General information	**Name, code and number of credits**	CSA521, Computer Vision and Perception Systems, 4 KU / 8 ECTS
	Departament	Computer Science
	Program (bachelors, master)	Master
	Semester	Spring 2026
	Subject teacher (s)	PhD, Associate Professor Leyla Muradkhanli
	E-mail:	leyla@khazar.org
	Lecture room	11 Mehseti str. (Neftchilar campus), Room # 301, Saturday
	Advice hours	by appointment
Prerequisites	**Programming (Python), Linear Algebra**	
Language of instruction	English	
Type of subject (compulsory/elective)	Compulsory	
Resources	**Textbooks** 1. Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd ed., Springer, 2022. electronic version available on https://szeliski.org/Book 2. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 4th edition, Pearson, 2017. 3. D. Forsythe and J. Ponce, Computer Vision: A Modern Approach, 2nd ed., Pearson, 2012.	
Course description	This course introduces the fundamental principles and modern techniques of computer vision and perception systems. The course will cover basic principles of image processing, image recognition using both classical methods and deep learning, and multiple view geometry for visual navigation. It will explore the topics of image formation, image features, image segmentation, motion estimation, tracking, and object detection and recognition.	
Course objectives	This course provides an introduction to the fundamental concepts and standard algorithms in image processing and computer vision. The course combines theoretical foundations with hands-on implementation using OpenCV, PyTorch/TensorFlow, and real-world datasets.	
Learning outcomes	By the end of the course, students will be able to: • identify basic concepts, terminology, theories, models and methods in the field of computer vision • implement linear filters and convolution • implement edge detection algorithms • apply a variety of techniques for image segmentation	

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- design of a computer vision system for a specific problem

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<tr><td rowspan="8">Teaching methods</td><td>Lecture</td><td colspan="2">x</td></tr>
<tr><td>Group discussion</td><td colspan="2">x</td></tr>
<tr><td>Lab exercise</td><td colspan="2">x</td></tr>
<tr><td>Simulation</td><td colspan="2">x</td></tr>
<tr><td>Case analysis</td><td colspan="2"></td></tr>
<tr><td>Course paper</td><td colspan="2">x</td></tr>
<tr><td>Others</td><td colspan="2"></td></tr>
<tr><td rowspan="11">Assessment</td><td>Components</td><td>Date/deadline</td><td>Percentage (%)</td></tr>
<tr><td>Midterm Exam</td><td></td><td>30</td></tr>
<tr><td>Case studies</td><td></td><td></td></tr>
<tr><td>Class Participation</td><td></td><td></td></tr>
<tr><td>Laboratory Work (Assignments)</td><td></td><td>20</td></tr>
<tr><td>Project</td><td></td><td>15</td></tr>
<tr><td>Paper Presentation</td><td></td><td></td></tr>
<tr><td>Final Exam</td><td></td><td>35</td></tr>
<tr><td>Others</td><td></td><td></td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
<tr><td>Rules (Teaching policy and behaviour)</td><td colspan="3">
Assignments
Five assignments will be during the semester. It includes image enhancement and filtering, feature extraction, morphological operations, image segmentation and object detection. The assignments must be submitted in class on the due date.
Project
Students design and implement a perception system such as:

Autonomous navigation module
Real-time object detection system
Face recognition system
Gesture recognition system
The project includes proposal, implementation, report and presentation.

Students should submit 12-15 pages of research paper, program codes and will give 15-minute presentation to the class, in the last week of the semester.
Preparation for class
The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work on relevant problems.
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	We will also have many review sessions throughout the semester. These review sessions will take place during the regular class times. **Withdrawal (pass/fail)** This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is normally expected to achieve a mark of at least 65% to pass. In case of failure, he/she will be required to repeat the course the following term or year. **Cheating/plagiarism** Cheating or other plagiarism during the Quizzes, Midterm and Final Examinations will lead to paper cancellation. In this case, the student will receive a zero (0) without any consideration. **Professional behavior guidelines** The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited. **Ethics** Students should not arrive in late to class. All cell phones must be turned off and stowed away before entering class. Use of any electronic devices is not allowed in the classroom and violators will be punished accordingly.

Tentative schedule

Week	Date	Topics to be covered	Tasks/Resources
1.	21.02.26	**Introduction to Computer Vision** Digital Image Representation: Sampling, quantization, and pixel connectivity.	Ch.1,2 [1]
2.	28.02.26	**Image Enhancement and Filtering** Spatial filtering (smoothing, sharpening), noise reduction, frequency domain filtering (Fourier transform) and convolution. ***Lab. work 1***	Ch.3 [1]
3.	07.03.26	**Morphological Operations** Erosion, dilation, opening, and closing ***Lab. work 2***	Ch.3 [1]
4.	14.03.26	**Feature Extraction** Edge & Contour Detection: Sobel, Canny edge detection, Laplacian of Gaussian. Corner & Interest Points: Harris corner detector ***Lab. work 3***	Ch.7 [1]
5.	21.03.26	**Holiday**	
6.	28.03.26	**Feature Detection and Matching Techniques** Scale Invariant Feature Transformation (SIFT) Speeded-Up Robust Features (SURF) Histogram of Oriented Gradients (HOG)	Ch.7 [1]

7.	04.04.26	**Image Segmentation** Thresholding K-Means clustering Region-based segmentation Active contours Watershed algorithms ***Lab. work 4***	Ch.6, 7 [1] Ch.9 [3]
8.	11.04.26	**Midterm exam**	
9.	18.04.26	**Motion and Tracking** Motion Analysis and Activity Recognition Motion Detection and Tracking Optical flow Background subtraction Kalman filter	Ch.9 [1] Ch.10, 11 [3]
10.	25.04.26	**Video Processing** Object tracking techniques Multi-object tracking Moving Object Detection	Ch.9 [1] Ch.10, 11 [3]
11.	02.05.26	**Deep Learning for Computer Vision** Neural Network Foundations Perceptron, backpropagation, and optimization. Convolutional Neural Networks Convolutional layers, pooling, regularization, and architecture	Ch.5 [1]
12.	09.05.26	**Object Detection and Recognition** Image Classification ***Lab. work 5***	Ch.6 [1]
13.	16.05.26	**Object Detection and Recognition** Object detection (YOLO, Faster R-CNN) ***Lab. work 5***	Ch.6 [1]
14.	23.05.26	**Perception System Applications** Face detection Pedestrian detection Remote Sensing and Satellite Imaging Robot navigation	Ch.6 [1] Ch.17, 20, 21 [3]
15.	30.05.26	**Project Presentations**	
Final exam			