1 Course Objectives

This course is designed to be a broad, self-contained, yet fairly rigorous introduction to the principles of neural computation with emphasis on machine learning, data mining and knowledge discovery, and their applications in artificial intelligence, neural and cognitive modelling, data mining and knowledge discovery, for undergraduate and graduate students in computer science, bioinformatics and computational biology, engineering, mathematics, psychology, neuroscience, cognitive science, and related disciplines. Assignments and projects are used to help clarify basic concepts.

2 Prerequisites

The recommended prerequisites for fully benefiting from the material covered in this course include:

- Knowledge of algebra, discrete mathematics, and calculus (comparable to that provided by a college freshman or sophomore level courses in mathematics);

- Knowledge of algorithms and data structures, and the ability to design and code modular, extensible, well-documented, and error-free computer programs in at least one modern high-level language (e.g., C++, Java);

- Working knowledge of the Unix environment, editors (vi or emacs), and X-windows (or the ability to quickly acquire the necessary skills).

If you have any questions or concerns about the prerequisites, please be sure to talk to the instructor.

No prior exposure to advanced mathematics, theory of computation, or neuroscience is assumed. In order to make the course accessible to an inter-disciplinary audience, the necessary concepts in mathematics (e.g., linear algebra, calculus of variations, simple differential equations, probability theory), and computer science (e.g., theory of computation, algorithms, information theory, artificial intelligence, computational learning theory) are carefully introduced or reviewed as appropriate in the context in which they arise in the treatment of neural computation.
3 Course Staff

Instructor  Jin Tian
office       107 Atanasoff Hall
phone       294-8433
e-mail      jtian@cs.iastate.edu
office hours  TR 1:00-2:00pm

The course web page http://www.cs.iastate.edu/~cs474/cs474.html will be used to convey course materials, assignments, course-related announcements, etc. We will use electronic mail to reach you when necessary. You are therefore strongly encouraged to get into the habit of reading your electronic mail and checking the course Web page once a day.

Active student participation in classroom discussion is strongly encouraged. The instructor will be available for discussion of material covered in class as well as problem sets, laboratory assignments, etc. during the scheduled office hours (or at times otherwise pre-arranged by appointment). The instructor can also be reached by electronic mail.

4 Computer Accounts

We will be using the Computer Science Departmental facilities for the course–related laboratory assignments. If you are enrolled in the course, you will be provided with an account on the departmental instructional machines (if you do not have one already).

The Computation Center holds tutorials that are designed to help a new user to get familiar with Unix, E-mail, World-wide Web, etc. on a regular basis. Please contact the Computation Center for a schedule and information on signing up for one of these tutorials.

As a student in a course offered through the Computer Science department and a user of the ISU computer facilities, you are to abide by the department’s Code of Computer Ethics. Please note that any suspected violations of the code of ethics are viewed extremely seriously by the university.

5 Assignments, Examinations, and Grading

There will be regularly scheduled problem sets, programming assignments, examinations to help you master the course material and to help us evaluate your progress.

There will be two examinations - given approximately around the 7th week and the 15th week of the semester respectively. Problem sets will be handed out roughly every two weeks throughout the semester. There will be two or three laboratory assignments. The assignments are designed to enhance your understanding of the underlying mathematical concepts and to provide you with practical hands-on experience with neural network and machine learning algorithms.

The course grades will be roughly based on problem sets (35%), laboratory assignments (20%), two examinations (20% each), and participation in classroom discussion (5%).

6 Policy on Collaboration, Late Assignments

Discussion of general concepts and questions concerning the problem sets and laboratory assignments among students is encouraged. However, each student is expected to work on the solutions individually.
Sharing of solutions (including segments of code) to assignments is forbidden unless explicitly instructed otherwise. Suspected cases of academic misconduct will be fully pursued in accordance with ISU policies.

Unless otherwise announced, problem sets will be accepted up to at most 3 days beyond the due date with a 10% late penalty per day. Problem sets turned in later than 3 days after the due date will be assigned zero credit. Laboratory assignments will be accepted up to at most 7 days beyond the due date at a 5% late penalty per day. Laboratory assignments turned in later than 7 days after the due date will be assigned zero credit. Rare exceptions to this policy might be made (at the discretion of the course staff) under demonstrably extenuating circumstances.

7 Syllabus

The following is a tentative list of topics not necessarily in the order in which they will be covered in the course. Specific reading assignments and brief lecture outlines will be posted on the course homepage periodically.

- Multi-layer networks: Backpropagation algorithms
- Radial basis functions
- Applications in pattern recognition
- Statistical models of learning: Bayesian learning, maximum likelihood techniques, Bayesian optimal classifier, Belief networks, parametric and non-parametric estimation techniques, and related approaches.
- Instance-based Learning: K-Nearest neighbor classifiers, prototype learning, Distance-based Learning Algorithms
- Computational Learning Theory: PAC learning framework, error bounds, sample and time complexity of learning, efficient learning algorithms, accuracy boosting.

8 Textbooks and References

There is no required textbook for the course. The recommended textbook Machine Learning by Tom Mitchell provides a fairly comprehensive introduction to learning systems from an artificial intelligence perspective. Elements of Artificial Neural Networks by Mehrotra, Mohan, and Ranka and Neural Network Learning and Expert Systems by Gallant provide fairly accessible introductions to some of the key topics in neural networks. Artificial Intelligence: A Modern Approach provides by Russell and Norvig provides a good overview of artificial intelligence. Lectures will draw upon a variety of additional sources. A list of useful references is given at http://www.cs.iastate.edu/~honavar/texts/texts.html. You are also encouraged to explore several on line resources on related topics (see the course web page for pointers.) However, you will not generally be responsible for materials other than that which is covered in lectures, assigned readings, handouts, assignments or projects.
9 Other Courses in Artificial Intelligence and Related Areas

Besides Com S 474, Computer Science department offers the following courses in Artificial Intelligence and related areas: *Principles of Artificial Intelligence* (Com S 472 (572 DL)), *Computational Models of Learning* (Com S 672), *Advanced Topics in Artificial Intelligence and Cognitive Modelling* (Com S 673), and *Research Seminar in Artificial Intelligence* (Com S 610). Descriptions of these courses as well as information on current research in artificial intelligence, machine learning, and neural computation in the Computer Science department at ISU is available at http://www.cs.iastate.edu/~honavar/aigroup.html

**Note to students with disabilities:**

If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me soon. Please request that a Disability Resources staff send a SAAR form verifying your disability and specifying the accommodation you will need.