COLORADO STATE UNIVERSITY

COURSE SYLLABUS
ECE556 - AI for Radar and Remote Sensing
9:30-10:45AM, T/R | Engineering Room D102

(Live sessions and recordings will be available for online students.)

Instructor Information

Name: Haonan Chen

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Office Location: Engineering B116 Office Hours: T/R 11am-12pm

Communication Policy: Responses to emails will be provided within 24 hours; available on Teams during non-office hours.

Prerequisites for Course

CS152 with a minimum grade of C or CS163 with a minimum grade of C or CS164 with a minimum grade of C; ECE303 with a minimum grade of C or STAT303 with a minimum grade of C; MATH369 with a minimum grade of C.

Textbook

Goodfellow, I., Y. Bengio, and A. Courville, *Deep Learning*. MIT Press, 2016.

Bringi, V. N., and V. Chandrasekar, *Polarimetric Doppler Weather Radar: Principles and Applications.* Cambridge University Press, 2001. (Chapters 7 & 8)

Additional References

Notes and reading materials will be distributed by the instructor.

Course Description & Objectives

The objective of this course is to familiarize students with mathematical and conceptual background of artificial intelligence (AI) through introducing a broad range of machine learning algorithms. Students successfully completing this course will be able to interpret radar and satellite data, as well as their multidisciplinary applications. Emphasis will be placed on using AI to tackle these applications, including precipitation identification, classification, estimation, and prediction. Using hands-on exercises, this course will also immerse students into various deep learning techniques such as convolutional neural network (CNN), recurrent neural network (RNN), long short-term memory network (LSTM), and generative adversarial network (GAN).

Course Content	Course Topics
Part 1	Fundamentals of AI and machine learning: Definition, input feature, target label, model capacity, hyperparameters, overfitting, underfitting, training, validation, and test
Part 2	Radar and remote sensing technologies: Modern systems, observations, data interpretation, and multidisciplinary applications.
Part 3	Deep learning algorithms: Decision tree and random forest, artificial neural network, support vector machine, self-organizing map, neuro-fuzzy algorithm and *K*-means clustering, CNN, RNN, GAN, LSTM, and transfer learning
Part 4	Hands-on machine learning with Scikit-learn, TensorFlow, and PyTorch

Course Schedule

WEEK	TOPIC/SUB-TOPIC
1	Course overview; Fundamentals of AI and machine learning – I
2	Fundamentals of AI and machine learning – II
3	Deep learning algorithms: Decision tree and random forest
4	Hands-on machine learning with Scikit-learn
5	Radar and remote sensing technologies – I
6	Radar and remote sensing technologies – II
7	Radar and remote sensing technologies – III
8	Deep learning algorithms: artificial neural network
9	Spring break
10	Hands-on machine learning with TensorFlow
11	Deep learning algorithms: Neuro-fuzzy algorithm and *K*-means clustering
12	Deep learning algorithms: Convolutional neural network (CNN)
13	Deep learning algorithms: Transfer learning and U-net models
14	Deep learning algorithms: RNN and LSTM
15	Deep learning algorithms: GAN
16	Course summary; Final project presentations

Grading Policy

Homework 25%

Mid-term 40%

Final Project* 35%

**The topic of the final project must be approved by the instructor. A final report (50%) and an oral presentation (50%) must be delivered by the last week of the semester.*