# ISYE 3803, Syllabus

## *Foundations of Modeling, Data, and Intelligent Decision Systems*

### (Fndns of Intel Decsn Systems), 3.000 credits

- Days: TBD
- Time: TBD
- Location: TBD

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**Instructor**
Dr. Johannes Milz
(he/him/his)

**Teaching Assistants**
TBD

**Instructor Team Email**
isye3803fall2026@groups.gatech.edu
This email address allows the entire instructor team to view your email and respond more quickly as a team. Please use this email for any questions related to course content or logistics.


**Study Session**
TBD
I will be present for the first 30 minutes; the session may extend until 6:00 pm depending on attendance and interest.

**Study Sessions**
- Days: TBD
- Time: TBD
- Location: TBD

# General Information

## Course Description

An introduction to modeling, data, and optimization foundations for modern intelligent decision systems, with a focus on large language models. Topics include tokenization, embeddings, transformers and attention, supervised learning (least squares, logistic regression), empirical risk minimization, gradient and stochastic gradient methods, evaluation and robustness, and responsible AI use. Includes Python-based computational labs and applied case studies in decision-making contexts.

## Prerequisites

Students are expected to have a good foundation in calculus, linear algebra, probability, and basic programming skills in Python. The following courses are required prior to enrollment:

- MATH 2603 (Introduction to Discrete Mathematics)
- CS 2316 (Data Manipulation for Science and Engineering)
- ISYE 2027 (Probability with Applications), or MATH 3215 (Probability & Statistics)

## Course Goals and Intended Learning Outcomes

**Course Goals** This course is designed to:

- Give students a clear understanding of how language models work, from basic ideas (tokens and simple models) to modern systems (transformers and large language models).
- Show how data and optimization shape model training and behavior.
- Build practical skills through short programming labs and applied case studies, including working with modern tools and compute.

- Teach students how to judge model output using simple tests, clear metrics, and careful reasoning about failure cases.
- Enable students to adapt existing models to new tasks by using fine-tuning and retrieval-based approaches.

**Intended Learning Outcomes** Upon successful completion of the course students will be able to:

1. **Explain** how language models work at a high level, from tokens and simple baselines to transformers and large language models.
2. **Prepare** text data for modeling (cleaning, tokenizing, splitting into train/validation/test) and **avoid** common data mistakes (leakage).
3. **Train and evaluate** basic models using data, gradient-based training, and clear metrics.
4. **Adapt** an existing model to a new task by using fine-tuning and retrieval with provided sources.
5. **Describe** privacy, bias, and data-source risks and **write** clear documentation of intended use and limits.

# Course Requirements & Grading

## Grading Policy

The grade will be determined from the following grading scheme:

| | |
|---|---|
| Participation | 5% |
| Individual homework assignments | 25% |
| Weekly in-person quizzes (10 minutes) | 25% |
| Extended in-person quizzes (4 in total, 30 minutes) | 30% |
| Group project | 15% |

## Extra Credit Opportunities

None.

## Description of Graded Components

### Participation

- **Study Session Survey:** Complete the short Canvas survey for any scheduled study sessions (details and deadlines posted on Canvas).
- **Initial Survey:** The initial survey will be available on Canvas after the first day of class and is due by **Friday of the first week at 11:59 p.m.** This early deadline allows me to review your responses and use them to tailor the course starting from the second week. This *short set of questions* is designed to help me get to know you better, including your background, interests, and learning preferences. Your responses will provide valuable insights that will allow me to tailor the course content to better meet your needs and ensure that your learning experience is both relevant and engaging. You will receive full credit upon submission, and an anonymized summary will be shared via Canvas.
- **PACE Tour:** We will likely have a PACE tour; details and any required follow-up will be posted on Canvas.

### Individual homework assignments

There will be approximately 4 graded individual homework assignments. Each homework assignment will have about 2 to 4 homework problems. Their due date are given in the course schedule below. Homework assignments and their due dates will be posted on Canvas.

- Homework assignments may include reading tasks intended to support quizzes, discussions, or project work. You are expected to complete all assigned readings by the homework due date and be prepared to engage with the material during the lecture that follows.
- You may discuss your assignments with the professor, teaching assistants, fellow students, and others. However, you are expected to write up your solutions to individual homework on your own.
- You are welcome, even encouraged, to work on your homework assignments during our **Study Sessions**.
- Submission instructions will be provided on Canvas along with each homework assignment.
- We recommend starting your homework assignments early to give yourself ample time to work through the problems. By beginning early, you will have the opportunity to thoroughly understand the material, troubleshoot errors, and seek help if needed, ensuring a more successful and less stressful learning experience.
- You will submit your homework assignments via Canvas. You are responsible for ensuring that your homework solutions are easily read by the graders, that all pages of your solution are included in the submission, and that no part of the solution was cut off during the upload to Canvas. Corrupted files will receive zero credit; again, it is your responsibility to ensure that any file uploaded to Canvas is readable to the instructor team.
- Late assignments and extensions are not allowed. There will be a short grace period for Canvas uploads after the deadline. Any submission received beyond the grace period will be considered late.
- After the due date detailed solutions to the homework problems will be made available electronically.
- Your lowest homework grade will be dropped.

**Quizzes**

This course uses two types of in-person quizzes to reinforce understanding and provide regular feedback on your learning progress.

- **Weekly Quizzes (10 minutes).**
  - Each week, a short quiz will be given **in person at the start of the first lecture of the week**. Weekly quizzes are designed to reinforce key ideas from recent material. They will begin promptly at the scheduled start time, and late arrivals may not be given extra time.
  - Weekly quizzes will **not** be held during weeks that include an extended quiz, holidays, breaks, or the first day of class.
  - To allow for occasional absences or conflicts, your **lowest quiz score will be dropped**.
- **Extended Quizzes (30 minutes).**
  - Four longer quizzes will be given during the semester in place of traditional midterm and final exams. These extended quizzes will cover a broader range of material, integrating concepts from multiple weeks. They will be conducted **in person** and follow the same format as weekly quizzes but at greater depth. Extended quiz dates will be announced in advance. During a week with an extended quiz, there will be no weekly (short) quiz.
  - The final extended quiz will take place during final exam week, scheduled at the time the course's regular final exam would have been held, according to the official Georgia Tech Final Exam Matrices.
  - To allow for occasional absences or conflicts, your **lowest quiz score will be dropped**.

*Scheduling note.* The "first lecture of the week" means the first class meeting on the course calendar for that week. For example, if our meetings are Tuesday/Thursday, the weekly quiz will typically occur on Tuesday (except during extended-quiz weeks, holidays, or breaks).

*Coverage.* Quizzes will cover all material up to and including the previous week's lectures, including homework. The first quiz may also assess prerequisite topics. Extended quizzes will assess cumulative material from multiple weeks.

*Accessibility.* If you are eligible for extended time, please contact the instructor during the first week of the semester so we can arrange an alternative plan (e.g., taking the quiz earlier in the day or completing it at the testing center through the Office of Disability Services). Because quizzes occur at the beginning of class and lecture starts promptly afterward, extended time cannot be accommodated during the regular class period.

### Exams

There are **no traditional midterms or final exam** in this course. Instead, assessment will take place through the four extended in-person quizzes described above. These are designed to evaluate your understanding of course concepts in a cumulative and applied manner, replacing the structure of conventional exams.
The final extended quiz will be held during final exam week at the time the course's regular final exam would have been scheduled, according to the official Georgia Tech Final Exam Matrices.

### Group Project

One group project is required in this course. It is designed to foster collaboration and give you the opportunity to apply concepts from class to more complex, real-world problems involving automation. Below are the key guidelines:

- **Group Formation:** Each group may consist of up to four students. You are responsible for forming your own group and submitting your group name and member list via Canvas by the specified deadline. If you have difficulty finding a group, please contact isye3803fall2026@groups.gatech.edu for assistance.
- **Project Ideas and Selection:** If possible, each group should select its own project (or propose a project related to automation within the broad scope of the class), subject to approval. Details, deadlines, and timelines will be announced on Canvas.
- **Meeting with Instructional Team:** Before submitting the proposal, each group must schedule and complete a meeting with the instructional team by the deadline listed in the course schedule. This meeting is required to confirm scope, feasibility, and expectations, and to identify any required changes before the proposal is finalized.
- **Project Proposal:** Each group must submit a short project proposal describing the problem, objectives, approach, and planned deliverables by the deadline. Details, deadlines, and timelines will be announced on Canvas.
- **Final Presentation:** Each group will give a brief presentation of its project on the last day of class. Presentation length, format, and submission instructions (if any) will be announced on Canvas.
- **Submission Requirements:** One submission is required per group. Submissions must be uploaded via Canvas and must include:
  - A typed, well-organized project report clearly stating your group's findings and conclusions.
  - All numerical results, data, and relevant code used in your analysis.
- **Project Report:** The report should be clear, professional, and well-structured. It must include a brief statement identifying which tasks each group member worked on, along with a summary of each member's overall contributions.
- **Collaboration Policy:** Collaboration within your group is essential and encouraged. However, collaboration or sharing of work between different groups is strictly prohibited.

## Grading Scale

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

| | |
|---|---|
| A | [90%, 100%] |
| B | [80%, 90%) |
| C | [70%, 80%) |
| D | [60%, 70%) |
| F | [0%, 60%) |

According to policy, grades at Georgia Tech are interpreted as follows:

| | |
|---|---|
| A | Excellent (4 quality points per credit hour) |
| B | Good (3 quality points per credit hour) |
| C | Satisfactory (2 quality points per credit hour) |
| D | Passing (1 quality point per credit hour) |
| F | Failure (0 quality points per credit hour) |

See http://registrar.gatech.edu/info/grading-system for more information about the grading system at Georgia Tech.

# Course Materials

## Course Text

There is no required textbook for this course. My lecture materials will be made available to you through Canvas.

## Additional Materials/Resources

### Books and Book Drafts

1. Daniel Jurafsky and James H. Martin. *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, with Language Models*. 3rd edition, 2025. Online manuscript released August 24, 2025. URL: https://web.stanford.edu/~jurafsky/slp3/

### Research Papers

1. Yoshua Bengio, Réjean Ducharme, and Pascal Vincent. A neural probabilistic language model. In T. Leen, T. Dietterich, and V. Tresp, editors, *Advances in Neural Information Processing Systems*, volume 13. MIT Press, 2000. URL: https://proceedings.neurips.cc/paper_files/paper/2000/file/728f206c2a01bf572b5940d7d9a8fa4c-Paper.pdf
2. Adam Tauman Kalai, Ofir Nachum, Santosh S. Vempala, and Edwin Zhang. Why language models hallucinate, 2025. URL: https://arxiv.org/abs/2509.04664, arXiv:2509.04664
3. Ashish Vaswani, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N. Gomez, Łukasz Kaiser, and Illia Polosukhin. Attention is all you need, 2023. URL: https://arxiv.org/abs/1706.03762, arXiv:1706.03762
    - Revised version of Ashish Vaswani, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N Gomez, Łukasz Kaiser, and Illia Polosukhin. Attention is all you need. In I. Guyon, U. Von Luxburg, S. Bengio, H. Wallach, R. Fergus, S. Vishwanathan, and R. Garnett, editors, *Advances in Neural Information Processing Systems*, volume 30. Curran Associates, Inc., 2017. URL: https://proceedings.neurips.cc/paper_files/paper/2017/file/3f5ee243547dee91fbd053c1c4a845aa-Paper.pdf.

### Online Tutorials

1. Nvidia, *Generative AI and LLM Learning Paths*, https://www.nvidia.com/en-us/learn/learning-path/generative-ai-llm/?deeplink=courses--8
2. Hugging Face, *Learn*, https://huggingface.co/learn and Hugging Face. The hugging face course, 2022. https://huggingface.co/course, 2022. [Online; accessed January 12, 2026]
3. Google, *Get Started with Machine Learning*, https://developers.google.com/machine-learning/resources
4. IBM, *What are large language models (LLMs)?*, https://www.ibm.com/think/topics/large-language-models?

### Video Material

1. 3Blue1Brown, *Neural Networks*, https://www.youtube.com/playlist?list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi

## Course Website

I will be using the Course's Canvas Page throughout the semester. On the Canvas page, you should be able to access important information about the course including but not limited to the most updated version of the syllabus and lecture slides, quizzes, homework assignments, solutions to homeworks as well as course announcements. I will also use the Canvas page to provide feedback on your homework assignments, quizzes, and record grades. Please make sure that you check the Canvas system regularly so you do not miss out on important course information.

## Compute and Additional Resources

Most homework assignments will have coding assignments. Any commercial software required for the course will be available through the computer labs on campus and/or free academic licenses.

- The VLab provides Georgia Tech students, faculty and staff a way to access a Windows Desktop with certain software preinstalled from any computer with Internet access. See https://it.iac.gatech.edu/services/vlab.
- Georgia Tech is providing Overleaf Professional features for all students, faculty and staff. See https://www.overleaf.com/edu/gatech.
- Some assignments will require generating graphical illustrations of sets. We recommend using WolframAlpha (see https://www.wolframalpha.com) and/or Mathematica for this purpose. Georgia Tech offers an academic license for Mathematica, which you can access at https://software.oit.gatech.edu.
- The Office of Information Technology (OIT) provides a range of AI tools and resources designed to support students, faculty, and staff in their academic and research activities. For more detailed information and resources, please visit https://oit.gatech.edu/ai.
- The **PACE (Partnership for an Advanced Computing Environment) Cluster** offers high-performance computing resources for research and education. Students with compute-intensive projects may benefit from exploring its capabilities. See https://pace.gatech.edu.
- The **AI Makerspace for Engineering** is used in this course to support homework and projects. Access to the Makerspace is provided through PACE. Learn more at https://coe.gatech.edu/academics/ai-for-engineering/ai-makerspace.

# Course Expectations & Guidelines

## Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/. Any student suspected of cheating or plagiarizing on an exam or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

## Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

## Responsible Use of Course Materials

The materials provided in this course, including lecture notes, slides, recordings, and any other instructional content, are intended solely for the personal use of enrolled students. Redistribution, reproduction, or publication of these materials, in any form, including posting on external websites or sharing with individuals not enrolled in the course, is strictly prohibited without explicit permission from the instructor. These materials are protected under intellectual property laws, and violations of this policy, as outlined by the Georgia Tech guidelines on Responsible Use of Course Materials, may result in disciplinary action. For more details, refer to: https://generalcounsel.gatech.edu/legal-affairs/responsible-use-course-materials.

## Participation

While attendance is not mandatory, I strongly encourage you to attend the lectures. Regular attendance will keep you engaged with the material and provide opportunities for deeper understanding and interaction. All students are expected to: (i) complete and submit all homework assignments on time, and (ii) take the exams at their scheduled times.

I firmly believe that regular attendance is essential for achieving the highest level of success in your academic pursuits. Consistent participation not only deepens your understanding but also maximizes the benefits of your educational experience.

## Collaboration & Group Work

Students may not copy solutions from any source, but are encouraged to use academic references, such as textbooks or research papers as needed. You are encouraged to discuss homework problems with your classmates and learn from each other, but each person must write up and submit their own homework solutions. Copying or rephrasing someone else's work is unacceptable. Further, copying someone else's work is a disservice to your own understanding of the material. There is a big difference between the ability to read and understand a solution and the ability to create and write one. You are allowed to use the materials listed in the syllabus in preparation of your homework responses. If you use material outside those listed in the syllabus, you should cite the material used.

## Responsible Use of Generative Artificial Intelligence (AI) Tools

In this course, the use of Generative AI tools (such as Microsoft Copilot) is encouraged as part of your learning and creative process. These tools can support brainstorming, revising drafts, exploring alternative perspectives, and practicing communication with emerging technologies. However, responsible use is expected. See https://gatech.service-now.com/home?id=kb_article_view&sysparm_article=KB0044077 for more details.

*AI Usage Statement* If you make use of Generative AI tools in completing an assignment, your submission must include a brief **AI Usage Statement** outlining:

- Which tools were used
- When they were used
- What prompts or questions were given
- How the AI output informed or shaped your final submission

*Expectations* You are expected to critically engage with any AI-generated content and ensure your final work reflects your own understanding and academic voice. Generative AI should **never** be used to fabricate data, cite non-existent sources, or bypass learning objectives.

Use of Generative AI must comply with Georgia Tech's *Honor Code* and academic integrity guidelines.

At Georgia Tech, the Office of Information Technology (OIT) provides a range of AI tools and resources designed to support students, faculty, and staff in their academic and research activities. For more detailed information and resources, please visit https://oit.gatech.edu/ai.

## Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Late assignments will be accepted only and make-up exams will be given only for documented reasons of illness, family emergency, or participation in approved Institute activities (see http://catalog.gatech.edu/rules/12/ for more information). Final exams will be re-scheduled in accordance with Georgia Tech's policy, also found at http://www.catalog.gatech.edu/rules/12/.

## Student-Faculty Expectations Agreement

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgment, and responsibility between faculty members and the student body. See http://www.catalog.gatech.edu/rules/22/ for an articulation of some basic expectation 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 Use of Mobile Devices in the Classroom

Research on learning shows that unexpected noises and movement automatically divert and capture people's attention, which means that one student's use of a mobile devices (laptops, cell phones, tablets,etc.) can distract another student and disrupt their ability to learn. In addition, students using mobile devices often become engaged in matters that are not related to the class they are attending. Further,research indicates that students taking notes on laptops tend to process less as they take notes, and the depth of their learning suffers.

Although students may use laptop and tablet devices, these devices should be used only for matters related to our class. For the reasons listed above, I encourage students to be mindful in terms of how using laptop and tablet devices may be impacting their own learning. Cell phones should be silenced and stored during classroom time. In the synchronized sessions, cell phone, tablet and laptop can be used to follow the class,not to become a distraction.

### Email

When sending emails to isye3803fall2026@groups.gatech.edu, please use your Georgia Tech email address and include "ISYE 3803" in the subject line. This will make sure that your email gets properly filtered in my inbox and allow the instructor team to provide a more timely response.

### Regrading requests

If you think there has been an error in the grading of your assignment or exam, you have seven calendar days from the day it was returned to the class to submit it for a re-grade. When you submit a regrade request, you must provide a written explanation of the suspected grading mistake. Re-grading entails re-grading the entire assignment or exam; therefore, the re-grade process may result in your submission receiving a higher or a lower score after all of the problems have been reconsidered. Regrade requests must be submitted through Gradescope.

### Recordings of Class Sessions and Required Permissions

Classes may not be recorded by students without the express consent of the instructor unless it is pursuant to an accommodation granted by the Office of Disability services. Class recordings, lectures, presentations, and other materials posted on Canvas are for the sole purpose of educating the students currently enrolled in the course.
Students may not record or share the materials or recordings, including screen capturing or automated bots, unless the instructor gives permission. Digitally proctored exams may require students to engage the video camera, but those recordings will not be shared with or disclosed to others without consent unless legally permitted.
If students are identifiable by their names, facial images, voices, and/ or comments, written consent must be obtained before sharing the recording with persons outside of currently enrolled students in the class.

## Campus Resources for Students

These are resources on campus that are available to students:

- **The Counseling Center:** https://counseling.gatech.edu/
  The Counseling Center educates students for life by providing a variety of services and programs that are consistent and consonant with the strategic plan goals of the Institution and the Division of Student Life. Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, crisis intervention, referral services, as well as outreach programming, and consultation for faculty and staff, family and friends of Georgia Tech students. All counseling services are confidential and free of charge for eligible students. The Counseling Center provides brief or short-term therapy for a variety of presenting issues.
- **The Center for Assessment, Referral, and Education (CARE):** https://care.gatech.edu/
  CARE is the primary resource for mental health support at Georgia Tech.
- **The Division of Student Life:** https://studentlife.gatech.edu/content/get-help-now
  Student Engagement & Well-Being provides a number of services to assist students with medical and personal emergencies.
- **Office of the Dean of Students:** https://studentlife.gatech.edu/about/dean-students
  The Office of the Dean of Students provides a number of services to assist students with medical and personal emergencies.