ITCS 4152
Syllabus
Spring 2025

Welcome to ITCS 4152 – Computer Vision! My name is Srijan Das, and I will be your instructor for this course. This is a challenging course that covers a lot of technical and application-oriented material. However, if you stay on track with weekly activities and avail of the numerous opportunities to seek help when needed, I see no reason why you would not succeed in this class. Start your journey by reading this syllabus in detail.

Course Information

Course Number ITCS 4152
Course Title: Introduction to Computer Vision
Term: Spring 2025
Credit Hours: 3
Mode of delivery: in-person
Meets: Monday and Wednesday 5:30 PM – 6:45 PM
Location: CHHS 380
Online materials and video conferencing: Canvas and Zoom

Instructor: Srijan Das
Contact: sdas24 “at” charlotte.edu
Office Hours: Friday 11:00 AM - 1:00 PM (in-person/zoom) appointment recommended
Location: Woodward 410E

TA: Tonmoy Hasan (thasan1@charlotte.edu)
TA Office Hours: Tuesday 3:00 PM - 5:00 PM
Thursday 3:00 PM - 5:00 PM

Course Description

Computer Vision is the study of enabling machines to "see" the visual world (i.e., understand images and videos). In this course, the students will learn fundamental computer vision algorithms and have opportunities to implement them. Further, we will be discussing more recent state-of-the-art visual representation learning approaches.

Course Prerequisites

For ITCS 4152, this course has a prerequisite of ITCS 3156 (Introduction to Machine Learning). The concepts of Linear Algebra and Matrices will be crucial in understanding the foundations of this course. If you have not mastered some concepts in 2164 which is a prerequisite of ITCS 3156, please get in touch with me or the TA for additional resources/help. Also, the ability to program will be necessary. We will be programming in Python (OpenCV, NumPy, SciKit). For deep learning exercises, we will use Pytorch.

Course Objectives

Having successfully completed the first module of this course you will be able to:

- Implement basic image processing algorithms

Having successfully completed the next two modules of this course, you will be able to demonstrate knowledge and understanding of:

- Current approaches to image formation and image modelling
- Current approaches to basic image processing and computer vision
- Human and computer vision systems

Having successfully completed the last module of this course you will be able to:

- Develop and evaluate solutions to problems in computer vision
- Demonstrate awareness of the current key research issues in computer vision
- Analyze and design a range of algorithms for image processing and computer vision

Class Support

Instructor Office Hours: Professors will host office hours on Fridays from 11:00 AM to 1:00 PM in Woodward 410E/Zoom. Please use this time to ask more conceptual questions or talk to the Professors. If you have in-depth homework help, please visit TA office hours instead.

TA Office Hours: IAs will hold office hours throughout the week to answer conceptual, homework, and discussion questions.
Note: **TAs are not required to debug your code.** Because office hours tend to have long wait times, course staff needs to be fair in answering as many questions as possible, and it's thus infeasible for an TA to spend 20 minutes debugging someone's code. Before you make a code debugging-related request, please take time to thoroughly debug your code. Thank you!

List of Topics to be covered

- **Module 1: Fundamentals of Computer Vision**
  - Image Formation
  - Image Filters
  - Image derivatives
  - Edges (Canny Edge Detector)
  - Interest Point Detection (Harris Corners detectors)
  - Local Image Descriptors and Template Matching (SIFT)

- **Module 2: Deep Neural Networks**
  - ML basics (Recognition/classification)
  - Basics of DNNs (Perceptrons)
  - Convolutional Neural Networks (CNNs)

- **Module 3: Applications of Computer Vision**
  - Image Classification
  - Object Segmentation & Detection

Background reading materials

On Canvas, you will find a collection of basic Python programming examples presented in a Jupyter notebook format. Additionally, a set of slides covering fundamental mathematical concepts will be made available on Canvas.

- Python programming:
  - Python for Everybody
  - Python lecture
- Probability and statistics:
  - Basic probability theory (pp. 12-19) in Pattern Recognition and Machine Learning.
- Linear Algebra:
  - Chapter 2 in DL textbook on Linear Algebra.
  - Chapter 2 on Linear Algebra in Mathematics for Machine Learning.
  - Inderjit Dhillon's Linear Algebra Background
  - Gilbert Strang's Introduction to Linear Algebra
  - Petersen et al.'s The Matrix Cookbook
  - Mike Brookes' Matrix Reference Manual
- Calculus:
  - Basic properties for derivatives, integrals, exponentials, and logarithms.
  - Chapter 4.3 in DL textbook on Numerical Computation.
  - Gilbert Strang's Calculus texbook.

Textbooks

Computer Vision: Algorithms and Applications by Richard Szeliski
Computer Vision: A Modern Approach by David Forsyth and Jean Ponce

Video Materials

First Principles of Computer Vision – by Shree Nayar
CS231n: Convolutional Neural Networks for Visual Recognition – by Fei Fei Li, Andrej Karpathy, Justin Johnson
Introduction to Computer Vision – Free course at Udacity (also offered at Georgia Tech as CS 6476)

Assessment

Course Grades

- **Assignments** (30%): 5 assignments (programming intensive)
  Completing all homework assignments is mandatory for all students, only 4 out of the 5 assignments are required to be completed.
  - You are expected to do assignments by yourself.
  - Even if you discuss them with your classmates, you should turn in your own code and write-up. Do not share your code!
  - 3 free late dates for the semester, after that 10% penalty per day.
  - You cannot exceed a max of 4 late days per assignment.
- **Final Project** (30%): team project with presentation and reports
- **Mid-term Exam** (20%)
- **In Class Practice Sessions** (20%)

Optional **End-term Exam** to replace any one of the above sections.

Grading Scale

- 90% and above: A
- 80% to 89.99%: B
- 70% to 79.99%: C
- 60% to 69.99%: D
- Below 60%: F

The instructor has the authority to adjust the grading scale at any point during the course. Such modifications are likely to occur when the class average falls below a specific threshold.

Academic Integrity

Ethical behavior is an important part of being an engineer. It is a part of our responsibility to act ethically and honestly, and moreover, ethical behavior is what helps you learn best. Cheating is fundamentally dishonest and antisocial behavior. We have a zero-tolerance policy for cheating. Any offense will result in negative points for the category that the offense occurs in, with no bound on how negative it can go, and a referral to the Accountability Office.

You are not permitted to upload any of our problems, solutions, or your own solutions to our problems to any site that is accessible by other people. Use Canvas to discuss content. The only limited exceptions to this are online communication mediums between you and the collaborating individuals explicitly listed on your homework assignment. Looking at online solutions from previous semesters or other students is forbidden, as is sharing of your solutions with others. Furthermore, students all have an affirmative duty to report possible cases of cheating or unauthorized communication to the course staff, immediately. Acknowledgement of and failure to report cheating implicates the bystander since this is academic misconduct. Cheating hurts us all and engineering ethics requires us to point out wrongdoing when we are aware of it. To summarize, you are expected to follow the UNC Charlotte Code of Student Academic Integrity for all activities, assignments, and exams in this course (http://legal.uncc.edu/policies/up-407).

Collaboration

You are encouraged to work on homework problems in study groups of up to five people, however, **you must always write up the solutions on your own**. You are not permitted to look at the final written solution even for members of your own study group. Similarly, you may use books or online resources (not solutions from previous terms) to help solve homework problems, but **you must always credit all such sources in your writeup and you must never copy material verbatim**. We believe that most students can distinguish between helping other students and cheating. Explaining the meaning of a question, discussing a way of approaching a solution, or collaboratively exploring how to solve a problem within your group is an interaction that we strongly encourage. But you should write your homework solution strictly by yourself. You must explicitly acknowledge everyone whom you have worked with or who has given you any significant ideas about the homework.

Course Policies

- **My (instructor's) commitment**: You can expect me to be courteous, respectful, and punctual; be well organized and prepared for class; answer questions clearly and in a non-negative fashion; be available during posted student drop-in / office hours or notify you beforehand if I am unable to keep them.
- **Your commitment**: The best way to learn and master the concepts covered in this course is to engage with the course material and then engage in discussions and activities with your fellow students and your instructional team (i.e., instructor/IAs).
- **Course material**: All course material will be available on Canvas. Please check Canvas periodically. Course materials, including presentations, tests, exams, outlines, and similar materials, are protected by copyright. You are free to take notes and make copies of course materials for your own educational use. However, you may not, nor must you allow others to reproduce or distribute lecture notes and course materials publicly without my express written consent. This includes providing materials to commercial course material suppliers such as CourseHero, Chegg and other similar services. If you publicly distribute or display or help others publicly distribute or display copies or modified copies of the course material, you may be in violation of University Policy 406 (https://legal.uncc.edu/policies/up406), The Code of Student Responsibility.
- **Course announcements and communication**: I will use Canvas for all announcements and other course related communications. Please make sure to check Canvas on a regular basis to ensure that you do not miss any important information. You should also use Canvas to ask/answer questions pertaining to the class. Please use email communication only for personal/grade related issues.
- **Exercises/Assignments**: You will work on numerous exercises/assignments throughout the semester. These exercises are designed to help you apply and / or get hands-on experience with course concepts. You are encouraged to discuss the questions with your lightweight team, but you must individually submit the exercise/assignment on Canvas (e.g., for questions that require a written response, you may discuss the idea in your team, but must write the final answer in your own words; for exercises/assignments that require you to write a program, you may discuss the algorithm/steps with your team, but you must write the final program on your own). Most exercises/assignments that have auto-graded components allow two attempts, giving you an opportunity to correct mistakes you may make on auto-graded questions during your first attempt. All exercises/assignments have firm due dates, with a grace period where you can still submit, but will incur a small penalty. Having firm due dates will help you stay on track with course material and will help us give you timely feedback on your submissions.
- **Grading**: Teaching assistants will be responsible for grading in-class activities, tests and assignments. If you believe that an error has been made in grading, please bring it to the TA. If you are unable to resolve the issue with the TA, please reach out to me.
- **Engagement**: As mentioned earlier, this class is a collaborative space. A portion of your overall course grade will be determined based on how you engage with me, your TAs and

with your lightweight team members. Details about how points will be awarded/deducted will be posted explicitly on Canvas.

- **Missed course work/tests**: If you have any medical emergencies, care-giver concerns or other documented reasons for being unable to submit exercises/assignments on time, being unable to attend a test, etc., please reach out to me (ahead of time whenever possible) and we can work together to find a suitable solution.
- **Disability services**: Many students have visible or invisible disabilities. UNC Charlotte is committed to access to education and offers accommodations that allow all students to achieve their full potential. If you have a disability and need academic accommodations, please send me your accommodation letter as early as possible. You are encouraged to meet with me to discuss the accommodations outlined in your letter. For more information on accommodations, contact the Office of Disability Services (https://ds.uncc.edu/) at 704-687-0040 or disability@uncc.edu.
- **Non-discrimination:** No student will be discriminated against in this class based on age, race, nationality, religion, sexual orientation, gender identity/expression, veteran's status, country of origin, or group affiliation. You are expected to behave in a respectful manner towards others in the class, both in virtual and face-to-face settings. Continuous or repeated disrespectful behavior will be considered to be creating a hostile environment, which constitutes a violation to the University Policy 406 (https://legal.uncc.edu/policies/up-406), Code of Student Responsibility. In such a case, you will be referred to the Office of Student Conduct or the Title IX Office. Based on such referral, the Director or designee will determine whether a Formal Charge(s) shall be pursued and whether the Formal Charge(s) constitutes a Minor Violation or a Serious Violation, based on your prior record or facts and circumstances related to the case.
- **Syllabus Revisions**: I may modify standards and requirements set forth in this syllabus if a need arises. I will notify you of any such changes by announcement on Canvas and revision to this syllabus page.

Acknowledgement

This course has been inspired by the Computer Vision course by Kristen Grauman (Meta/UT), Devi Parikh (Meta/Gatech), Michael S. Ryoo (Google/Stony Brook), and Shree K. Nayar (Columbia). The background reading materials are adapted from Razvan Bunesco's Machine Learning course. This syllabus structure is adapted from ITSC3146 by Harini Ramaprasad (UNC Charlotte) and CS 189/289A by Jennifer Listgarten and Jitendra Malik (University of California, Berkley).