

# ECE 457B Fundamentals of Computational Intelligence Winter Term Winter 2022

## Instructor:

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## Teaching Assistants:

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## Schedule:

Online: Asynchronous lectures (UW Learn)

In-Person: Mondays and Fridays: 10:00am-11:20 am online

Tutorial: Wednesday 07:00-07:50pm

## Course Description:

The course discusses fundamentals and recent advances made in the field of computational intelligence. The course focuses on highlighting the latest tools of machine learning and approximate reasoning for building accurate models based either on collected data or past experiential knowledge stored in the form of rules base. The course covers fundamental aspects of machine learning for building model prediction and powerful classifiers. It highlights concepts in supervised and unsupervised learning, artificial neural networks, deep learning, feature extraction, feature selection, dimensionality reduction, classification and clustering, support vector machines. It also tackles aspects related to approximate reasoning based on fuzzy set theory to build reliable and easily interpreted inference engines when data is scarce. Various performance metrics will be studied to assess the validity of the produced models. Throughout the course, multiple examples and case studies are provided in significant application domains, from autonomous driving to intelligent manufacturing, from natural language understanding to speech recognition and computer vision, from stock market prediction to disease early detection and diagnosis.

## Prerequisite Material:

Linear algebra, advanced calculus, discrete mathematics, Boolean algebra or equivalent, optimization.

## **Material for the Course:**

All material related to the course (lectures, assignments, other pertinent documents) and updates are posted on LEARN. Lectures are taught in person or on Learn.

## **Online Course delivery mode:**

- The lectures will be recorded asynchronously and posted on learn
  - An exception would be the first lecture, which will be delivered synchronously
    - Will also be recorded and available on Lean
- Once we go back to in-person lectures, the lectures are going to be delivered in-class as in pre-Covid era

## **Course Textbooks (nice to have but not mandatory):**

- Machine Learning, S. Marsland, 2nd Edition, CRC Press, 2015 Dive into Deep Learning, A. Zhang, Z. Lipton, M. Liu, and A. Samola, Release.16.0, 2021.
- Computational Intelligence: A Methodical Introduction, R. Kruse, C. Borgelt, C. Braune, 2nd Edition, Springer, 2016
- Soft Computing and Intelligent Systems Design, F. Karray and C. de Silva, Addison Wesley Pub. 2004 Other pertinent readings will be posted online (on Learn) on regular basis.

## **Main Topics:**

1. The course will be divided in modules. Approximate duration of various modules is provided below:
2. Overview on machine learning using connectionist modelling: learning and acquisition of knowledge, features of neurocomputing; supervised vs unsupervised, reinforcement learning (one week and half)
3. Concepts in data preparation, feature selection, dimensionality reduction
4. Major classes of artificial neural networks for classification, clustering and regression: from simple structures to multilayer neurons, kernel-based networks, self-organizing maps, support vector machine
5. Deep learning and applications (two and half weeks)
6. Fuzzy set theory, generalized fuzzy operations and composition of relations (one week and half)
7. Approximate reasoning, fuzzy logic decision-based systems (one week and half)

## **Course Marking Scheme:**

The course assessment would vary based on whether we can have an in-person examination or not. We should be able to decide of which way it would go before the first assignment is rolled out.

## **Assessment:**

Assignments (35%):

- 15%
- 10%
- 10%

Three assignments (Dropbox submission):

1. Assignment #1 will be posted on Jan. 28 at noon and due on Dropbox Folder February 11 at noon.
2. Assignment #2 will be posted on Feb.25 at noon and due on Dropbox Folder March 11 at noon.
3. Assignment #3 will be posted on March 21 at noon and due on Dropbox Folder April 4 at noon.

Two Exams (65%):

- Midterm 20%: Feb 18<sup>th</sup> at 10:00 am -11:20 am.
- Final 45%: Date and location assigned by Registrar's office. UW Finals are held in April.

## **Turnitin:**

Text matching software (Turnitin®) will be used to screen assignments in this course. This is done to verify that use of all materials and sources in assignments is authentic. Students will be given an option if they do not want to have their assignment screened by Turnitin®.

## **Attendance:**

While the material will be posted, the instructor strongly encourages the students to attend regularly the lectures and the tutorials.

## **Instructor/TAs Availability:**

If the instructor/TAs are not able to hold the in-person session, an alternative session will be help online with the link posted on Learn. The session(s) will be recorded and posted.