ACADEMIC YEAR: 2016/2017

Course Number COMP498G/691G		**Course Title** Computer Vision	
Department Computer Science and Software Engineering	**Semester** Winter 2017	**Type** Elective	**Credits** 4.00
Level Undergraduate/Graduate	**Prerequisites** N/A		
Schedule Class – Tu 5:45PM - 8:15PM, MB 2.265 SGW Lab – Tu 8:30PM - 10:30PM, TBA			
Instructor Charalambos Poullis	**Office Hours** Wed. @ 14:00-16:00 and by appointment	**Office** EV3.183	**Email** charalambos@poullis.org
Teaching Assistant Xichen Zhou	**Office Hours** By appointment	**Office** EV9.113	**Email** xeechou@gmail.com

COURSE DESCRIPTION

This course introduces basic techniques and concepts in computer vision including image formation, grouping and fitting, geometric vision, recognition, perceptual organization, and the state-of-the art software tools. The student will learn fundamental algorithms and techniques, and gain experience in programming vision-based components; in particular, how to program in OpenCV, a powerful software interface used to process data captured from passive and active sensors.

COURSE OBJECTIVES

The primary objective of the course is to provide a comprehensive introduction to computer vision and the related programming principles required when designing and developing vision-based systems. More specifically the course aims to cover the following:

- Introducing the programming principles and algorithms used in computer vision
- Designing, developing, testing and debugging of vision-based components
- Gaining practical experience with the vision library, OpenCV.

LEARNING OUTCOMES

By the end of this course, students will be able to:

- identify and explain the core concepts in computer vision
- employ programming principles, data-structures and algorithms of computer vision for processing
- compare, criticize and assess state-of-the-art techniques in computer vision
- develop OpenCV applications

COURSE CONTENTS

- Image formation: camera models, radiometry, linear filters and edge detection, interest point/feature detection
- Grouping and fitting: Hough transform, RANSAC, image alignment
- Geometric Vision: camera calibration, epipolar geometry, two-view and multi-view stereo, structure from motion
- Recognition: image classification, face detection and recognition, object detection, part-based models
- Perceptual organization: segmentation, optical flow
- A project
- Laboratory: two hours per week.

TEACHING METHOD

The course comprises of weekly lectures and practical training; both in the form of labs and individual assignments. ***It is emphasized that attendance to the lectures and labs is compulsory.***

ASSESSMENT

Programming Assignments (x3)	45%
Midterm	15%
Quiz	15%
Project (x1)	20%
Participation	5%

Programming Assignments/Project: The goal of the programming assignments and the project is to gain practical experience in programming vision-based components with OpenCV. There are three programming assignments and one project. The assignments *may* have a small amount of extra credit. Please refer to the schedule for the assignment/project descriptions and due dates. All assignments must be done ***individually***.

Midterm: The midterm exam will be *assigned* on Tuesday, February 14th 2017.

Quiz: The quiz will take place on Tuesday, April 11th 2017.

Participation: Class participation is an important component of the grade. This involves attending the lectures and labs regularly, asking and answering questions, and participating on the class discussion board.

Submission: The assignments should be submitted by midnight on the day they are due. Assignments submitted within the 7 days following the initial deadline will also be accepted for grading however, there will be a deduction of 2 points from the total assignment grade and [if applicable] no extra credit will be given. Any assignment submitted past those 7 days will receive a grade of 0.

Example: If the initial deadline was on Oct 13th and you submit your assignment anytime between Oct 14th and Oct 20th, then the maximum grade you can receive is 8 out of 10. If you submit on Oct 21st or later, then the grade is 0.

RECOMMENDED TEXTBOOKS

1. Computer Vision: A Modern Approach (2nd Edition) by David A. Forsyth, Jean Ponce. **ISBN-13:** 978-0136085928

2, Computer Vision: Algorithms and Applications by Richard Szeliski. **ISBN-13:** 978-1848829343

COURSE SCHEDULE

The list below provides a summary of the material that will be covered during the course as well as a tentative schedule. Labs will support topics covered in the lectures and provide hands-on exercises.

Date	Topic	Reading	Notes
1. 10 JAN	• Syllabus • Introduction to Computer Vision	Szeliski Ch. 1	Assignment 1 out
2. 17 JAN	• Image formation	Szeliski Ch. 2	
3. 24 JAN	• Image processing	Szeliski Ch. 3	Assignment 1 due Assignment 2 out
4. 31 JAN	• Feature detection and matching	Szeliski Ch. 4	
5. 07 FEB	• Feature-based alignment	Szeliski Ch. 6	Assignment 2 due
6. 14 FEB	• Image stitching	Szeliski Ch. 9	Midterm assigned
7. 28 FEB	• Dense motion estimation	Szeliski Ch. 8	Midterm due Assignment 3 out
8. 07 MAR	• Structure from motion	Szeliski Ch. 7	
9. 14 MAR	• Recognition	Szeliski Ch. 14	Assignment 3 due Project assigned
10. 21 MAR	• Stereo Correspondence	Szeliski Ch. 11	
11. 28 MAR	• 3D Reconstruction	Szeliski Ch. 12	Project due
12. 04 APR	• Image-based rendering	Szeliski Ch. 13	
13. 11 APR	• Quiz		

COMMUNICATION

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Find our class page at: piazza.com/concordia_university/winter2017/comp498g691g/home

GRADUATE ATTRIBUTES

As part of either the Computer Science or Software Engineering program curriculum, the content of this course includes material and exercises related to the teaching and evaluation of graduate attributes. Graduate attributes are skills that have been identified by the Canadian

Engineering Accreditation Board (CEAB) and the Canadian Information Processing Society (CIPS) as being central to the formation of Engineers, computer scientists and information technology professionals. As such, the accreditation criteria for the Software Engineering and Computer Science programs dictate that graduate attributes are taught and evaluated as part of the courses. The following is the list of graduate attributes covered in this course, along with a description of how these attributes are incorporated in the course.

Knowledge base: Knowledge of computer vision. Introduction to vision API. Image formation: camera models, radiometry, linear filters and edge detection, interest point/feature detection. Grouping and fitting: Hough transform, RANSAC, image alignment. Geometric Vision: camera calibration, epipolar geometry, two-view and multi-view stereo, structure from motion. Recognition: image classification, face detection and recognition, object detection, part-based models. Perceptual organization: segmentation, optical flow.

Problem analysis: Use mathematical models as basis for the implementation of problems requiring computer vision. Analyze the requirements and constraints of the problem in order to determine what design and implementation solutions will be used.

Design: Design and compose computer vision components involving many aspects such as stated in the course description.

Use of tools: Use specific computer vision software development APIs to develop elaborated applications, make an educated decision on the tools and APIs to use based on the established requirements, constraints and design.