Carnegie Mellon University

Department of Mechanical Engineering
24-787 Artificial Intelligence and Machine Learning for Engineering Design
Spring 2014

Time and Location:	MW 12:30 PM – 2:20 PM, PH A22
Instructor:	Matt Eicholtz meicholt@andrew.cmu.edu Wean Hall 3412 *Office hours*: by appointment
Course Assistant:	Arvind Ranganathan arvindr@andrew.cmu.edu Wean Hall 3414 *Office hours*: Th 10 AM – 12 PM
Grader:	Shweta Singh sdsingh@andrew.cmu.edu
Course Website:	http://www.cmu.edu/blackboard

Course Description:
This course will cover fundamental artificial intelligence (AI) and machine learning (ML) techniques useful for developing intelligent software tools to support engineering design and other tasks. We will examine the theory behind these techniques, learn the issues related to their efficient implementation, and discuss several practical applications. In addition to weekly lectures, the course includes several in-class learning activities, regular homework assignments, and a substantial project in which the students will work in teams to implement one or more of the algorithms discussed in class to an interesting problem of their choice. A basic working knowledge of a scientific programming language (MATLAB, C/C++, Java) is highly recommended.

Course Objectives:
Upon successful completion of this course, students should be able to:
- describe the theory behind several AI/ML algorithms
- determine the applicability of specific AI/ML algorithms to various problems
- develop efficient MATLAB implementations of AI/ML algorithms to solve real-world applications
- effectively communicate ideas related to AI/ML in conference-quality presentations and papers

Course Topics:
Topics covered in the course may include, but are not limited to:
- Probability and Bayes Theory
- Decision Trees
- Pattern Recognition
- Bayesian Classifiers

- Neural Networks
- Dimensionality Reduction
- Clustering/Mixture Models
- Support Vector Machines
- Optimization
- Evolutionary Computation
- Search
- Constraint Satisfaction

Textbooks:
There is no required textbook for this course. However, the following textbooks are recommended for those who wish to develop a deeper understanding of the course topics:

- C. M. Bishop, *Pattern Recognition and Machine Learning*. New York, NY: Springer, 2006.
- S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*. 3rd ed., Upper Saddle River, NJ: Prentice Hall, 2010.
- R. O. Duda, P. E. Hart, and D. G. Stork, *Pattern Classification*. 2nd ed., New York, NY: John Wiley & Sons, 2001.
- T. Mitchell, *Machine Learning*. New York, NY: McGraw-Hill, 1997.
- P. H. Winston, *Artificial Intelligence*. 3rd ed., Addison-Wesley, 1993.
- I. H. Witten, E. Frank, and M. A. Hall, *Data Mining: Practical Machine Learning Tools and Techniques*. 3rd ed., Burlington, MA: Morgan Kaufmann, 2011.

Assessment:

- Assignments – 60%
- Project – 30%
- Class participation – 10%

Assessment Details:
Assignments – There will be approximately 6-7 assignments throughout the semester. Each assignment will involve some theory questions along with programming exercises. The programming exercises will focus on implementation of an algorithm discussed in lecture, and in many cases sample code will be given to assist you. You will be graded on how well your computer program works, so please test and debug your code carefully. In addition to submitting your source code, you will typically be required to submit a report describing your program.

**Your lowest homework grade will be dropped.*
**You are strongly encouraged to start assignments well in advance of the due date; it is highly unlikely that you will be able to complete the entire assignment the night before it is due.*

Project – Students will work in teams of 2-3 individuals to complete a significant project throughout the semester. Each team will apply one or more AI/ML algorithms discussed in class to a problem of their choice (subject to approval by the instructor). It is recommended that the project relate to the students' research or another engineering task, if applicable. Projects will culminate with an in-class presentation and conference-style report. More details, including potential project ideas, will be provided as the semester progresses.

Class participation – Students are expected to be active participants in their learning. This includes attending lectures and engaging in class discussions. In-class exercises may be given, without warning, throughout the semester to encourage student involvement. These exercises should be relatively simple and will not require expert knowledge of the subject matter; rather they are meant to reinforce the basic

concepts presented in class. The in-class exercises will be graded on a 0/1/2 scale, where 0 indicates no participation, 1 means the student participated but with little to no effort, and 2 represents completion of the exercise with moderate effort.

Final Grade:
Your final grade will appear as a letter grade according to the following scale:

90-100%	A
80-89%	B
70-79%	C
60-69%	D
0-59%	R

Policies:
Late Assignments – All homework submissions are due by midnight (*i.e.* 11:59:59 PM) on the scheduled date. The following grading policy will apply to submissions after the deadline:

- Less than 2 hours after the deadline: you will be eligible for 90% of your nominal grade.
- Between 2-12 hours after the deadline: you will be eligible for 70% of your nominal grade.
- Between 12-24 hours after the deadline: you will be eligible for 50% of your nominal grade.
- More than 24 hours after the deadline: submissions this late will receive a score of 0%.

Collaboration – Students are encouraged to discuss challenges encountered in the homework assignments. However, any student collaboration should have the goal of *understanding better*, not *saving time by sharing work*. Here are some examples of unauthorized collaboration:

- Using code written by a classmate (all code, unless authorized by the instructor, must be original)
- "I don't understand this homework question." "Here, look at my solution…"

When in doubt regarding collaboration, consult the instructor.

Academic Integrity – Students in this course are expected to hold themselves to high standards of academic integrity. Cheating, plagiarism, and unauthorized assistance are serious academic offenses with serious consequences. If you are discovered engaging in any of these behaviors, you will earn a failing grade on the assignment in question, and further disciplinary action may be taken, in accord with the university's policies. For more information, please check out the following links:
http://www.cmu.edu/policies/documents/AcademicIntegrity.htm
http://www.cmu.edu/academic-integrity/index.html