

MSAI-495 Introduction to Computer Vision– Spring 2025

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Classes: Tu/Th 11:00am - 12:30pm in Tech M177

☐ What to learn?

- **Fundamentals on computer vision:** binary image processing, region segmentation, texture synthesis, edge detection, color, contour, motion analysis, visual tracking, geometry and stereo.
- **Profound understanding of math:** least square estimation, dynamic programming, eigenvalue decomposition, and maximum likelihood estimation.
- **Building your own tools:** connected region finder, morphological operators, histogram equalizer, color segmenter, Canny edge detector, texture generator, Hough transform, region tracker.

☐ Reference textbook

- R. Jain, R. Kasturi, and B. G. Schunck, Machine Vision , McGraw-Hill, Inc. 1995.

☐ How to achieve that?

- *No written exams!* but 7 machine problems (MPs). Each assignment is the implementation of a specific computer vision algorithm with a written report. **Each is expected a 3-6 hours of work**, depending on your understanding of the algorithms and your coding skills. You cannot use OpenCV libraries, but you need to have your native implementation.
- *Course projects:* there is a list of projects to choose from. The projects are expected to be complete vision applications with demos. You can use existing libraries (including OpenCV), but you need to show your novelty in terms of the applications. Simply repeating the examples of any libraries is unacceptable. In general, **3-5 weeks efforts are generally expected for a quality project** (design, implementation, experiments, demo and presentation).
- *Course mini-workshop:* project demos and presentations.

☐ Your grades?: MP (70%); 15-page projects report (30%);

Parts	Week	Date	Lectures	Reading	MP Asn
Basic	W-1	04/01(Th)	NU Monday		
		04/03(Th)	Introduction and Image geometry	Ch.1 & handout	
	W-2	04/08(Tu)	Basic binary image analysis and CCL	Ch.2.1-2.5	MP#1
		04/10(Th)	Morphological operators and OCR	Ch.2.6-2.7	MP#2
	W-3	04/15(Tu)	Histogram techniques	handout	MP#3
		04/17(Th)	Color models & color segmentation	Ch. 10 & handout	MP#4
	W-4	04/22(Tu)	Edge detection	Ch.5.1-5.4 & handout	MP#5
		04/24(Th)	Hough transform	Ch.6.8 & handout	MP#6
Core	W-5	04/29(Tu)	2D Motion analysis and object tracking	Ch.14.1-6 & handout	MP#7
		05/01(Th)	Image stitching	handout	
	W-6	05/06(Tu)	Local visual features	handout	
		05/08(Th)	Camera calibration and pose estimation	Ch.12.1-12.10 & handout	
	W-7	05/13(Tu)	Stereo vision and 3D reconstruction	handout	
		05/15(Th)	Texture modeling and synthesis	handout	
	W-8	05/20(Tu)	Basics in object detection	handout	
		05/22(Th)	Basics in object recognition	handout	
Advc.	W-9	05/27(Tu)	Visual SLAM	handout	
		05/29(Th)	Visual question answering	handout	
	W-10	06/03(Tu)	Project presentations (I)		
		06/05(Th)	Project presentations (II)		