Computer Vision
CAP 5416 Section 09E9
Class Periods: Tuesday (7th Period): 1.55pm-2.45pm; TH (7th & 8th period): 1.55pm-3.50pm
Location: CSE E220

Academic Term: Fall 2021

Instructor:
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Office Hours: Tuesdays 3.00-4.00pm and by appointment.

Teaching Assistant/Peer Mentor/Supervised Teaching Student: **TBA**
Please contact through the Canvas website
- email address: office hours:

Course Description

Introduction to image formation and analysis. Monocular imaging system projections, camera model calibration, and binocular imaging. Low-level vision techniques (denoising etc.), segmentation and representation techniques, and high-level vision (classification/recognition).

Course Pre-Requisites / Co-Requisites

MAC 2312 or Equivalent, COT 4501 or equivalent and Proficiency in MATLAB or Python. Course instructor will determine Equivalency.

Course Objectives

Students will learn and become proficient in many fundamental processing methods in computer vision including the geometry of 2-dimensional image formation namely, projective geometry; sampling theorem and image spatial resolution; image filtering and edge and corner detection (also data driven features as in deep networks); image denoising and restoration; variational framework and regularization for solving low-level vision problems; image segmentation techniques (active contours, and deep-active contours, K-means clustering, graph cuts, mean-shift, deep neural networks); Stereo image formation and matching, and surface reconstruction using variational splines; motion fields and optical flow with applications to image panorama formation; linear-subspaces learning with applications to image and shape recognition; deep learning (CNNs) and geometric deep learning with applications.

Students will be assigned written and programming assignments on all of the above topics on a regular basis to test their understanding as well as to gain a hands on experience with camera calibration, camera intrinsic and extrinsic parameter estimation, image stitching to create panoramas, image in-painting to restore poor quality images, extracting shapes of objects from images, shape and image classification.

Required Textbooks and Software
- **Title** : Computer Vision, Algorithms and Applications
- **Author**: Richard Szeliski
- **Publication date and edition** : 2011, First edition.

ISBN number: 978-1-84882-935-0

Recommended Materials

- **Title** : Multiview Geometry
- **Author**: Richard Hartely and Andrew Zisserman
- **Publication date and edition** : 2004, Second Edition
- **ISBN number** : 0521540518

Course Schedule

Week 1: Introduction to Computer Vision
Week 2: Projective Geometry in 2D and Homographies
Week 3: Projective Geometry in 3D, Homographies and Camera Calibration
Week 4: Fourier Transforms and Convolution
Week 5: Sampling Theorem, Edge Detection
Week 6: Features and Feature Detection, Multi-resolution pyramids
Week 7: Image Denoising and Restoration
Week 8: Variational Calculus +Regularization; Midterm-1 (on the Thursday of the week)
Week 9: Image Segmentation
Week 10: Image Segmentation (continued)
Week 11: Stereo and Surface reconstruction
Week 12: Texture and texture segmentation
Week 13: Motion fields and Optical Flow
Week 14: Deep Learning and Image classification
Week 15: Wrap up and Midterm-2

F2F Course Policy in Response to COVID-19

We will have face-to-face instructional sessions to accomplish the student learning objectives of this course. In response to COVID-19, the following policies and requirements are in place to maintain your learning environment and to enhance the safety of our in-classroom interactions.

- *You are required to wear approved face coverings at all times during class and within buildings. Following and enforcing these policies and requirements are all of our responsibility. Failure to do so will lead to a report to the Office of Student Conduct and Conflict Resolution.*
- *This course has been assigned a physical classroom with enough capacity to maintain physical distancing (6 feet between individuals) requirements. Please utilize designated seats and maintain appropriate spacing between students. Please do not move desks or stations.*
- *Sanitizing supplies are available in the classroom if you wish to wipe down your desks prior to sitting down and at the end of the class.*
- *Follow your instructor's guidance on how to enter and exit the classroom. Practice physical distancing to the extent possible when entering and exiting the classroom.*
- *If you are experiencing COVID-19 symptoms (Click here for guidance from the CDC on symptoms of coronavirus), please use the UF Health screening system and follow the instructions on whether you are able to attend class. Click here for UF Health guidance on what to do if you have been exposed to or are experiencing Covid-19 symptoms.*
- *Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work. Find more information in the university attendance policies.*

Attendance Policy, Class Expectations, and Make-Up Policy

Class attendance is highly recommended since I will only use the text book as a guide but will be covering material drawn from research papers and other references, most of which will be posted on the class website. **Cell phones**

must be in silent mode during class hours. Late homeworks will not be accepted. For programming assignments, one day late will be allowed at a penalty of 15% of the grade and two days at 30% of the grade. No programming assignments will be accepted later than two days beyond the deadline. Make up exams will only be permitted in cases of illness or family emergencies but will require documented proof .
Excused absences must be in compliance with university policies in the Graduate Catalog (http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance) and require appropriate documentation.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (4)	100 each	20%
Programs (4)	100 each	30%
Midterm Exam (2)	100 each	50%
		100%

Grading Policy

Final letter grades will be relative and on a curve.
More information on UF grading policy may be found at:
http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades

Students Requiring Accommodations
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording
Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.
A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session. Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript

of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.ufl.edu/.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://care.dso.ufl.edu.

On-Line Students Complaints*:* http://www.distance.ufl.edu/student-complaint-process.