Course Syllabus

Computer Vision (CSCI 4220U)

Faisal Qureshi
http://faculty.ontariotechu.ca/qureshi

Computer Science, Faculty of Science
Ontario Tech University

Fall 2020
Instructor
Faisal Qureshi
Email: faisal.qureshi@uoit.net
Office: UA4032
Web: http://faculty.uoit.ca/qureshi

Lectures
Tuesday, 2:10 pm - 5 pm, online (First day of lectures, Tuesday, September 8, 2020.)
Please use this Google Meet link for lectures meet.google.com/vfz-bopt-xcn. You will need your Ontario Tech U .net email address to access this link.

Online Etiquette
To get the most out of these online lectures, please follow the following rules
- If you have a camera, keep it turned on.
- Please mute your mic, when not asking a question.
- Be respectful, and avoid strong language, such as all caps, exclamation points.
- Be forgiving and generous. Online lectures are different from inclass lectures. Be kind to each other.
- Most importantly, have fun!

Labs
In case the course has multiple lab sections. Each student will be assigned to one of these lab sections. All labs cover the same material. The space in lab sections is limited, and these slots are filled on a first-come bases.
Please check mycampus for up to date information about course scheduling.

Office hours
Tuesday, 11 am - 12 pm, online, or by appointment.
Use this Google Meet link for office hours https://meet.google.com/ssi-osun-pwg.

Description
This course introduces students to computer vision – the science and technology to make computers “see.” The goal of computer vision is to develop computational machinery to extract useful information from images and videos. The course will study various steps of the overall image analysis pipeline. Topics covered will include: image formation, image representation, segmentation, feature extraction, motion analysis, object detection, camera calibration, and 3D visual reconstruction. A secondary focus of this course will be computer vision applications, e.g., mobile vision, which rely heavily upon the fundamental theory and techniques covered in this course.

Grading
- Class participation and exercises 10%
- Lab participation and completion 30%
- Quizzes 60%

A student must get 50% in at least three quizzes to pass the course.
Important dates

Study break during the week of Oct 13

Ontario Tech University’s academic calendar that lists important dates (and deadlines) is available at here.

Course calendar

Week 1
- Image formation
  - Pinhole camera model
  - Homogeneous coordinates
  - Perspective projection
  - Orthographic projection
  - Projective geometry
  - Vanishing points

Week 2
- Image representations
- Image filtering
  - Convolution
  - Average filter
  - Gaussian filter
  - Separable filters

Week 3
- Image derivatives
- Difference of Gaussians
- Edge detection
  - Canny edge detector
- Quiz 1

Week 4
- Image filtering (contd.)
  - Integral images
  - Bilateral filtering
- Template matching
  - Cross-correlation
- Gaussian Image pyramids
- Laplacian Image pyramids
- Image blending

Week 5
- Image histograms
- Local image features
- Interest point detection
  - Harris corner detectors

Week 6
- Local image descriptors
  - SIFT descriptors
- Quiz 3
Week 7
- Model fitting
  - Line fitting
  - Least squares
  - Robust least squares
- RANSAC

Week 8
- Model fitting (contd.)
  - Hough transform
- Image stitching
  - Homography

Week 9
- Camera calibration
- Optical flow
- Quiz 3

Week 9
- Multi-view geometry
  - Stereo depth estimation

Week 10
- K-nearest neighbours
- Naïve Bayes classifier

Week 11
- K-means clustering
- Dimensionality reduction
  - Principle Component Analysis (PCA)
  - Eigen faces

Week 12
- Deep learning and computer vision
- Quiz 4

Course work

Quizzes
All quizzes will be online. The quizzes will also be time-limited and open book (unless otherwise specified.)

Final exam
This course has no final exam.

Reading material
We will use the following textbook for this course. I will be assigning reading assignments from this textbook:
Students are encouraged to take their own notes during lectures.

You will find the following computer vision books useful.

- *Fundamentals of Computer Vision* by Mubarak Shah
- *Multi View Geometry in Computer Vision* by Richard Hartley and Andrew Zisserman

**Programming Resources**

We will primarily use Python + OpenCV in this course. I recommend that you install Anaconda Python Distribution, which comes prepackaged with all the necessary packages. The following Python packages/environment are highly relevant for this course:

- numpy;
- scipy;
- matplotlib; and
- jupyter notebook.

**Course policies**

**Class Participation and Inclass Exercises**

Student participation in lectures and laboratories is strongly recommended. It is often difficult to assign a class participation mark. At the same time; however, I feel that it is important to reward students who make lectures lively and interesting for everyone. In order to assign class participation marks, I will provide in-class exercises and quizzes during during each lecture. Theses exercises will require programming and will cover the topic currently under discussion. These exercises are due before the end of the lecture. When grading these exercises, I will focus more on the attempt rather then the correct solution. Paying attention during lectures and taking your own notes is one way to successfully complete these exercises.

**Course Work Submission**

Unless otherwise instructed, all course work should be submitted using course Canvas.

**Partial marks**

Assignments will primarily be evaluated based on the correctness of solutions; however, partial credit may be assigned for documentation, discussion, etc.

**Remarking**

It is extremely important that all work is fairly graded. Please submit a remark request by email within 5 days of receiving the grade. The email must contain the reasons for which you think the work should be remarked. *Please note that a remark may result in a lower grade.*

**Late submissions**

The penalty for a late submission is 10% per day. A lab, an assignment, or a project will get a zero if submitted more than 48 hours after the submission deadline.

**Email traffic**

The instructor and the TA will make every effort to respond to emails in a timely manner; however, it may take up to two working days to respond to an email. It simply means that emails sent right before a deadline may not be answered in time. Urgent emails may be sent to “faisal.qlres@ontariotechu.net” with the subject line “csci 4220u - fall 2020”.
Discussions
Appropriate use of discussion groups include clarification of lecture material and assignments and other concerns and comments about the course that might of general interest to course participants. Please do not post assignment solutions to the discussion groups.

Collaboration
I encourage you to work together when discussing assignments/projects; however, it doesn’t mean that you should share your written solutions or that you submit someone else’s work as your own.

Course evaluation
It is important that every student participates in course evaluations. Course evaluations, which are completely anonymous, provide extremely useful feedback to the instructor and the TA, helping improve the course.

Academic integrity
Assignments and tests must be strictly individual work. Ontario Tech University takes academic dishonesty very seriously. Please read and understand Ontario Tech University’s policy on academic integrity available here

Accessibility
Students with disabilities may request to be considered for formal academic accommodation in accordance with the Ontario Human Rights Code. Students seeking accommodation must make their requests through the Centre for Students with Disabilities in a timely manner, and provide relevant and recent documentation to verify the effect of their disability and to allow the University to determine appropriate accommodations. More information about Student Accessibility Services (SAS) is available here.

Freedom of Information and Protection of Privacy Act
Ontario Tech University is governed by the Freedom of Information and Protection of Privacy Act (“FIPPA”). In addition to providing a mechanism for requesting records held by the university, this legislation also requires that Ontario Tech University not disclose the personal information of its students without their consent. FIPPA’s definition of “personal information” includes, among other things, documents that contain both your name and your Banner ID. To ensure that your rights to privacy are protected, the I encourage you to use only your Banner ID on assignments or test papers being submitted for grading (the exception to this rule are midterm and final exams, since these are returned individually). This policy is intended to prevent the inadvertent disclosure of your information where graded papers are returned to groups of students at the same time. If you still wish to write both your name and your Banner ID on your tests and assignments, please be advised that Ontario Tech University will interpret this as an implied consent to the disclosure of your personal information in the normal course of returning graded materials to students. Please contact the Ontario Tech University Chief Privacy Officer at accessandprivacy@ontariotechu.ca for more information.

Sexual Violence Policy
Ontario Tech University is committed to the prevention of sexual violence in all is forms. For any Ontario Tech University student who has experienced Sexual Violence, Ontario Tech University can help. Ontario Tech University will make accommodations to cater to the diverse backgrounds, cultures, and identities of students when dealing with individual cases.
If you think you have been subjected to or witnessed sexual violence:

• Reach out to a Support Worker, who are specially trained individuals authorized to receive confidential disclosures about incidents of sexual violence. Support Workers can offer help and resolutions options which can include safety plans, accommodations, mental health support, and more. To make an appointment with a Support Worker, call 905.721.3392 or email studentlifeline@ontariotechu.ca
• Learn more about your options at: here