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Introduction to Machine Learning (CS 412)
Fall 2019
3 credit hours (undergraduates) or 4 credit hours (graduates)
Prerequisites: CS 251; and IE 342 or STAT 381; or consent of instructor

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Course webpage: Blackboard, and https://piazza.com/uic/fall2019/cs412

Instructor: Dr. Xinhua Zhang	CRNs: 43875, 43876
North end, Level 3, Richard Daley Library	**Lectures**: Tu Th 5-6:15 PM
(312) 413-2416	**Classroom**: LC F6
zhangx@uic.edu	**Office hours**: W 2-4 PM (or by appt.)

Teaching Assistants	TBA	TBA
Email:		
Office location:		
Office hours:		

Office hours start from week 2 (week of Sept 2).

Course description:

Machine learning is the study of systems that improve automatically based on past experience. This course will introduce common machine learning tasks (e.g., classification, density estimation, clustering) and some of the successful machine learning techniques and broader paradigms that have been developed for these tasks. The course is programming- intensive and a large emphasis will be placed on tying machine learning techniques to specific real-world applications through hands-on experience.

Course Materials:

Required Texts (available electronically via UIC library or web)

Ethem Alpaydin, *Introduction to Machine Learning*, 3rd edition. MIT Press, 2014.

Reference:

[GBC] Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*. MIT Press, 2016.

[Murphy] Kevin P. Murphy. *Machine Learning: A Probabilistic Perspective*. MIT Press, 2012.

Although all lectures will be recorded by Echo 360, all students are strongly recommended to come to the lecture in person because it will be much more effective for learning. Furthermore, technical problems may occur in recording from time to time.

Eligibility

CS 251, IE 342 or STAT 381, or consent of instructor.

To ensure that all students understand the math required in course, a self-evaluation will be posted on Blackboard and Piazza, along with some background math readings.

Electronic Communication

1. Blackboard will contain all materials relevant to the class, syllabus, lecture notes, assignments and solutions, grades, etc. You can also see you own grades. For the first two weeks when registration is not finalized, course materials will also be made available on Piazza.

2. For general announcements and notifications, I will send email to the whole class via Blackboard. Please check your email frequently, especially around deadlines (homework and exams).

3. Piazza will be used for Question and Answer ONLY. The system is highly catered to getting you help fast and efficiently from classmates and myself. Rather than emailing questions to the instructor, you are encouraged to post on Piazza your *technical* questions, general questions about the course content, assignments, grading rubric, etc. If you have any problems or feedback for the Piazza developers, email team@piazza.com.

   Find our Piazza class page at: https://piazza.com/uic/fall2019/cs412

4. If you have any personal or non-technical questions such as medical considerations, please send an email directly to the instructor (zhangx@uic.edu) or the TA (if instructed to do so, e.g. dispute of grading).

Evaluation Criteria (all dates below are tentative)

Student understanding of course material and synthesis of knowledge will be evaluated using four typed homework assignments, a midterm examination, a final examination, and a course project.

Four homework assignments will be due approximately every 3 weeks. They focus on conceptual understanding, and the first three assignments will have a programming component.

A midterm examination is scheduled to be held in-class on October 24.

16 groups will be formed to conduct a course project, with 6-7 students in each group. The project aims to apply machine learning techniques to "real world" datasets. It will have a **proposal** (due on Oct 23), a **report** (due on Dec 15, and maximum 6 pages with template provided), and an **oral presentation** for each group at the two sessions in week 15 (Dec 3 and 5).

A final examination is scheduled according to UIC policy on ?? (check later).

Grading Policy. The overall course grade of each student will be determined based on:

1. Homework assignments: 30% = 3 * 8% (assignments 1-3) + 6% (assignment 4)
2. Midterm exam: 25%
3. Final exam: 30%
4. Course Project: 15%

All the evaluations, including each of the four assignments, will be graded out of 100, and their weighted average will be used to determine the final letter grade (A/B/…) **based on threshold**:

> A: 80 - 100
> B: 70 ~ 79
> C: 60 ~ 69
> D: 0 ~ 59

I reserve the right to **raise** your letter grade.

Important Note: To pass the class you must get at least 50% of the total available points for the two exams. That is:

$$50 \leq \frac{0.25 * \text{midterm} + 0.30 * \text{final}}{0.25 + 0.30}$$

Programming languages

Assignment: Python

Course project: You can choose your own programming language.

Course Policies

Academic dishonesty will not be tolerated. Please see the CS department policy below on the topic; this policy specifies penalties for violations. Academic misconduct will be handled according to UIC's Student Disciplinary Policy: http://dos.uic.edu/conductforstudents.shtml

What is academic dishonesty? To hand in any work which is not 100% the student's creation, unless you are explicitly allowed to do so.

Collaboration Policy

1. **Homework**: Discussion of homework assignments and solutions with other students <u>is</u> permitted. However, each student must submit his or her own write-up for the homework assignment and fully understand what he or she submits. Each student should be prepared to explain his or her homework assignment submissions to the instructor and teaching assistant if his or her "full understanding" is in doubt.

   For computer programs, if we cannot determine who copied from whom, we may, at our discretion, give failing grades to both students. It is the responsibility of all engineering and computer science professionals to safeguard their company's "trade secrets." An employee who allows trade secrets to be obtained by competitors will almost certainly be fired. So, YOU are responsible for making sure that your directories have permissions set so that only you can read your files, for being sure to log out at the end of working in the computer lab, etc.

2. **Course project:** all members of each group should make nearly the same level of contribution to the course project. All members should be responsible for the whole submission of the team, not only his/her own contributed part. You are supposed to

understand the work of your teammates inside out and be able to answer questions when asked. If one member plagiarized, then **all members** of the team will receive the **same** penalty.

3. **Exams (midterm and final): All work on all exams must be individually performed.**

Policy for Missed or Late Evaluation

1. **Late submission**s: Late submissions will not be accepted in any case, unless there is a **documented** personal emergency. Arrangements must be made with the instructor as soon as possible after the emergency arises, preferably well before the homework due date.

   Advice: If for whatever reason you don't manage to finish an assignment, hand in what you have. Partial credit will be given.

2. **Statute of limitations**: **Three weeks!** No grading questions or complaints — no matter how justified — will be listened to **three** weeks after the item in question has been returned.

3. **Missed exams**: Missed exams cannot be made up unless there are extenuating circumstances (death, severe illness, etc.) **and** the student has e-mailed instructor **in writing <u>before</u>** the exam. A mark of 0 is earned for the exam if the above policy is not adhered to.

Religious Holidays

Students who wish to observe their religious holidays shall notify the faculty member by the tenth day of the semester of the date when they will be absent. The faculty member shall make every reasonable effort to honor the request, not penalize the student for missing the class, and if an examination or project is due during the absence, give the student an exam or assignment equivalent to the one completed by those students in attendance. If the student feels aggrieved, he/she may request remedy through the campus grievance procedure.
http://oae.uic.edu/docs/ReligiousHolidaysFY20152017.pdf

CS department policy on academic dishonesty

The CS Department will not tolerate cheating by its students. The MINIMUM penalty for any student found cheating will be to receive an F for the course and to have the event recorded in a department and/or College record. The maximum penalty will be expulsion from the University.
Cheating includes all the following, though this is not a complete list:

- Copying or any other form of getting or giving assistance from another student during any test, quiz, exam, midterm, etc.
- Plagiarism–turning in writing that is copied from some other source.
- Obtaining solutions to homework by posting to the Internet for assistance, purchasing assistance, obtaining copies of solutions manuals for instructors, and obtaining copies of previous year's homework solutions.
- Computer programs: Any time you look at another student's code, it is cheating. (Exception: If you are EXPLICITLY told that you may do so by the instructor.)

A (Very) Tentative weekly schedule on the next page

Week	Topic	Readings	Evaluation
1	Introduction	Chapter 1 of Alpaydin	
1	Basic linear algebra, probability and statistics	Chapter 2.1-2.3 of GBC	
2		Chapter 2.1-2.3 of Murphy	
2	Supervised learning	Chapter 2 of Alpaydin and lecture notes	Assignment 1 out w. Naïve Bayes
3	Parametric methods for classification	Chapter 4.1-4.5 of Alpaydin	
3	Naïve Bayes	Chapter 5.7 of Alpaydin Chapter 3.5.1, 3.5.2 of Murphy	
4	Bayesian estimation applied to naïve Bayes	Chapter 16.1, 16.2 of Alpaydin	
4	**Tutorial 1**		
5	Bayesian estimation applied to naïve Bayes	Chapter 16.1, 16.2 of Alpaydin	
5	Multivariate methods	Chapter 5 of Alpaydin	Assignment 1 due
6	Multivariate methods	Chapter 5 of Alpaydin	Assignment 2 out w. k-nearest neighbor
6	Clustering	Chapter 7 of Alpaydin	
7	Nonparametric methods	Chapter 8 of Alpaydin	
7	Design and Analysis of ML Experiments & cross validation	Chapter 19 of Alpaydin Supplementary slides	
8	**Tutorial 2**		
8	Revision and course project introduction		Assignment 2 due
9	Decision Trees	Chapter 9 of Alpaydin	
9	**Midterm**		Assignment 3 out w. logistic regression
10	Decision Trees	Chapter 10 of Alpaydin	
10	Linear discrimination	Chapter 10 of Alpaydin	Project proposal due (Sunday)

11	Linear discrimination	Chapter 10 of Alpaydin	
11	Kernel machines	Chapter 13 of Alpaydin	
12	**Tutorial 3**		
12	Combining Multiple Learners	Chapter 17 of Alpaydin	Assignment 3 due
13	Multilayer Perceptrons	Chapter 11 of Alpaydin	Assignment 4 out
13	Multilayer Perceptrons	Chapter 11 of Alpaydin	
14	**Tutorial 4**		
14	Convolutional networks	Chapter 9 of GBC	Assignment 4 due
15	Course project presentation		