The University of Jordan
School of Engineering
Department of Computer Engineering
Fall Semester – A.Y. 2024-2025

Course:	Computer Vision – 0917549 (3 Cr. – Elective Course)
Catalog Data:	Introduction to computer vision including fundamentals of computer vision at the low, medium and high levels. Topics include image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, video processing, deep-learning algorithms for image classification, object recognition, object detection and scene understanding. The course focuses on the practical aspects and implementation of these topics through homework assignments and project.
Prerequisites by Course:	0917451 AI and Machine Learning
Prerequisites by Topic:	Students are assumed to have good background in mathematics, particularly, calculus, linear algebra, statistics, probability, good background in machine learning and Python programming skills
Textbook:	1. Raphael Gonzales and Richard Woods, Digital Image Processing, 4th Edition, Pearson, 2018. 2. Richard Szeliski , Computer Vision: Algorithms and Applications, 2nd Edition, Springer, 2021. 3. M. Elgendy, Deep Learning for Vision Systems, 1st Edition, Manning, 2020. 4. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow: Concepts: Tools, and Techniques to Build Intelligent Systems, 2nd Edition, O'Reilly Media, Oct 2019.
References:	1. D. Forsyth and J. Ponce Andries, Computer Vision: A Modern Approach, 22nd Edition, Pearson India, 2011. 2. Jan Erik Solem, Programming Computer Vision with Python, O'Reilly Media, 2012.
Course Website:	https://sites.google.com/view/iyadjafar
Schedule & Duration:	16 Weeks, 48 lectures, 50 minutes each (including exams).
Minimum Student Material:	Text book, class handouts, some instructor keynotes, calculator and access to a personal computer and internet.
Minimum College Facilities:	Classroom with whiteboard and projection display facilities, library, and computational facilities.
Course Objectives:	This course introduces the students to the basic concepts of computer vision at a number of different levels: 1. Computer vision definition, goals, applications and challenges. 2. Low-level computer vision tasks for image filtering, edge detection, corner detection. 3. Feature extraction and matching. 4. Medium-level computer vision tasks for image segmentation and binary image processing.

5. High-level computer vision tasks for object detection, image classification and semantic segmenation using deep learning techniques.

Course Outcomes and Relation to ABET Program Outcomes:

Upon successful completion of this course, a student should be able to:

1. Demonstrate a sound understanding of the definition of the computer vision field and its applications [2].
2. Understand computer vision algorithms at low, medium and high levels [2].
3. Use computers and software tools to perform computer vision tasks using available packages [1].
4. Communicate the development of a solution for a computer vision problem through a detailed technical report and a short presentation [3].
5. Work within a team to solve a real-world problem in computer vision [5].

Course Topics:

1. What is Computer Vision, Computer Vision Applications
2. Image Formation and Representation, Color and Color Spaces, Image Statistics, Point Operations Convolution and Filtering, Image Scaling, Image Interpolation, Geometric Transformation
3. Edge Detection Using Derivatives, Canny Edge Detector, Edge Linking, Hough Transform for Line and Circle Detection
4. Corner Detection, Blobs Detection, SIFT
5. Basic Thresholding, Otsu Optimal Thresholding, Variable Thresholding, Segmentation as Clustering
6. Geometric Features of Binary Objects, Segmentation of Binary Images, Morphological Processing
7. Recognition Tasks, Classical Recognition Pipeline, Overview of Machine Learning
8. Artificial Neural Networks Review, Deep Learning, Convolutional Neural Networks
9. CNN Design Patterns, LeNet-5, AlexNet, VGGNET, Inception and GoogLeNet, ResNet
10. Whole Image Classification, Object Detection, Semantic Segmentation, Instance Segmentation, Autoencoders and Generative Adversarial Networks

Computer Usage:

Students are expected to solve several homework assignments and a term project using Python programming and computer vision package.

Attendance:

Class attendance will be taken every class and the university's polices will be enforced in this regard.

Assessments:

Quizzes and Exams.

Grading policy:

Homework	10%
Project	10%
Midterm Exam	30%
Final Exam	50%

Instructors:

Class Time and Location:

Program Outcomes (PO)

1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3	An ability to communicate effectively with a range of audiences

4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Last Updated: JULY 13TH, 2024