**COURSE OUTLINE**

Introduction to Computer Vision

Term – 2.02

MBA (BA, AI &ML) 2020-22

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| Faculty Name | Dr. Hemachandran K |
| Email ID |  |

**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*

**Intended Learning Outcomes**

At the end of the course, students will be able to:

1. Recognize and describe both the theoretical and practical aspects of computing with images.

2. Connect issues from Computer Vision to Human Vision

3. Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.

4. Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images.

5. Get an exposure to advanced concepts leading to object and scene categorization from images.

6. Build computer vision applications.

**Recommended and Reference Textbooks**

R. Szeliski, "Computer Vision: Algorithms and Applications", Springer

**Software Requirements for the Course**

Microsoft Office

MacOS 10.15 / Windows 10/ Linux VM

Python – Jupyter Notebook – Anaconda Navigator

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

**\*Note\* –**

**Readings**: Each session is preceded by a reading assignment. It is important to keep on top of the reading, which will be assumed during the lecture and discussion in class. You should set aside 2 hours to compete each reading. We do not expect you to fully understand everything before coming to class, but the goal is to prepare for class, familiarize yourself with new terminology and definitions, and to determine which part of the subject you want to hear more about. We encourage you to bring questions to class about material that is confusing. Other students might share your confusion.

In addition, you will be provided with handouts by the designated lecturer on a subject related to the session. You are expected to read the paper before class and collate your queries before arriving the lecture hall. The query should be thought provoking about the assigned paper.

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| **Sn.** | **Topic** | **Intended Learning Outcomes** | **Reading/Reference** |
| 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 | Chapter 1 |
| 2-3 | Cameras and Optics; Light and Color and Image Filtering | 1. Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.  2. Become familiar with the major technical approaches involved in computer vision. | Chapter 2.1, 2.1.5, 2.2, 2.3 |
| 4-5 | Thinking in Frequency; Interest points and corners | 1. Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.  2. Become familiar with the major technical approaches involved in computer vision. | Chapter 3.2, 3.5.2, 8.1.1, 4.2, 4.1.1, 4.1.2 |
| 6-7 | Local image features; Model fitting, Hough Transform | 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. | Chapter 4.1.3, 4.3.2, 6.1, 2.1 |
| 8-9 | RANSAC and transformations; Stereo intro and Camera Calibration | 1. Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.  2. Become familiar with the major technical approaches involved in computer vision. | Chapter 11, 6.2.1 |
| 10-11 | Epipolar Geometry and Structure from Motion | 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. | Chapter 7 |
| 12 | Stereo Correspondence and Optical Flow | 1. Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.  2. Become familiar with the major technical approaches involved in computer vision. | Chapter 11, 8.4 |
| 13-14 | Recognition and Bag of Words | 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. | Chapter 14.3,2 |
| 15-16 | Large-scale retrieval: Spatial Verification, TF-IDF, Query Expansion, feature encoding | 1. Build computer vision applications.  2. Get an exposure to advanced concepts leading to object and scene categorization from images | Chapter 14.3,2 |
| 17-18 | Crowdsourcing and Human Computation; Object Detectors Emerge in Deep Scene CNNs and Deeper Deep Architectures. | 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.  3. Build computer vision applications. | Chapter 6 |
| 19-20 | "Unsupervised" Learning and Colorization | 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 | Chapter 9 |

**Performance Evaluation Components for the Course**

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| **Session No.** | **Marks** | **Evaluation Form** |
| **Continuous Evaluation** | | |
| **2** | 5 | Quiz |
| **4** | 5 | Quiz |
| **6** | 5 | Quiz |
| **8** | 5 | Quiz |
| **10** | 5 | Quiz |
| **12** | 5 | Quiz |
| **14** | 10 | Assignment |
| **16** | 10 | Assignment |
| **18** | 10 | Assignment |
| **20** | 10 | Class Participation |
| **End Term Examination** | | |
| **After Course Completion** | 30 | Written Test |

**Assignment Schedule**

All assignments are to be presented in class along with the submission of a written report in soft copy format.

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| **Name of Assignment** | **Date of Submission** | **Take-home**  **or in-class** | **Individual work or Team-work** | **Other Instructions** |
| Virtual Paint | As per Woxsen standards | Take-home | Team-work | Use OpenCV in Python and complete this assignment |
| Paper Scanner | As per Woxsen standards | Take-home | Individual work | Use OpenCV in Python and complete this assignment |
| Number Plate Detector | As per Woxsen standards | Take-home | Individual work | Use OpenCV in Python and complete this assignment |

Computational assignments will ask you to develop implementations of algorithms for search, game-solving, constraint satisfaction, knowledge representation and reasoning, and planning, to apply them to different real-world problems, and to analyze the performance. We expect that all code will run, be well-written and be commented appropriately; the course staff is always happy to help explain style and conventions. The written components ask you questions about the concepts and methods that you have learned and to reflect on the performance of your implementations.

Attendance & Punctuality

Learning is an interactive process. Woxsen students are admitted partly based on the experience they bring to the school and what they can add to class discussions. Therefore, attendance is an important aspect of studying here. Students are expected to be present in all the classes. Absence is only appropriate in cases of extreme personal illness, injury, or close family bereavement. Voluntary activities are never valid reasons for missing any class. The faculty, with the assistance of the Faculty Associate, shall keep track of students’ attendance and decide on the nature and extent of penalty for any absence from the class. Penalty may include reduction in grade or repetition of the course.

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 should be turned away unless they have a valid reason to be permitted to attend.

Faculty should not consider attendance of sessions as a component of performance evaluation. The grading system at Woxsen accounts for this.

**External Websites Disclaimer**

Neither the instructor nor Woxsen School of Business is responsible for the content of external websites discussed in the classroom and/or linked to via online course materials, e-mail messages, message boards, or other means. Referred websites are for illustrative purposes only, and are neither warranted nor endorsed by the faculty or Woxsen School of Business. Web pages change frequently, as do ownership of domain names. While every effort is made to ensure proper referencing, it is possible that students may, on occasion, find materials to be objectionable for reasons beyond our control.

**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 without the explicit written consent of the author and/or faculty.

**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 behavior that reflects well on students and the school. All students enrolled in these courses are expected to follow the Students’ Code of Ethics, which they have been given at the time of enrolling for the program and pledged to adhere to. 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.