Image and Video Processing

Overview

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Image Processing vs. Computer Vision

- Image/video processing
  - Low level processing to
    - Enhance original data (denoising, contrast enhancement, increase sampling rate, deblurring, stabilization)
    - Compression: to reduce the data rate for storage/transmission
- Computer vision
  - High level processing to
    - Detect and classify objects, Semantic level segmentation
    - Recover 3D structure/scene from 2D
- In between (Intermediate level)
  - Feature detection, low level (color based) segmentation
  - Image alignment (generating panoramas, image registration)
  - Motion estimation (to enable video compression, object tracking, object detection)
  - Depth estimation (to enable 3D reconstruction from stereo)
- This class will focus on low and intermediate level

Applications

- Social media and entertainment (content creation, delivery, and presentation)

- Visual Communications (video chat and conferences)

- Medical Image analysis (tissue/organ/tumor segmentation, image alignment, change detection)

- Robotics (recognizing objects, mapping the environment)

- Law Enforcement (deblurring of video, face detection and recognition, license # recognition, fake media detection)

- Education/training (online teaching, video tutorials)

- Advertising

- …

Breakdown of the Course

- Image processing basics

- Video processing basics

- Feature extraction

- Image alignment and stitching based on feature correspondence

- Stereo and multiview image/video basics

- Image and video compression

- Deep learning based image processing and classification

- Both theory and practical implementation in python

- See Syllabus for more details.

Class Requirement

- Weekly lectures
- 2 tutorials related to programming
- Weekly written homework: Not graded. Solution will be provided.
- Bi-weekly (approximately) quizzes based on written homeworks (40%)
  - To encourage you to review the lecture material, many are not covered in programming assignment. Quiz will be based on written HW problems.
  - Will be done in the last 20 minutes of the class. Dates posted in course website.
- Six programming assignment (in Python) (30%)
  - We will provide partially completed Jupyter notebooks to guide you. You can either complete the Jupyter notebooks, or write your python code from scratch to challenge your self!
- Team Projects (30%)
  - Proposal: 2 pt, Midterm report: 3 pt, Final report: 5 pt, presentation: 10 pt, content: 10 pt.
  - Find your project partner(s) ASAP.
- No exam
- Lots of work but you will learn a lot and you can do it!

Homework

- Written HW will be assigned after each lecture but will not be graded. Solution will be provided. You should try to review the lecture material and do the problems yourself before checking the solution. Quizzes will be based on the written HW.

- Programming assignment will be due as posted. The assignment is typically given 2 weeks ahead of due time. Each assignment counts for 10 points. But total will be renormalized to 30. So each assignment contribute 5 points towards your final total.

- Late submission of programming assignment will be accepted up to 3 days late, with 2 pt (out of 10 pt) deduction for each day.

- Students can work in teams, but you must submit you **own** solutions.

- If there are special circumstances that make it hard you to complete in time, you should reach out to the Office of Student Advocacy, to request accommodation.

Quizzes

- Quizzes will be held approximately biweekly, in lieu of exams.

- Quiz problems will be similar to the written HW problems.
  - Two problems per quiz, 15 minutes.
  - 7 quizzes planned. Total count 40 points, ~6 pt per quiz towards the final total.

- Quiz will be conducted towards the end of the lecture time:
  - Open notes, but no phone/computer/ipad access, and no discussion with others
  - Please make every attempt to attend the quiz at the scheduled time! No make up allowed unless in extraordinary situations with approved accommodation by the Office of Student Advocacy.

Project

- Team Projects
  - 2 to 3 people in a team: bigger scopes expected for a larger team. Each member should be primarily responsible for some of the tasks.
- Project topics:
  - A list of suggested topics is given, each with a mentor (my PhD students and class TAs) assigned. They are there to help you.
  - If you want to work on a project outside the list, please speak to me. I may be able to find a mentor for you.
  - You would need to self-study for the chosen subject, which may not be covered until later in the class. Some suggested topics are not covered in the class.
- Four deadlines
  - Determine project team and possible project topics and submit preliminary proposal (just name and preliminary topic) (week 3)
  - Submit project proposal (should have read some papers and have a project plan) (week 5)
  - Submit midterm project report (Week 10)
  - Proj presentation and submit final project report (Week 15)

Office Hours

- Please come see us! We are here to help.

- Yao Wang: Mon 4-5 PM (online or in-person), Wed 4:30-6 PM (after class or in office), or appointment by email.

- TA office hour: TBA (see homepage for update). In person as well as online.

- Zoom links will be posted in NYU brightspace site.