Computer Vision with Deep Learning

Course Instructor:
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Course Description:
Computer vision is a field that focuses on building machines that can see. In this course, we will cover the fundamentals of major tasks in computer vision, starting from the basics of image formation to modern computer vision methods based on deep learning. By the end of this course, students will have a solid foundation for conducting research in computer vision and the necessary technical background to understand and implement state-of-the-art vision papers.

Learning Resources, Technology and Texts
Recommended Textbooks:

- Forsyth, David A., and Jean Ponce. "A modern approach." *Computer vision: a modern approach*, 2003
- Szeliski, Richard. *Computer vision: algorithms and applications*. Springer Nature, 2022.
- Zhang, Aston, et al. *Dive into deep learning*. Cambridge University Press, 2023.

Prerequisite
- Background in linear algebra (MA 26500 Linear Algebra)
- Background in probability (STAT 41600 Probability)
- Background in machine learning (CS 37300 Data Mining & Machine Learning)
- Be comfortable with Python

Grading Criteria
- Five homework assignments with programming (50%)
- Midterm (25%)
- Final project (25%)

The final grade will be curved and no stricter than the cutoff: A+: 97-100, A: 93-96, A-: 90-92, B+: 87-89, ..., etc.

Attendance

Students are expected to attend the lectures in person; however, I will not take formal attendance.

Course Schedule (Tentative)

Each module covers roughly a 2~3 weeks.

1. Image Processing
   - Low-level image representation
   - Sampling, interpolation, transformation
   - Filtering and edge detection
2. Grouping and Fitting
   - Least squares fitting, robust fitting
   - RANSAC
   - Image stitching
3. Image formation / 3D Vision
   - Camera models
   - Camera calibration
   - Light, sharing, and color
   - Multiview Stereo and NeRF
4. Deep learning + Vision
   - Statistical learning framework
   - Image classification, detection, segmentation
   - Advanced topics (image generation, 3D vision, language and vision, etc.)