# CS6350: Computer Vision

July-Nov Semester 2026
Slot; G
**Slots: Monday: 12:00-12:50 pm, Wednesday: 5:00-5:50 pm**
**Thursday: 10:00-10:50 am, Friday: 9:00-9:50 am**

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Note: The course webpage is **www.cse.iitm.ac.in/~vplab/computer_vision.html**. A google group will be formed for course related communications; please check the email regularly.

## 1 Course Objectives

Computer Vision focuses on development of algorithms and techniques to analyze and interpret the visible world around us. This requires understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis, visual geometric modeling, stochastic optimization etc. Knowledge of these concepts is necessary in this field, to explore and contribute to research and further developments in the field of computer vision. Applications range from biometrics, medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc.

## 2 Learning Outcomes

- To apply mathematical modeling methods for low, intermediate and high level image processing tasks
- To be able to design new algorithms to solve recent state of the art computer vision problems.
- To perform software experiments on computer vision problems and compare their performance with the state of the art (DL-based say)
- To develop a broad knowledge base so as to easily relate to the existing literature.
- To gather a basic understanding about the geometric relationships between 2D images and the 3D world.
- To build a complete system to solve a computer vision problem.

## 3 Course prerequisite(s)

COT

## 4 Classroom Mode

Traditional lectures (4 [50 mins. slots] per week) with slides. 5-6 tutorials are tentatively planned to be conducted within these slots.

## 5 Textbooks

- Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
- Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, March 2004

## 6 Reference Books

- R. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.
- K. Fukunaga; Introduction to Statistical Pat- tern Recognition, Second Edition, Academic Press,Morgan Kaufmann, 1990.

## 7 Course Requirements

You are required to attend all the lectures. If you miss any of them it is your responsibility to find out what went on during the classes and to collect any materials that may be handed out or informed. Class participation

is strongly encouraged to demonstrate an appropriate level of understanding of the material being discussed in the class. Regular feedback from the class regarding the lectures will be very much appreciated.

## 8 Planned Syllabus

- Digital Image Formation and low-level processing: Overview and State-of-the-art, *Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean*, Affine, Projective, etc; *Fourier Transform*, Convolution and Filtering, Image Enhancement, Restoration, *Histogram Processing*

- Depth estimation and Multi-camera views: *matrix transformation,* Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

- Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale- Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

- Image Segmentation: *Region Growing, Edge Based approaches to segmentation*, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

- Pattern Analysis: *Basics of Probability and Statistics*, Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

- Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

- Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation. Photo-metric Stereo; Use of Surface Smoothness Con-straint; Shape from Texture, color, motion and edges.

The topics shown in *italic* font will be left for self-study.

## 9 Tentative Grading Policy

The following allocation of marks is tentative. The flexibility will be used to the benefit of average grades for the entire class.

| | |
|---|---|
| Mid Sem (50 mins) | 15-20 |
| End Sem Exam (120-150 mins) | 35-40 |
| TPA* | 30-35 |
| Tuts(best n-1) | 10-15 |
| Total | 100 |

## 10 Tentative Schedule (Dates)

Tentative dates of activities throughout the semester:

| | |
|---|---|
| Extra Classes | TBA |
| Finalizing the groups by students | 15/08/2026 |
| Choice of TPA by students | 25/08/2026 |
| TPA Assignment to each group | 30/08/2026 |
| TA Interaction for TPA | TBA |
| Interim TPA Review (optional) | TBA |
| Tutorial 1 | 13/08/2026 |
| Tutorial 2 | 10/09/2026 |
| **Mid Semester Exam** | **24/09/2026** |
| Tutorial 3 | 01/10/2026 |
| Tutorial 4 | 15/10/2026 |
| Tutorial 5 | 29/10/2026 |
| **End Semester Exam** | **19/11/2026** |
| Final TPA Demo/Viva Slot 1 (Tentative) | 31/10/2026 |
| Final TPA Demo/Viva Slot2 (Tentative) | 07/11/2026 |

## 11 Academic Honesty

Academic honesty is expected from each student participating in the course. NO sharing (willing, unwilling, knowing, unknowing) of assignment code between students, submission of downloaded code (from the Internet, or anywhere else) is allowed.

Academic violations will be handled by the IITM Senate Discipline and Welfare (DISCO) Committee. Typically, the first violation instance will result in ZERO marks for the corresponding component of the Course Grade and a drop of one-penalty level in final course grade. The second instance of code copying will result in the same as above for marks but drop two levels of final course grades at the end of semester. The DISCO Committee of IIT Madras will also be intimated of the matter.

Please protect your Moodle account password. Do not share it with ANYONE. Do not share your aca- demic disk drive space on the Campus LAN.

***Each proxy in the attendance will be penalized by 5% of (absolute) final marks. It becomes 2% each for the donor & beneficiary, if both accept the fault.***

**Tutorials are not exams. Occasional exchange of technical ideas is permitted, but**

**not copying. No complaints of copying will be entertained after the tutorial. If you find anybody copying, immediately inform the TA's present. If guilty, their copies will be taken away and they will obtain 0 marks for that tutorial. Based on CSE-DCC approval, re- evaluation of End Sem exam papers will only be done in front. Only minor clarifications, totaling errors, any missed corrections will be considered till that time. In case if classes are conducted in online mode, recording of any discussions on your digital device without taking permission of the teacher is disallowed. If any is found to do that, it will be reported to the Dept/IITM level ethical committee. Recorded video lectures may not be dis- tributed to anyone else, other than TAs, registered students. Posting the same on any platform online/digital media is illegal and will also be reported.**

**Please Note:**

- Participants should be available for one online session per month, scheduled on a Saturday, with a typical duration of 90 minutes (11:00 AM–12:30 PM)**.**
- The Wednesday G-slot class may extend until 6:00 PM. In addition, TA interaction sessions may occasionally (approximately once a month) continue until 6:30 PM, with prior notice.
- Clash with any event (placement, GN courses, etc) will not be considered for rescheduling discussions.
- Please use the lecture slides as a brief reference containing key points, concepts, and relevant links. They are intended to supplement, not replace, the prescribed textbooks and course materials.

## 12 Basic Preparation and Background knowledge

The students are expected to have a basic knowledge of the following:

- Linear Algebra
- Euclidean Geometry (2D and 3D).
- Fundamentals of Probability and Statistics.
- Basics of DSP.
- Programming - Python/C/C++/OpenCV
- Basics of PRML (may give you an advantage) and Deep Learning (only for TPA).

Miscellaneous Instruction :

- Self-study topics of the syllabus, as announced, may be studied without delay.
- Advisable to learn & use OpenCV techniques for TPA.
- Clarification of topics covered in class can be asked over email to TA or Google form circu- lated.
- Students are expected to make their own arrangements- personal laptops, servers or desktops in their respective departments, or even use Google Colab. Only during the final demo, a GPU-based server will be kept ready for installation and use.
- You may use any AI tools for your TPA. Ensure that it is clearly acknowledged in the report. Any modifications and contributions must be specified clearly.