CAP 6411 - Computer Vision Systems

Section: 0001

College of Engineering and Computer Science

Department of Computer Science

Course Information

Term: Fall 2025
Class Meeting Days: TR
Class Meeting Time: 03:00PM - 04:15PM
Class Meeting Location: VAB 0111
Modality: P
Credit Hours: 3.00

Combined Course Details

This syllabus applies to CAP 6411 0001, CAP 6411 0V01, CAP 6411 0V02.

Instructor Information

Name: Ser-Nam Lim
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Office Hours
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Teaching Assistants

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Office Hours

Every Thursday after class

Course Description

CAP 6411 ECS-CS 3(3,0)Computer Vision Systems: PR: CAP 5415. Recent systems contributing toward recognition, reasoning, knowledge representation, navigation, and dynamic scene analysis. Comparisons, enhancements, and integrations of such systems. Occasional.

CAP6411

Online Students: use this zoom id 668 547 7176

Hi students:

Welcome to the Fall 2025 semester, and thank you for choosing this class.

As a start, please ask yourselves these questions:

1. **Most importantly, you will need to have your own access to a high end GPU and occasionally, you will need 2-3 GPUs. You may need at least an A100, preferably H100. There are different places you can rent them such as colab, etc. Please ensure that you have access to GPU compute resources yourself, otherwise it will be very challenging for you to complete assignments and team projects.**

2. Have you taken CAP5415? This is a **good** class to take beforehand because the goal of this class is not to go through all the computer vision topics, which are covered in CAP5415, but to hone your skills in building computer vision systems.

Further, if you have the experience below, you are also likely ready to take the course:

- You are enrolled in a PhD program, and your dissertation is on computer vision.
- You have 2 years of industrial/research experience in computer vision.
    - You have contributed significantly to at least two githubs that are on computer vision, or,
    - You are the first author of a CSRanking paper that was published (ARXIV will not count).
- You have taken another graduate computer vision class (5000 and above) and received a A- or above grade.
- While these are not mandatory, it will be an easier time for you if you have the above experience already.

3. Do you have any experience in coding and training deep learning models, including Convolutional Neural Networks (CNN), transformers, etc.?

4. By signing up for this class, you agree to the following (if you do not agree, please drop the class):

    1. You agree that assignments are to be submitted on or before the deadline indicated. You agree that you will not email/text/ping the Professor nor the grader about leniency for late submission under any circumstances. All assignments are submitted to webcourse so you need to accommodate for a situation where the system is down -- this will not be a reason to ask for leniency for any late submission.

    2. You agree that all assignments and team projects are to be submitted to webcourse and not directly to the professor or the grader.

    3. You agree that any dishonesty and plagiarism once discovered will be given a F grade for the course immediately. This includes copying individual assignments from other students in the course. This includes working on individual assignments together.

    4. You agree to pull your weight in any team projects. You agree that if discovered you are riding the coat tail of your teammates in team project, you deserve a 0 for the team project even though the other team members get

higher scores, i.e., it is not necessary all team members get the same score on a team project.

Syllabus

The goal of this course is to equip the students with the abilities to understand the state of the art techniques in computer vision, replicate results that have been reported in papers (taking open-sourced github code mostly), making recommendations how to improve and/or deploy to real-world settings. Note that we won't be able to cover all the topics in computer vision, particularly from the perspective of the goal of this course to learn how to build computer vision systems.

Topics covered (subject to changes):

1. **Model efficiency**:
   - One of the key things in building CV systems is that many models these days are not deployable as they are too big, e.g., KV caching, profiling, distillation, etc.

2. **Foundational Models**, e.g.:
   - Basics:
     - Convolutional Neural Networks (CNN), e.g. Residual Networks ([ResNets](#)), for ImageNet classification.
     - Vision Transformer ([ViTs](#)) for ImageNet classification.
     - R-CNN models (fast, [faster R-CNN](#)) for object detection.
     - Panoptic segmentation ([link](#))
     - [CLIP](#) models for image-text zero shot classification.
     - VAE
   - Multimodal LLM (MLLM) e.g. LLaVA-OV [LLaVA](#), Sophia-VL, InternVL, etc.
   - Others: Grounding DiNO [DinoV2](#); A Simple Framework for Contrastive Learning of Visual Representations ([SimCLR](#)); Segment Anything Model ([SAM](#)), etc.

3. **Generative Models**, e.g.:
   - Basics:

- - - Stable diffusion/LDM (link)
    - Autoregressive Generative Model
    - ControlNet
    - Image generation
  - Video Generation: Hunyuan, WAN, framepack
    - I2V, T2V
    - Long video generation
    - etc.
4. **Agentic AI** (topics to be determined)
   - Agents will be everywhere in the next decade, we will learn how to build "generic agents" e.g. agent that generate videos and post to X for you.

Class Format

1. There are about 16 weeks of classes, twice a week on Tue and Thu, 3-4:15pm. We will have online and face to face format. **If there is strong consensus from the class, we can also do mostly online (zoom) and maybe meet once a month (last Thursday of each month)**. The week of Oct 19, I will be traveling to the ICCV conference, so that week will be for working on team project and assignments. Any weeks we have to go online due to unforeseen circumstances will be announced.

2. Reading papers before class will be beneficial, but not required. Before each class, a paper will be posted for you to read ahead of the class. I will go through the paper technique (with slides) and corresponding results that were reported in class.

Potential Valuable Resources

HuggingFace has a large repo of valuable models and code in computer vision, language and multimodal. It may be helpful for your assignments and team projects to find code snippets, models, etc.

Student Learning Outcomes

After successful completion of this course, students will become a top AI coder, ready for the industry.

Required Course Materials and Resources

GPU compute
Notes: Students are responsible for getting their own GPU compute, see course description for details.

Course Assessment and Grading Procedure

Individual assignments (70% of your grade):

- After we go through a topic (which can take 1-3 classes), each student will submit a video demo **a week** after the paper is taught, where the student will record a video of how the code is ran on example inputs. Each student will provide a short report (1-3 pages) on what was learned, and what have been some issues trying to run the code. Finally, the report should also contain some thoughts on how the model can be improved and/or deployed to the real world.

- **This is a computer vision system class, which means that each assignment will be given heavy emphasis on the speed and memory requirement of the model. Each assignment will thus require you to make modifications to speed up and lower the memory requirements of the models we are discussing. To be specific, credit will be given for faster and more memory efficient inference in the assignment, while points can be taken off for slow inference. We will spend our first or second class (depending on how much time we will take in the first class to clarify logistics) talking about model efficiency.**

- Each assignment will be given a score out of 100. We will then divide the total score by the number of assignments we managed to do multiplied by 100. 70% of this final score goes towards the final grade score.

- Plagiarism: Students should not be sharing or copying code and/or report. The goal of these assignments is to ensure each student get first hand knowledge of running these state of the art techniques. **Students are not to work together on individual assignments which constitute dishonesty**.

- **NOTE:** all submissions need to be uploaded to webcourse, and no assignment submitted to the professor or grader will be accepted or acknowledged. All submissions CANNOT contain any links (e.g., google drive) where you upload your submission files or anything. Lastly, the assignment due date is the hard stop date, all late submissions will be given a zero score.

Team project (30% of your grade):

- **Due on Nov 14th.** Each team will submit a detailed report and a video of demo. In the next two weeks, we will have 4 days, Tue and Thu of the following two weeks, where each team will present their project and a live demo. To ensure fairness (otherwise the team doing the last demo has the most time to finish the project), the live demo must be as close to the submitted video as possible. Projects will be judged according to:
- **Speed and memory-efficiency (50%)**
- Creativity and novelty (20%)
- Code clarity and correctness (20%)
    - Clarity of report (10%)
    - Motivation of the idea is clearly articulated
    - Literature review is comprehensive
    - Experiments clearly showing good performance
    - A section on what was accomplished each week and the designation of tasks
- Outcome of the team project can be an interesting system or a publishable paper. For latter, there is potential to work with me further to develop it into a full paper.
- In addition, we will also look at the size of the project (on a scale of 0 to 1, where 1 is worthy of about 3.5 months of efforts from start of course to Dec 4th). This will be used as a multiplier - let's say you score 80 on the first three bullets but your project size is graded at 0.6 as it is not fully needing 3.5 months, then the final project score is 48.
- We will have groups of 4-5 students for each project team.
    - Also, to ensure fairness that each team member has carried his/her own weight, each team member would also need to furnish an individual report, which will be very similar to the individual assignment report:

- Report on the part you did, and how it impact the team project. (25%)

- Code zip of the part you coded. (25%)

- Video of YOU live demoing, explaining and presenting the system. (25%)

- New ideas/insights/hustle you provided to the team. (25%)

- IN ADDITION, you individual report needs to be signed off by ALL team members, i.e., their signatures must be on your report. I usually use pdf signatures but any form is accepted.

- There will be zero tolerance on academic dishonesty. If we detect possible academic dishonesty, it will be immediately submit to UCF's academic integrity team to deal with.

- The final team project grade will be 70% of individual report as described above and 30% of team level grade. So if at the team level report/video/demo/code, the team score a 80, but at the individual level you score a 70, then your score will be 80 x 0.3 + 70 x 0.7 = 73. Conversely if the team did an amazing project and score 100 and you have not been carrying your weight and score a 10 individually, then you will be given a team project score of 37.

- Team project topics: AI agents

- Plagiarism: Teams are welcome to share code and knowledge.

Grading Scale

Individual Assignments: The contribution of your assignments to the final grade will be $S_{ind} = 0.7 \times S_{total}/S_{max}$. $S_{total} = \sum_{i \in N} S_i$, where S_i is the score of the ith assignment and N is the total number of assignments. $S_{max} = \sum_{i \in N} T_i$, where T_i is the maximum possible score of the ith assignment (usually 100). Extra bonus points that students earn clearly gives you an edge. A student may do so well that he/she has perfect score each time plus bonus and possibly $S_{total} > S_{max}$, in which case, $S_{total} := S_{max}$.

Team Project: The contribution of your team project to the final grade will be $S_{proj} = 0.3 \times S_{project}$. This is self-explanatory.

Final score: $S_{ind} \times 100 + S_{proj}$

Grading Scheme:

A: X >= 95

A-: 91<= X <=94

B+: 87<= X <= 90

B: 83 <= X <= 86

B-: 80 <= X <= 82

C+: 75 <= X <=79

C: 70 <= X <= 74

D: 60 <= X <= 69

F: X <= 59

Grading Scale

Letter Grade	Percentage
A	95-100%
A-	91-94%
B+	87-90%
B	83-86%
B-	80-82%
C+	75-79%
C	70-74%
D	60-69%
F	0-59%

Policies for Course Grade

Makeup Work Policy

Will not be accepted, except if you have a doctor's note or other valid official proof of your circumstances, dated before the due date.

Missed/Late Assignments

Will not be accepted, except if you have a doctor's note or other valid official proof of your circumstances, dated before the due date.

Attendance

Attendance will be taken and my policy is that you should not miss more than 20% of the classes.

- **Please ensure you have the UCF Here mobile app as the attendance will be taken via you scanning QR code with your app twice.**

- **We are all grownups so if there are attenuating situations, this is not a hard rule. Please come talk to me if you are facing difficulties.**

Artificial Intelligence (AI) Use Policy

Students are not to use chatgpt or other LLMs to generate their reports.

Disability Access & Accommodations

The University of Central Florida is committed to providing equal access to all students with disabilities (ADHD, learning disabilities, Autism, chronic medical conditions, physical disabilities, etc.). To receive consideration for reasonable disability-related course accommodations, disabled students must contact Student Accessibility Services (SAS) and complete the steps required for SAS to review accommodation requests. More information can be found on the UCF Student Accessibility Services website under the Start Here tab or by contacting SAS directly (Ferrell Commons 185; sas@ucf.edu; Phone - 407-823-2371).

Approved accommodations are shared with course instructors via the SAS Course Accessibility Letter. Implementing certain accommodations may require discussion about specific considerations of the course design, course learning objectives, and the individual academic and course challenges experienced by the student. While students with disabilities or chronic health needs are also encouraged to discuss any course

concerns with professors in addition to contacting SAS, professors are not required to facilitate disability-related adjustments to the course unless the professor has received a Course Accessibility Letter from SAS that outlines approved accommodations.

Academic Integrity

Students should familiarize themselves with UCF's Code of Conduct at Student Conduct and Integrity Office. According to Section 1, "Academic Misconduct," students are prohibited from engaging in:

1. Academic misconduct is defined as any submitted work or behavior that obstructs the instructor of record's ability to accurately assess the student's understanding or completion of course materials or degree requirements (e.g., assignment, quiz, and/or exam). Examples of academic misconduct include but are not limited to: plagiarism, unauthorized assistance to complete an academic exercise; unauthorized communication with others during an examination, course assignment, or project; falsifying or misrepresenting academic work; providing misleading information to create a personal advantage to complete course/degree requirements; or multiple submission(s) of academic work without permission of the instructor of record.

2. Any student who knowingly helps another violate academic behavior standards is also in violation of the standards.

3. Commercial Use of Academic Material. Selling of course material to another person and/or uploading course material to a third-party vendor without authorization or without the express permission of the University and the instructor of record. Course materials include but are not limited to class notes, the instructor of record's slide deck, tests, quizzes, labs, instruction sheets, homework, study guides, and handouts.

4. Soliciting assistance with academic coursework and/or degree requirements. The solicitation of assistance with an assignment, lab, quiz, test, paper, etc., without authorization of the instructor of record or designee is prohibited. This includes but is not limited to asking for answers to a quiz, trading answers, or offering to pay another to complete an assignment. It is considered Academic Misconduct to solicit assistance with academic coursework and/or degree requirements, even if the

solicitation did not yield actual assistance (for example, if there was no response to the solicitation).

Responses to Academic Dishonesty, Plagiarism, or Cheating

Students should also familiarize themselves with the procedures for academic misconduct in UCF's student handbook, [The Golden Rule](#). UCF faculty members have a responsibility for students' education and the value of a UCF degree, and so seek to prevent unethical behavior and respond to academic misconduct when necessary. Penalties for violating rules, policies, and instructions within this course can range from a zero on the exercise to an "F" letter grade in the course. In addition, an Academic Misconduct report could be filed with the Office of Student Conduct and Academic Integrity, which could lead to disciplinary warning, disciplinary probation, or deferred suspension or separation from the University through suspension, dismissal, or expulsion with the addition of a "Z" designation on one's transcript.

Being found in violation of academic conduct standards could result in a student having to disclose such behavior on a graduate school application, being removed from a leadership position within a student organization, the recipient of scholarships, participation in University activities such as study abroad, internships, etc.

Let's avoid all of this by demonstrating values of honesty, trust, and integrity. No grade is worth compromising your integrity and moving your moral compass. Stay true to doing the right thing: take the zero, not a shortcut.

Title IX

Title IX prohibits sex discrimination, including sexual misconduct, sexual violence, sexual harassment, and retaliation. If you or someone you know has been harassed or assaulted, you can find resources available to support the victim, including confidential resources and information concerning reporting options at [Let's Be Clear](#) and [UCF Cares](#).

For more information on access and community engagement, Title IX, accessibility, or UCF's complaint processes contact:

- Title IX – ONAC – [Office of Nondiscrimination & Accommodations Compliance](#) & askanadvocate@ucf.edu
- Disability Accommodation – Student Accessibility Services – [Student Accessibility Services](#) & sas@ucf.edu
- [Access and Community Engagement](#) (including the Ginsberg Center for Inclusion and Community Engagement, Military and Veteran Student Success, and HSI Initiatives)
- UCF Compliance and Ethics Office – [Compliance, Ethics, and Risk Office](#) & complianceandethics@ucf.edu
- The [Ombuds Office](#) is a safe place to discuss concerns.

Reporting an Incident or Issue

If you believe you have experienced discrimination by any faculty or staff member, contact the Office of Nondiscrimination & Accommodations Compliance via the [ONAC website](#) or at 407-823-1336. You can also choose to report using the UCF Integrity Line either anonymously or as yourself at 1-855-877-6049 or by using the [online form](#). UCF cares about you and takes every report seriously. For more information see the [Reporting an Incident or Issue Webpage](#).

Class Schedule

<div align="center">Course Schedule</div>

Week	Topic
1	
2	
3	
4	
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6	
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8	
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10	

Week	Topic
11	
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16	

Deployed Active-Duty Military Students

Students who are deployed active-duty military and/or National Guard personnel and require accommodation should contact their instructors as soon as possible after the semester begins and/or after they receive notification of deployment to make arrangements.

Campus Safety

At UCF's Public Safety and Police, safety is the top priority. Emergencies on campus are rare, but if one should arise, it's important to be familiar with some basic safety and security concepts.

- In an emergency, always dial 911.

- Every UCF Classroom has an Emergency Procedure Guide posted on a wall near the door, which will show you how to respond to a variety of situations. This guide can also be found found online [here](#).

- In the event of an active threat, remember **AVOID**, **DENY**, **DEFEND**. Choose the best course of action and act immediately. Watch the video [here](#) to learn more.
  - **AVOID**. Pay attention to your surroundings and have an exit plan. Get as much distance and as many barriers between you and the threat as quickly as possible.
  - **DENY**. When avoiding is difficult or impossible, deny the threat access to you and your space. Lockdown by creating barriers, turning the lights off and remaining quiet and out of sight. Make sure your cell phone is silenced, but do not turn it off.

- **DEFEND**. When you are unable to put distance between yourself and the threat, be prepared to protect yourself. Commit to your actions, be aggressive and do not fight fairly. Do whatever it takes to survive.
- For emergencies on campus, UCF will utilize the [UCF Alert](#) system. All UCF students, faculty, and staff are automatically enrolled to receive these email and text alerts, however, it's a good idea to frequently ensure your [contact information is up to date](#).

Financial Aid Accountability

All instructors/faculty are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please complete this activity by the end of the first week of classes or as soon as possible after adding the course. Failure to do so may result in a delay in the disbursement of your financial aid.