SH. A.
أكاديميـــة الشــروق

المعهد العالى للحاسبات وتكنولوجيا المعلومات
مدينة الشروق ـ القاهرة
شعبة علوم الحاسب

Course specification

Course Code: CS 445

Course Title: Computer Vision System

Academic Year: /

١

Course specification
(CS 445 - Computer Vision Systems)

Course Outline	
Faculty:	*HICIT- (Higher Institute for Computers & Information Technology-El Shorouk Academy)*
Programme(s) on which the course is given:	Undergraduate program in Computer Science
Major or minor element of programme:	Compulsory
Department offering the program	Department of Computer Science
Department offering the course:	Department of Computer Science
Level	Forth Level
Date of specification approval	DD/MM/YYYY

Basic Information			
Code: CS 445	*Title:*	Computer Vision System	
Prerequisites:	CS 443 Digital image processing		
Weekly Hours:			
Lecture: 2	**Exercise:**	**Practical: 2**	**Total:** 3 credit hours

Professional Information

Course Aims:

The aim of this course is to introduce the principles, models and applications of computer vision, as well as some mechanisms used in biological visual systems that may inspire design of artificial ones. the course will cover: image formation, structure, and coding, edge and feature detection, neural operators for image analysis, texture, color, stereo, and motion, wavelet methods for visual coding and analysis, interpretation of surfaces, solids, and shapes, data fusion, probabilistic classifiers, visual inference and learning. other recent related topics.

Program ILOs Covered by Course			
Knowledge and understanding	Intellectual Skills	Professional and practical skills	General and Transferable skills
A6, A7, A9, A18	B1, B3, B7, B15	C2, C10, C16	D1, D4, D9

Intended learning outcomes of course (ILOs)

a. Knowledge and Under-Standing:
  a1. Overview, computer imaging systems and main phases of Digital image processing-based computer system.
  a2. Image formation and sensing.
  a3. neural operators for image analysis.
  a4. Edge detection performance, Hough transform, corner detection.
  a5. Feature extraction, shape, histogram, color, spectral, texture.
  a6. wavelet methods for visual coding and analysis.
  a7. Classifications and recognition methodologies.

b. Intellectual Skills:
  b1. Design of systems that includes software and hardware.
  b2. Problem analysis and problem decompositions.
  b3. Thinking of problem-solving using transformations to suitable domain.

c. Professional and practical skills
  c1. Apply Image enhancement and segmentation.
  c2. Apply features extractions techniques.
  c3. Perform Image Segmentations using thresholding.
  c4. Hands on open CV, Neural networks using Keras.
  c5. Image recognition using tradition and deep neural networks.

d. General and transferable skills
  d1. Communicate with others; work in a team and involvement in group discussion and seminars.
  d2. Present data and results orally and in written form.
  d3. Understanding of people and teams' formation.
  d4. Differentiates between alternatives methodologies.

Contents

Topic	Contact Hours	
	lecture	Lab
Introduction Background, requirements and issues, human vision	2	2
Image formation: geometry and photometry Geometry, photometry (brightness and color), quantization, camera calibration	4	2
Image segmentation and Feature Extraction Various methods of image segmentation, edge detection, object proposals, SIFT features	2	2
Multi-view Geometry Shape from stereo and motion, feature matching, surface fitting, Active ranging	4	4
Object Recognition: Traditional Methods HoG/SIFT features, Bayes classifiers, SVM classifiers	2	2
Introduction to Neural Networks Artificial neural networks, loss functions, backpropagation and SGD, Batch Normalization	2	2
Object Recognition: Deep Learning Methods Image classification, object detection and semantic segmentation, adversarial attacks. Various neural network	4	4

architectures, visualization techniques.		
Motion analysis and Activity Recognition Motion detection and tracking, Inference of human activity from image sequences	2	2
Selected Topics Examples: Face recognition, Image grounding, Visual question answering	4	4

Teaching and learning methods	
Teaching and learning methods	**Used**
Lectures	√
Tutorial Exercises	√
Practical Lab	√
Discussions.	√
Self – Learning (Reading material, Websites search,)	√
Self-studies	-
Group work	-
Presentation	-
Problem solving/problem solving learning based	√
Case study	-
Synchronous E-Learning	√
Video lectures	√
Asynchronous E-Learning	√

Student assessment methods & Schedule		
Methods	**Used**	**Week#**
Midterm Exam	√	**8**
Final Exam	√	**16**
Course Work & Quizzes	√	**2-14**
Practical Exam	√	**15**

Assessment Weight	
Assessment	Weight %
Mid Term Exam	15
Practical Exam	15
Final Exam	60%
Course Work & Quizzes	10%
Total	100

Course Work &Quizzes
Short Exams, Assignments, Research, Reports, Presentations
Class discussion

List of references	
Essential books (textbooks)	- Digital Image Processing , Rafael C. Gonzalez and Richard E. Woods, Pearson prentice Hall,2011. - Learning OpenCV: Computer Vision in C++ with the OpenCV,Adrian Kaehler, Gary Bradski, AMAZON 2014 - "Computer Vision: A Modern Approach", D. Forsyth and J. Ponce, 2010. - "Deep Learning: Algorithms and Applications", I. Goodfellow, Y. Bengio and A. Courville, 2017 (online version available at no cost for personal use). - "A Guide to Convolutional Neural Networks for Computer Vision", S. Khan, H. Rahmani, S. Shah and M. Bennamoun, 2018 (online version available from a USC account). - "Computer Vision: Algorithms and Applications", Richard Szeliski, 2010 (online version available at no cost for personal use).
Course notes	E-Learning Portal
Recommended books	
Periodicals, website	
Videos link	

Required Facilities		
Tools & SW (Technology facilities):	– Anaconda – Python/OpenCV – Microsoft TEAMS to create virtual classrooms for lectures, discussions for project. – Academy Portal (MOODLE) to make electronic quizzes and electronic midterm exam. – Academy Portal (MOODLE) to upload project deliverable and assignment. – Academy portal (MOODLE) to upload electronic material.	
Teaching facilities:	Whiteboard	√
	Computer Lab	√
	Data show	√
	E-Learning	√
	Videos	√
	Website	√

Course Content/ILO Matrix

Course Contents	Knowledge & understanding							Intellectual skills			Professional and practical skills						General			
	a1	a2	a3	a4	a5	a6	a7	b1	b2	b3	c1	c2	c3	C4	C5	C6	d1	d2	d3	d4
Introduction Background, requirements and issues, human vision	X																x			
Understanding Image formation			x											X						
Image segmentation and Feature Extraction	X																			
feature matching, surface fitting		X		x				x	x	x										
Object Recognition		X	x	x							x	x	x	X		x			x	
Neural Networks Artificial neural						x			x		x									
Image classification, object detection and semantic segmentation												x			x					
visualization techniques					x													x		
Motion analysis						x									x					
Face recognition, Image grounding, Visual question answering							x						x		x					x

Learning Method /ILOs Matrix

Learning Methods	Knowledge and understanding							Intellectual skills			Professional and practical skills					General			
	a1	a2	a3	a4	a5	a6	a7	b1	b2	b3	c1	c2	c3	C4	C5	d1	d2	d3	d4
Lectures	X	X	X	X	X	X	X		X							X		X	
Tutorials and Lab	X							X			X	X	X	X		X			X
Exercise & Assignment		X	X	X	X	X	X	X	X		X		X		X	X	X	X	

Assessment Methods /ILOs Matrix

Assessment Methods	Knowledge & understanding							Intellectual skills			Professional and practical skills					General			
	a1	a2	a3	a4	a5	a6	a7	b1	b2	b3	c1	c2	c3	C4	C5	d1	d2	d3	d4
Midterm Exam	X		X	X	X		X	X	X		X							X	
Final term Exam	X	X		X		X		X		X	X						X		X
Quizzes and Project			X						X		X	X	X	X	X			X	
Semester work	X		X					X		X	X		X			X	X		X

Course ILOs Vs Program ILOs

Course ILOs	Prog ILOs	Knowledge & understanding				Intellectual skills				Professional and practical skills			General		
		A6	A7	A9	A18	B1	B3	B7	B15	C2	C10	C16	D1	D4	D9
Knowledge and Understanding	a1	x													
	a2		x												
	a3		x												
	a4			x											
	a5			x			x								
	a6				x		x								
	a7			x	x			x							
Intellectual skills	b1					x	x								
	b2					x									
	b3						x	x	x						
Professional and practical skills	c1									x	x	x			
	c2									x		x			
	c3										x	x			
	c4									x		x			
	c5									x	x	x		x	
General skills	d1												x		
	d2												x		
	d3														x
	d4													x	

Course Coordinator　: Dr. Abdellatief Hussien **(　　　　　　)**
Head of Department : Dr. Ahmed El-Abbassy **(　　　　　　)**
Date: --/--/2023