Syllabus: Image Processing and Computer Vision (IMGS 682)
Spring 2018
Instructor: Prof. Christopher Kanan

Course Description: This course will cover methods in image processing and computer vision, with an emphasis on the state-of-the-art techniques currently used in academia and industry. Topics will include image filtering, edge detection, corner detection, segmentation, object/image/face classification, object detection, morphological operators, object tracking, image registration, and video activity classification. Students are expected to have some familiarity with college-level calculus, linear algebra, and basic probability and statistics (conditional probability, mean, variance, etc.). Computer programming skills are expected (e.g., you are expected to have taken one or more classes involving extensive computer programming and not merely editing other's code). The course requires a significant amount of computer programming.
Class 3, Credit 3 (S)

Prerequisites: IMGS-616 or permission of the instructor.

Class Location and Time: Tuesdays and Thursdays, 9:30AM - 10:50AM, CAR-2155

Required Text: The main book for the class is "Computer Vision: Algorithms and Applications" (2011) by Richard Szeliski. While you can buy a hardcopy of the text, it is also freely available online. You can download a PDF of the book here: http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf
There will also be readings from other sources.

Instructor Contact:

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Evaluation and Grading: The final course grade will be weighted as follows:

Homework:	45% (5 assignments worth 9% each)
Project:	25%
Midterm:	15%
Final:	15%

Homework: Your homework submissions must cite any references used (including articles, books, code, websites, and personal communications). All solutions must be written in your own words, and you must program the algorithms yourself. *Unless specifically authorized, you are not to use external code from the web or toolboxes*.

Your homework solutions must be prepared in LaTeX and output to PDF format. If you don't already know LaTeX, this is an excellent opportunity to start using it. Many academic conferences and journals require LaTeX formatted submissions. Your solutions should include all diagrams, written explanations, code, and program output relevant to the problem.

While there are only five homework assignments, each assignment will be time consuming. You have at least three weeks for each assignment. Starting early lets you ask a TA and instructor for help on specific problems if you get stuck. Many students have failed assignments because they did not start two or more weeks in advance. The homework assignments are planned to cover these topics:

- Homework 1 - Linear Algebra, Classifiers, PCA
- Homework 2 - Image Processing, Color, Image Enhancement, Morphological Operators
- Homework 3 - Edge detection, Corner detection, Homographies
- Homework 4 - Segmentation and Object Classification
- Homework 5 - Video Analysis and Object Detection

Project: You are required to complete a project. The project should go beyond what is taught in the class, but it does not necessarily need to move the frontier forward. You may use the programming language of your choice. Replicating results from a recent paper and comparing it to other works, would be a good project. Feel free to run your early ideas by me. The schedule for the project is as follows:

1. **Project Proposal**: The project proposal will clearly state what you plan to do. It should contain a list of three to six milestones and deadlines. You should list the questions the project will address and that will be discussed in the report. You should list what software you will be using or will build upon. Describe the datasets you will use and how how will you know if the project is successful. Describe the hypotheses you will test and the related work. The proposal should be a well organized document in continuous english, and it should not be merely an outline. You should be able to re-use much of the text for the final report. It should be two to four pages long (not including references) and formatted in CVPR format. It should be typeset using LaTeX, and submitted as a PDF.

2. **Revised Project Proposal**: The revised proposal should take into account the comments received by the instructor and TA. It should be more polished than your project proposal, and should have an updated timeline with any progress you have made.
3. **Project Report**: The project report will describe the project, i.e., what you did and the result. It should be four to eight pages long (not including references) and formatted in CVPR format. It should be typeset using LaTeX, and submitted as a PDF. See slides for additional instructions for how the report should be organized.

Policy on Late Work: Late work will be penalized at 10% off per day the assignment is late. After the 5th day, the assignment will no longer be accepted. You will have 3 or more weeks to do each homework assignment. Assignments involve a large time commitment, and you are unlikely to complete them by the deadline if you wait until the night before. I urge you to begin them immediately after they are assigned. If you get stuck, starting early ensures you have enough time to ask us for help.

Programming Environment: All homework assignments must be done in Python. For the class project, you may use the programming environment of your choice. Note that we will be unable to provide any programming help for projects.

Notes on Plagiarism: Plagiarism is a serious offense and is in violation of the RIT Student Academic Integrity Policy (http://www.rit.edu/academicaffairs/policiesmanual/d080). If you are unsure of what constitutes plagiarism in written documents, a good description can be found here: http://isites.harvard.edu/icb/icb.do?keyword=k70847&pageid=icb.page342054

For your assignments, you must cite all work that you refer to. You must not copy any text verbatim, even if you cite it. The text must be paraphrased, and this should not be done excessively. Plagiarism does not just occur in written documents; it also occurs in code. Many of the algorithms we will code and problems we will solve have been solved by others who have posted code (in various programming languages) online. It is unacceptable (and it is considered plagiarism) to copy code developed by others and submit it as your own. (This includes code that is written by your fellow students!) Even making minor changes, such as changing variable names, function names, formatting, etc., is not enough to allow you to claim your submission as your own because the underlying structure of the code remains unchanged.

The consequences of plagiarism, whether in code or in written documents, are at the discretion of the instructor, and can be as severe as automatic failure of the course.

Academic Accommodations: RIT is committed to providing reasonable accommodations to students with disabilities. If you need accommodations such as special seating, note taking services, or extended time or a different environment due to a disability, please go to the Disability Services Office. It is located in the Student Alumni Union, room 1150. If you receive accommodation approval, you must make me aware of this fact prior to the date that accommodations with be necessary.

Course Schedule: The following schedule lists dates for class topics. The content in this schedule is tentative and subject to change. It is your responsibility to attend class and to remain informed of any changes that may be announced.

Lecture	Week	Date	Assignments	Class Topics / Activities
1	1	1/16	Homework 1 Assigned	Introduction, Course Overview
2		1/18		Math Background Review
3	2	1/23		Classifiers: Basics & Nearest Neighbor
4		1/25		PCA & Dimensionality Reduction
5	3	1/30		Classifiers: Perceptron and SVM
6		2/1		Classifiers: Neural Networks & Deep Learning
7	4	2/6 (GL)	Homework 2 Assigned	Images & Image Enhancement
8		2/8	Homework 1 Due	Color Spaces & Color Constancy
9	5	2/13		Filtering & Paper Anatomy
10		2/15		Binary Images & Morphological Operators
11	6	2/20	Project Proposal Due	Edge Detection
12		2/22	Homework 3 Assigned	Corner Detection
13	7	2/27		Image Features & SIFT
14		3/1	Homework 2 Due	Mosaics and Homographies
	8	3/6	Revised Project Proposal Due	Midterm Review
		3/8		Midterm
	9	3/13		Spring Break
		3/15		Spring Break
15	10	3/20	Homework 4 Assigned	Unsupervised Segmentation Part 1
16		3/22		Unsupervised Segmentation Part 2
17	11	3/27	Homework 3 Due	Convolutional Neural Networks
18		3/29	Homework 5 Assigned	Transfer Learning for CNNs
19	12	4/3		Object Detection Using Sliding Windows
20		4/5	Homework 4 Due	
21	13	4/10		Object Detection Using Region Proposals
22		4/12		Deep Learning Applications, RGB-D, & Stereo
23	14	4/17		Computer Vision + Natural Language Processing
24		4/19	Homework 5 Due	Video: Activity & Video Classification Video: Tracking
25	15	4/24		Video: Optical Flow
26		4/26	Final Project Report Due	Final Review
	16			Final Exam (Location / Date / Time TBD)