Faculty: Information Technology	
Department: Data Science and Artificial Intelligence	**Program: Bachelor**
Academic year:	**Semester: 2**

Course Plan

First: Course Information

Course No.: 1505461	***Course Title: Computer Vision***	***Credit Hours: 3***	***Theoretical: 3***	***Practical:***
Prerequisite No. and Title: 1505366- Digital Image Processing	***Section No.:***	***Lecture Time:***		
Level in JNQF	***7***			
Type Of Course:	☐ ***Obligatory University Requirement*** ☐ ***Elective University Requirement*** ☐ ***Obligatory Faculty Requirement*** ☐ ***Elective Faculty Requirement*** ■ ***Obligatory Specialization Requirement*** ☐ ***Elective Specialization Requirement*** ☐ ***Ancillary course***			
Type of Learning:	☐ ***Face-to-Face Learning*** ■ ***Blended Learning (2 Face-to-Face + 1 Asynchronous)*** ☐ ***Online Learning (2 Synchronous+ 1 Asynchronous)***			

Second: Instructor's Information

Course Coordinator:				
Name:	***Academic Rank:***			
Office Number:	***Extension Number:***	***Email:***		
Course Instructor:				
Name:	***Academic Rank:***			
Office Number:	***Extension Number:***	***Email:***		
Office Hours:	***Sunday***	***Monday***	***Tuesday***	***Wednesday*** ***Thursday***

Third: Course Description

This course explores the fundamentals of computer vision with a focus on image classification, object localization, object detection, and image segmentation. Gain insights into advanced concepts such as multi-label classification, and distinguish between semantic segmentation and instance segmentation. This course emphasizes hands-on experience by utilizing TensorFlow to build robust object detection and image segmentation models. Learn to implement popular models, including regional-CNN and ResNet-50, and leverage pre-trained models available on TensorFlow Hub. Gain practical skills in configuring models for training, and explore the power of transfer learning to detect and localize objects effectively.

Fourth: Course Objectives

1. Gain a comprehensive understanding of the foundational principles behind digital images, including image formation, light interactions, sensor technologies, and computational image representation. Develop proficiency in essential manipulation techniques such as filtering, edge detection, and segmentation.
2. Acquire the skills to extract meaningful features, such as shapes, textures, and edges, from images. Learn the art of matching these features across images to identify similarities and differences, enhancing your ability to analyze and interpret visual data.
3. Train as an "object whisperer" by constructing and training machine learning models for object recognition and classification. Dive into advanced algorithms like convolutional neural networks (CNNs) to achieve robust object detection in real-world scenarios.
4. Move beyond individual objects and delve into the intricacies of scene analysis. Explore computer vision techniques for tasks like scene reconstruction, motion tracking, and anomaly detection, fostering a holistic understanding of visual data within complex environments.
5. Explore the broad spectrum of applications for computer vision in diverse fields, including medical imaging, robotics, and autonomous systems. Engage in discussions about the ethical considerations surrounding this powerful technology and actively promote responsible development and utilization. Gain the skills to bridge theoretical knowledge with practical applications in real-world scenarios.

Fifth: Learning Outcomes

Level descriptor according to (JNQF)	*CILOs Code*	*CILOs* If any CLO will not be assessed in the course, mark NA.	*Associated PILOs Code* *Choose one PILO for each CILO**	*Assessment method* *Choose at least two methods*
Knowledge	**K1**	Identify the basic terms associated with computer vision, including object localization, object detection, and image segmentation.	**PK1**	• Mid-term Exam • Final Exam
	K2	Apply the pre-trained models and Media Pipe techniques to solve modern problems.	**PK2**	• Mid-term Exam • Final Exam
	K3	Define principles, concepts, and computer vision architecture of practical problems.	**PK4**	• Quizzes • Mid-term Exam • Final Exam
Skills	**S1**	Analyze and evaluate the design and implementation of computer vision methods.	**PS2**	• Mid-term Exam • Final Exam
	S2	Design various computer vision architecture as R-CNN, Fast R-CNN, Faster R-CNN.	**PS3**	• Mid-term Exam • Final Exam
	S3	Select and apply appropriate methods and computational tools to solve problems using pre-trained models.	**PS2**	• Mid-term Exam • Final Exam
	S4	Design and construct computer vision systems using appropriate methods.	**PS3**	• Quizzes • Mid-term Exam • Final Exam
	S5	Be able to communicate effectively in a group.	**PS4**	• Quizzes • Mid-term Exam • Final Exam
Competencies	**C1**	Solve the problems by using new architecture.	**PC1**	• Participation

*CILOs: Course Intended Learning Outcomes; PILOs: Program Intended Learning Outcomes; For each CILO, the PILO could be the same or different.

Sixth: Learning Resources

Designated Book:	**Python Deep Learning**		
Print	***Year:* 2019**	***Print***	***Year:* 2019**
Additional Sources: ***Website:***	• **Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition, Springer, 2021.** • **Mohamed Elgendy, Deep Learning for Vision Systems, Manning,2020**		
Teaching Type:	■ ***Classroom*** □ ***Laboratory*** □ ***Workshop*** ■ ***MS Teams*** ■ ***Moodle***		

Seventh: Course Structure

Week	Course Intended Teaching Outcomes (CILOs)	Topics	Teaching Procedures*	Teaching Methods**	References***
Week 1	K1, K2, K3, S1	Introduction OpenCV: Drawing	Face-to-Face	Lecture, In class Questions	Chapter 1
	K1, K2, K3, S1	Real-time face	Asynchronous	Asynchronous	
Week 2	K1, K2, K3, S1, S1 S2	OpenCV: Contour Edge Detection	Face-to-Face	Lecture, In class Questions	Chapter 1
	K1, K2, K3, S1, S1 S2	Object Detection: A journey from R-CNN to Mask R-CNN and YOLO	Asynchronous	Asynchronous	
Week 3	K1, K2, K3, S3 S5	OpenCV: Sketching and Threholding Face and Eyes Detection	Face-to-Face	Lecture, In class Questions	Chapter 2
	K1, K2, K3, S3 S5	Animate 3D Characters Using WebCams and MediaPipe	Asynchronous	Asynchronous	
Week 4	K1, K2, K3, S3 S5	OpenCV: Face and Eyes Detection Operations	Face-to-Face	Lecture, In class Questions	Chapter 2
	K1, K2, K3, S3 S5	Analyze a Soccer game using Tensorflow Object Detection and OpenCV	Asynchronous	Asynchronous	
Week 5	K1, K2, K3, S3 S5	MediaPipe Face Detection	Face-to-Face	Lecture, In class Questions	Chapter 2
	K1, K2, K3, S3 S5	Sign Language Detection	Asynchronous	Asynchronous	

Week 6	K1, K2, K3, S1 S2	MediaPipe Face Mesh	Face-to-Face	Lecture, In class Questions	Chapter 3
	K1, K2, K3, S1 S2	MediaPipe Hands	Asynchronous	Asynchronous	
Week 7	K1, K2, K3, S1 S2	MediaPipe Hands	Face-to-Face	Lecture, In class Questions	Chapter 3
	K1, K2, K3, S1 S2	MediaPipe Holisti	Asynchronous	Asynchronous	
Week 8	K1, K2, K3, S1 S2	How to Code a Machine Learning Lip Reading App	Face-to-Face	Lecture, In class Questions	Chapter 3
	K1, K2, K3, S1 S2	Vision Transformer with TensorFlow	Asynchronous	Asynchronous	
Midterm Exams					
Week 9	K1, K2, K3, S3 S5	MediaPipe Holistic MediaPipe Pose	Face-to-Face	Lecture, In class Questions	Chapter 4
	K1, K2, K3, S3 S5	Transformer in Vision Domain	Asynchronous	Asynchronous	
Week 10	K1, K2, K3, S3 S5	Generative Methods	Face-to-Face	Lecture, In class Questions	Chapter 4
	K1, K2, K3, S3 S5	Understanding Semantic Segmentation with UNET	Asynchronous	Asynchronous	
Week 11	K1, K2, K3, S3 S5	Generative Methods	Face-to-Face	Lecture, In class Questions	Chapter 4
	K1, K2, K3, S3 S5	Semantic Segmentation U-Net	Asynchronous	Asynchronous	
Week 12	K1, K2, K3, S3 S5	Stable Diffusion	Face-to-Face	Lecture, In class Questions	Chapter 5
	K1, K2, K3, S3 S5	Medical Image Segmentation	Asynchronous	Asynchronous	
Week 13	K1, K2, K3, S3 S5	Stable Diffusion	Face-to-Face	Lecture, In class Questions	Chapter 5
	K1, K2, K3, S3 S5	Semantic segmentation with U-Net	Asynchronous	Asynchronous	
Week 14	S3, C1	Revision / students presentations	Face-to-Face	Discussion activity	-------
	S3, C1	Revision / students presentations	Asynchronous	Online discussion activity	
Final Exams					

*Teaching procedures: (Face-to-Face, synchronous, asynchronous). ** Teaching methods: (Lecture, video….).
*** Reference: (Pages of the book, recorded lecture, video….)

Eighth: Assessment Methods

Methods	Online Learning	Blended Learning	Face-To-Face Learning	Specific Course Output to be assessed **If any CILO will not be assessed in the course, mark NA.								
				K1	K2	K3	S1	S2	S3	S4	S5	C1
First Exam												
Second Exam												
Mid-term Exam		35		✓	✓	✓	✓	✓	✓	✓	✓	
Participation		5										✓
Asynchronous Activities												
Quizzes												
Assignments		10				✓				✓	✓	✓
Group presentation												
Final Exam		50		✓	✓	✓	✓	✓	✓	✓	✓	
Total out of 100		100										

Ninth: Course Policies

- All course policies are applied to all teaching patterns (online, blended, and face-to-face Learning) as follows:
  a. Punctuality.
  b. Participation and interaction.
  c. Attendance and exams.
- Academic integrity: (cheating and plagiarism are prohibited).