Course Description
(A Special Topic Course)

Title of the course: Statistical Pattern Recognition and Its Applications in Computer Vision

Course director: Dr. Lei Wang (RSISE, ANU)
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Formal Description of course: This course provides students with modern pattern recognition techniques and their applications to the field of computer vision. The first part of this course introduces the fundamental theories and approaches in the field of statistical pattern recognition to help the students become familiar with the basic principles of pattern recognition. The second part of this course discusses a variety of problems in computer vision and demonstrates how they can be solved by using these pattern recognition techniques.

Informal Description of course: During the last decade, statistical pattern recognition has made significant progress. Many new pattern recognition algorithms, methods, and approaches have been developed. As one of the major applications of pattern recognition techniques, computer vision has also gained great success thanks to these new pattern recognition techniques. These two fields have become deeply coupled to each other. This course starts from the basic principles of statistical pattern recognition and then pays particular attention to the newly developed algorithms, for example, the kernel-based methods, boosting, component analysis, and so on. For each of these algorithms, its applications to the field of computer vision is discussed based on the research work recently published on top conferences and journals in computer vision. Through this course, the students are expected to have a good understanding of the state-of-the-art pattern recognition techniques and the related computer vision applications.

Curriculum: Proposed course outline is as follows:
1. Introduction of pattern recognition
2. Bayesian decision theory
3. Maximum-likelihood and Bayesian parameter estimation
5. Unsupervised learning (K-means clustering, Hierarchical clustering)
6. EM algorithm, Gaussian Mixture Model, and Hidden Markov Model
7. Linear discriminant analysis
8. Kernel methods and the applications to Computer Vision
9. Stochastic methods and non-metric methods
10. Algorithm-independent machine learning (No Free Lunch Theorem, Ugly Duckling Theorem, Occam's Razor,...)
11. Boosting techniques and the applications to Computer Vision
12. Component analysis methods and the applications to Computer Vision (PCA, LDA, ICA, MDS, ISOMAP, LLE,...)

Presenter: Dr. Lei Wang and Dr. Hongdong Li

Dates and locations: Semester 2, One 2-hour lecture per week, location is to be decided

Workload: 24 hours of lectures, 48 hours of reading and preparing for
Assumed knowledge of course: Undergraduate linear algebra and probability;

Prerequisites, entry requirements: Undergraduate, Master, and Ph.D. students in the fields of computer science or engineering are all welcome;

Assessment procedures: 4 assignments and 1 final oral presentation;

Assignment options for the course: Four assignment will be handed out during the course, a pass will be dependent upon the attendance (20%), assignments (50%), and the final oral presentation (30%);

Examiners: Dr. Lei Wang and Dr. Hongdong Li.