Syllabus*

*List of topics and (especially) dates are tentative. In the last month, one class per week will be for student project presentations.

1. Modeling Spatial Relationships  ~ (Jan 15 - Jan 29)
   - Gradient regularizers, patch models based on GMMs, sparse dictionaries, field-of-experts, etc. Optimization algorithms for inference. Restoration with plug-and-play denoisers.
   - Graphical Models and Markov Random Fields (MRFs). Inference algorithms including loopy belief-propagation, graph cuts with expansion and swap moves, etc. Mean field with efficient data-structures for fully-connected MRFs.
   - Combining neural networks outputs with MRF models. Incorporating MRF inference within a network.

2. Depth and Motion Estimation  ~ (Jan 31 - Feb 12)
   - Un-rectified and multi-view stereo with plane sweep.
   - Inference with planarity and higher-order priors on depth.
   - Large displacement optical flow, and layered models for flow.
   - CNN-based methods for stereo and flow.
   - Monocular Depth and Normal Estimation.

3. Classification & Recognition  ~ (Feb 14 - Feb 26)
   - Interest point detectors. Traditional region (SIFT, HoG) and scene (GIST) descriptors.
   - Content-based Image Retrieval. Object Detection with the Deformable Parts Model.
   - CNN-based object detection. Image and Instance Segmentation.

4. Computational Photography I  ~ (Feb 28 - Mar 19)
   - Texture Synthesis. Seam Carving.
   - Image Harmonization. CG2Real.
   - Motion Magnification.
   - Photo UnCrop. Image Inpainting. Image Editing with Smart Contours.

5. Advanced Photometric Reasoning  ~ (Mar 21 - Apr 2)
   - Uniqueness results: when does shading determine shape?
   - Modern algorithms for shape from shading, intrinsic image decomposition, and photometric stereo.
   - Neural network based Color Constancy. Lighting separation with flash/no-flash.

6. Computational Photography II  ~ (Apr 9 - Apr 23)
   - Dark flash photography.
   - Coded aperture and coded exposure photography. Light-field cameras.
   - Other non-traditional cameras.

Policies

Grade: Evaluation in this course will be based on the following

- 25%: Five homework “paper reviews”. You will be asked to read a paper and write a short (1-2 page) review. The following is a tentative schedule of when the papers will be assigned and reviews due:
  - Review 5. Assigned: Apr 4, Due: Apr 23.
- 60%: Two Projects (30% each).
  - Project II: Topics 3-5. Report Due: Apr 28.

- 15%: Presentation (based on project I). Presentation dates will be assigned randomly and posted during the semester. Irrespective of the presentation date, slides for the presentation for all students will be due before the first presentation date (~ in late March).

All submissions will be through Canvas. The final grade boundaries will be decided at the end of the course based on the distribution of scores.

**Late Policy:** All homework reviews, project reports, and presentation slides must be submitted by 11:59 PM on their due dates. There will be no extensions given. We recommend you submit early leaving a buffer of a few days to account for unexpected delays.

**Collaboration and Academic Honesty:** Discussion about course topics with your classmates is encouraged (in person, and on piazza) but all homework reviews are projects are expected to be completed individually. While completing the projects, it is OK to rely on code posted online, but this should be acknowledged in the project report. Any instances of plagiarism will be reported to the school, and will attract strict penalties.