**Course Outline**

**Academic Year 2024, Semester 1**

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| **Institution:** | Assumption University of Thailand (AU) |
| **Department:** | Computer Science (CS) |
| **Campus:** | Suvarnabhumi Campus |
| **Faculty:** | Vincent Mary School of Engineering, Science and Technology (VMES) |

**General Information**

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| **Course Code and Title:** | CSX 4213 Computer Vision  CSX 4613 Selected Topic in Computer Vision |
| **Total Credits:** | 3 credits (3-0-6) |
| **Program and Type of Course:** | BS CS, Major Elective Course Group 1(B)  Selected Topic, Major Elective Course Group 2 |

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| **Name of Teaching Faculty Member** | **Assigned Section** |
| Asst. Prof. Dr. Dobri Atanassov Batovski | 541 |

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| **Semester and Year the subject is offered according to the program’s study plan:** | |
| Semester: First Semester | Year: Third Year |

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| **Pre-requisite:**  (Please specify, otherwise state “none”) | For Group 1(B): CSX 3001 Fundamentals of Computer Programming and ITX 2007 Data  Science |
| **Co-requisite:**  (Please specify, otherwise state “none”) | None |
| **Classroom:**  (Please specify, otherwise state “none”) | LSM 0403 |

**Objectives and Course Learning Outcomes**

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| **The Course’s objectives -** On completion of this subject, the students should be able to: |
| - Describe the main applications of computer vision. |
| - Describe the model fitting and optimization methods in computer vision. |
| - Describe the deep learning techniques in computer vision. |
| - Explain the need of forming image mosaics for specific computer vision applications. |
| - Explain the use of video surveillance techniques in computer vision. |
| - Explain the importance of recognizing, classifying and tracking objects in images. |
| - Master the methodology of problem solving in computer vision. |
| - Practice selected computer vision algorithms with specialized software tools. |
| - Describe known ethical issues related to computer vision. |

**Course Description and Implementation**

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| **Course Description** |
| Fundamental problems and techniques in computer vision: image formation, camera image geometry, feature detection in images, edge/line detection, recovery of shape from images, forming image mosaics; video surveillance techniques; recognizing, classifying and tracking objects in images. |

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| **Number of lecture - lab - self-study hours** | | | |
| **Lecture hours** | **Tutorial hours**  **(if any)** | **Practice / Field Experience / Internship hours** | **Self-Directed Learning hours** |
| 45 hours | - | - | 90 hours |

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| **Academic Advice and Guidance provided** |
| The lecturer provides academic advice and guidance to students (individual/group) for 6 hours/week on Wednesdays and Thursdays, 9 a.m. - 12 noon, in Room VME 0408. |

**Teaching Plan (Lesson Plan and Teaching Method)**

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| **Week** | **Topic(s)** | **Hours** | **Course Learning Objectives** | **Teaching Method**  **(Teaching & Learning Activities)** | **Instructional Media (if any)** | **Faculty Members** |
| **1** | Introduction to Computer vision: History of Computer Vision and Basics of Image Formation | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **2** | Image Processing: Operators, Filters, Transforms and Geometric Transformations | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **3** | Model Fitting and Optimization in Computer Vision | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **4** | Deep Learning Techniques in Computer Vision  Software Quiz #1 | 3 | Understanding of theoretical and numerical concepts; Evaluation of software skill development | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **5** | Recognition in Computer Vision: Classification, Object Detection, and Semantic Segmentation. | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **6** | Feature Detection and Matching | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **7** | Image Alignment and Stitching  Software Quiz #2 | 3 | Understanding of theoretical and numerical concepts; Evaluation of software skill development | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **8** | Make-up session for the completion of software assignments; and  Summary of Midterm Examination Topics | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **9** | Midterm Examination | 3 | Evaluate the knowledge gained during weeks 1-7. | Evaluation: Midterm Examination |  |  |
| **10** | Motion Estimation: Translational Alignment, Parametric Motion, Optical Flow, and Layered Motion | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **11** | Computational Photography and Super-resolution | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **12** | Structure from Motion and Simultaneous Localization and Mapping (SLAM)  Software Quiz #3 | 3 | Understanding of theoretical and numerical concepts; Evaluation of software skill development | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **13** | Depth Estimation and Deep Neural Networks | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **14** | Three-dimensional (3D) Reconstruction and Surface Representations | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **15** | Image-based Rendering: Video-based Rendering and Neural Rendering  Software Quiz #4 | 3 | Understanding of theoretical and numerical concepts; Evaluation of software skill development | Lecture,  Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **16** | Make-up session for the completion of software assignments; and  Overview of Final Examination Topics | 3 | Understanding of theoretical and numerical concepts; Mastering computer vision using Python | Discussion/  Software Assignments,  Directed Self-Study/  Assigned Reading Materials | Power point presentation, websites, video presentation; Python software | Asst. Prof. Dr. Dobri Atanassov Batovski |
| **17** | Final Examination | 3 | Evaluate the knowledge gained during weeks 10-15. | Evaluation: Final Examination |  |  |

**Assessment - Evaluation Plan and Proportion of Evaluation (%)**

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| **Evaluation Methods** | **Week on which the evaluation of the degree of attainment of the learning outcomes would be administered** | **Total** |
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| 1. Midterm Examination | Exam time specified by the Office of the Registrar | 20% |
| 2. Computer vision Project | Throughout the Semester | 20% |
| 3. Software Quizzes | Classes #4, #7, #11 and #14 | 20% |
| 4. Final Examination | Exam time specified by the Office of the Registrar | 40% |
| Total | At the end of the semester | **100%** |

**Note on Course Withdrawal**

Students will not be automatically debarred from the final exam even if they have attended less than 80% of the classes. However, the university registrar examines attendance records to track Visa holders.

If a student decides to continue on the course after **the withdrawal deadline, Friday, 20 September 2024**, the student will get a grade that is calculated from their accumulated score.

Students who are absent from the final examination cannot pass this course.

**Teaching and Learning Resources**

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| **Main Text(s) and Teaching Materials:** |
| The main reading materials are to be provided in class. |

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| **Essential Teaching Resources:** |
| Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition, 2022, Springer, ISBN-13: 978-3030343712. |

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| **Recommended Teaching Resources:** |
| IEEE Transactions on Computer vision, <http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?reload=true&punumber=83>. |