

AE4803 RLI Syllabus

Foundations of Machine Learning, 3-0-0-3 Credits

Instructor Information

Instructor Jose Magalhaes he/his	Email Jose.magalhaes@gatech.edu	Office Hours TBD
Teaching Assistant(s) TBD	Email TBD	Office Hours TBD

General Information

Description

This course introduces foundational methods, theory, and implementation for scientific machine learning, with a primary focus on regression models. Students will learn how to formulate scientific machine learning problems by (a) selecting a parametrized model class, and (b) defining an optimization problem to select the model parameters. Several formulations for both linear and nonlinear regression will be introduced, with emphasis on understanding both the mathematical concepts underlying the methods as well as hands-on implementation and assessment of the learned models. Programming assignments will use python. The course will introduce/review basic python programming as well as the use of the numpy, scipy, pandas, pytorch or Tensorflow, and matplotlib modules.

Pre-Requisites

- (1) Introductory programming: CS 1371 or CS 1301 or equivalent programming proficiency,
- (2) Multivariable calculus (MATH 2552 or equivalent),
- (3) Linear Algebra (MATH 1553/1554 or equivalent), and
- (4) Probability and statistics (BMED 2400, ISYE 3770, ECE 3077, or MATH 3670).

Course Goals and Learning Outcomes

Upon successful completion of this course, you will be able to:

1. Understand the fundamental paradigm of machine learning (ML) methods as a combination of prescribing a parametrized model class and formulating an optimization problem to select parameters.
 - a. Define the regression problem and be able to recognize whether a task can be naturally formulated as a regression problem.
 - b. Explain how the supervised learning methods covered in class can be interpreted/explained in terms of this paradigm.
2. Implement, validate, and test basic versions of the supervised learning methods covered in class by
 - a. Writing organized and correct Python code that implements the methods discussed,
 - b. Assessing the performance and accuracy of the learned models using appropriate metrics,
 - c. Applying appropriate model validation strategies and reporting their results,
 - d. Describing potential limitations of the learned models.
3. Read, write, and orally communicate clear and precise technical descriptions of machine learning algorithms, experiments, and results, including correct use of standard mathematical notation and terminology.

Course Requirements & Grading

Graded assignments, late/missed work, grade corrections and submission policies

Your final grade will be based on the following components:

- **20% “smaller” assignments, including:**
 - Pre-class assignments, e.g., reading + answering related questions in order to be prepared for class
 - In-class assignments, usually a group exercise with a short deliverable (eg code or text upload)
 - Post-class assignments, generally a short “minute paper” reflection on what was covered in class
- **50% “larger” homework assignments (5 total):** these will generally involve writing to code to implement and test methods and submitting a write-up as a Jupyter notebook.
- **30% Final Project**

Extra credit: opportunities will be limited and announced during term.

Grading errors: We are happy to correct errors in grading, including incorrect input of your grade online, mistakes in calculating totals, and incorrect deductions (you lost points for something you didn't do). Contact the course TA to correct errors in grades. We do not take regrade requests that are matters of judgment (for example amount of partial credit awarded to a partially correct solution). The reason for this is to preserve consistency across students; if multiple students have the same partially correct solution we do not want to give inconsistent grades due to regrades.

How/where to turn in assignments: Assignments generally will be submitted on Canvas.

Grading Scale

I will use the following standard scale as a basis for assigning final letter grades at the end of term. I may adjust the cut-offs slightly at the end of term, but only in students' favor. Once grade cut-offs are decided they are final.

A	90-100%
B	80-89.99%
C	70-79.99%
D	60-69.99%
F	0-59.99%

Course Materials

Course Text

There is no required text for this course. The material will be drawn from a variety of sources, course notes will be linked from Canvas and a running list of other potential helpful resources will be updated as term progresses.

Course Website and Other Classroom Management Tools

We will use Canvas and may use Gradescope.

Course Schedule

- Weeks 1 - 2: Linear regression
- Weeks 2 - 3: Nonlinear regression
- Weeks 4 - 5: Non-regression topics

Course Expectations & Guidelines

Academic Integrity

You are expected to adhere to Georgia Tech's Academic Honor Code. More information can be found at <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>.

Suspected honor code violations will be referred to the Office of Student Integrity for investigation and follow-up.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, please contact me as soon as possible so we can make sure you have what you need. A formal accommodations letter can be arranged through the Office of Disability Services at (404)894-2563 or <http://disabilityservices.gatech.edu/>. With or without a formal letter, please contact me as early as possible to help things run smoothly.

Attendance and/or Participation

Because we do not have a course text, class is the primary source of material that you are expected to learn. You should generally be attending class in order to earn the highest possible grade. However, I recognize that life and other commitments can get in the way of attending class. Minute papers and problem-based learning assignments that are associated with class sessions are due at 11:59pm the day of class but will be accepted up to 1 week after class for full credit.

Collaboration, Group Work, and Use of Outside and Online Resources

Collaboration is encouraged. Use of online resources, including ChatGPT and other similar AI tools, is allowed. However, I strongly caution students that overreliance on AI will limit your mastery of the material. Collaborators and use of outside tools should be reported on Canvas where requested for each assignment.

Extensions, Late Assignments, & Re-Scheduled/Missed Quizzes

General policy on late/missed assignments is as follows:

- **Pre-class “smaller” assignments:** Late work not accepted.
- **In/post-class “smaller” assignments:** Accepted up to 1 week late.
- **“Larger” homework:** accepted late until we post solutions, which can be any time starting at the due time. The lowest homework score will be automatically dropped in the calculation of the final grade.
- **Problem-solving reviews:** must be completed at your individual/group scheduled time.

Exceptions to the above in case of extenuating circumstances can be arranged with the support of the Dean of Students.

Student-Faculty Expectations Agreement

I commit to the expectations outlined in the Student-Faculty Expectations Agreement and expect students to do the same. You can review the agreement here: <https://catalog.gatech.edu/rules/21/>

Student Use of Mobile Devices in the Classroom

Please set mobile devices to silent and please also turn your vibration notifications off in the classroom.

Additional Course Policies

Food and drink: If you spill drinks or food, clean it up.

Religious observances: Please contact me as early as possible if you require accommodation for religious observances.

Statement on inclusivity

My goal is to create a learning environment that supports a diversity of thought, academic backgrounds, personal backgrounds and experiences, and honors students' identities, including race, gender, sexuality, religion, and ability.

- Please let me know if your preferred name and personal pronouns differ from those appearing in Georgia Tech institute records - the beginning of term survey is a good place to do this, but you can also email me. That said, you should never feel pressured to share your pronouns in this class.
- If you feel that your performance in class is being impacted by your experiences outside of class, please come talk with me if you feel comfortable doing so. A list of other support resources available to students at Georgia Tech can be found at success.gatech.edu.
- I, like many people, am continuing to learn about individual biases, historic and systemic oppression, diverse experiences and identities, and inclusive teaching and research. If something is said or done in class that makes you uncomfortable, I encourage you to talk to me about it. I recognize that impact is different from intent, and I strive to listen and respond with openness and compassion.

Georgia Tech School of Aerospace Engineering Values



Integrity

I achieve excellence by embodying the highest ethical standards and communicating openly, authentically, and with humility.



Respect

I extend courtesy to everyone and promote a culture of inclusion, fairness, and equity.



Community

I am a global citizen and celebrate our collective achievements and contributions to the world around us.



Accountability

I take ownership of my actions and value the responsibility to honor public trust.



Adaptability

I embrace change as a path to progress, success, and innovation.

Discussion Points

1. **Honesty:** The School of Aerospace Engineering values honesty and integrity of all members of our community. An important element of this value is the academic honor code. Georgia Tech Honor Challenge Statement: I commit to uphold the ideals of honor and integrity by refusing to betray the trust bestowed upon me as a member of the Georgia Tech community.
Honor Code: http://policylibrary.gatech.edu/student-affairs/academic-honor-code#Article_I:Honor_Agreement
2. **Well Being:** The School of Aerospace Engineering values the complete well-being of all members of its community, which includes professional, physical, spiritual, emotional, and social dimensions. There are numerous resources to support the health and well-being of all members of our community: <https://gatech.instructure.com/courses/108574>

Mental Health Resources:

Emergencies: Can either Call 911 or call Campus Police at 404.894.2500 <http://www.police.gatech.edu/>
Center for Assessment, Referral, & Ed. (CARE): <https://care.gatech.edu/> 404.894.3498 (Counselor On-Call)

Counseling Center: <https://counseling.gatech.edu/> 404.894.2575

Stamps Health Services: <https://health.gatech.edu/> 404.894.1420

Student Life and Dean of Students: <https://studentlife.gatech.edu/content/get-help-now>
404.894.6367

Victim-Survivor Support (VOICE): <https://healthinitiatives.gatech.edu/well-being/voice> 404-385-4464/(or 4451)

National Suicide Prevention Lifeline: 1.800.273.TALK (8255)

Georgia Crisis and Access Line: 1.800.715.4225

COVID-19 Safety

GT Safety Guidelines: <https://health.gatech.edu/tech-moving-forward>

Current guidance is summarized at the site above and please continue to follow the site above and other Institute communications in case changes occur:

3. **Social Justice:** The School of Aerospace Engineering values social justice for all members of the Georgia Tech community and the larger society. Social justice means that everyone's human rights are respected and protected. We stand committed in the fight against racism, discrimination, racial bias, and racial injustice. Our shared vision is one of social justice, opportunity, community, and equity. We believe that the diversity and contributions from all of our members are essential and make us who we are. We believe that our impact must reach beyond the classroom, research labs, our campus, and the technology we create, but must also improve the human condition where injustice lives. We will continue to work to understand, value, and celebrate all people and create an inclusive educational and work environment that welcomes all.

As a matter of policy, Georgia Tech is committed to equal opportunity, a culture of inclusion, and an environment free from discrimination and harassment in its educational programs and employment. Georgia Tech prohibits discrimination, including discriminatory harassment, on the basis of race, ethnicity, ancestry, color, religion, sex (including pregnancy), sexual orientation, gender identity, national origin, age, disability, genetics, or veteran status in its programs, activities, employment, and admissions.

<http://policylibrary.gatech.edu/equal-opportunity-nondiscrimination-and-anti-harassment-policy>