TEXAS A&M UNIVERSITY

Course Syllabus

Course Information

Course Number:	*ENGR 698-603*
Course Title:	*Machine Learning for Computer Vision*
Section:	*Section*
Time:	*1 - 4 pm (From Mon to Fri)*
Location:	*BLOC 163*
Credit Hours:	1 *Credit, 15 hours in total*

Instructor Details

Instructor:	*Yalong Pi*
Office:	*BLOC 221C*
Phone:	*9792559203*
E-Mail:	*piyalong@tamu.edu*
Office Hours:	*By appointment*

Course Description

This course is a project-based, 15-hour intensive course on advanced computer vision. Participants will explore topics such as image classification, transfer learning, object detection, segmentation, and real-world projects. Through a combination of lectures and hands-on lab sessions, students will gain practical skills in implementing algorithms such as ResNet, VGG, YOLO, DETR, Mask RCNN, and UNet. By the end of the course, participants will be equipped to analyze visual data and apply deep learning techniques to solve real-world computer vision challenges.

Course Prerequisites

Graduate level or equivalent
Python

Special Course Designation

https://github.com/TAMIDSpiyalong/Machine-Learning-for-Computer-Vision has all the lab materials.

Course Learning Outcomes

Upon successfully completing this course, a student will be able to

- Understand advanced concepts in computer vision, including image classification, transfer learning, object detection, and segmentation.

- Implement and apply deep learning algorithms such as ResNet, VGG, YOLO, DETR, Mask RCNN, and UNet.
- Analyze visual data and develop solutions to real-world computer vision challenges using Python tools that are traditional (OpenCV) and machine learning based (e.g., Pytorch or Tensorflow).
- Apply data preprocessing and postprocessing techniques for computer vision applications.
- Effectively utilize learning resources, including textbooks, online tutorials, and open-source libraries, for further self-learning.

Textbook and/or Resource Materials

There is an abundance of available learning materials, simply choose one that resonates with you and embark on your journey confidently.

1. *Computer Vision: Algorithms and Application, by Richard Szeliski.*
    a. http://szeliski.org/Book/
2. Digital Image Processing Using Matlab, 3rd version, by R.C. Gonzalez.
    a. https://www.amazon.com/DIGITAL-IMAGE-PROCESSING-USING-MATL/dp/0982085419
3. Modern Computer Vision with PyTorch
    a. https://github.com/PacktPublishing/Modern-Computer-Vision-with-PyTorch
4. *The following textbooks can also be useful references for different students:*
    a. *Multiple View Geometry in Computer Vision, by Richard Hartley and Andrew Zisserman.*
    b. *Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce.*
5. *Dive into deep learning*
    a. *https://d2l.ai/chapter_computer-vision/index.html*
6. *Pytorch*
    a. *https://pytorch.org/tutorials/beginner/transfer_learning_tutorial.html*
7. *TensorFlow*
    a. *https://www.tensorflow.org/tutorials/load_data/images*
8. *OpenCV*
    a. *https://docs.opencv.org/4.x/d9/df8/tutorial_root.html*
    b. *https://pyimagesearch.com/start-here/*
9. *Kaggle*
    a. *https://www.kaggle.com/*

Grading Policy

- *Assignments and Quizzes: 40 %*
- *Projects: 60 %*
- *Letter grade conversions from total scores will use the following standard conventions:*
    - *A = 90 to 100*

- *B = 80 to 89*
- *C = 70 to 79*
- *D = 60 to 69*
- *F < 60*

Course Schedule

This will be a one-week, 15-hour course. The course schedule can be adjusted based on the feedback from the students. The tentative schedule is as follows:

- *Day 1: Classification Fundamentals and Convolutional Neural Network (CNN)*
  - *1:00 - 1: 20: Intro*
  - *1:20 - 2:20 pm: Lecture*
  - *2:30 - 4:00 pm: Lab Day1*
    - *Simple CNN*
    - *American sign language dataset*

- *Day 2: Data Augmentation, Evaluation, and Transfer-learning*
  - *1:00 - 1: 20: Quiz on Day 1*
  - *1:20 - 2:20 pm: Lecture*
  - *2:30 - 4:00 pm: Lab Day2a&2b*
    - *ResNet*
    - *Dog breed classification*

- *Day 3: Object Detection and Tracking*
  - *1:00 - 1: 20: Quiz on Day 2*
  - *1:20 - 2:20 pm: Lecture*
  - *2:30 - 4:00 pm: Lab 3*
    - *YOLO&DETR*
    - *TAMIDS traffic management project*

- *Day 4: Segmentation and Autocoder*
  - *1:00 - 1: 20: Quiz on Day 3*
  - *1:20 - 2:20 pm: Lecture*
  - *2:30 - 4:00 pm: Lab 4*
    - *Mask-RCNN&UNet*
    - *TAMIDS animal science project*

- *Day 5: Generative Adversarial Networks (GANs) and Beyond*
  - *1:00 - 1: 20: Quiz on Day 4*
  - *1:20 - 2:20 pm: Lecture*
  - *2:30 - 4:00 pm: Lab 5*
    - *Work on your own projects.*
    - *TAMIDS cotton water stress classification projects*

University Policies

This section outlines the university level policies that must be included in each course syllabus. The TAMU Faculty Senate established the wording of these policies.

***NOTE**: Faculty members should not change the written statements. A faculty member may add separate paragraphs if additional information is needed.*

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

Texas A&M at College Station
You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Texas A&M at Galveston
You can learn more about the Honor Council Rules and Procedures as well as your rights and responsibilities at tamug.edu/HonorSystem.

Texas A&M at Qatar
You can learn more about academic integrity and your rights and responsibilities at Texas A&M University at Qatar by visiting the Aggie Honor System website.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below) Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Texas A&M at College Station
Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu.

Texas A&M at Galveston
Disability Resources is located in the Student Services Building or at (409) 740-4587 or visit tamug.edu/counsel/Disabilities.

Texas A&M at Qatar
Disability Services is located in the Engineering Building, room 318C or at +974.4423.0316 or visit https://www.qatar.tamu.edu/students/student-affairs/disability-services.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and

must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Texas A&M at College Station
Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

Texas A&M at Galveston
Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with the Counseling Office in the Seibel Student Center, or call (409)740-4587. For additional information, visit tamug.edu/counsel.

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the Galveston Campus' Title IX webpage.

Texas A&M at Qatar
Texas A&M University at Qatar students wishing to discuss concerns in a confidential setting are encouraged to visit the Health and Wellness website for more information.

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care by utilizing available resources and services on your campus

Texas A&M College Station

Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org Links to an external site..

Texas A&M at Galveston
Students who need someone to talk to can call (409) 740-4736 from 8:00 a.m. to 5:00 p.m. weekdays or visit tamug.edu/counsel for more information. For 24-hour emergency assistance during nights and weekends, contact the TAMUG Police Dept at (409) 740-4545. 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org Links to an external site..

Texas A&M at Qatar
Texas A&M University at Qatar students wishing to discuss concerns in a confidential setting are encouraged to visit the Health and Wellness website for more information.

Campus-Specific Policies

Texas A&M at Galveston

Classroom Access and Inclusion Statement

Texas A&M University is committed to engaged student participation in all of its programs and courses and provides an accessible academic environment for all students. This means that our classrooms, our virtual spaces, our practices and our interactions are as inclusive as possible and we work to provide a welcoming instructional climate and equal learning opportunities for everyone. If you have an instructional need, please notify me as soon as possible.

The Aggie Core values of respect, excellence, leadership, loyalty, integrity and selfless service in addition to civility, and the ability to listen and to observe others are the foundation of a welcoming instructional climate. Active, thoughtful and respectful participation in all aspects of the course supports a more inclusive classroom environment as well as our mutual responsibilities to the campus community.

The following statements below are optional. Leave as is to include, or delete if preferred. Either way, delete this note.

Statement on the Family Educational Rights and Privacy Act (FERPA)

FERPA is a federal law designed to protect the privacy of educational records by limiting access to these records, to establish the right of students to inspect and review their educational records and to provide guidelines for the correction of inaccurate and misleading data through informal and formal hearings. Currently enrolled students wishing to withhold any or all directory information items may do so by going to howdy.tamu.edu and clicking on the "Directory Hold Information" link in the Student Records channel on the MyRecord tab. The complete FERPA Notice to Students and the student records policy is available on the Office of the Registrar webpage.

Items that can never be identified as public information are a student's social security number, citizenship, gender, grades, GPR or class schedule. All efforts will be made in this class to protect your

privacy and to ensure confidential treatment of information associated with or generated by your participation in the class.

Directory items include name, UIN, local address, permanent address, email address, local telephone number, permanent telephone number, dates of attendance, program of study (college, major, campus), classification, previous institutions attended, degrees honors and awards received, participation in officially recognized activities and sports, medical residence location and medical residence specialization.

College and Department Policies

College and departmental units may establish their own policies and minimum syllabus requirements. As long as these policies and requirements do not contradict the university level requirements, colleges and departments can add them in this section. Please remove this section if not needed.