**Course Outline**

Machine Learning for Imaging: Computer Vision

Term 3.02

MBA BA AI ML

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**Brief Description and Relevance of the Course**

This course provides an introduction to computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding. We'll develop basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. The focus of the course is to develop the intuitions and mathematics of the methods in lecture, and then to learn about the difference between theory and practice in the projects.

\**The course will require the students to develop lab-based projects*

**Programme ILOs Addressed**

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| **ILO** | **Definition** |
| Critical Thinking | Apply the knowledge of mathematics, science, management theories and practices to solve business problems. |
| Problem Analysis | Identify, formulate, research literature, and analyze business and technical problems to arrive at substantiated conclusions using Artificial Intelligence |
| Design/development of solutions | Design solutions for complex business and technical problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| Planning and Execution | Ability to plan, organize and execute operations |

**Course ILOs**

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| **Course ILO** | **Mapping to Programme ILO** |
| CILO 1: Recognize and describe both the theoretical and practical aspects of computing with images. | Critical Thinking |
| CILO 2: Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision. | Problem Analysis |
| CILO 3: Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images. | Design/development of solutions |
| CILO 4: Get an exposure to advanced concepts leading to object and scene categorization from images and Build computer vision applications. | Planning and Execution |

**Reading Material Recommended**

| **Code** | **Textbook/Article/Report Name** | **Edition/Year** | **CILO Mapped** |
| --- | --- | --- | --- |
| T1 | R. Szeliski, "Computer Vision: Algorithms and Applications", Springer | 2010 | CILO 1, 2 and 3 |
| T2 | Practical Machine Learning for Computer Vision - Valliappa Lakshmanan, Martin Görner, Ryan Gillard  Publisher: O’REILLY | 2021 | CILO 3,4 and 4 |
| T3 | Computer Vision Using Deep Learning: Neural Network Architectures with Python and Keras by Vaibhav Verdhan  Publisher: Apress | 1st ed. Edition, Kindle Edition | CILO 2,3 and 4 |

**Session-Wise Topics and Reading/References**

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| **Sn.** | **Topic** | **Session Intended Learning Outcome** | **Reading Material Code** | **CILO** |
| 1 | Introduction to Computer Vision | 1. Recognize and describe both the theoretical and practical aspects of computing with images.  2. Connect issues from Computer Vision to Human Vision | *T1* | CILO1 |
| 2 | Accessing of Images, Apply filters on the images and How to access webcam | 1. Importing of Images, videos and accessing webcam using Opencv | *T1* | CILO2 |
| 3 | Fetching of YouTube videos and downloading and saving the first 4 videos searched through keyword | 1. Searching videos by using keywords 2. Download automatically into the drive suing YoutbeDL package | *Mini Project* | CILO3, 4 |
| 4 | From Videos extracting the frames and storing it in the specified folder | Accessing of multiple Videos using opencv and extracting the frames of each video and storing it in different folder | *Mini Project* | CILO4 |
| 5 | Apply prewitts, sobel,scharr, Roberts filter on a image | 1. Describe various methods used for registration, alignment, and matching in images.  2. Get an exposure to advanced concepts leading to object and scene categorization from images. | *T1* | CILO2 |
| 6 | By Mouse click we can the image pixel coordinate and BGR values | How to extract the pixel coordinates and BGR values on any image by clicking on that particular pixel | *T1* | CILO2 |
| 7 | Accessing the webcam and drawing the shapes on the image, fetching the coordinate and BGR values | Accessing the webcam and working on the webcam screen | *T1* | CILO2 |
| 8 | Draw a bounding box on the image or object detected |  | T2 |  |
| 9 | Text extraction | Text extraction from Images Image using Pytesseract, easyocr and opencv | T2 | CILO3, 4 |
| 10 | Feature extraction and matching on a image | 1. Describe various methods used for registration, alignment, and matching in images.  2. Get an exposure to advanced concepts leading to object and scene categorization from images. | T2 | CILO3, 4 |
| 11 | Object Detection | Object detection using YOLO model | T2 | CILO3, 4 |
| 12 | Emotion Detection | Accessing the video and extracting the emotions from the video | T2 | CILO3, 4 |
| 13 | Facial Recognition | Identifying the faces through facial recognition model | T2 | CILO3, 4 |
| 14 | Age and Gender Prediction | Detecting the Age and gender from the video frames using pretrained models | T2 | CILO3, 4 |
| 15 | Image Classification using CNN | 1. Build a CNN model for image classification | T2 | CILO3, 4 |
| 16 - 20 | Capstone project | 1. Build computer vision applications.  2.Recognize and describe both the theoretical and practical aspects of computing with images.  3.Connect issues from Computer Vision to Human Vision |  | CILO 4 |

**Performance Evaluation Components for the Course**

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| **Session No.** | **Marks** | **Evaluation Form** | **CILO** |
| **Continuous Evaluation** | | |  |
| **12** | 10 | Quiz/ Practical Exam | CLIO 1,2 |
| **21** | 30 | Project | CLIO 3,4 |
| **End Term Examination** | | |  |
| **After Course Completion** | 40 | End Term | CLIO 3,4 |

Attendance & Punctuality

Learning is an interactive process. Students are expected to be present in all the classes. Absence is only appropriate in exceptional circumstances. Voluntary activities are never valid reasons for missing any class.

Students may refer to the student handbook for regulations covering attendance.

Students who do not meet attendance requirements will not be permitted to write the end term examination and will be required to repeat the course with the next batch of students.

Late arrival is disruptive to the learning environment; students are expected to be in class before the scheduled commencement time. Students arriving for class after the scheduled commencement time will be turned away unless they have a valid reason to be permitted to attend.

**Copyright**

The content provided by the faculty in the class is copy-righted. Students are instructed not to distribute or share content used during courses with external entities.

**Student Code of Ethics**

Each student enrolled in this course accepts personal responsibility to uphold and defend academic integrity and to promote an atmosphere in which all individuals may flourish. The Students’ Code of Ethics strives to set a standard of honest behaviour that reflects well on students and the school. All students enrolled in these courses are expected to follow the Students’ Code of Ethics contained in the student handbook. Unethical and unfair practices adopted by students may lead to penalties such as having to repeat the course or having the student’s enrollment cancelled.