ECE 597/697NM – Neuromorphic Engineering

Fall 2022 Syllabus

Instructor: Prof. Qiangfei Xia (qxia@umass.edu)
Day & Time: Tu Th 4 – 5:15 pm (Marston 220)
Office Hours: Tu Th 11:00 am – 12 pm (Marcus 201D)
Credits: 3
First Class: 9/6/2022

Overview

Introduction to fundamental biological neuron models, algorithms and techniques for learning spatio-temporal patterns, and software frameworks for implementing spike-based computation. Understanding of the hardware foundation for bio-inspired computation from transistors and emerging devices to neuromorphic circuits and systems. Investigation of low-power, low-latency applications of neuromorphic engineering in machine vision, robotics, autonomous vehicles, etc.

Note: It is strongly recommended that students have completed ECE 310 (Circuits & Electronics II) and ECE 344 (Fundamentals of Semiconductor Devices) with a C or better.

Enrollment cap: 20/20

Grading: Mid-term (30%), classroom presentation (30%), team-based project (40%)
— The midterm exam will be open-book, open-note.
— Make-up exams will be given only if you provide a valid written excuse and notify the instructor before the missed exam. Other missed exams will be considered failures.
— Your presentations will be graded by the entire class (including the instructor). Based on a detailed set of rubrics, your score will be an average of the total points you get from your audience.
— Projects will be team-based (2 undergrads, 2 grads). You form your teams and choose your projects from the suggested list provided by the instructor (you have the option to come up with your own topics). Grading will be based on the design, simulation, or demo that should be professionally documented in the final report.
— Respect the copyright of the software, the intellectual property, and the opinions and efforts of your teammates and classmates. Substantiate your claims during writing or discussing.

Important dates (tentative):
— September 29, topics of projects to the class
— October 6, project teaming decision

- October 11, topics of presentation to the class
- October 18, email instructor presentation topic and project title/teaming
- October 25, midterm exam (open book, open note)
- October 27, Presentation outline overview
- November 1, student presentations start
- December 15, project report due

References:
1. Eric R. Kandel, John D. Koester, Sarah H. Mack, Steven A. Siegelbaum. Principles of Neural Science. McGraw Hill / Medical; 6th edition (March 29, 2021).
2. Wulfram Gerstner & Werner Kistler. Spiking Neuron Models: Single Neurons, Populations, Plasticity. Cambridge University Press; 1st edition (August 26, 2002).
3. Carver Mead, Analog VLSI and Neural Systems. Addison-Wesley; 1st edition (January 1, 1989).
4. S.-C. Liu et al., Event-Based Neuromorphic Systems. Wiley; 1st edition (February 16, 2015).
5. Sebastian Raschka & Vahid Mirjalili. Python Machine Learning. Packt Publishing (3rd edition. December 12, 2019).
6. Selected journal papers by the instructor.
7. Instructor notes, reading materials, etc. will be uploaded to Moodle in the Cloud (umass.moonami.com) on a weekly basis.
8. Echo 360 recording (https://echo360.umass.edu). Need log in with your netID and password.

Health and Wellbeing.
You are not alone at UMass – many people care about your wellbeing and many resources are available to help you thrive and succeed. The College recognizes that coursework is challenging and that classes are not the only demand in your life. Success in this course and the College of Engineering depends heavily on your personal health and wellbeing. Recognize that while stress is an expected part of the college experience, it can be compounded by unexpected setbacks or life changes outside the classroom. Strive to reframe challenges as an unavoidable pathway to success. Reflect on your role in taking care of yourself throughout the term, before the demands of exams and projects reach their peak. Please feel free to reach out to me about any difficulty you may be having that may impact your performance as soon as it occurs and before it becomes too overwhelming.

You can learn about the confidential mental health services available on campus by calling the Center for Counseling and Psychological Health (CCPH) by visiting their website at umass.edu/counseling. Check-out some of their great, NEW free resources. There are many other resources on campus for students facing personal, financial or life challenges to find support, stay in school, and graduate (https://www.umass.edu/studentlife/single-stop). Within the College, you may reach out to myself, your academic advisor, the Office of Student Affairs (http://engineering.umass.edu/current-students/academics-advising) or the Office of Diversity, Equity, and Inclusion (rees@umass.edu). I encourage you to contact support services on campus

that stand ready to assist you. Remember that as your instructor, I am here to help you find the resources you need.

Accessibility Support Services.
Your success in this class is important to me. We all learn differently and bring different strengths and needs to the class. The University of Massachusetts Amherst is committed to making reasonable, effective and appropriate accommodations to meet the needs of all students and help create a barrier-free campus. If you have a qualifying disability and require accommodations while participating in this course, please work with Disability Services to have an accommodation letter sent to me in a timely manner. If you have a disability but are not yet affiliated with Disability Services, please register with Disability Services (https://www.umass.edu/disability/students). Information on services and materials for registering are also available on their website www.umass.edu/disability.

If you are eligible for exam accommodations, your exams will be administered by the exam proctoring center. Contact Disability Services immediately, and comply with their exam scheduling policies, including the requirement that you book your exams at least seven days in advance of the exam date. *It is incumbent upon you contact me during the first few weeks of the semester, or shortly following registration with Disability Services, to ensure that your accommodations are being sufficiently met, including extra time and note-taking access, as applicable.*

Finally, beyond disability accommodations, if there are aspects of the course that prevent you from being fully included in the class, please let me know as soon as possible. Together we'll develop strategies to meet both your needs and the requirements of the course.

Academic Honesty Statement.
Maintaining the integrity of scholarship and research within institutions of higher education requires a cultural commitment. All members of the UMass Amherst community are expected to be knowledgeable of and uphold our academic honesty policies (https://www.umass.edu/honesty/). Academic dishonesty includes but is not limited to cheating, fabrication, plagiarism, and *abetting or facilitating* dishonesty. Instructors are requested to take reasonable steps to address academic misconduct, and appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Any person who has reason to believe that a fellow student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor or an alternate, trusted member of the faculty or College administration as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Community members may fill out the College's classroom experience form (https://tinyurl.com/UMassEngineerClassroom) to report academic dishonesty anonymously. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent.

Cheating and Plagiarism Policy

The University Academic Honesty Policy Applies in this and all courses. This policy can be found on the University Web Page (https://www.umass.edu/honesty/). Appendix B covers plagiarism, cheating, fabrication, and facilitating dishonesty. Students are expected to be familiar with the definitions and examples provided.

Inclusivity.
Everyone should feel that they are an integral part of the community and that all individuals and their perspectives are respected. A diversity of perspective and experience provides a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued or respected for any reason, please speak with me privately. If you wish to communicate with someone else in the College or University, there are several ways to do so anonymously or to provide contact information if you so choose:

1. Notify the University Diversity, Equity, and Inclusion Office through the "Report a Climate Incident" form: https://www.umass.edu/diversity/incident-report-form
    Note that this form requires sharing name and contact information.
2. Speak with Assistant Dean Dr. Paula Rees (rees@umass.edu).
3. Report an incident anonymously to the College of Engineering Diversity, Equity, and Inclusion Office
    • Climate Concerns and Suggestions - https://tinyurl.com/UMassEngineerClimate
    • Classroom Experience - https://tinyurl.com/UMassEngineerClassroom
4. Reach out to the departmental DEI Committee
    •   Anonymous ECE feedback form: https://ece.umass.edu/ece-diversity-equity-inclusion (scroll down for feedback link)

We are all members of an academic community with a shared responsibility to cultivate a climate where all individuals are valued and where both they and their ideas are treated with respect.

Pronouns and Names.
Everyone has the right to be addressed by the name and pronouns that they use for themselves. Students can indicate their preferred/chosen first name and pronouns on SPIRE, which appear on class rosters. Please let me know what name and pronouns I should use for you if they are not on the roster. A student's chosen name and pronouns are to be respected at all times in the classroom. To learn more, please see this resource: https://www.umass.edu/stonewall/sites/default/files/pronouns_intro.pdf

Gender Respect and Title IX.
The University of Massachusetts Amherst aspires to be a university environment that is free of discrimination, sexual harassment, and sexual violence. Faculty have the responsibility to inform students of resources and reporting options. If you or someone you know has experienced sexual assault, sexual misconduct, or sexual discrimination please see https://www.umass.edu/titleix/what-to-do for information about resources and reporting options. A report to the Title IX Coordinator may be made at any time (including during non-business hours) by using the Title IX Coordinator's email (TitleIXCoordinator@umass.edu), telephone number (413.545.6124) or mail. UMass Amherst

is committed to supporting community members who report concerns of prohibited conduct. Please reach out to me if you would like assistance connecting with any of these resources/options.