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
Richard Szeliski. Computer Vision: Algorithms and Applications. 2011th Edition. Springer.
ISBN-13: 978-1848829343
ISBN-10: 1848829345

David Forsyth, Jean Ponce. Computer Vision: A Modern Approach, 2nd Edition. Pearson, 2011. (Optional)
ISBN: 9789332550117

Richard Hartley. Multiple View Geometry in Computer Vision, 2nd Edition. Cambridge University Press, 2004. (Optional)
ISBN-13: 978-0521540513
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%)
  - (10%) Homework #1
  - (10%) Homework #2
  - (10%) Homework #3
  - (10%) Homework #4
  - (10%) Homework #5
- Team Project (45%)
  - (5%) Project proposal
  - (10%) Project mid-term report
  - (15%) Project presentation
  - (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:
  - 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.utdalls.edu/syllabus-policies for other policies

Schedule

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

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