

ECE 591-35 Spring 2026
Artificial Intelligence of Things
TuTh 4:30PM - 5:45PM -- 02213 Engineering Building 3

Instructor:

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Teaching Assistants:

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Course Outline:

This course provides an introduction to Internet of Things (IoT) and data mining techniques to extract knowledge from IoT data. Topics include challenges in the design of IoT systems, limitations of existing protocols such as HTTP, security issues, and leveraging cloud infrastructure to achieve the full potential of IoT. Students will learn about the overall process of data collection and analysis to support knowledge discovery. They will apply supervised and unsupervised automated learning methods to extract patterns, make predictions and identify groups from data. Gained knowledge will be used to support and optimize IoT applications. The course involves a project involving data collection, processing and analysis, and a research paper presentations. Programming will be done in python.

Learning Outcomes:

Upon completion, students will be able to:

- Understand IoT specific communication paradigms such as publish-subscribe and push-pull.
- Explain and contrast IoT related protocols such as MQTT and CoAP.
- Program IoT devices such as Intel Raspberry Pi, Arduino, or LoRa devices.
- Leverage cloud platforms to implement IoT applications.
- Perform real time data collection.
- Identify and contrast the major types of data and data representations.
- Implement and apply various methods for supervised and unsupervised automated learning (e.g. Decision Trees, KNN, ANNs Regression, Clustering).
- Explain and contrast methods for evaluating the performance of automated learning algorithms (e.g. holdout, k-fold cross validation, and leave-one-out cross validation).
- Identify ethical issues in data analysis applications, such as the impacts of data bias.
- Motivate, justify, and qualify conclusions obtained from an analysis.

Prerequisites:

Basic programming ability. An undergraduate course in networking fundamentals is helpful but not strictly required.

Textbook:

There is no textbook required for this course. This textbook is optional.

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining (2nd Edition), Pearson, 2018, ISBN-13 : 978-0133128901

Grading:

There are two midterm exams, five homeworks, a project, a paper presentation and a final exam, weighted as follows:

Homeworks: 20%

Paper presentation: 5%

Midterms: 25%

Project: 25%

Final: 25%

Homeworks and projects can be worked out in groups of two (at most)

All exams are cumulative

All exams are closed book and notes

Grades and Solutions will be posted after each assignment or exam

The grading scheme is as follows:

97.5% and up: A+

92.5%-97.4%: A

90%-92.4%: A-

87.5-89.9%: B+

82.5%-87.4%: B

80%-82.4%: B-

77.5-79.9%: C+

72.5%-77.4%: C

70%-72.4%: C-

67.5-69.9%: D+

62.5%-67.4%: D

60%-62.4%: D-

57.5-59.9%: E+

52.5%-57.4%: E

50%-52.4%: E-

<50%: F

Late Homeworks:

Completed assignments should be submitted through Moodle by 11:45PM (15 min before Midnight) on the due date (Refer to the important dates tab). It is your responsibility to make sure that your homework is not submitted late. Solutions will be accepted up-to three days after the due date but will receive a maximum grade of 50%.

Missing Tests:

The schedule (refer to Curriculum and Important Dates tab) shows the exams' due dates. Please mark your calendars. I will not give makeup exams for missing a test without a certified medical excuse or prior instructor approval.

Tests missed with certified medical excuses or prior instructor approval will be dealt with individually. If you miss the final exam without a valid excuse, a zero will be averaged into your grade.

Students with Disabilities:

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653, http://www.ncsu.edu/provost/offices/affirm_action/dss/ For more information on NC State's policy on working with students with disabilities, please see http://www.ncsu.edu/provost/hat/current/appendix/appen_k.html

Academic Integrity:

See the university statement on academic integrity: http://www.ncsu.edu/provost/academic_policies/integrity/reg.htm

See also the student code of conduct: <http://www.fis.ncsu.edu/ncsulegal/41.03-codeof.htm>

Copying of code or other content from any source must be approved in advance by the instructor or the TA. Anything else is plagiarism.

Important Dates: Please check the course schedule below.

Panopto Recordings: TBD

Course Schedule:

Week 1: 1/12-1/18: Background

Introduction to IoT

Introduction to AI and data mining

Lecture Slides: [Introduction]

Week 2: 1/19-1/25: The Internet

Packet switching vs circuit switching

TCP/IP protocol stack

TCP vs UDP

Client/server model

HTTP protocol

Lecture Slides: [Internet]

Week 3: 1/26-2/1: IoT Protocols

Publish/subscribe model

MQTT

CoAP

Mosquitto

IBM Cloud

Lecture Slides: [IoT Protocols]

Week 4: 2/2-2/8: IoT Devices

Arduino

Raspberry Pi

LoRa

Lecture Slides: [IoT Devices]

Thu 2/5: Homework 1 Due

Week 5: 2/9-2/15: Data

Attributes

Preprocessing

Similarity and Dissimilarity measures

Lecture Slides: [Data]

Week 6: 2/16-2/22: Classification I

Tue 2/17: Wellness day (no classes)

Decision Trees

Overfitting

Model evaluation

Lecture Slides: [Classification I]

Week 7: 2/23-3/1: Classification II

Tue 2/24: Midterm I

Rule-based classifiers

Nearest neighbor classifiers

Lecture Slides: [Classification II]

Thu 2/26: Homework 2 Due

Week 8: 3/2-3/8: Classification III

Bayesian networks

Regression

Artificial Neural Networks

Deep Learning

Support Vector Machines

Lecture Slides: [Classification III]

Week 9: 3/9-3/15: Association I
Basic concepts
Rule generation
Evaluation
Lecture Slides: [Association I]

Week 10: 3/16-3/22: **No classes**
Spring break (no classes)
Thu 3/19: Homework 3 Due

Week 11: 3/23-3/29: Association II
Handling attributes
Patterns
Lecture Slides: [Association II]

Week 12: 3/30-4/5: Clustering I
K-means
Hierarchical Clustering
DBSCAN
Cluster evaluation
Lecture Slides: [Clustering I]
Thu 4/2: Homework 4 Due

Week 13: 4/6-4/12: Clustering II
Tue 4/7: Midterm 2
Self-organizing maps
Density-based clustering
Lecture Slides: [Clustering II]

Week 14: 4/13-4/19: Clustering III
Graph-based clustering
Scalability
Lecture Slides: [Clustering III]

Week 15: 4/20-4/26: Anomaly Detection
Thu 4/23: Paper presentations
Thu 4/23: Homework 5 Due
Lecture Slides: [Anomaly Detection]

Week 16: 4/27-4/28:
Tue 4/28: Last day of classes
Project presentations

Final Exam
Will be held on **Thu 4/30: 3:30pm-6:00pm**