Course Information

Course: ECE 4803: AI for Engineering

Semester: Spring 2027

Instructor Information

Instructor: Fariborz Farahmand

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General Course Information

Description

This course explores AI paradigms for electrical and computer engineering, covering optimization, Bayesian, deep, physics-informed, generative, and causal learning alongside human-AI systems, safety, and security.

Course Learning Outcomes

- Utilize novel AI methods to address complex ECE challenges and collaborate across computer science and engineering disciplines.
- Optimize power systems using advanced gradient methods.
- Develop digital twin hardware using Bayesian learning methods.
- Process physiological signals by deploying convolutional neural networks.
- Use physics-informed neural networks to analyze physical laws in ECE with limited data.
- Apply generative AI methods to hardware manufacturing
- Investigate autonomous vehicle failure using rigorous causal inference frameworks.

Course Materials

There is no required textbook for this course. However, the following books are excellent references:

- S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, Pearson (4th Edition), 2020. (https://aima.cs.berkeley.edu/)

- I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, MIT Press, 2016. ((https://www.deeplearningbook.org/)
- J. Pearl, M. Glymour, and N. P. Jewell, *Causal Inference in Statistics*: A Primer, John Wiley & Sons, 2016. (https://web.cs.ucla.edu/~kaoru/primer-complete-2019.pdf)

Related research papers will be available on Canvas.

Topical Outline

- Introduction to AI & Machine Learning Paradigms
- Bayesian Learning & Probabilistic Reasoning
- Causal Inference
- Linear Algebra & Optimization
- Deep Learning
- Physics Informed Neural Networks (PINNs)
- Generative AI
- AI Safety & Security
- Human-AI Systems
- Emerging Trends: ECE Research and Development in the AI Era

Each topic includes case studies.

Grading Policy:

There is no final exam for this course. Grades will be assigned on the following basis:

- Assignments (individual): 30%
- Project final report (group): 35%
- Project final presentation (group): 35%

Your final grade will be assigned as a letter grade according to the scale:

A: 90-100%, B: 80-89%, C: 70-79%, D: 60-69%, and F: $\leq$ 59%

AI Usage Policy:

To maintain academic integrity in written and coded deliverables, AI tools are restricted to foundational brainstorming, syntax debugging, and editing assistance, while the generation of final content remains prohibited. This policy is enforced during the evaluation of the final report,

presentation, and homework, where students must individually justify and defend their submitted work.

Course Policies

Code of Conduct and Disability Services

All conduct in this course will be governed by the Georgia Tech Honor Code and Institute Absence Policy. If you are a student with learning needs that require special accommodation, make an appointment with Office of Disability Services to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible to set up a time to discuss your learning needs

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Student Well-Being:

At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being (student-resource-guide (gatech.edu)**.**