

SYDE 522 – Foundations of Artificial Intelligence

Winter 2022

All course material, information, announcements and communication via “LEARN.uwaterloo.ca”
All meetings/lectures via MS Teams

Course Outline

The objective of this course is to introduce students to fundamental concepts of artificial intelligence. An overview of different learning schemes will be provided, including supervised and unsupervised algorithms. The main focus of this course will be on dimensionality reduction, clustering, classification, deep and shallow artificial neural networks, and reinforcement learning. Ethical aspects of artificial intelligence will be discussed

Course Objectives

- To learn the basic concepts in Artificial Intelligence and its relation to Machine Learning
- 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: Thursday, January 6st, 2022
Last Lecture: Thursday, March 31st, 2022
Course Project Consultaion Tuesday, April 5th

Lectures: Tuesday 16:30 – 18:20
 Thursday 16:30 – 17:20
Tutorials: Thursday 17:30 – 18:20
Location: E7 4417 (TEAMs for online)
Reading Week: February 20-27, 2022

Instructor: Morteza Babaie, Shivam Kalra

- Email: {mbabaie, Shivam.Kalra, tizhoosh}@uwaterloo.ca
- Website: <https://kimialab.uwaterloo.ca/kimia/>
- Office: E2

Teaching Assistants

- Sobhan Hemati, Kimia Hemmatirad, and Milad Sikaro
[sobhan.hemati, kimia.hemmatirad, milad.sikaroudi@uwaterloo.ca]

Grading Scheme

- Q: Quizzes (9) 36%
- A: Assignments (3) 30%
- Project Paper 33%

Assignments:

All assignments are completed using Python notebook

Each assignment will be given a week deadline for completing

There would be two office hours by TAs, one after handing out the assignment and the second one after receiving the assignment grade

Lecture Topics

Week	Topic	Workload	Date
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	Q1	19 Jan
3. Week	Dealing with Data, Encoding, and Experiments K-Fold Cross Validation, Leave-One-Out, Decision Trees	A1,Q2	26 Jan
4. Week	Classification and Clustering K-Means and FCM, Support Vector Machines	Q3	2 Feb
5. Week	Classification and Clustering Support Vector Machines, Self-Organizing Maps	Q4	9 Feb
6. Week	Learning: Perceptrons, MLPs, and Backpropagation algorithms	IR, A2, Q5	16 Feb
7. Week	Reading Week (20-27) Feb		
8. Week	Learning: Deep Learning: autoencoders, CNNs	Q6	2 Mar
9. Week	Learning: Deep Learning: autoencoders, CNNs	Q7	9 March
10. Week	Special Topics: Medical Imaging	Q8	16 March
11. Week	Special Topics: Privacy-preserving ML and Federated Learning	A3	23 March
12. Week	Uncertain and Vague Knowledge Evolving Fuzzy Inference Systems, Evolutionary Algorithm	Q9	30 March
13. Week	Ethics of Machine Learning Ethics and Philosophy, Ethics and Social Consciousness		

Q1-Q9 are quiz dates

A1-A3 are assignment releasing dates

IR is an interim report for the course project (no marks)

Course Project Paper

The result of the course project will be a scientific paper (maximum 6 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 April 28, 2021, ****

Textbook

No particular textbook will be used.

If you are interested, these textbooks are useful:

1- Artificial Intelligence: A Modern Approach, 4th US ed. by Stuart Russell and Peter Norvig

2- [Deep Learning, MIT Press book, Ian Goodfellow and Yoshua Bengio and Aaron Courville](#)

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 not be of a “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 the 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.