DS 2500: Intermediate Programming with Data
Spring 2026 Boston Campus

Course Information

Dates: January 7 – April 26, 2026
Lecture Schedule (DS2500):

- [Sec 1] TF 9:50 AM - 11:30 AM (Mugar 201) – Deahan Yu
- [Sec 2] TF 1:35 PM - 3:15 PM (Mugar 201) – Deahan Yu
- [Sec 3] TF 1:35 PM - 3:15 PM (Cargill Hall 097) – Benjamin Gyori

Lab Schedule (DS2501):

- [Sec 7] W 8:00 AM - 9:40 AM (WVH 210B) – Sudhiksha Kandavel Rajan
- [Sec 1] W 9:50 AM - 11:30 AM (WVH 212) – Angelia Loo
- [Sec 3] W 11:45 AM - 1:25 PM (WVH 210A) – Aditya Sairam Govindan
- [Sec 5] W 11:45 AM - 1:25 PM (WVH 212) – Thanya Mysore Santhosh
- [Sec 6] W 1:35 PM - 3:15 PM (WVH 210A) – Jane Adams
- [Sec 8] W 1:35 PM - 3:15 PM (WVH 212) – Dawnbee Hwang
- [Sec 9] W 3:25 PM - 5:05 PM (WVH 210A) – Jane Adams
- [Sec 4] W 4:40 PM - 6:20 PM (WVH 212) – Shruti Panicker

Teaching Team:

Instructor	**Email**	***Office hours / Location**
Benjamin Gyori (he/him)	b.gyori@northeastern.edu	Thurs, 9-10:30am / Zoom or in-person in 177 Huntington (office 909, requires advance notice/access)
Deahan Yu (he/him)	d.yu@northeastern.edu	Mon 1:30-3pm / ME 316B ME: Meserve Hall
Teaching Assistants		
Aditya Sairam Govindan	govindan.a@northeastern.edu	Mon, 11am -12:30pm/online
Angelia Loo	loo.a@northeastern.edu	Mon, 9-10:30am/online
Dawnbee Hwang	hwang.daw@northeastern.edu	Wed, 12-1:30pm/Ryder Hall 271
Jane Adams	adams.jan@northeastern.edu	Wed, 8-9:30am/online
Shruti Panicker	panicker.s@northeastern.edu	Wed, 1-2:30pm/Ryder Hall 220
Sudhiksha Kandavel Rajan	kandavelrajan.s@northeastern.edu	Thu, 12-1:30pm /Ryder Hall 156
Thanya Mysore Santhosh	mysoresanthosh.th@northeastern.edu	Thu, 1:30-3pm / online

*Online office hour Zoom links will be provided on Canvas

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Course Description

DS 2500 offers intermediate to advanced Python programming for data science. Covers object-oriented design patterns using Python, including encapsulation, composition, and inheritance. Advanced programming skills cover software architecture, recursion, profiling, unit testing and debugging, lineage and data provenance, using advanced integrated development environments, and software control systems. Uses case studies to survey key concepts in data science with an emphasis on machine-learning (classification, clustering, deep learning); data visualization; and natural language processing. Additional assigned readings survey topics in ethics, model bias, and data privacy pertinent to today's big data world. Offers students an opportunity to prepare for more advanced courses in data science and to enable practical contributions to software development and data science projects in a commercial setting.

Accompanied by DS2501: Lab for DS2500 (1.00 credit) in which students will practice the programming techniques discussed in lecture through hands-on experimentation.

DS2501 is a co-requisite for DS2500; make sure you’re signed up for both.

Course Prerequisites: DS 2000 & 2001 (Programming with Data & Data Science Programming

Practicum) or CS 2000 (Introduction to Program Design and Implementation), with a grade of D- or higher

Course Learning Goals

Through active engagement and completion of course activities, you will be able to:

1. **Obtain intermediate to advanced-level Python programming skills** using concepts including object-oriented programming and encapsulation for data science applications.
2. **Apply introductory machine learning techniques** to analyze and predict outcomes from data using classification, clustering, regression, and deep learning methods.
3. **Create effective data visualizations** that clearly communicate insights from complex datasets using appropriate Python libraries and tools.
4. **Process and analyze diverse data sources** including web APIs, JSON, and various file formats while implementing proper data cleaning, scaling, and preprocessing techniques.
5. **Develop professional software development skills** including unit testing, debugging, and collaborative programming practices essential for data science projects.

Course Materials & Tools

Technology

You will need to have access to a device that connects to the internet so that you can access email, Canvas, Piazza, and Gradscope. Students can borrow equipment and access other learning technology from Information Technology Services. For tech support, see ITS Northeastern Tech Resources.

> **Canvas:** All course details and materials will be posted on our Canvas course site. You may also ask questions that may be helpful for your fellow classmates in Discussions.
>
> **Piazza:** We will be using Piazza as a space for peer-to-peer help. You are encouraged to collaborate and discuss course materials with each other. However, **please refrain from posting full answers directly on Piazza**. Piazza is intended for peer support, but the teaching team will still check in daily (except weekends and holidays). Please understand that prompt responses from us are not guaranteed. To join, visit the Piazza tab on Canvas or https://piazza.com/class/mk1w0mvy18t4gl#
>
> **Gradescope:** We will use Gradescope to submit all homeworks, labs, and project assignments. You can access Gradescope via Canvas or https://www.gradescope.com/courses/1211980

Recommended Textbooks

Intro to Python for Computer Science and Data Science. Deitel & Deitel. Pearson, 2019. ISBN: 0135404673. Available free online or purchase.

The textbook is available online via Northeastern's digital library. You do not need to read the textbook ahead of lecture; it's most useful as reference materials or for looking up new examples.

Course Expectations

Expectations for the course: Transparency & Progress over Perfection

We are here to guide your learning and will challenge you to actively engage in the learning process through class activities, assignments, and more. This course will provide clear and open communication regarding grading criteria, instructions, and policies. We will try our best to create a

fair and trusting learning space so that you can fully understand what is expected and how to achieve your goals.

We believe in progress over perfection. This course is designed to encourage continuous effort for success and learning. We will do our best to give you the tools, feedback, and support to gradually develop your skills and knowledge, and will always welcome suggestions for improvement.

Expectation when asking programming questions

When asking programming questions in any setting, such as office hours, Piazza, or 1-on-1 appointments, you should be prepared to explain your thought process and should be able to walk through your lines of code. Make sure you have done the groundwork first—this means reviewing the material, trying to solve the problem on your own, and identifying where you're stuck before seeking help. If you can't articulate what you have done or specify which part you need help with, the teaching team won't be able to assist.

Expectation for all of us: Good Citizen

We are all citizens in this learning community, and it is important for us to show respect and courtesy towards one another. Let's be good citizens. As good citizens, we respect the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities.

Evaluation

You will receive one grade that will appear on your transcript for both DS2500 and DS2501. Your grade will be evaluated based on your homeworks, labs, quizzes, and project. All homeworks are weighted the same, regardless of the specific number of points.

Factor	Number	Points	Weight
Homework	3	2,700	27%
Labs	10	2,000	20%
Quizzes	3	2,700	27%
Team Project	1	2,600	26%
		10,000	100%

Letter Grades

To pass the course, you must attain a final grade of 60% (D-) or higher. We use natural rounding, so 95.6% becomes 96% but 95.4% becomes 95%. Your final grade for the course will use the following breakpoints to convert from letter to number grades.

Letter	Range
A	95-100
A-	90-94
B+	87-89
B	83-86
B-	80-82

C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	< 60

Homeworks

We'll have **three homeworks (assignments)** during the semester. These are problem sets about concepts we learn from the previous weeks. *They are to help you a) learn by firsthand experience and b) acquire **learning objectives 1, 2, 3, 4, 5.*** Homeworks are **due by 11:59 PM** on Gradescope.

Your homework will be graded on three separate rubrics:

1. *Accuracy*. You'll answer quantitative questions about the dataset on gradescope. These answers are auto-graded. Gradescope can be a little picky, so make sure you don't put extraneous characters or whitespace in your answers—and double-check the "correct/incorrect" confirmation!
2. *Code Quality*. You'll submit your code as well, which we will review and grade based on its modularity, readability, and reusability. Please see our DS2500 grading guidelines for more information.
3. *Visualization*. You'll be asked to submit screenshots/downloads of Python plots on some of your homework. We expect these plots to be labeled, easy to read and understand, and appropriate for the data.

Homeworks will be scored and returned to you, on Gradescope. After getting your homework back, you have the option to file a regrade request under one of the following categories:

- *Clarity* — you're not sure why points were taken off, even though you've read the rubric and your grader's comments.
- *Correction* — your grader mistakenly took points off.

When filing a regrade request, specify which category the request belongs in. You'll receive a response, and possibly an updated score, from your grader. After that, if you still have concerns or questions about your grade, email your instructor.

Late submissions are allowed with a penalty. See section Late Policies. After the late deadline, no submissions will be accepted.

Please carefully read the policy on Academic Integrity / External Resources and Plagiarism and Cheating sections of the syllabus before preparing your homework.

Labs

Labs are scheduled on **Wednesdays**. You'll have small programming exercises about the topics that we cover during class that are **due by 11:59 PM on the following day (i.e., Thursday)**, though we encourage you to submit at the end of your lab section. Labs are usually released around 6 pm on Tuesdays, the day before the lab. *They are created to help you a) learn by working together, b) participate in class, and c) acquire **learning objectives 1, 2, 5**.* Late submissions are allowed with a penalty. See section Late Policies. After the late deadline, no submissions will be accepted.

Please carefully read the policy on Academic Integrity / External Resources and Plagiarism and Cheating sections of the syllabus for your lab assignments.

Quizzes

We'll have three in-class, on-paper, closed-book quizzes during the semester. *The quizzes are to help you a) acquire the ability to apply knowledge and skills without external resources and b) acquire* ***learning objects 1, 2***. Please make sure they are on your calendar so you don't miss class that day. Quiz dates are:

- Quiz 1 (covers weeks 1-4): Tuesday, February 3rd
- Quiz 2 (covers weeks 5-9): Friday, March 13th
- Quiz 3 (covers weeks 10-12): Friday, April 3rd
- Each quiz is up to 70-min long although it's designed so that it can be completed in a shorter time.
- Only pen, pencil, and erasers are allowed. No other items such as cheat sheets, calculators, electronic devices, etc. are allowed.

If you have a Disability Access Services (DAS) accommodation related to quizzes, it is your responsibility to arrange to take the quizzes in the DAS office. Make sure you set this time up at least a week ahead of the scheduled quizzes to guarantee the time and space you need.

Semester Team Project

You'll work with a team (3-4 members) to complete a project over the course of the semester. *The semester project is to help you gain a) hands-on experiences, b) explore a dataset of interest and apply analyses, c) present and communicate your work clearly to your peers, and d) acquire* ***learning objects 2, 3, 4, 5.*** More details will be provided later in the semester.

You'll choose a new dataset(s) and delve into it with your teammates. We expect a substantive project that incorporates the contributions of all teammates. Five separate components will be graded:

1. Team Formation & Topic (submit by ~~2/17~~ 2/20)
2. Proposal (submit by 3/10)
3. Progress Report (submit by 3/31)
4. In-class Presentation (4/14 and 4/17)
5. Final report (with code & data)

No late submissions will be accepted.

Course Schedule

- Items that are due by that date or taking place on that day are **highlighted in bold**.
- Topics covered in each class may change while deadlines, the quiz day, and the presentation day remain fixed.

Week 1		Wednesday, 1/7	Friday, 1/9
		No lab	Introduction
Week 2	Tuesday, 1/13	Wednesday, 1/14	Friday, 1/16
	Review of foundational Python programming 1 (variable assignment, commenting, str, list, tuples)	**Lab01***	Review of foundational Python programming 2 (dictionary, conditionals)
Week 3	Tuesday, 1/20	Wednesday, 1/21	Friday, 1/23
	Review of foundational Python programming 3 (loops) HW1 out	**Lab02***	Review of foundational Python programming 4 (functions, main(), csv)
Week 4	Tuesday, 1/27	Wednesday, 1/28	Friday, 1/30
	Advanced Python concepts (variable scope, lambda functions, list comprehension, error handling)	**Lab03***	Object-oriented programming, Encapsulation & program design **HW1-R**
Week 5	Tuesday, 2/3	Wednesday, 2/4	Friday, 2/6
	Quiz 1	**Lab04***	Project description, ideation
Week 6	Tuesday, 2/10	Wednesday, 2/11	Friday, 2/13
	Google Colab, Python libraries (matplotlib, pandas)	Lab session for review/assistance with Google Colab & project topic idea **Lab01-04-L***	Web scraping **HW1-L**
Week 7	Tuesday, 2/17	Wednesday, 2/18	Friday, 2/20
	APIs & JSON HW2 out ~~**Team Project Report (team + topic)**~~	**Lab05***	Statistics for Data Science 1 (types of data, central tendency) **Team Project Report (team + topic)**
Week 8	Tuesday, 2/24	Wednesday, 2/25	Friday, 2/27
	Snow day	**Lab06***	Statistics for Data Science 2 (data distributions and plots) **HW2-R**

Week 9 *Spring Break*	Tuesday, 3/3	Wednesday, 3/4	Friday, 3/6
	No Class	*No lab*	*No Class*
Week 10	Tuesday, 3/10	Wednesday, 3/11	Friday, 3/13
	Data manipulation, feature extraction (scaling and normalizing data, extracting feature, dealing with missing data) **Team Project Proposal**	**Lab07***	**Quiz 2**
Week 11	Tuesday, 3/17	Wednesday, 3/18	Friday, 3/20
	Similarity and distance measures, Analyzing & Predicting data without labels: Clustering HW3 out	**Lab08*** **Lab05-07-L***	Analyzing & Predicting data with labels: KNN **HW2-L**
Week 12	Tuesday, 3/24	Wednesday, 3/25	Friday, 3/27
	Analyzing & Predicting numeric values: Linear Regression	**Lab09***	Analyzing & Predicting binary/multi class: Logistic Regression **HW3-R**
Week 13	Tuesday, 3/31	Wednesday, 4/1	Friday, 4/3
	Review and practice **Team Project Progress Report**	**Lab10***	**Quiz 3**
Week 14	Tuesday, 4/7	Wednesday, 4/8	Friday, 4/10
	Project check-in 1 (for Tuesday presentation groups)	*No lab* **Lab08-10-L***	Project check-in 2 (for Friday presentation groups) **HW3-L**
Week 15	Tuesday, 4/14	Wednesday, 4/15	Friday, 4/17
	Team Project Presentations 1	*No lab*	**Team Project Presentations 2**
Final Week	Tuesday, 4/21		
	Team Project Deliverables		

* Labs are due by the following day (i.e., Thursday)

Late Policies

- **HWx-R** is a regular deadline for HW **x.**

- **HWx-L** is the late deadline for homework **x**. A 100 points deduction will be applied to the homework grade. That is, you can earn a maximum of 800 points. For example, if you didn't submit or earned fewer than 800 for the regular deadline of HW2 and you wish to earn up to 800, you may complete HW2 and submit it any time by the HW2-L deadline.
- **Labx-y-L** is the late deadline for labs **x - y**. For example, there are four labs (Lab01-04), and any of these labs can be resubmitted until the Lab01-04-L deadline. There will be a 50-point deduction **per lab** applied to the grading.

Communication

Reaching Out to Instructors

As instructors of this course, we are here to support your learning journey in every way possible and to help you succeed in this course. We will do our best to support you. We plan to check in with you as needed, either before or after classes or via email. However, we may overlook your needs, so please don't just wait. Reach out to your lecture instructor via email for any concerns or obstacles hindering your learning or anything sensitive in nature. During the week, we'll respond within 24 hours, but don't expect a response after 6pm. On the weekends we'll be slower to respond, but if you reach out over a weekend you can expect to hear back in the following week..

Your feedback is important for enhancing your learning experience and it will not impact your grades. You can reach out by speaking directly or sending an email.

Please come to office hours. If these times don't work, we can arrange a meeting. To schedule an alternative meeting time, email us with the course number in the subject line; otherwise, we may miss your email. I look forward to a productive and enjoyable learning experience together.

Inclusive Classroom

We believe that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

We invite everyone to raise their hands to ask and answer questions during class, and to engage in discussion with classmates. However, we know it's not always the easiest thing to speak up in a big classroom, or to clarify your thoughts in real time.

To create and preserve a classroom atmosphere that optimizes teaching and learning, all participants share a responsibility in creating a civil and non-disruptive forum for the discussion of ideas. This includes all ways you interact with classmates and the teaching team—in lectures, office hours, Piazza, etc.

Name and Pronoun Usage

As this course includes some discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please email your instructor of the necessary changes.

Academic Integrity

External Resources

We believe that having an AI-related resource like ChatGPT or Claude will enhance our life/work when it is used properly. However, in this course where we are just beginning to learn how to code and think algorithmically, we strongly discourage using AI tools. Please refrain from using them as much as possible for the course. Relying on AI at this early stage may hinder the development of a strong foundation in programming, computational thinking, and data science.

You may use other external resources, such as textbooks and the Internet, to enhance your understanding. If you use one to complete any course work, then you must 1) properly cite the source using APA citation style, and 2) work out a solution yourself and/or write responses in your own words. Following these steps are considered as declared use of external resources, which you will not be penalized for. However, anything other than the declared use (e.g. copying and pasting) is considered plagiarism and cheating. Similarly, you may be quizzed individually on your work at any time. If you cannot explain how your code works or why you wrote it that way, it will be considered a violation of academic integrity.

For detailed information on what constitutes these actions and the associated consequences, refer to Plagiarism and Cheating.

Collaboration

Collaboration is highly encouraged in this class, as a form of active learning. However, you must write your submission on your own, in your own words, before turning it in. If you worked with someone else, you must list all collaborators on your written submission to ensure proper credit is given. Failing to list all collaborators will result in a grade deduction of up to 20% for that specific submission. Copying solutions from a classmate is considered cheating. For detailed information on what constitutes these actions and the associated consequences, refer to Plagiarism and Cheating.

Plagiarism and Cheating

Engaging in cheating or plagiarism will result in three things: 1) 0 points for the particular work, 2) a deduction to your final grade (equivalent to 10% of the final grade), and 3) a report filled with OSCCR (Office of Student Conduct and Conflict Resolution). The university's academic integrity policy discusses actions regarded as violations and consequences for students: https://osccr.sites.northeastern.edu/academic-integrity-policy/

- Submissions: All written submissions must be your own, original work. Original work for narrative questions is not mere paraphrasing of someone else's completed answer. You must not share written answers with each other at all. In other words, no two submissions should be identical or excessively similar, such as by only changing variable names. If two or more solutions appear very similar, even if not identical, the teaching team may contact the involved parties for further investigation.
- Quizzes: Failure to adhere to the quiz instructions (e.g., continuing to work after time has expired, using anything else other than what's allowed, etc.) will be considered cheating.

Attendance

As an on-ground class, it is expected that you attend in-person, and it is highly encouraged to attend lectures as we will do many hands-on programming exercises together. However, attendance is not mandatory, so there is no need to inform the teaching team about your absences. Please note that the presentations and quizzes will take place in class. Do not miss these days, as your grade will be significantly affected if you miss. Also, your attendance is highly encouraged for the last week of

classes during all presentation days as your attendance will be graded as part of your semester project grade. See “Course Schedule” for those days.

Accommodation

Students who wish to receive academic services and/or accommodations should visit the Disability Access Services (DAS) at 20 Dodge Hall. For more information, visit https://disabilityaccessservices.sites.northeastern.edu/. Once you have done so, please provide your letter from the DAS to me as early in the semester as possible, and no later than one week before the date you require accommodations. I will arrange the necessary accommodations. Please note that accommodations may not be possible if the letter is provided too late.

For any other accommodations, please have WeCare contact me on your behalf. Once we get confirmation from them, we will figure it out.

Student athletes who anticipate challenges in being able to participate in class or submit assignments on time should speak to us as soon as possible about available alternatives or allowances.

Title IX Protections and Resources

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal funding. Any NU community member who has experienced such discrimination, sexual assault, relationship violence, stalking, coercion, and/or sexual harassment, is encouraged to seek help. Confidential support and guidance can be found through University Health and Counseling Services, the Northeastern Center for Spirituality, Dialogue, and Service, and the Office of Prevention and Education at Northeastern (OPEN).

Note that faculty members are considered “responsible employees” at Northeastern University, meaning they are required to report all allegations of sex or gender-based discrimination to the Title IX Coordinator.

Alleged violations can be reported non-confidentially to the Title IX Coordinator within The Office for Gender Equity and Compliance at: titleix@northeastern.edu and/or through NUPD (Emergency 617.373.3333; Non-Emergency 617.373.2121). Reporting Prohibited Offenses to NUPD does NOT commit the victim/affected party to future legal action. In case of an emergency, call campus police or 911. For additional information and assistance please see the Office of Institutional Diversity and Inclusion webpage.

Resources for Non-US Citizen Students

Northeastern’s Global Safety Operations Center has established a dedicated phone line, supported 24/7, for immediate questions about immigration enforcement. Anyone approached on campus by an immigration official should call 617-373-1234 for further guidance. International students should not hesitate to reach out to the Office of Global Services with any questions.

As always, please stay vigilant for scams, no government official will ever demand immediate payment, threaten deportation, or ask for sensitive personal information over the phone or by email.

If you receive any suspicious messages or calls, do not respond—reach out to the Office of Global Services or Northeastern University Police for assistance. You can refer to this information page on Safety and Scams.