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| **Computer Vision** | | | |
| **Course Code:** | CS 4XX | **Semester:** | 8th |
| **Credit Hours:** | 3 | **Prerequisite Codes:** | None |
| **Instructor:** | Asif Rajput | **Class:** | BS CS + SE |
| **Office:** | 207 | **Telephone:** | - |
| **Lecture Days:** | TBD | **E-mail:** | asifali@iba-suk.edu.pk |
| **Class Room:** | TBD | **Consulting Hours:** | Mondays 12-1pm (preferably by prior email) |

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| **Course Description:** | |
|  | With a single glance a human interprets the entire scene. How many objects are present in the scene and where they are located. Which person is present in the scene. What will happen next. However, computers lack this capability. We have seen only face detectors so far working in our mobile phones? What is the challenge in understanding the 3D scene, i.e., the identity, the location and the size of the objects present in the scene. In this course we will introduce the basic concepts related to 3D scene modelling from single view and multiple views. |

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| **Course Objectives:** | |
|  | The objectives of this course are to:  - Understanding the single view geometry concepts  - Understanding the multiple view geometry concepts  - Apply concepts of CV for solving real world problems |

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| **Course Learning Outcomes (CLOs):** | |  |  |
| Upon completion of the course, it is expected that you will be able to: | | **PLO \*\* Mapping** | **BT Level\*** |
|  | 1. Understand computer vision algorithms, tools and techniques | PLO 1 | C2 |
|  | 1. Develop solutions for image/video understanding and recognition | PLO 3 | C2 |
|  | 1. Use modern tools to solve practical problems. | PLO5 | C3 |
|  | \* BT= Bloom’s Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain   * Knowledge(C-1), Comprehension(C-2), Application(C-3), Analysis(C-4), Synthesis(C-5), Evaluation(C-6) * Perception(P-1), Set(P-2), Guided Response(P-3), Mechanism(P-4), Complete Overt Response(P-5), Adaption(P-6),Organization(P-7) * Receiving(A-1), Responding(A-2), Valuing(A-3), Organization(A-4), Internalizing(A-5)   \*\* PLOs are published on department website |  |  |

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| **Books:** | |
| **Text Book:** | * Computer Vision: Algorithms and Applications, Rick Szeliski, Springer, 2011. http://szeliski.org/Book/ |
| **Reference Books:** | * Multiple View Geometry in Computer Vision, by Richard Hartley and Andrew Zisserman. * Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce. * Digital Image Processing, by Rafael Gonzalez and Richard Woods. |
| **Topics to be Covered:** | |
| Introduction to Computer Vision  Linear Algebra and Matlab Premier  Feature Detection and Description  Corner, Interest Point, SIFT, SURF, HOG, Model Fitting and RANSAC...  Image / Scene Classification and Recognition  Face Recognition, Person Re-Identification, Bag of Visual Words, Deep Learning Frameworks…  Object Detection and Segmentation  Object detection, Instance segmentation, Semantic segmentation etc. | |

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| **Lecture Breakdown:** | | | | | |
|  | **Week No.** | | **Topics** | **Assessment** | **Remarks** |
|  | 1 | CV Introduction; Revision of Prerequisites; Linear Algebra | |  |  |
|  | 2 | Image Filtering, Gradients, Convolution and Correlation | |  |  |
|  | 3 | Edge Detection (Sobel, Prewitt, LoG) | |  |  |
|  | 4 | Feature Extraction (Interest Point/ Key point Detectors, Corner Detectors) | |  |  |
|  | 5 | Feature Matching | |  |  |
|  | 6 | SIFT Feature Detector/Descriptor | |  |  |
|  | 7 | HOG Descriptor | |  |  |
|  | 8 | Fitting and Alignment, Least Square, RANSAC | |  |  |
|  | 9-10 | Deep Learning for Images (Convolutional Neural Networks Basics) | |  |  |
|  | 11 | CNN architectures – I ( AlexNet, VGG, Inception) | |  |  |
|  | 12-13 | CNN architectures – II (Resnet, DenseNet) + Optional (case study) | |  |  |
|  | 14 | Object Detection (R-CNN, Fast R-CNN, Faster R-CNN, RFCN) | |  |  |
|  | 15 | Object Detection (YOLO, SSD) + Optional (case study) | |  |  |
|  | 16 | Deep Segmentation architecture (Instance vs Semantic) | |  |  |
|  | 17 | Evaluation Metrices (Ranks, CMC etc) + pipeline building | |  |  |
|  | **18** | **ESE** | | | |

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| **Tools / Software Requirement:** | |
|  | Python, OpenCV |

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| **Course Assessment** | |
| **Exam:** | 1 Mid Exam and 1 Final Exam |
| **Home work:** | 2 Assignments |
| **Semester project:** | 1 Report for the term/semester project |
| **Quizzes:** | 3-4 Quizzes |

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| **Course Assessment Weightage (tentative)** |
| **Theory: 67%** |
| * Quizzes: 10% |
| * Assignments: 10% |
| * OHT-1: 25% |
| * End Semester Exam: 50% |

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| **Grading Policy:** | |
| **Quiz Policy:** | The quizzes will be unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is at the instructor’s discretion. |
| **Assignment Policy:** | In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No ‘best-of’ policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams. |
| **Plagiarism:** | SIBA maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people’s work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SIBA plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action. |