ECE657A: Data and Knowledge Modeling and Analysis
Winter 2020
University of Waterloo, Faculty of Engineering
Department of Electrical and Computer Engineering

Lectures:

January 6 – April 3, 2019
Mondays, 5:30am –8:20pm in room E7 4053

Instructor:
Prof. Mark Crowley, E5 4114
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Office hours: arrange for appointment by email

Course TAs:

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Course Description

Engineers encounter data in many of their tasks, whether the sources of this data may be from experiments, databases, computer files or the Internet. There is a dire need for effective methods to model and analyze the data and extract useful knowledge from it and to know how to act on it. In this course you will learn the fundamental tools for organizing cleaning and extracting useful features from data and preparing it for data science and machine learning tasks including supervised, unsupervised and reinforcement learning approaches. Students will gain practical experience with coding and analysis through assignments. Research students will have opportunity to connect course material to their research as a project instead of some of the assignments. Research students will also each carry out an in-depth review of a recent research paper as this is critical in keeping up with this literature.

Recommended background: Data Structures and Algorithms, Probability, or consent of instructor.
Evaluation:

30% Assignments (three assignments, done alone)
10% Special Assignment:
   MEng: Regular assignment
   MASc/PhD: Research Topic – Define Data Analysis Problem, Data Set, write conference paper style report on methodology and findings. Possible class presentation of work at end of term.
10% Paper Reviewing – pick 2-3 related papers and write such a review. This could be on a suggested set of papers or on the research area of the MASc/PhD students.
50% Final Exam

Getting Help:

- Discussion board: piazza.com/uwaterloo.ca/winter2020/ece657a
  - Go there and sign up with your UWWaterloo email
- Email the Teaching Assistant and Instructor: Office Hours will be arranged once term starts as needed
- AccessAbility Services: http://uwaterloo.ca/accessability-services
  - If you need any accommodations, or assistance with exams, learning environment, assignments, talk to this office and they can help anonymously.

Major Topics:

1. Data types, sources, nature, scales and distributions
2. Data representations, transformation and normalization
3. Feature extraction and selection, manifold learning, dimensionality reduction and normalization
4. Classification: Distance based, Decision Tree based, Statistical based, Deep Learning based.
6. Other Unsupervised Learning: Auto-Encoders, Vector Embeddings, Association Rule Mining

Additional Resources and Links:

- See resources posted to LEARN
- See resources updated and posted to external course website:
Textbooks:

There is no required textbook. But most of the course is based on the following books and will be useful to take a look at them.


   Online for free at http://www.deeplearningbook.org (first half covers many of basics of this course, second half focusses on Deep Learning which we will talk about for a couple lectures briefly.)


Papers and electronic references will be made available on the course website which is on LEARN (go to http://learn.uwaterloo.ca to log in).

Recipe for success:

Ask questions. Attend lectures. Do assignments. Ask questions.

Most of all, have fun.

Policy and Rules

Academic Integrity:

In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

Grievance:

A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.
Discipline:
A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline, http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Plagiarism-detection software may be used on any submitted work.

Appeals:
A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals, http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for students with disabilities:
The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.