CS231A Project Discussion

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Winter 2015
Overview

- Project Logistics
- Class Coverage and Ideas
  - Geometry
  - Recognition
- Example Projects
- Helpful Resources
CS231A Project Logistics

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Project Logistics

- Teams of 1 – 4
  - Number of people is taken into account when grading project

- Suggestions for project direction
  - Replicate an interesting paper
  - Compare different methods to a benchmark
  - Use a new approach to an existing problem
  - Implement an interesting system
  - Original research
Sharing Project with Another Class

- Sharing projects is generally allowed
- Must be approved by both our staff and the other class’ staff
- Project must be big enough that you can clarify which parts of the project were done for which class
  - Each part must be substantial enough to hold as a single project
- Will need 2 separate write ups
Using your Research as a Project

- If your research is vision related, this is usually okay
- Must be approved by our staff
- In your write up, explicitly explain what you got from CS231A and how it helped
Project Grading

- Course Project is 38% of your final grade
  - Project Proposal - Required
  - Midterm Progress Report – 5%
  - Presentation – 8%
  - Final Report – 25%
Project Proposal

- Due on 2/2
- Maximum of 4 pages
- Must include:
  - Title and authors
  - Introduction to your project
    - What’s the problem
    - Why is it interesting
  - Technical approach
  - Milestones
  - References
- You will be assigned a project mentor
Project Midterm Progress Report

- Due on 2/20
- Maximum of 4 pages
- Halfway between proposal and final report
- Must include:
  - Title and authors
  - Introduction to your project
    - What’s the problem
    - Why is it interesting
  - Technical approach
  - Milestones
    - Achieved
    - Remaining (dates and goals)
  - References
Project Presentation

• Presentation dates on 3/9, 3/10, and 3/11
• 4 Minutes Total
  • 3 Minutes Talk
  • 1 Min Q & A
• Include at least:
  • Problem Motivation/Description
  • Technical Approach
  • Results
  • Quick “elevator pitch”
  • Audience participation
Final Project Report

• Due on 3/18
• Maximum 10 pages
• Submit code + report
  • Can request to not make project public
Project Report Contents

- Title and Authors
- Abstract
- Introduction
  - Introduce the problem you want to solve, explain why it is important to solve it
- Literature Review
  - Review of previous work
  - Describe why your method is better than previous work.
- Technical Approach
  - Summary of the technical solution.
  - Details of the technical solution.
- Experiments
  - Show numerical/quantitative and qualitative results
- Conclusions
- References.
Class Coverage - Geometry

- Camera Models / Calibration
  - Single camera and how we model it
- Single View Metrology
  - Estimating geometry from a single view
- Epipolar Geometry (Stereo Vision)
  - Estimating geometry from two viewpoints
- Structure from Motion
  - Using motion / several viewpoints to estimate structure
- Volumetric Stereo
  - Using multiple views to map 3d points
Geometry Project Ideas

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Geometry Idea - Morphed View

Geometry Idea - Morphed View
Geometry Idea – Single View Geometry

D. Hoiem, A.A. Efros, and M. Hebert, “Automatic Photo Pop-up”, ACM SIGGRAPH 2005
Geometry Idea – Scene Augmentation

The ‘yellow line’ in football games

THE VIRTUAL FIELD
The computer-generated map of the field appears as a blue grid on the computers used. It is manipulated to fit the cameras’ views.

THE LOOK OF THE LINE
The size and appearance of the line can be changed. It can look like paint on artificial surfaces or like chalk on grass fields.

CAMERA POSITIONS
Three cameras are used in the process. One is at the 50-yard line, and the others are at about the 25-yard lines.
Geometry Idea – Scene Augmentation

• Identifying occlusions, surfaces, etc from image/video
Geometry – 3d Models
Geometry Idea – Hardware and Systems

Use multiple cameras
Depth Cameras
Calibrate
Etc…
Geometry Idea – Hardware and Systems

Stanford University
CS231A Course Coverage - Recognition

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Class Coverage - Recognition

- Fitting and Matching
- Detectors and Descriptors
- Object Classification
- 2D / 3D Object Detection
- 2D / 3D Scene Understanding
Recognition Project Ideas

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Recognition Idea – Matching

M. Brown and D. G. Lowe, Recognizing Panoramas, ICCV 2003
Recognition Idea – Mid Level Segmentation

- Image segmentation
Recognition Idea – Image Completion

Recognition Idea – Object Recognition
Recognition Idea – Face Recognition
Recognition Idea - Classification
Recognition Idea – Pose Estimation
Recognition Idea – Gesture Recognition
Recognition Idea – Action Recognition

- standing
- walking
- turn around
- sit down
- sitting
Recognition Idea – Scene Understanding
Where to get Project Ideas

- Project suggestions provided by us – posted on website / Piazza
- Interesting vision papers in Journals
  - CVPR, ECCV, ICCV
- Computer vision research groups at Stanford
  - Email professors or their grad students
    - Silvio Savarese *
    - Fei-Fei Li
    - Sebastian Thrun
    - Daphne Koller
- **Look at last year’s projects**
  - [http://cvgl.stanford.edu/teaching/cs231a_winter1415/projects.html](http://cvgl.stanford.edu/teaching/cs231a_winter1415/projects.html)
- Come up with your own ideas
Data Sets Available

- Caltech – Object classification
- Face datasets
- Pedestrians
- Youtube videos
- Stanford Dogs Dataset
- Gesture
- Video surveillance
- Light field
- Sports
- Image Stitching

- Medical
- Buildings
- Plants
- 3d Photography
- RGBD scenes
- Traffic
- Head tracking
- Eye tracking
- Segmented images
- SO MANY MORE …
Quick Links to Dataset Aggregators

- http://riemenschneider.hayko.at/vision/dataset/
Useful Things

- OpenCV
  - Industry standard
  - Support for lots of programming languages
- Matlab
  - Image Processing/Computer Vision toolboxes
- Various camera / sensors
  - Depth sensors
    - Kinect
    - Leap motion
  - Tablet
    - NVIDIA
    - Amazon fire
Face Recognition
Example Project - Mustachify
Example Project - Mustachify
Character Recognition in TV Show
Facial Verification using Fisher Vectors and Deep Nets
Action Recognition
Hand Gesture Recognition

Figure 2. Rectangular hand shape is used to select part of the scene to be cropped out.

Figure 3. Two main components: gesture detection and object selection.
Tracking Objects in Youtube Videos

Figure 4. Snapshots from Soccer Video showing tracking under multiple view points
Research Oriented
Keypoint Descriptor Inspired by Retinal Computation
Comparative Study of Color Edge Detectors
Genetic Algorithm for Jigsaw Puzzle Solver
General Classification
Beer Label Recognition Engine

Figure 2: Bottle Photos w/ Varying Angles and Illumination
Sketch Based Object Recognition

Sketch Canvas

Top Categories (ranked highest to lowest)
- face (25.8%)
- head (18%)
- alarm clock (6.26%)
- skull (5.52%)
- snowman (4.95%)
- strawberry (3.76%)

Sketch tools: Brush, Eraser, Clear Screen, Search

Top Matches (ranked from left to right, top to bottom)
Geometry
Analyzing All-22 NFL Film

*Figure 2: Automatic detection of yardlines on a football field (left) using the Hough transform (right).*
Analyzing All-22 NFL Film (cont.)

Figure 4: Automatic recognition of Baltimore players, with bounding box overlaid on play image (left) and on the underlying processed image (right) that exposes the unique color features of the Baltimore players: black pants.
Chess Analysis
3D Reconstruction from Multiple Images

Figure 4: Sparse and Dense 3D models for the Fountain dataset
Computer Vision for Augmented Reality
Final Notes - Advice

- Choose your team well
- Make sure the scope of your project fits a quarter
  - A good plan may be to have a minimum goal, goal, and moonshot
- Constrain your problem smartly
- See what data is available if you’re doing a recognition project
- You may need to plan ahead / learn outside material
- Use software when available
  - OpenCV
  - Matlab
- Come ask questions – we’re happy to talk
- Have fun!