

SYDE 522 – Machine Intelligence

Winter 2020

All course material, information, announcements and communication via “[LEARN.uwaterloo.ca](https://learn.uwaterloo.ca)”

Course Outline

The objective of this course is to introduce the students to the main concepts of machine intelligence as parts of broader framework of “artificial intelligence”. An overview of different learning, inference and optimization schemes will be provided, including Principal Component Analysis, Support Vector Machines, Self-Organizing Maps, Decision Trees, Random Forest, Backpropagation Networks, Autoencoders, Convolutional Networks, Fuzzy Inferencing, Bayesian Inferencing, Evolutionary algorithms, and Ant Colonies.

Course Objectives

- To learn the basic concepts behind machine learning/intelligence
- To learn different meta-heuristics for function approximation
- To learn how to choose the right learning technique for a given problem
- To learn the difference between shallow and deep learning
- To learn how to verify the learning capabilities of a given technique
- To learn how to run experiments and validate/compare algorithms
- To learn how to do research to write a scientific paper

Lectures and Tutorials

First Lecture: Tuesday January 7th, 2020

Last Lecture: Thursday April 2nd, 2020

Lectures:	Tuesdays	16:00 – 17:20
	Thursdays	16:00 – 17:20
Tutorials:	Thursdays	17:30 – 18:20
Location:	STC 0040	

Office Hours

Tuesdays 13:00 – 15:00
Thursday 13:00 – 15:00

Reading Week: February 18-21, 2020

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Teaching Assistants

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Grading Scheme

- **Q:** Quizzes (6) 30%
- **A:** Assignments (4) 32%
- Project Paper 38%

Lecture Topics

Week	Topic	Tasks
1. Week	Introduction What is Intelligence? A bit on Terminology A Brief History of MI/ML	
2. Week	Dealing with Data, Encoding and Experiments Data Compression: PCA and t-SNE, Fisher Vector	Q1
3. Week	Dealing with Data, Encoding and Experiments VLAD, Other encoding methods, K-Fold Cross Validation, Leave-One-Out	A1
4. Week	Classification and Clustering K-Means and FCM, Support Vector Machines	Q2
5. Week	Classification and Clustering Support Vector Machines, Self-Organizing Maps	A2
6. Week	Learning Perceptrons, MLPs and Backpropagation algorithms	Q3
7. Week	Reading Week	
8. Week	Learning Deep Learning: autoencoders, CNNs and GANs	
9. Week	Learning Deep Learning: autoencoders, CNNs and GANs	A3, Q4
10. Week	Learning Reinforcement Agents	
11. Week	Uncertain and Vague Knowledge Evolving Fuzzy Inference Systems, Decision Trees, Random Forests	A4, Q5
12. Week	Uncertain and Vague Knowledge Probabilistic Methods: Naive Bayesian, Hidden Markov Models	
13. Week	Ethics of Machine Learning Ethics and Philosophy, Ethics and Social Consciousness	Q6

Note: Dates/content of lectures/quizzes/tasks are flexible and subject to change

Course Project Paper

The result of the course project will be a scientific paper (**maximum 4 pages plus one page for references**). The project paper will be marked as follows:

Topic Difficulty/Novelty	10%
Format & Organization	10%
Writing Style/Clarity	5%

Background Review	15%
Dataset	15%
Experiments	20%
Results	20%
References	5%

More information will be provided during lectures and via LEARN.

**** Deadline for Project Paper: midnight of Friday April 22, 2020 ****

Textbook

No particular textbook will be used. A list of several reference books will be provided.

Rules for Group Work

- Quizzes: All online quiz questions should be answered by individual students without any help from others
- Assignments: Group work is encouraged but submissions should be not be of “copy/paste” nature
- Project Paper: Group projects are encouraged but should be coordinated with the instructor in advance

Rules for Submissions

- Missed online quizzes will be marked with zero.
- Late assignments will be penalized with 10% per day.
- Submitted project papers after the deadline will be marked with zero.
- Project papers should be uploaded to designated dropbox folder on LEARN. Email submissions will be marked with zero.
- Only PDF submissions will be graded.

Note: The instructor should be notified about any valid reason (e.g. illness, co-op interviews) for missing the course workload.

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, 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 an academic offence, and to take responsibility for his/her actions. A student

who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

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) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

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.

Turnitin.com and alternatives: Plagiarism detection software (Turnitin) will be used to screen assignments in this course. This is being done to verify that use of all material and sources in assignments is documented. In the first week of the term, details will be provided about the arrangements for the use of Turnitin and alternatives in this course. Students will be given a reasonable option if they do not want to have their assignment screened by Turnitin. See: <http://uwaterloo.ca/academicintegrity/Turnitin/index.html> for more information.