Computer Vision – Fall 2025

Course Description: Computer vision is the process of using computers to acquire images, transform images, and extract symbolic descriptions from images. This course provides an introduction to this field, covering topics in classical computer vision such as image formation, feature extraction, location estimation, and object recognition, as well as modern computer vision techniques based on neural networks, mechanisms of training and running these networks, and their applications in computer vision. Hands-on homework will be assigned to practice popular CV software tools.
By the end of the semester, students should be able to:

- Understand the fundamental and modern concepts, problems, and solution techniques in computer vision
- Apply computer vision techniques to solve common problems in research and industrial applications, such as image filtering, 3D reconstruction, and recognition
- Use image processing and image understanding software tools

Course Repository: https://github.com/ariarobotics/cv

Prerequisites:

- Linear algebra, calculus, probability, and statistics
- Algorithms, and Python (or C++)

This course will require you to program in python. If you do not know Python, consider going through any of many online Python introduction lectures available on YouTube, such as Dr. Camp's Python Videos.

Time/Location: Fall 2025; Mon/Wed 3:00-4:15pm; CoorsTek 130

Instructor: Kaveh Fathian, Assistant Professor, Computer Science Department

- **Office**: Brown 280-N
- **Office hours**: Mon/Wed 4:15-5:00pm (after class)
- **Personal website**: https://sites.google.com/view/kavehfathian/
- **Lab website**: https://www.ariarobotics.com/

Assessments and Grading:

- **Homework (60 pts):** There will be up to **12 homework assignments**. Students are allowed to discuss the problems, help each other, use online resources, etc., however, they must understand the solutions and prepare/submit the homework **individually**. **Identical** submissions are considered plagiarism and will receive a **zero** grade. Homework solutions will **not** be posted. Homework **submission deadlines** will **not** be **extended** except in extraordinary circumstances, and **late homework** will receive a grade of **zero**. The **lowest grade** (or missed) homework will be **dropped** automatically and not considered toward the final grade. **Three or more missed homework** will result in an **Incomplete grade.**
- **Exams (40 pts):** There will be **4 exams** scheduled during the regular class hours. The exams are based on lecture slides, class discussions, and homework. Exams will be **in person**, in the classroom. Students who require alternative testing location/arrangement are responsive for submitting those requests. Students will **not** be allowed to use any resources during the quiz (such as lecture notes, online search, generative AI, calculators, or smartphones). The **lowest grade** (or absent) exam will be **dropped** automatically and not considered toward the final grade. **No make-up exam** will be given even if the student submits an **excused absence** (except in extraordinary circumstances, determined at instructor's discretion, in which the student must provide **documentation** to justify). Any **missed exam** will receive a grade of **zero. Two or more missed exams** will result in an **Incomplete grade.**
- **Bonus points (10 pts):** The instructor may assign *optional* extra assignments, projects, etc., as bonus points. The bonus points are designed to help students improve their final grade.
- **Attendance:** Attendance is **mandatory** but not monitored. Some of the course material will only be discussed in the class and will not be recorded or posted on the slides. The instructor is not responsible for correcting attendance issues due to negligence.

Final grade: Homework (60pts) + exams (40pts) = 100pts
Bonus points: Your final grades will be amended by adding your bonus points: Amended final grade = final grade + bonus points (10pts max). Any amended grade higher than 100pts will be capped at 100.
Rubric: Based on the amended final grade:

[93, 100]	A
[90, 93)	A-
[87, 90)	B+
[83, 87)	B
[80, 83)	B-
[77, 80)	C+
[73,77)	C
[70, 73)	C-
[67, 70)	D+
[63,67)	D
[60, 63)	D-
[0, 60)	F

Logistics:

- The main communication channel between the students and the instructor/TAs is the **Ed Discussion** sever (not email or Canvas). The Ed Discussion server link is incorporated into Canvas (left panel). All class announcements, questions/discussions, etc., will be posted on Ed Discussion.
- Students are expected to have a **computer** (e.g., a personal laptop) to take **quizzes** on Canvas in the class. Students **cannot** use their **smartphones** to take the quiz. Workstation computers are available in the class. Furthermore, students can loan laptops from Mines ITS or the CS department if needed.
- Information about the class **TA**s and their office hours is posted at: https://github.com/ariarobotics/cv

Resources:

There is no required textbook. Lecture slides and other course material will be provided at https://github.com/ariarobotics/cv
Recommended books (many available for free online):

Computer vision:

- Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010 (online draft)
- Klette, Concise Computer Vision: An Introduction into Theory and Algorithms, 2014
- Hartley and Zisserman, Multiple View Geometry in Computer Vision, Cambridge University Press, 2004
- Forsyth and Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2002
- Palmer, Vision Science, MIT Press, 1999

Learning:

- Goodfellow, Bengio, Courville, Deep Learning, MIT Press, 2016
- Mitchel, Machine Learning, McGraw-Hill, 1997
- Duda, Hart and Stork, Pattern Classification (2nd Edition), Wiley-Interscience, 2000
- Sutton & Barto, On-line book. The classic reference to the field of reinforcement learning.

Graphical models:

- Koller and Friedman, Probabilistic Graphical Models: Principles and Techniques, MIT Press, 2009

Course schedule:

Detailed class schedule is available at: https://github.com/ariarobotics/cv
The schedule is subject to changes. Quiz/homework dates will not change (except in extraordinary circumstances).

Policy on missed classes, exams, or late assignments:

- The **lowest exam grade** (or an absent exam) will be automatically dropped and will not count toward the final grade.
- The **lowest homework grade** (or a missed submission) will be automatically dropped and will not count toward the final grade.
- In-person class **attendance is mandatory** as some material will be discussed only in the class and not recorded/posted.
- **No late submissions** are allowed. Late homework will receive a score of **zero**.
- Exceptions to above may be granted only under extraordinary circumstances and at the instructor's discretion, in which the student must provide **documentation**.

Other important course policies:

- Any form of **academic dishonestly, misconduct**, or **plagiarism** will be taken very seriously and prosecuted.
- Use of any resources is **NOT allowed** during exams. Use of generative AI tools (e.g., ChatGPT) is allowed outside of the class.
- **Professional language and etiquette** are expected from all students (see Mines policy). Report to the instructor if you feel that inappropriate conduct or behavior has occurred.

Mines Policies & Campus Resources:

Absences:

Mines students are expected to fulfill their academic requirements through attendance and/or participation. Class attendance is required of all students unless the student has an excused absence granted by the school or the student's professor. An

excused absence awarded by the school or professor comes after a student's request or initiative. To review the Excused Absence Policy and/or to request an excused absence, please visit https://www.mines.edu/student-life/student-absences/.

Sexual Misconduct, Discrimination, and Retaliation:

Discrimination, Harassment, and Sexual Misconduct of any type, including sexual harassment, sexual assault, dating violence, domestic violence, and stalking, are prohibited under the Policy Prohibiting Sexual Misconduct, Discrimination, and Retaliation. Please see the Office for Institutional Equity website for information on Sexual Misconduct and Discrimination.

Preferred First Name:

Mines recognizes members of the campus community may prefer to use a first name other than their legal name to identify themselves. Many services on campus, like Canvas, utilize and display preferred first names. Additional information on preferred name, including how to update your preferred name, is available at the Office For Institutional Equity website.

Academic Integrity:

Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining, and fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and effectively evaluate every student's academic achievements, and giving credence to the university's educational mission, its scholarly objectives, and the substance of the degrees it awards. We desire an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times. Please read the full academic misconduct/integrity policy for full definitions of academic misconduct. Additionally, please use resources provided by the Office of Community Standards for guidance should you need to know more about the procedures of the policy for academic misconduct/integrity.

Generative Artificial Intelligence:

The Office of the Provost encourages the entire University community to explore the uses and impacts of GenAI technologies, whether through critical discussions or creative applications. Based on a review of the most recent Guidelines for Using Generative Artificial Intelligence at Colorado School of Mines, the use of GenAI for this course will be allowed outside of the class, however, it is prohibited during the class (e.g., for coding sessions and during exams).

Grading Policy:

Extra credit may be offered for additional learning activities related to this class. Unless otherwise detailed in this syllabus, the awarding of extra credit is at the discretion of the instructor and is not guaranteed.

Course Issues and Concerns:

As part of good professional practice, students are encouraged to speak with the faculty directly to raise issues and concerns with regards to the course professionally in compliance with the student code of conduct. Students can also reach out to the course coordinator or the head of the department the course is being offered through. The department head can investigate and work with the faculty member to resolve course-related concerns. Students' final point of contact is the college dean who can make any final decisions.

Disability Support Services:

Disability Support Services (DSS) works collaboratively with students, faculty, and staff to minimize barriers and support an accessible campus community. When barriers to access occur, Disability Support Services works one-on-one with students to determine accommodations and facilitate access to programs and services. If you've been approved for accommodations through Disability Support Services, please contact your professor to confirm receipt of your accommodation letter and to discuss the implementation of accommodations in this course. Please visit mines.edu/disability-support-services for more information or to request accommodations.

Digital Accessibility:

The Colorado School of Mines is committed to supporting an accessible digital environment for all members of our community, including students with disabilities. If you have an accessibility concern with Canvas or any digital materials or software used in this course, please contact your professor or request support from Information & Technology Solutions. Please visit https://www.mines.edu/accessibility/ for more information.

Student Outreach & Support (SOS) Resources:

If you feel overwhelmed, anxious, depressed, distressed, mentally or physically unhealthy, or concerned about your wellbeing overall, there are resources both on- and off-campus available to you. If you need assistance, please ask for help from a trusted faculty or staff member, fellow student, or submit a referral for yours. As a community of care, we can help one another get through difficult times. If you are concerned for another student, offer assistance and/or ask for help on their behalf. Students seeking resources for themselves or others should visit mines.edu/sos.

Student Outreach and Support can help connect you with a variety of resources; some of those might include:

- Counseling Center – https://www.mines.edu/counseling-center/ or students may call to make an appointment. There are also online resources for students on the website. Located in the Wellness Center 2nd floor. Located at 1770 Elm St.
- Health Center - https://www.mines.edu/student-health/ or students may call to make an appointment. Located in Wellness Center 1st floor.
- Colorado Crisis Services - For crisis support 24 hrs/7 days, either by phone, text, or in person, Colorado Crisis Services is a great confidential resource, available to anyone. http://coloradocrisisservices.org, 1-844-493-8255, or text "TALK" to 38255. Walk-in location addresses are posted on the website.

In an emergency, you should call 911, and they will dispatch a Mines or Golden PD officer to assist.

Diversity and Inclusion:

At Colorado School of Mines, we understand that a diverse and inclusive learning environment inspires creativity and innovation, which are essential to the engineering process. We also know that in order to address current and emerging national and global challenges, it is important to learn with and from people who have different backgrounds, thoughts, and experiences.

Our students represent every state in the nation and more than 90 countries around the world, and we continue to make progress in the areas of diversity and inclusion by providing Diversity and Inclusion programs and services to support these efforts.

Center for Academic Services and Advising (CASA):

CASA provides a variety of services to support students during their time at Mines. Please see www.mines.edu/casa for a complete list of current support services.

The Writing Center:

The Writing Center is a free academic support service for undergraduate and graduate students. Professional consultants and peer tutors provide support with all forms of communication including technical and scientific reports, academic essays, and oral presentations. Students can make an online or in-person appointment at any stage of their project, from brainstorming to final revisions.

To learn more about their services and to make an appointment, please visit writing.mines.edu. For questions, please e-mail writing@mines.edu