Welcome to:
EECE-4715/5715 IoT and Tiny Machine Learning
Syllabus – Spring 2026

Course Info
EECE-4715/5715 IoT and Tiny Machine Learning, 3 credits
Prerequisites: EECE-3015 Digital Electronics Lab
Lecture: Tue, Thu, 9:30-10:45AM, Olin Engineering 494
Course website #1 on D2L: http://d2l.mu.edu
Course website #2 public: http://dejazzer.com/**eece4710**/index.html

Instructor
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Catalog Description
This course introduces students to applied tiny machine learning (TinyML) for embedded Internet of Things (IoT) devices. The emergence of embedded machine learning (ML) frameworks like TensorFlow Lite for microcontrollers, coupled with the pervasiveness of low-power embedded devices will usher the proliferation of artificial intelligence (AI)-powered IoT devices. Covered topics will include low-power design, energy harvesting, sensor data fusion and ML methods for lifetime prediction.

Textbook(s)
[1] Pete Warden and Daniel Situnayake, TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers, O'Reilly Media, 1st edition, 2020. ISBN-10: 1492052043.

Hardware Kit
This course uses a learning approach based on hands-on activities and assignments. To verify IoT programs on real hardware, a course HW kit is used. The kits includes a microcontroller board (Arduino Nano 33 BLE Sense – as of the time of drafting this syllabus, but this may be changed later) and several sensor modules.

Course Objectives
The goal of this course is to teach electrical and computer engineering students theoretical concepts and practical skills of embedded Internet of Things (IoT). Emphasis is put on machine learning technique applied to problems from the IoT area. Specific objectives include the following:
1. Learn techniques to design embedded systems used in IoT.
2. Utilize sensor modules to design environment monitoring IoT devices.
3. Develop machine learning models and techniques for the IoT. Program such techniques in Python and embedded C/C++ using Tensorflow Lite.
4. Deploy and verify these techniques on real hardware.
5. Learn low power methods for microcontroller-based systems.
6. Learn the type of energy harvesting techniques appropriate for specific IoT applications.
7. Apply testing and debugging strategies.
8. Prepare informative and organized lab reports that describe the methodologies employed, the results obtained, and the conclusions made in a laboratory experiment.

Relationship of Course Objectives to ABET Student Outcomes
The course objectives partially fulfill the following ABET student outcomes: 1, 2, and 6.

Course Policies
Grading: Grading is based on the following components:
- Class participation: 10%
- Homework assignments: 50%

- Research articles reviews: 10%
  - Undergraduate – written reviews
  - Graduate – written reviews + one in-class presentation using slides
- Project: 30%

Grading scale:
A [94-100]%; A- [90-94)%; B+ [87-90)%; B [83-87)%; B- [80-83)%; C+ [77-80)%; C [73-77)%; C- [70-73)%; D+ [67-70)%; D [60-67); F [0-59)%.

Re-grading: Re-grading requests should be made within a week from the date of the graded item (homework assignment, exam, or project) becoming available.

Homework policy: Homework assignments will be assigned throughout the semester. Here are the rules and policies about that:
- **Late submissions will not be accepted.** All homework assignments should be submitted before the deadline (the beginning of the class on that day). If you are absent from class or you know that you will be absent from class, you should as soon as possible arrange with the instructor for any missed work. It is the student's responsibility to contact the instructor in such a case. Arrangements made in advance of an absence (if approved) may allow full credit to be given for late work.
- Collaboration on homework is ok (I encourage you to study in groups), copying is not ok; a separate solution is required from each student.
- Include your name only (not MUID) on all homework assignments, reports, exams, etc.
- Turn in solutions that are written clearly and neatly; turning in disorganized or esthetically-ugly solutions with scratched-out text, figures, and formulas, etc. is penalized by deducting grade-points even if the final answer is correct.
- All assignments must be turned in via D2L. The handwritten portions must be electronically scanned and converted to PDF.

Academic integrity: All submitted work should be your own. Instances of plagiarism and cheating will result in all students involved getting an automatic zero on the assignment/exam/project and potentially a failing grade based on the severity of the case. Please refer to the Marquette University's academic integrity/honesty policies and procedures: http://bulletin.marquette.edu/undergrad/academicregulations/#academicintegrity

Attendance: I encourage everyone to attend all the lectures and actively participate in class discussions. While attendance will not be taken, note that students may be withdrawn from a course as a result of excessive absences (i.e., when more than 6 classes have been missed in a 3 credit course). Please read the Marquette University's undergraduate attendance policy:
http://bulletin.marquette.edu/undergrad/academicregulations/#attendance

Class participation: You are expected to (pro)actively participate in this course. Active participation means to study the assigned reading items before class, ask and answer questions, and participate in discussions during lectures. Proactive participation means to search and read – on your own – additional information (e.g., online articles, research papers, textbooks, etc.) related to the topics of this course and to share it with the other students and the instructor during in class or outside discussions.

Special needs: If you have a disability and require accommodations, please contact your instructor early in the semester so that your learning needs may be appropriately met. You will need to provide documentation of your disability to the Office of Disability Services (OSD). If you are unsure of what you need to qualify for services, visit the OSD website at http://www.marquette.edu/disability-services/forms.shtml or contact the Office of Disability Services at 414-288-1645. The Office of Disability Services is located in Marquette Hall 05.

The use of AI tools: The use of artificial intelligence (AI) tools such as ChatGPT for any aspect related to this course (search for online information, synthesis and writing reports on a certain topic, writing of source code, etc.) is generally not recommended in this class. The reason for that is because at this level, I would like you to learn to do most of these items on your own, without relying on AI helpers. However, if you find AI tools as being helpful in your education, then, that it ok. But, I do have one warning and some requirements/rules.

Warning: It may be possible that what AI tools tell you to actually be false information and this may result in learning and assimilating wrong facts/concepts; you must be aware of that. **Requirements**: **1)** When it comes to source code – I expect you to understand and know how to explain *each and any line* of code that you are supposed to turn in as part of your assignments; if you are caught turning in source code written by AI tools that you do not understand and do not know to explain what it does, *you may receive zero credit for the assignment*. Please do not steal your own hat and sabotage your own learning. **2)** When it comes to written reports (lab reports, paper reviews, project reports) you must write your own reports – no AI tools are allowed to write one's reports. You may use AI tools to search for related literature, get answers to various questions – but, please do not copy that directly into your own reports; in your reports you must use your own words describing the information provided by AI tools.

Usage of media and electronic devices: Usage of cell phones, laptops, tablets, newspapers, magazines, etc. is **not allowed** during lectures unless for activities related to the lecture or instructed to do so by the instructor.

Food (not applicable if format is Distance Learning): **Please do not bring food to consume during lectures**. Eating is noisy and possibly smelly and may distract and impair your colleagues' learning experience. Small snacks are ok.

Homework Assignments
Most of the homework assignments involve writing code in Python and embedded C to implement various embedded IoT systems and verification of written programs either via simulations or deployment and testing on the hardware kit used in the course. This course uses a hardware kit, which includes a microcontroller board and several different types of sensors. It is assumed that each student has a personal laptop, which shall be used in the classroom activities and hands-on exercises.

Paper Reviews
Students will be required to read assigned technical research papers (related to the topics discussed in lectures) and write (typed, Times New Roman font, font size 11, and single line spacing) reviews due at the beginning of the class on the due date. The reviews must be uploaded on D2L as PDF files. Each review must include 1) a statement of the problem that is (attempted) to be solved by the paper, 2) a discussion of the solution proposed by the paper, 3) a list of strengths of the solution, 4) a list of drawbacks or limitations, and 5) ways to improve the proposed methods/techniques. In writing these reviews, please use your own words and do not just copy-and-paste from the abstract or the body of the reviewed papers.

Project – Undergraduate Students
This is a *team* (3 students per team) based project, which must be finished by the last week of the semester. You must propose your own project, which must be approved first by the instructor. The execution of this project will be done with an entrepreneurial mindset: you must choose a problem to solve, formulate it, propose a solution, and implement the solution with the objective of creating a preliminary prototype of a product as if you worked in a start-up. Working on your project will be done continuously having in mind the start-up; you want to create a product that will solve better an existing problem or a new problem and which will help improve human life while being viable for monetization as well. Do not start working on a project before having it approved. More details about the project will be discussed in class.

Project – Graduate Students
Graduate students will be required to work on an *individual* semester long **research project**. The research project will be an original research effort with the potential of resulting in a conference quality paper and associated presentation. You will be expected to propose, execute, write up, and present independent and original research. It must be finished by the last week of the semester. You must propose your own project, which must be approved first by the instructor. The deliverables will include implementation and a report written in a conference paper format to be submitted for consideration of publication. Do not start working on a project before having it approved. More details about the project and its grading will be discussed in class.

Tentative course outline and schedule (Note: This is subject to change during the term)

Week	Topics
1, 2,3,4,5	**Part 1: Foundations of Machine Learning (ML)** About the course and Syllabus Introduction to IoT and TinyML The Machine Learning Paradigm Building Blocks of Deep Learning (DL) - Introduction Building Blocks of DL - Regression with Dense NN Building Blocks of DL - Classification with Dense NN Image Classification using CNN Introduction to Edge Impulse – CNN with Cifar-10 Datasets and Model Performance Metrics Preventing Overfitting
6,7	**Part 2: Sensors** Sensors and IoT applications Wireless sensor networks Sensor data collection Sensor fusion
8,9,10,11,12	**Part 3: Applications and Deployment to Microcontrollers** TFLite and TFLite-Micro TinyML Kit Overview TFL-Micro Hello World Hello World Code Walkthrough Motion Classification - Introdution Motion Classification using MCU (Nano 33) K-means Clustering and Anomaly Detection Anomaly Detection Hands-On Lab Keyword Spotting - Introduction KWS using MCU Image Classification - Introduction Image Classification using Edge Impulse Studio
13,14	**Part 4: Energy Harvesting Techniques** Energy harvesting techniques Solar, electromagnetic, mechanical (piezo) Simulations in Spice
15	**Part 5: Security in IoT** Security aspects
16	Conclusion

Examination dates
There are no exams in this course.

Breaks
Jan. 19: MLK Jr. day
March 8-14: Spring break
April 02-6: Easter break
May 1: Design day

Statement on stress, anxiety, and mental health
I greatly value your experience in this class, and it is my duty to facilitate a safe, caring, and productive learning environment. I recognize that you may experience a range of emotional, physical, and/or psychological issues, both in and out of the classroom, that may distract you from your learning. If you are experiencing such issues, please come see me – I am here to listen too. We can also discuss what further resources might be available to you.