitations (continued)

- **Non-rigid, deformable objects not captured well with representations assuming a fixed 2d structure; or must assume fixed viewpoint**

- **Objects with less-regular textures not captured well with holistic appearance-based descriptions**
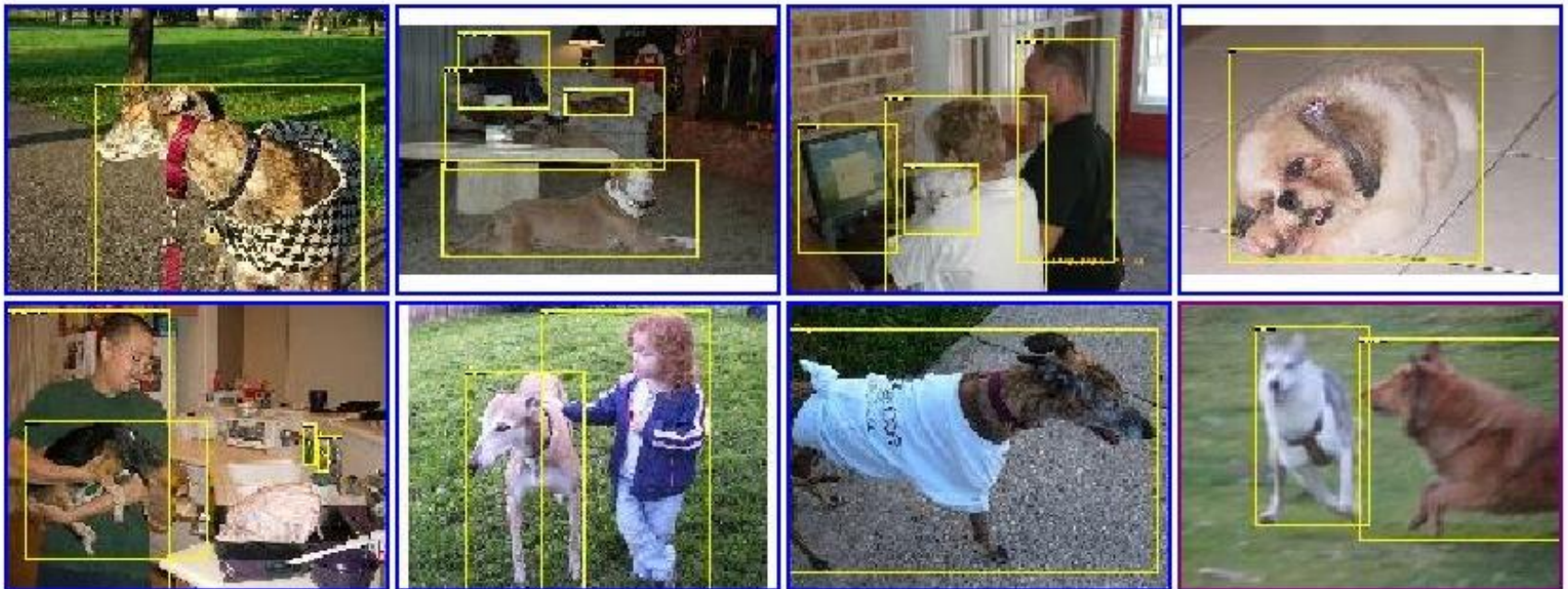
Limitations (continued)

- **If considering windows in isolation, context is lost**

Sliding window   **Detector's view**

Visual Object Recognition Tutorial

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Limitations (continued)

- **In practice, often entails large, cropped training set (expensive)**

- **Requiring good match to a global appearance description can lead to sensitivity to partial occlusions**

Image credit: Adam, Rivlin, & Shimshoni

Summary

- Basic pipeline for window-based detection

  - Model/representation/classifier choice

  - Sliding window and classifier scoring

- Viola-Jones face detector

  - Exemplar of basic paradigm

  - Plus key ideas: rectangular features, Adaboost for feature selection, cascade, hard negatives.

- Pros and cons of window-based detection