Course Description
This course covers the fundamental concepts and methods, as well as state-of-the-art theories and technologies, in the field of image processing and visual communications. Topics include fundamental digital image and video processing methods; image analysis and understanding; statistical and perceptual image modeling and processing; and compression, streaming, robustness, scalability and security issues in visual communications.

Course Outline
1) Digital image and video processing
Intensity transformations for image enhancement; spatial domain linear filtering; frequency domain linear filtering; nonlinear image filtering; image sampling and interpolation; motion and digital video processing.

2) Image analysis and understanding
Edge detection; image segmentation; energy preserving and energy compaction; principle component analysis and independent component analysis; sparse representations; wavelet and multiresolution image analysis; non-linear image analysis.

3) Statistical and perceptual image modeling and processing
Spatial domain image statistics; Fourier domain statistical image models; wavelet domain statistical image models; Markov random field models; computational models of the human visual system; perceptual image quality assessment and processing; data-driven image processing algorithms.
4) **Visual communications: compression, streaming, robustness, scalability and security**

Video compression and standards; quality-of-service and quality-of-experience, video streaming; error resilience coding and error concealment for robust visual communications; multiple descriptive coding; scalable image and video coding and communications; security issues in multimedia communications; image and video watermarking and data hiding.

**Textbooks and References**

No required textbook. Electronic copies of lecture notes/slides will be provided.

Additional reference books and materials include:


**Projects**

Students will form 3-student teams. Each team will work on and present two *self-selected* projects:

1) A review project that surveys and comments on a specific topic;
2) A research project that attempts some new investigations in a specific direction.

Each team will have two in-class presentations, one for the review project and one for the research project. The presentations will be in the middle and the end of the term, respectively. The students on the same team will share the presentation tasks. One or multiple students from the same team should give the presentations, and every student is required to appear in at least one of the review or research project presentations.

The project presentation slides and reports should be submitted via Dropboxes at LEARN. Each presentation or report file should be submitted online by one of the team members only.

**Screening of Project Reports**

Text matching software (Turnitin) may be used to screen the project reports. The software is used to verify that all materials and sources used in the reports are properly documented. The submissions are stored on a US-based server. If any students are concerned about their privacy and/or security, they should notify the Instructor and the TA and choose to send their reports to the Instructor or TA directly.

**Grading**

- Review project: 20%
- Research project: 30%
- Final exam: 50%