Course Syllabus

Course Information

Course Number/Section  CS 6384.002
Course Title  Computer Vision
Term  Spring 2022
Class Level  Graduate
Activity Type  Lecture
Days & Times  Monday & Wednesday 1:00 PM – 2:15 PM
Location  ECSN 2.126
Course Modality  Face-to-Face
Credit Hours  3

Professor Information

Instructor  Prof. Yu Xiang, Ph.D.
Office Phone  (972) 883-3891
Email Address  yu.xiang@utdallas.edu
Office Location  ECSS 4.702
Office Hours  Monday & Wednesday 3:30PM – 4:30PM

Teaching Assistant Information

Teaching Assistant  Jikai Wang
Email Address  jikai.wang@utdallas.edu
Office Location  Teams
Office Hours  Tuesday 1:00PM – 2:00PM

Course Pre-requisites, Co-requisites, and/or Other Restrictions

CS 5343 Algorithm Analysis and Data Structures

Course Description

Theory and practice of computer vision. Provides in-depth overview of computer vision, including geometric primitives and transformations, camera models, image features, epipolar geometry and stereo, structure from motion and SLAM, 3D reconstruction, variations of modern neural networks and various recognition problems such as object detection, semantic segmentation, and human pose estimation.

Student Learning Objectives/Outcomes

- Ability to understand geometric primitives and transformations
- Ability to understand projective geometry in camera models
- Ability to understand keypoint-based image features
- Ability to apply methods for camera calibration and camera pose estimation
- Ability to understand epipolar geometry, structure from motion and 3D reconstruction techniques
- Ability to understand principles and architectures of modern neural networks
- Ability to develop methods for various recognition problems from images and videos
**Required Textbooks and Materials**
ISBN-10: 1848829345

ISBN: 9789332550117

ISBN-10: 0521540518

Textbooks and some other bookstore materials can be ordered online or purchased at the UT Dallas Bookstore.

**Technical Requirements**
In addition to a confident level of computer and Internet literacy, certain minimum technical requirements must be met to enable a successful learning experience. Please review the important technical requirements on the Getting Started with eLearning webpage.

**Course Access and Navigation**
This course can be accessed using your UT Dallas NetID account on the eLearning website. Please see the course access and navigation section of the Getting Started with eLearning webpage for more information.

To become familiar with the eLearning tool, please see the Student eLearning Tutorials webpage. UT Dallas provides eLearning technical support 24 hours a day, 7 days a week. The eLearning Support Center includes a toll-free telephone number for immediate assistance (1-866-588-3192), email request service, and an online chat service.

**Communication**
This course utilizes online tools for interaction and communication. Some external communication tools such as regular email and a web conferencing tool may also be used during the semester. For more details, please visit the Student eLearning Tutorials webpage for video demonstrations on eLearning tools.

**Distance Learning Student Resources**
Online students have access to resources including the McDermott Library, Academic Advising, The Office of Student AccessAbility, and many others. Please see the eLearning Current Students webpage for more information.

**Server Unavailability or Other Technical Difficulties**
The University is committed to providing a reliable learning management system to all users. However, in the event of any unexpected server outage or any unusual technical difficulty which prevents students from completing a time sensitive assessment activity, the instructor will provide an appropriate accommodation based on the situation. Students should immediately report any problems to the instructor and also contact the online eLearning Help Desk. The instructor and the eLearning Help Desk will work with the student to resolve any issues at the earliest possible time.
Grading Policy
Credit Distribution
• Homework (50%)
  o (10%) Homework #1
  o (10%) Homework #2
  o (10%) Homework #3
  o (10%) Homework #4
  o (10%) Homework #5
• Team Project (45%)
  o (5%) Project proposal
  o (10%) Project mid-term report
  o (15%) Project presentation
  o (15%) Project final report
• In-Class Activity (5%)

Grading Scale
• A  93 or above
• A-  90-93
• B+  87-90
• B   83-87
• B-  80-83
• C+  77-80
• C   70-77
• F   70 or below

Course Policies
• eLearning is the official information portal for this course. Course announcements, homework, lecture slides, assignments, and grades will be communicated via eLearning
• Final course grade will be posted in Galaxy by the Records Office
• Attendance:
  o Required for mandatory class sessions. There will be 1-point deduction for each mandatory class absence in Team Project participation score (5%). There will be zero point for class participation if the number of absences is three or more.
• If you decide to stop attending class, be sure to drop or withdraw from the course. Otherwise, you risk receiving an ‘F’ or ‘NF’ for the course.
• No additional individual assignments can be assigned for extra credit. Only assignments that are available to the entire class may count toward the course grade.

UT Dallas Syllabus Policies and Procedures
Please visit http://go.utdallas.edu/syllabus-policies for other policies
### Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Monday</th>
<th>Wednesday</th>
<th>Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/17 Martin Luther King Day</td>
<td>1/19 Introduction to Computer Vision</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1/24 Geometric Primitives and Transformations</td>
<td>1/26 3D Rotations</td>
<td>HW1 release on 1/31, due 2/7 at 11:59PM CT</td>
</tr>
<tr>
<td>3</td>
<td>1/31 Camera Models</td>
<td>2/2 Visual Rendering I</td>
<td>Project description release on 2/7, proposal due 2/14 at 11:59PM CT</td>
</tr>
<tr>
<td>4</td>
<td>2/7 Visual Rendering II</td>
<td>2/9 Keypoint Features I</td>
<td>HW2 release on 2/16, due 2/23 at 11:59PM CT</td>
</tr>
<tr>
<td>5</td>
<td>2/14 Keypoint Features II</td>
<td>2/16 Edges, Contours, and Lines</td>
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<tr>
<td>6</td>
<td>2/21 Camera Calibration and Pose Estimation</td>
<td>2/23 Epipolar Geometry and Stereo</td>
<td></td>
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<tr>
<td>7</td>
<td>2/28 Structure from Motion and SLAM</td>
<td>3/2 3D Reconstruction</td>
<td>HW3 release on 3/2, due 3/9 at 11:59PM CT</td>
</tr>
<tr>
<td>8</td>
<td>3/7 Convolution Neural Networks I</td>
<td>3/9 Convolution Neural Networks II</td>
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<tr>
<td>9</td>
<td>3/14 Spring Break</td>
<td>3/16 Spring Break</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3/21 Recurrent Neural Networks</td>
<td>3/23 Transformers</td>
<td>Project mid-term report due 3/28 at 11:59PM CT</td>
</tr>
<tr>
<td>11</td>
<td>3/28 Generative Neural Networks</td>
<td>3/30 Neural Networks for 3D Data</td>
<td>HW4 release on 3/30, due 4/6 at 11:59PM CT</td>
</tr>
<tr>
<td>12</td>
<td>4/4 Visual Representation Learning</td>
<td>4/6 Optical Flow and Correspondences</td>
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</tr>
<tr>
<td>13</td>
<td>4/11 Object Detection</td>
<td>4/13 Semantic Segmentation</td>
<td>HW5 release on 4/13, due 4/20 at 11:59PM CT</td>
</tr>
<tr>
<td>14</td>
<td>4/18 Pose Estimation of Objects, Hands and Humans</td>
<td>4/20 Images and Languages</td>
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<tr>
<td>15</td>
<td>4/25 Computer Vision in Robotics</td>
<td>4/27 Guest Lecture: Dr. Fei Xia</td>
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<tr>
<td>16</td>
<td>5/2 Project Presentation I</td>
<td>5/4 Project Presentation II</td>
<td>Project final report due 5/11 at 11:59PM CT</td>
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*The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.*
Topics

Introduction
  • Introduction to computer vision

Image Formulation
  • Geometric primitives and transformations
  • 3D Rotations
  • Camera models
  • Visual Rendering

Feature Detection and Matching
  • Keypoint features
  • Edges, contours, and lines

3D Vision
  • Camera calibration and pose estimation
  • Epipolar geometry and stereo
  • Structure from motion and SLAM
  • 3D Reconstruction

Deep Learning
  • Convolutional neural networks
  • Recurrent neural networks
  • Transformers
  • Generative neural networks
  • Neural networks for 3D data
  • Neural implicit 3D representations

Recognition
  • Optical flow and correspondences
  • Object detection
  • Semantic segmentation
  • Object pose estimation
  • Human and hand pose estimation
  • Images and languages

Application
  • Robotics