ATENEO DE MANILA UNIVERSITY

Syllabus for Graduate Courses

A Course Information

Course Number	MATH 282.1			**No. of Units**	3
Course Title	Special Topics in Data Science: Computer Vision				
Prerequisites	MATH 71.1, MATH 40.1 (or equivalent)				
Department/Program	Mathematics			**School**	Science and Engineering
School Year	S.Y. 2024–2025			**Semester**	First Semester
Instructors	Christian Paul O. Chan Shio Richell Isaiah S. Flores				
Venue/Platform	SEC-A 303	**Section**	H	**Schedule**	Mon/Thu 6:30–8:00 PM

B Course Description

This course provides a comprehensive understanding of computer vision technologies for applied mathematics students. The course covers a range of topics including basic image processing techniques, object detection and recognition, image segmentation and feature extraction. Students learn about the mathematical foundations that shape different techniques and algorithms used in computer vision, as well as the latest developments of the field and how these technologies can be used in AI applications. Finally, this course equips students with the necessary skills and knowledge to develop innovative computer vision solutions that can help solve real-world problems.

C Course Learning Outcomes

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

Course Learning Outcomes

CLO 1: Mathematically interpret algorithms commonly used in computer vision libraries and tools.

CLO 2: Demonstrate core mathematical principles and concepts in image processing including image enhancement, filtering and transformation techniques.

CLO 3: Explain the theoretical foundations of simulation techniques in computer vision including the use of synthetic datasets, virtual environments, generative models and evaluation techniques assessing which is best for a particular situation.

CLO 4: Implement experiments that validate computer vision models and approaches.

CLO 5: Develop ethical decision-making skills when dealing with potentially inappropriate computer vision methodologies.

CLO 6: Realize innovative strategies in crafting new approaches in solving real-life problems.

D Course Outline and Learning Hours

The number of hours indicated for each module are only *rough estimates*. These were derived from an estimate that the student will allot at least 6 hours per week for this course.

> **Important!** The future is mutable. All topics and timeframes are tentative and subject to change until they have occurred.

#	Topics	CLOs	Hours
1	**Fundamentals of Digital Images** Pixel Representation Basic Mathematical Tools for Image Processing Intensity Transformations **Project 1** (Due date: Sept. 23, 2024) Color Models and Transformations	1 2 3 4 5 6	20
2	**Image Processing Algorithms** Filtering in the Frequency Domain Image Restoration and Reconstruction Image Transforms **Project 2** (Due date: Nov. 4, 2024) Morphological Image Processing Image Segmentation	1 2 3 4 5 6	40
3	**Computer Vision** Boundary Feature Descriptors Region Feature Descriptors Whole-Image Features Scale-Invariant Feature Transform **Project 3** (Due date: Dec. 6, 2024)	1 2 3 4 5 6	30

E Assessments and Rubrics

Project 1	35%	1 2 3 4 5 6
Project 2	40%	1 2 3 4 5 6
Project 3	25%	1 2 3 4 5 6
TOTAL	100%	

F Teaching and Learning Methods

Lectures	1 2 3 4 5 6
Reading Assignments	1 2 3 4 5 6
Programming Exercises	1 2 3 4 5 6
Final Project	1 2 3 4 5 6

G Required Readings

- Rafael C. Gonzalez and Richard E. Woods. *Digital Image Processing*. Pearson, 4th edition, 2018.

H Suggested Readings

- Charu C. Aggarwal. *Neural Networks and Deep Learning: A Textbook*. Springer International Publishing, 2018.
- Jay Dawani. *Hands-On Mathematics for Deep Learning: Build a Solid Mathematical Foundation for Training Efficient Deep Neural Networks*. Packt Publishing, 2020.
- Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. *Mathematics for Machine Learning*. Cambridge University Press, 2020.
- Mohamed Elgendy. *Deep Learning for Vision Systems*. Manning, 2020.
- Joseph Howse and Joe Minichino. *Learning OpenCV 4 Computer Vision with Python 3: Get to Grips with Tools, Techniques, and Algorithms for Computer Vision and Machine Learning*. Packt Publishing, 3rd edition, 2020.
- Reinhard Klette. *Concise Computer Vision: An Introduction into Theory and Algorithms*. Undergraduate Topics in Computer Science. Springer, 2014.
- Simon J. D. Prince. *Computer Vision: Models, Learning, and Inference*. Cambridge University Press, 2012.
- Richard Szeliski. *Computer Vision: Algorithms and Applications*. Texts in Computer Science. Springer, 2nd edition, 2022.

I Grading System

Let x be your final grade. Then the grading scale is defined as follows:

$92 \leq x$	A
$87 \leq x < 92$	A–
$81 \leq x < 87$	B+
$75 \leq x < 81$	B
$69 \leq x < 75$	C
$x < 69$	F

Getting a grade of C or an F will not entitle you to any graduate credit for the course.

J Class Policies

Proper Conduct

Participants (both students and instructors) are expected to conduct themselves and treat others with respect, ensuring an inclusive and safe learning environment. As such, in accordance with the LS Gender Policy and the Code of Decorum, discrimination, harassment, or any form of misconduct on the basis of sex, gender, marital/parental status, sexual orientation, or gender identity/expression will *not* be tolerated.

Keep distractions to a minimum. The use of personal electronic devices for non-class related activities is prohibited during onsite class hours. Please turn them off or put them in silent mode during class.

Project Submissions

Each project is given two weeks to be accomplished. Late submissions will be accepted with deductions.

Special Contingencies

Students with physical or psychological challenges that can interfere with learning are encouraged to submit a request to notify their instructor with the Office of Guidance and Counseling (for psychological conditions) or the Office of Health Services (for physical/medical conditions), together with the relevant supporting documents. Requests should be made at the start of the semester or as soon as one's condition interferes with the fulfillment of one's academic responsibilities.

Regrading Policy

Students are given at most three (3) school days after the return of the assessment to make the necessary appeals and requests for corrections. After the said period, grade changes will no longer be entertained. The instructors reserve the right to review the entirety of the assessment, not just the item/part requested to be regraded. Note that this may result to an increase or decrease in the total score. All change-of-grade decisions are final.

Academic Integrity

Students are expected to exercise the highest level of academic integrity. Cheating or plagiarism will not be tolerated and will be treated as a grave offense (automatic F in the course). Disciplinary action will be pursued, following the process set by the university. Cheating during any graded activity includes, but is not limited to, posting of answers or hints related to any graded work in any online (e.g., social networking sites, chats) or offline (e.g., text messages) platform. Plagiarism also includes using AI tools without proper acknowledgement and citation.

Intellectual Property and Privacy

Do not share materials indiscriminately outside this class. This pertains mainly to links to certain course materials (which may contain copyrighted works), forms, or any other links referring to potentially sensitive information.

Additional Policies Policy

Additional policies, with due consultation with the students, may be implemented by the instructors to adapt to the class environment.

Consultation Hours

Name of Faculty	Email	Schedule	Venue
Christian Paul O. Chan Shio	cchanshio@ateneo.edu	Mon/Thu 3:00–5:00 PM (or by appointment)	SEC-A 321
Richell Isaiah S. Flores	riflores@ateneo.edu	Tue/Fri 2:00-4:00 PM (or by appointment)	SEC-A321

If you want to arrange for a consultation, send an email (or a message via Canvas). Both individual and group ($\leq$ 6 people) consultations are accepted. Consultations can either be done onsite or online. Consultations

must be scheduled at least 24 hours in advance, excluding Sundays and holidays. For individual consultations, sessions will be recorded to ensure a safe and secure space.

(updated as of August 5, 2024)