

# Welcome

Dear Students,

Thank you very much for your interest in CS585, Image and Video Computing. In this class, you will learn techniques used to interpret images and video and you will analyze and evaluate algorithms for various computer vision tasks. I hope to help you develop your toolbox that you will be able to use to develop creative solutions to visual problems in the class, your future studies, and your future career.

The applications we will cover are:

- object detection
- object recognition
- object tracking
- surveillance
- study of collective motion
- robot navigation
- video stabilization
- image mosaics

## 1 Instructor and Teaching Fellow

**Instructor: Diane H. Theriault** (deht@bu.edu)

(Office Hours: Friday 1-2 and 3-4:30 in EMA. By appointment other days in MCS 209.)

**Teaching Fellow: Wenxin Feng** (wenxinf@bu.edu)

(Office Hours: Monday 3:30 - 5 and 6 - 7 in EMA. By appointment other days in MCS 209.)

## 2 Location and Time

**Lectures:** Tuesday and Thursday from 12:30 - 2 PM  
MCS B33 (111 Cummington Mall, Basement).

**Labs:** Fridays from 11-12 and 2-3  
EMA 304 (Undergraduate Teaching Lab, Above Radio Shack and CVS.)

## 3 Book

Szeliski - Computer Vision: Algorithms and Applications, 11 (Springer); ISBN 9781848829343  
PDF available from the publisher's website: <http://szeliski.org/Book/>

## 4 Website

This term we will be using Piazza for class discussion. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. Find our class page at: <https://piazza.com/bu/spring2014/cs585/home>

## 5 Schedule

Week of	Tuesday	Thursday	Friday	Assignment	Projects
1/13		Introduction	Image representation	Thresholding and Color	
1/20	Image Formation	Connected Components	Gradients	Multi-scale edges	Project 1 Assigned
1/27	Face Detection	Pyramids	Corners	Templates	
2/3	SIFT / Object Recognition	HoG / Pedestrian Detection	Classifier Evaluation	Object classification (optional)	Project 1 Peer Review
2/10	Segmentation Projects	Segmentation Projects	Background Modeling	Single object tracking	Project 1 Presentations
2/17	Midterm	Data Association (Drop Date)	Kalman Filter	Multi-target Tracking	Project 2 Assigned
2/24	Feature Tracking	Pinhole Cameras, Stereo Matching	Triangulation	Depth Maps	
3/3	Epipolar Geometry	Structured Light	Kinect	Kinect (optional)	
3/10		Spring Break			
3/17	Optical Flow	Optical Flow, Con't	Video Stabilization	Video Stabilization (optional)	Project 2 Peer Review
3/24	Tracking Projects	Tracking Projects	Geometric Transformations	Transforming Images	Project 2 Presentations
3/31	RANSAC	Lenses / Radial Distortion	Image Blending	Image Mosaics	Final Project Assigned
4/7	Hough Transform	Structure from Motion	Robot Navigation	Robot Navigation	
4/14	Camera Calibration	Bundle Adjustment	Auto-calibration	Camera Calibration	
4/21	Fourier Transforms	Monday Schedule	Fourier Transforms	Fourier Transforms (optional)	Final Project Peer Review
4/22	Final Projects	Final Projects			Final Presentations

## 6 Grading

- Projects (30%)
- Weekly programming / written assignments (started in lab) (35%)
- Class participation / Weekly in-class group assignments (15%)
- Midterm (5%) and Final Exam (15%)

### 6.1 Criteria for Projects

The purpose of the class projects is to give you an opportunity to

- deeply investigate some technique or problem in computer vision
- practice being a scientist about evaluating your results
- practice your written and oral communication skills, which are essential in the workplace

Projects will be done in groups of 3-4. The class projects will be devoted to Object Detection and Segmentation, Object Tracking, and a Final Project with a topic of your choosing. For the first project, I will assign a segmentation algorithm to each group. For the second project, I will provide a list of possible tracking algorithms. For the third project, you will have broad latitude to choose your topic, though I will provide some suggestions.

You will be graded more on your scientific approach and critical thinking than on the results that you obtain. Though you should try to get the algorithm to work as well as it can, negative results are acceptable; you should try to explain why the algorithm did or did not work as expected.

The deliverables will be:

- an in-class presentation of approximately 15 minutes
- a written report of no more than three written pages in addition to no more than two pages of pictures and figures
- your code

Your report and presentation should contain:

- a clearly articulated problem statement
- a description of any relevant assumptions
- a brief description of how the algorithm works
- a description of your approach for evaluating the algorithm
- your results

Use of libraries to perform the technical work is encouraged. You may use whatever platform is most comfortable. Visual Studio 2012 with OpenCV 2.4.7 is provided on the lab computers.

The week before projects are due, we will do a round of peer-review, where each group will share a draft of the written report with four of your classmates, who will provide feedback about content and clarity. (Each group will receive four sets of feedback about the report.) I will not grade the first drafts except to check that you have provided them and they are coherent.

All of the project reports will be provided to all students in the class. **Your classmates will be responsible for the content of your presentation and report on the exams**, so be sure to do work that you will be proud of!

## 6.2 Criteria for Labs and Programming Assignments

The purpose of the programming assignments is to give you an opportunity to practice technical skills related to fundamental techniques in computer vision. I intend for them to be relatively short (2-3 hours), though they may take longer, depending on your background. The homework will be done using OpenCV 2.4.7 with Visual Studio 2012. I will provide skeleton code that you will be expected to fill in according to an assignment specification.

Programming assignment deliverables will include

- your source code
- a set of output files from running your code
- potentially short answer questions or math problems or proofs.

Weekly assignments will be assigned on Friday in lab, and will be due Monday at midnight, unless otherwise specified. There will be a **50% late penalty** assessed for homework submitted by midnight on Tuesday, and no credit thereafter. *If you have some personal reason that you cannot submit your homework on time, please contact Wenxin and I and we will work something out.*

To submit your work,

1. move output files from your assignment to the top level directory
2. clean your Visual Studio Solution, removing all temporary files.
3. put answers to the written questions in a file(s) at the top level directory of your code.  
*(For math-oriented portions of the assignments, you may typeset in LaTeX or Word. If you don't know how to correctly typeset math equations, write your solution very neatly, with good labels, on a piece of paper and take a clear, high resolution photograph of the paper. **Work that is not legible will not be graded.**)*
4. Clearly label all of your work.
5. Zip up your code, output files, and written answers.
6. Name the file `CS585_AssignmentX_username.zip`.
7. Submit the code with web-submit.

Each student must submit their own assignment. You may discuss the assignments with your peers. Please indicate any other students with whom you worked or resources you used to develop your solutions. We will grade your programming assignments by looking at your output and reading your code, so be sure to make it easy for us to see that you have fulfilled the requirements by commenting your code and following all directions about naming output files.

## 6.3 Criteria for Class Participation

For each lecture, I will assign a few small exercises or questions that will be included in the homework for the previous week to ensure that you have the necessary prerequisite knowledge in order to follow the next lecture.

In each lecture, new material will be presented in the first segment of the class. Then, the class will break into small groups to continue developing the ideas presented. After spending some time in groups, we will reassemble and discuss the findings of each group of students. To guide your thinking, I will provide discussion questions and an in-class protocol to be completed as a group.

I expect that everyone will be engaged in the group discussion and will not be looking at their phones or other technology unless it is to look something up or to take notes.

Please ask questions if you do not understand something or if I skipped steps that you do not know how to fill in. You are probably not the only one who is confused!

## **6.4 Criteria for Exams**

Exams will be held in class and will consist of problems similar to those encountered on the in-class and programming assignments. Students are responsible for being familiar with the material covered in the group presentations. You may bring one hand-written, double-sided letter-sized sheet of notes.