ECE 4580 Syllabus

Computational Computer Vision ECE 4580, Section A, 3 Credits

Fall 2026

Instructor Information

Instructor: Jeffery Hurley

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General Course Information

Description

This course introduces the theory, algorithms, and practical techniques that enable computers to interpret and reason about visual information. Students will study the full pipeline of modern computer vision, beginning with image formation, camera models, and low-level processing (filtering, edge and feature detection, image pyramids), and progressing through mid-level topics such as feature matching, optical flow, image stitching, segmentation, and stereo and multi-view geometry. The latter portion of the course covers high-level vision tasks including object detection, recognition, and tracking, with an emphasis on both classical methods (Kalman filtering, graph cuts, SIFT/ORB) and contemporary deep learning approaches (CNNs, ResNet and transfer learning, R-CNN family detectors, YOLO, and Vision Transformers).

Course Learning Outcomes

Derive and describe image formation with regards to world and camera relative geometry.

Describe the process of camera calibration and its related optimization formulations.

Apply stereo triangulation and epipolar constraints for solving vision related problems.

Describe the relationship between the heat equation, diffusion, and Gaussian smoothing.

Apply and implement differential and convolutional operators as discrete stencil operations.

Explain the role of optimization in solving vision-based problems or estimating visual properties.

Describe the purpose of adding prior constraints or regularization terms to computer vision derived optimization problems.

Describe fundamental approaches to segmentation and clustering.

Explain the equations underlying optical flow and their derivation from cost functionals.

Required Course Materials

There is not a required textbook. Class notes will be distributed when applicable. Online references will be provided also.

Grading Policy:

Programming Assignments 70%; MidTerm 10%; Final Project 20%.

A>90; B>80; C>70; D>60

Assignments

- Homework 1, 10%
- Homework 2, 10%
- Homework 3, 10%
- Homework 4, 10%
- Homework 5, 10%
- Homework 6, 10%
- Homework 7, 10%
- Midterm, 10%
- Final Project 20%

Description of Graded Components

There is a homework assignment for each of the major topics covered. The final project combines several of the topics covered.

Course Policies

Attendance and/or Participation

This will be an active classroom, where you will be expected to participate. I have noticed a drastic difference in the performance between students who regularly attend class and participate compared to those who don't. Therefore, course attendance and participation is considered when determining your final grade.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Core IMPACTS

This course does not count towards a Core IMPACTS area.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Pre- &/or Co-Requisites

ECE 2025 [min C] Prerequisite.
Some programming experience in MATLAB, C/C++, Python, or some software language.

Collaboration, Group Work, and Use of Generative AI

You are allowed to consult with other students on all homework assignments, but any work you turn in must be written in your own hand.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Late homework will be penalized accordingly. Homework extensions are given for illness, approved Institute activities or religious observances.