

## Course Syllabus

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### Course Information

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

### Professor Information

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

### Teaching Assistant Information

<i>Teaching Assistant</i>	TBD
<i>Email Address</i>	TBD
<i>Office Location</i>	TBD
<i>Office Hours</i>	TBD

### 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 Camera Models	HW1 release on 1/26, due 2/2 at 11:59PM CT
3	1/31 Photometric Image Formulation	2/2 Keypoint Features	Project description release on 2/2, proposal due 2/9 at 11:59PM CT
4	2/7 Edges, Contours, and Lines	2/9 Camera Calibration and Pose Estimation	HW2 release on 2/9, due 2/16 at 11:59PM CT
5	2/14 Epipolar Geometry and Stereo	2/16 Structure from Motion and SLAM	
6	2/21 3D Reconstruction	2/23 Convolution Neural Networks	HW3 release on 2/23, due 3/2 at 11:59PM CT
7	2/28 Recurrent Neural Networks	3/2 Transformers	
8	3/7 Graph Neural Networks	3/9 Generative Neural Networks	
9	3/14 Spring Break	3/16 Spring Break	
10	3/21 Neural Networks for 3D Data	3/23 Neural Implicit 3D Representations	Project mid-term report due 3/23 at 11:59PM CT
11	3/28 Optical Flow and Correspondences	3/30 Object Detection	HW4 release on 3/23, due 3/30 at 11:59PM CT
12	4/4 Semantic Segmentation	4/6 Object Pose Estimation	
13	4/11 Human and Hand Pose Estimation	4/13 Human Activity Recognition	HW5 release on 4/13, due 4/20 at 11:59PM CT
14	4/18 Object Tracking	4/20 Images and Languages	
15	4/25 Computer Vision in Robotics	4/27 Guest Lecture	
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
- Camera models
- Photometric image formulation

### Feature Detection and Matching

- Keypoint features
- Edges, contours, and lines
- Camera calibration and pose estimation

### 3D Vision

- Epipolar geometry and stereo
- Structure from motion and SLAM
- 3D Reconstruction

### Deep Learning

- Convolutional neural networks
- Recurrent neural networks
- Transformers
- Graph neural networks
- 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
- Human activity recognition
- Object tracking
- Images and languages

### Application

- Robotics