Course Number: CSC 872  
Course Title: Pattern Analysis and Machine Intelligence  
Course Level: Graduate/Senior undergraduate  
Number of Credits: 3  
Home Department: Computer Science  
Opening Term: Fall 2007  
Schedule: Three hours of lecture/discussion per week.  
Grading: Letter grading  
Prerequisite: A grade of C or better in CSC 510 and CSC 520; or Consent of Instructor

Catalog Description  

Expanded Description  
Introduction to Artificial Intelligence as a Pattern Analysis and Machine Intelligence (PAMI) Framework, Turing test, Branches of AI  
Overview: Representation for Problems and Knowledge  
Agent-based AI, Goal-based AI, Knowledge-based AI  
Rational Knowledge  
Rule-based AI, Propositional (Boolean) First Order Logic, Logical Inference  
Probabilistic Knowledge  
Uncertainty, Basic Bayesian Techniques, Graphical Knowledge Bases  
Overview: Problem Solving  
Search Algorithms  
Uninformed Search, Informed Search, A* Search  
Logical Inference with Uncertainty  
Introduction to Fuzzy Logic  
Continuous Optimization  
Gradient-Descent Algorithm, Simulated Annealing  
Overview: Learning  
Learning the Algorithms  
Decision-Tree,
Introduction to Biological and Artificial Neural Network

Learning the Parameters
Introduction to Statistical Pattern Recognition, Regression and Classification, Linear Discriminant Analysis, Support Vector Machine

Learning the Knowledge
Data Modeling, Principal Component Analysis, Kernel Density Estimation

Overview: Imaging Applications

Segmentation
Intensity-based Segmentation, Mean Shift Segmentation, Connected-Component Analysis, Model-based Segmentation,

Classification and Recognition
Biomedical Data Analysis, Face Recognition, X-Component-Analysis, X-Discriminant-Analysis

Course Objectives
The objectives of this course include:
• Teach the foundation of modern pattern analysis and machine intelligence (PAMI) studies, including artificial intelligence, machine learning, pattern recognition, neural network.
• Teach the basic and general concepts of representation, problem solving, and computational learning across the various domain instances and disciplines, facilitating the student’s understanding of how they relate to each other.
• Familiarize the students with fundamental and ubiquitous algorithms in the PAMI research and practice.
• Expose the students to imaging and vision applications as example problems.

Learning Outcomes
At the end of this course students will
• Have a comprehensive understanding of artificial intelligence, its related fields, and their relationships to one another.
• Be able to understand and formulate general problems in the PAMI formalism.
• Be able to apply pattern analysis and machine intelligence algorithms to learn and solve the PAMI problems.
• Be prepared for further advanced courses in the fields of artificial intelligence, machine learning, pattern recognition, neural network, computer vision and imaging.

These learning outcomes are designed to match with our programmatic goals by preparing students for further graduate studies in PhD level and by providing practical problem solving skills required to pursue an entry level research and development position in the industry.
**Instructional Method**
Classic classroom teaching via lectures by instructor and guest lecturers. Lab works for hands-on guided research projects.

**Method of Evaluation**
Student learning will be evaluated on the basis of
- Grade on homework assignments
- Grade on midterm examinations
- Grade on final examination or project
- Class participation.

The weight assigned to each element of evaluation will be determined by the instructor of the course on the first day of the class.

**Required Textbook**

**Recommended Reference**
*Pattern Classification (2nd Ed)*, Duda, R.O. and Hart, P.E. and Stork, D.G., Wiley-Interscience, 2000 (for pattern recognition)

*Neural Network for Pattern Recognition*, Bishop, C.M., Oxford University Press, 1996 (for machine learning and neural network and pattern recognition)


**Modified by:** K. Okada  
**Last Revision Approved:** February 14, 2007 (D. Petkovic, Chair)