# CVI620 - Computer Vision
## Summer 2025 Syllabus, Section NSB, Class Nbr 8209

## Course Description

As cameras are becoming a popular feature of standard PCs and mobile devices, it is important to be able to extract useful information from this data. This course covers simple computer vision concepts, such as capturing digital images and video, applying simple and arithmetic changes to images (e.g. crop, rotate, enhance color), and extracting information from images (e.g. finding or counting objects). Also, concepts such as tracking objects in a video sequence are introduced. Students will work on a project targeting a computer vision application such as face recognition, security systems, medical imaging, robotics, and others.

## Prerequisite(s)

To succeed in this course, students are expected to have basic knowledge of Python programming and mathematics.

Prior exposure to libraries such as NumPy and Matplotlib are recommended.

## Instructor Information

**Ellie Azizi** - Primary Instructor
Email: ellie.azizi@senecapolytechnic.ca
Summer 2025 Office Hours:
Students are welcome to book an online meeting with the instructor using https://calendly.com/elham-azizi749/30min?. Please ensure you book at least two business days in advance, unless it's an emergency.. Please ensure you book at least two business days in advance, unless it's an emergency.

## Online Synchronous and Asynchronous Mode

This class will be taught via an **online synchronous and asynchronous** instruction mode. Students are required to engage in scheduled and unscheduled classes online. Students are expected to participate in real-time interactive lectures for scheduled classes and work independently to complete learning modules for unscheduled classes.

## Times and Location

TTh 3:20pm-5:05pm in ONLINE

## Course Learning Outcomes

**Upon successful completion of this course the student will be able to:**

1. Describe the hardware and imaging components to setup a computer vision system
2. Discuss image representation techniques and standards to read and write grayscale and color digital image files
3. Solve image arithmetic problems to apply image effects
4. Explain feature detection methods to detect basic recognizable entities such as edges, corners, and blobs
5. Compare matching methods for object recognition to identify the strengths and weaknesses of each algorithm
6. Assess the optical flow method to track moving objects
7. Implement a vision system to solve a recognition or tracking problem

## Essential Employability Skills

- execute mathematical operations accurately
- apply a systematic approach to solve problems
- use a variety of thinking skills to anticipate and solve problems
- locate, select, organize, and document information using appropriate technology and information systems
- analyse, evaluate, and apply relevant information from a variety of sources
- interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals

- manage the use of time and other resources to complete projects
- take responsibility for one's own actions, decisions, and consequences

To find out the cost of books and learning material go here (https://www.bkstr.com/senecastore/shop/textbooks-and-course-materials/).

Any courses not listed on the bookstore webpage do not require any resources for purchase. All resources will be provided by your instructor.

# Reference Material

- A Practical Introduction to Computer Vision with OpenCV, Kenneth Dawson-Howe

- Learning OpenCV 3, Adrian Kaehler & Gary Bradski

- Deep Learning with Python, Francois Chollet

- OpenCV, opencv.org (https://cat.senecapolytechnic.ca/syllabi/2025-summer/cvi620-nsb-8209/opencv.org)

# Required Supplies

To fully participate in this course, students will need access to a computer with a stable internet connection, a functional webcam, and a microphone, as all exams will be monitored and occasional live discussions may take place. Python and all necessary libraries (including NumPy, Matplotlib, OpenCV, scikit-learn, and TensorFlow/Keras) will be introduced and configured during class sessions and students are required to install them. Access to GitHub is also required for submitting coursework and collaborating on projects.

# Modes of Evaluation

| Assessment Type | Percentage |
| --- | --- |
| Assignments | 15 |
| Labs | 20 |
| Quizzes | 15 |
| Midterm Exam | 15 |
| Final Exam | 20 |
| Final Project | 15 |
| Total | 100% |

All exams and some of the assignments in this course will be followed by a brief oral Q&A session. This is to ensure academic integrity and to give students an opportunity to discuss and reflect on their work. Be prepared to explain your solutions and reasoning during these sessions.

All students are required to submit the final version of their assignments on Learn@Seneca. However, for coding exercises, students must share their Git repositories (private and instructor added as collaborator), along with the final submissions, for the assignments. Commits and collaborations in the GitHub repositories will be tracked and may impact their scores. You can find an introduction to Git in course slides if not already familiar.

For your final project, you are expected to work individually (or in pairs) to apply the concepts learned throughout the course. The project should demonstrate a clear understanding of the topic, include data analysis or experimentation if applicable, and be presented in a structured and well-documented format. All code, results, and explanations must be original and clearly explained. A short written report and/or presentation may be required. More information will be announced accordingly.

# Note

To obtain a credit in this subject, a student must:

- Achieve 50% or better of the overall course.
- Achieve 50% or better of the quizzes and exams.
- Successfully complete the final project

# Schedule of Topics and Assignments

| Day | Date | Agenda/Topic | Reading(s) | Due |
|-----|------|--------------|------------|-----|
| Tue | 5/6 | - Welcome and course overview<br>- Introduction to Computer Vision and Imaging systems<br>- Roadmap of the field<br>- Human vision and cameras<br>- Installing prerequisites and system configurations<br>VSCode, Python, Virtualenv, Numpy, Pandas, OpenCV, matplotlib, ipykernel, Git | | |
| Thu | 5/8 | - Digital Cameras and Images<br>- Pixels, resolution, image size and shape<br>- Color models: Binary, Grayscale, RGB, HSV, etc. | | |
| Tue | 5/13 | - Introduction to NumPy library and arrays<br>- Introduction to matplotlib<br>- Introduction to OpenCV: reading, displaying, and saving images.<br>- Image Formats: PNG, JPEG (JPG), TIFF, etc.<br>- Image coordinates | Lab 1 | May 13 |
| Thu | 5/15 | - Basic image operations: slicing, crop, split, merge, min & max<br>- Basic image operations: rotate, padding, color model conversion<br>- Drawing on images<br>- PEP8 standard | Lab 2 | May 15 |
| Tue | 5/20 | - Creating annotations on visual data<br>- Introduction to videos and basic operations on video data using OpenCV<br>- Point operations and pixel transformations<br><br>- Arithmetic operations: addition and subtraction, multiply and divide<br>- Brightness and darkness | Assignment 1 | May 28 |
| Thu | 5/22 | - Thresholding<br>- Blending images<br>- Geometric transformations<br>- Resizing: upsampling and downsampling | Quiz 1 | May 23 |
| Tue | 5/27 | - Neighborhood operations<br>- Rotation<br>- Shear | | |
| Thu | 5/29 | - Assignment1 presentations | | |
| Tue | 6/3 | - Image noise<br>- Types of noise<br>- Denoising techniques<br>- Blurring<br>- Filters | Lab3 | June 3 |
| Thu | 6/5 | - Convolution<br>- Edges and lines<br>- Denoising using convolution<br>- Feature detection with convolution | | |

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| Tue | 6/10 | - Color pixel extraction, feature extraction from images using color information<br>- Shape feature extraction | Quiz 2 | June 14 |
| Thu | 6/12 | - Image and video feature extraction<br>- Object tracking<br>- Object detection using haarcascades | | |
| Tue | 6/17 | - Midterm Exam | Reserve presentation time slot | June 18 |
| Thu | 6/19 | - Midterm Exam presentations | | |
| Tue | 6/24 | Study Week | | |
| Thu | 6/26 | Study Week | | |
| Tue | 7/1 | - Introduction to Pandas<br>- Introduction to Machine Learning<br>- ML workflow<br>- Type of ML algorithms | Lab 4 | July 1 |
| Thu | 7/3 | - Supervised learning algorithms<br>- K Nearest Neighbor algorithm<br>- Distance metrics<br>- Classification | | |
| Tue | 7/8 | - Preprocessing techniques: null values, normalization, standardization, data distribution, etc.<br>- Image preprocessing techniques<br>- Data analysis practices | Lab 5<br>Assignment 2 release date | July 8<br>July 22 |
| Thu | 7/10 | - Regression<br>- Simple linear regression algorithm | | |
| Tue | 7/15 | - Gradient descent algorithm<br>- Loss function | | |
| Thu | 7/17 | - Logistic regression<br>- Logistic function<br>- Cross entropy loss | | |
| Tue | 7/22 | - Machine Learning for images<br>- Classifying images<br>- Detection from visual data | | |
| Thu | 7/24 | - Perceptron algorithm | Quiz 3 | July 26 |
| Tue | 7/29 | - Backward pass in MLP<br>- Neural networks | Final project release date | |
| Thu | 7/31 | - MLP for classification<br>- Evaluating models<br>- Post processing techniques | | |
| Tue | 8/5 | - Convolutional neural networks | Lab 6 | Aug 5 |
| Thu | 8/7 | - Advance CNNs<br>- YOLO<br>- Object detection<br>- Segmentation<br>- Pose estimation<br>- Object tracking | | |
| Tue | 8/12 | - Final exam | Reserve presentation time slot | Aug 13 |
| Thu | 8/14 | - Final exam presentation | Final project | |

## Missed Tests/Late Assessments

Due dates for all evaluations and assessments are posted. Evaluations can include projects, podcasts, videos, assignments, quizzes and/or tests and exams. Students are expected to meet the specified dates and deadlines. It is a best practice for all students to keep a copy of all submitted assignments.

Students who have extenuating circumstances that result in their being unable to meet the stated deadline are encouraged to contact their professor(s). A professor may (or may not) grant an extension to a posted due date. Such extension requests must be discussed prior to the due date, or very closely following. Late submission or completion of any assessments may be subject to a penalty grade deduction. Once feedback is posted and/or discussion of the assessment has taken place, students may not submit that version of the assessment for grading.

Late submission or completion of any assessments may be subject to a penalty grade deduction based on the following:

- Late Assignment Policy: Late assignment and project will be penalized by -25% per day. The maximum late penalty is - 100%.
- Missed lab work, quiz, and test are marked "0".
- There are no "make up" tests or quizzes

# Feedback on Assessments

Feedback to students regarding graded assessments can be provided in any of the following ways: posted on LEARN@Seneca, added to Grade Centre comments, taken up synchronously, and/or discussed with students.

Students are welcome to discuss feedback on completed and submitted assessments with their professor during a synchronous class, during posted "virtual" office hours, or by a mutually agreed upon appointment.

# Student Progression and Promotion Policy

| Letter Grade | Percentage Grade |
| --- | --- |
| A+ | 90% to 100% |
| A | 80% to 89% |
| B+ | 75% to 79% |
| B | 70% to 74% |
| C+ | 65% to 69% |
| C | 60% to 64% |
| D+ | 55% to 59% |
| D | 50% to 54% |
| F | 0% to 49% (Not a Pass) |
| OR | |
| EXC | Excellent |
| SAT | Satisfactory |
| UNSAT | Unsatisfactory |

Listed below are a number of important links to Seneca Polytechnic policies.

- Student Progression and Promotion Policy (http://www.senecapolytechnic.ca/about/policies/student-progression-and-promotion-policy.html)
- Grading Policy (http://www.senecapolytechnic.ca/about/policies/grading-policy.html)
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# Technical Requirements

The following checklists outline the technical requirements for all students starting and continuing at Seneca:

## Hardware checklist
- a computer that runs on Windows 10 or the latest Mac OSX and has up to date virus protection software
  - Windows 10 ARM64 (https://support.microsoft.com/en-us/windows/windows-10-arm-based-pcs-faq-477f51df-2e3b-f68f-31b0-06f5e4f8ebb5/) devices are **not recommended** as they will not allow you to install AppsAnywhere, GlobalProtect, VPN, MyApps or use Virtual Commons and other virtual machine apps
- high-speed broadband access (Cable or DSL) is highly recommended. Some programs or courses require more advanced systems. Please refer to the program information page for information on specialized requirements
- headphones or speaker and a microphone for in-class conversations and meetings with your professors

- a webcam (may be required for specific courses)
- individual courses may have additional hardware requirements

## Software checklist

- a web browser, such as Safari, Firefox, MS Edge, Google Chrome. Please note: You may need to upgrade your web browser to access online learning tools
- various applications are available to all full-time Seneca students, including Microsoft Office 365, Adobe Creative Suite, and Trend Micro
- Adobe Creative Suite includes a number of applications such as Premiere, Photoshop and more
- online teaching tools, including Blackboard, MS Teams, Zoom, BigBlueButton, and Webex
- individual courses may have additional software requirements for playing audio or video or other applications. You can also review the list of applications made available for home use on a Windows-based machine (http://myapps.senecapolytechnic.ca/)
  Note: Some applications may require you to install Student VPN to access licensed software
- antimalware software must be installed on all personal devices that will be used with your Seneca account. Visit the Malware and Virus Protection (https://students.senecapolytechnic.ca/spaces/185/it-security/wiki/view/963/malware-and-virus-protection/) page for free and paid antimalware software recommendations, or visit the Trend Micro Internet Security (https://students.senecapolytechnic.ca/spaces/189/software/wiki/view/1360/trend-micro-internet-security/) page for a free one-year license of this commercial antimalware software

## Mobile devices checklist

- Mobile devices may allow for some participation in your course(s), however they present limitations and we cannot guarantee your device will meet all your coursework needs.
- All students are required to install and use Microsoft Authenticator (https://students.senecapolytechnic.ca/spaces/186/it-services/wiki/view/4168/microsoft-multi-factor-authentication/) to access various services at Seneca. It's an important measure that provides an added layer of security on top of the login credentials for devices. In addition to using your username and password to log into these secure services, a second factor of authentication is required so that if your password becomes compromised, the intruder will not be able to log in. Use of multi-factor authentication is currently required for Blackboard, Office 365 (https://students.senecapolytechnic.ca/spaces/186/it-services/wiki/view/1003/office-365/) and VPN (https://students.senecapolytechnic.ca/spaces/186/it-services/wiki/view/1024/vpn/).
- A compatible Android (https://play.google.com/store/apps/details/?id=com.azure.authenticator) or iOS (https://apps.apple.com/app/microsoft-authenticator/id983156458/) mobile device that can be used to install Microsoft Authenticator is required.
- A cellphone data plan is not a mandatory requirement to use the Microsoft Authenticator app. The app can be used through a Wi-Fi connection or with no data connection.
- If you have a basic cellphone, you can choose to receive an SMS or a phone call as verification for second factor authentication.
- The Microsoft Authenticator app does not store any personal data.
- Authenticating through a mobile device is the only available option.

## Helpful sites to bookmark:

- MySeneca.ca (https://outlook.office.com/mail/inbox/) – access your Seneca email account
- Learn@Seneca (https://learn.senecapolytechnic.ca/ultra/institution-page/) – Seneca's learning management system and intranet portal

# Seneca Polytechnic Library Resources

Be sure to begin all research, assignment support and career preparation at Seneca Polytechnic Libraries (http://library.senecapolytechnic.ca) website.  Students can find information about our services and collections including, print and e-books, databases that will lead to thousands of articles in magazines, newspapers, journals, encyclopedias, carefully selected websites, how-to tutorials, streamed videos and much more.

Citation Style Guidelines (https://library.senecapolytechnic.ca/citingsources/): APA/MLA.  Please check with your professor on the preferred formatting.

# Seneca Policies

Below are the Seneca policies and links to more information.

## Academic Integrity

Seneca upholds a learning community that values academic integrity, honesty, fairness, trust, respect, responsibility and courage. These values enhance Seneca's commitment to deliver high-quality education and teaching excellence, while supporting a positive learning environment. Ensure that you are aware of Seneca's Academic Integrity Policy (http://www.senecapolytechnic.ca/about/policies/academic-integrity-policy.html)   Review

section 2 of the policy for details regarding approaches to supporting integrity. Section 2.3 and Appendix B of the policy describe various sanctions that can be applied, if there is suspected academic misconduct (e.g., contract cheating, cheating, falsification, impersonation or plagiarism).

Please visit the Academic Integrity at Seneca (http://open2.senecac.on.ca/sites/academic-integrity/for-students/) website to understand and learn more about how to prepare and submit work so that it supports academic integrity, and to avoid academic misconduct.

## Discrimination/Harassment

All students and employees have the right to study and work in an environment that is free from discrimination and/or harassment. Language or activities that defeat this objective violate Seneca's Policy on Discrimination/Harassment and shall not be tolerated. Information and assistance are available from the Student Conduct Office at student.conduct@senecapolytechnic.ca.

## Accommodation for Students with Disabilities

Seneca will provide reasonable accommodation to students with disabilities to promote academic success. If you require accommodation, contact the Accessible Learning Services Office (senecacnas@senecapolytechnic.ca) to initiate the process for documenting, assessing and implementing your individual accommodation supports for the classroom and Work-Integrated Learning (WIL) environments.

Accommodated students are required to meet the expected learning outcomes of courses.  Accommodations do not surpass the need for safety, or supersede academic policies and requirements.

## Camera Use and Recordings - Synchronous (Live) Classes

Synchronous (live) classes may be delivered in person, in a Flexible Learning space, or online through a Seneca web conferencing platform such as MS Teams or Zoom. Flexible Learning spaces are equipped with cameras, microphones, monitors and speakers that capture and stream instructor and student interactions, providing an in-person experience for students choosing to study online.

Students joining a live class online may be required to have a working camera in order to participate, or for certain activities (e.g. group work, assessments), and high-speed broadband access (e.g. Cable, DSL) is highly recommended. In the event students encounter circumstances that impact their ability to join the platform with their camera on, they should reach out to the professor to discuss. Live classes may be recorded and made available to students to support access to course content and promote student learning and success.

By attending live classes, students are consenting to the collection and use of their personal information for the purposes of administering the class and associated coursework. To learn more about Seneca's privacy practices, visit Privacy Notice (https://www.senecapolytechnic.ca/privacy.html).

# General Boilerplate

Please use this space for any additional information you would like to provide to students about this course. Please be sure to change the title of this element as well.

If you do NOT need this element, **click on the EYE icon to remove** the element.

NOTE: Please remember to **DELETE these instructions**.

Last updated: May 3, 2025 at 4:49 p.m.