

DS 483 Mathematics and Statistics for Machine Learning

School of Technology & Computing

5 Credits, Undergraduate Course
Effective Date: Winter 2023

Access to the Internet is required.

All written assignments must be in Microsoft-Word-compatible formats.

See the library's APA Style Guide tutorial for a list of resources that can help you use APA style.

Faculty Information

Professional experience information for instructors is found under *Faculty Information* in the online course menu.

Contact Information

Contact information for instructors is found under *Faculty Information* in the online course menu.

Email: [first name] [last name]

Phone: [xxx-xxx-xxxx]

Office Hours and Response Time: [I am available through MS Teams xxday and xxday nights between xx p.m.– xx p.m. I will respond within 24 hours. I will grade within 3 business days after the due date.]

Bio: (keep images under 300px wide)

Course Description

The fundamental mathematical tools needed to understand machine learning include linear algebra, analytic geometry, matrix decompositions, vector calculus, optimization, probability, and statistics. These topics are connected to four central machine learning methods: linear regression, dimension reduction, density estimation, and classification. Students completing this course will have an understanding of building intuition and practical experience with applying mathematical concepts to machine learning.

Course Resources

Required and recommended resources to complete coursework and assignments are found on the course [Reading List](#). The reading list can be found under Course Information in Brightspace as well as from the library homepage.

Note: Required resources that must be purchased by the student are tagged “Purchase from a vendor of your choosing.” Required resources with a direct link, “Available through CityU Library”, are available at no cost to students.

Students in Canada will see required resources they need to purchase tagged “Purchase from the Canadian Bookstore.” Students outside the U.S. and Canada should contact their advisor or textbook coordinator for additional information.

Course Outcomes

As a result of this course, students will know or be able to do the following:

- Understand fundamental mathematical and statistical concepts used in machine learning.
- Understand the concept of linear regression from the statistical perspective.
- Apply machine learning algorithms to a real-world problem using a programming language.

- Analyze machine learning models using mathematical and statistical concepts.
- Evaluate and interpret probabilistic and statistical models in machine learning.

Grading Scale

The grades earned for the course will be calculated using City University of Seattle’s decimal grading system, found in the current University Catalog (<https://www.cityu.edu/catalog/>).

Grading rubrics with details on how each assignment will be graded are located under *Assignments* and/or in *My Grades* in the online course menu. Students should review the rubric for each assignment prior to completing their work in order to understand how it will be assessed.

OVERVIEW OF REQUIRED ASSIGNMENTS	% OF FINAL GRADE	POINTS
<i>Instructor Determined Assignments</i>	20%	
The Muddiest Point (MP)	5%	50 = 5 points * 10 modules
Concept Debate (CD)	5%	50 = 5 points * 10 modules
Knowledge Check (KC)	10%	100 = 10 points * 10 modules
<i>Major Assessments</i>	80%	
Hands-On Skill (HOS)	20%	200 = 20 points * 10 modules
Programming Exercise (PE)	40%	400 = 40 points * 10 modules
Team Project (TP)	20%	Proposal: 30 points Progress: 70 points Final Report: 70 points Final PPT: 30 points Subtotal: 200 points
TOTAL	100%	1,000 points

Course Assignments and Grading

The instructor will provide grading rubrics explaining how this assignment will be graded.

The Muddiest Point (MP) & Concept Debate (CD)

All classes are required to use the Discussion Board to participate in MP and CB. Participation is an integral part of this course. It is defined as active engagement in discussing the MP and CD. A student posts an answer to a weekly discussion topic on Discussion Board. The student also posts a response to two other students’ posts by the end of each module. Comments and questions should be clear and thoughtful, with correct grammar, spelling, and punctuation. The instructor will grade the quality of your discussion postings on both content and response. References for your answers are strongly recommended. But APA styles are required for references and citations.

MP: Before class, students are required to submit the Muddiest Point (MP) activity. The purpose of this activity is to stimulate student engagement. The instructor uses the MP to assess how students understood the required readings. The instructor also uses the MP to customize the

lecture scope to implement Just-in-Time Teaching (JiTT). The MP consists of writing a brief reflective paragraph identifying the most confusing part (i.e., the MP) of the content covered in the upcoming module. If a student understands all concepts, the student needs to explain the most exciting or interesting aspect.

Criteria	% of Grade
Participation	80%
Writing	20%
TOTAL	100%

CD: The instructor poses a problem based on the key concepts of a lecture. After reflecting on the problem, students submit their first answer with justification identifying why the answer is correct. Then, students discuss their responses with their classmates. Students discuss their thought processes and solution with peers. Students then commit to an answer and re-submit their responses. The instructor reviews responses and thought processes with the correct answer through Weekly Announcements.

Criteria	% of Grade
Participation	50%
Writing	50%
TOTAL	100%

Hands-On Skill (HOS)

The instructor will assign hands-on skill practice exercises for students to learn specific programming languages, application programming interfaces (APIs), or tools related to programming assignments or virtual labs.

Criteria	% of Grade
Skill Exercise	70%
Engagement	20%
Correctness	10%
TOTAL	100%

Programming Exercise (PE)

The students must individually perform the programming exercise. Programs must be executable and robust. Non-executable programs will not receive any credits. Programs should deliver correct answers on all valid input and produce comprehensible error messages on invalid input. Programs also run correctly on all test data given within a reasonable time. Students should write programs that are comprehensible, clear, and follow proper style standards.

Criteria	% of Grade
Program Execution	40%
User Requirement	40%
Program Documentation	20%
TOTAL	100%

Knowledge Check (KC)

Weekly quizzes measure acquired knowledge of concepts covered in the course. Focus is on the underlying principles and concepts rather than memorization to solve the quizzes.

Criteria	% of Grade
Correctness	100%
TOTAL	100%

Team Project (TP)

Project Description: Implementing Machine Learning Models using Mathematics and Statistics Concepts

Students are required to demonstrate the mastery of mathematics and statistics related to machine learning using a scripting language determined by the instructor.

Teams consist of three to four students. Each team will use an instructor-approved topic relevant to the course.

The paper is to be between 6 and 7 pages. The required template for class submissions comes from international organizations, the Education Special Interest Group and the Computing Education + Information systems Applied Research. ([EDSIG/CONISAR](#)). The instructor may recommend teams submit their paper to conferences. Submissions are optional and will not impact the course grade. Additional revisions may be required after the course.

Three report templates and one presentation template are provided. The file name consists of team project number, team number, and the list of your team members. For example, "TP01 T03 Sam John Mark."

- TP01 for the proposal – "TP01 T0X Author1 Author2 Author3.docx"
- TP02 for the progress report – "TP02 T0X Author1 Author2 Author3.docx"
- TP03 for the final report – "TP03 T0X Author1 Author2 Author3.docx"
- TP04 for the final presentation slide – "TP04 T0X Author1 Author2 Author3.pptx"

As in any scholarly writing, students should not merely copy information from another author. Students should use evidence to support the contentions they have drawn from their findings and critically analyze related literature. In essence, each paper needs to be an analytical paper, not a summary of readings.

In addition, a team slide deck presentation is required.

- The presentation consists of 15+4 slides: 15 slides for content and 4 slides for cover, agenda, key reference, and Q&A.
- The PPT template is provided. Your team can change design and color.
- A presentation video (15 minutes) is required.
- A demo video (a maximum of 1-2 minutes) may be included. The demo time is included in the 15 minutes presentation.

Four submissions are required according to the following schedule:

- Proposal (1 page; 30 points) – Starting (Module 1) & Ending (Module 3)
- Progress Report (3-4 pages; 70 points; graded after the proposal has been submitted) – Starting (Module 4) & Ending (Module 7)

- Final Report (6-7 pages; 70 points; graded after the progress has been submitted) – Starting (Module 8) & Ending (Module 10)
- Final PPT (15+4 slides, 30 points; graded after the final report has been submitted) – Starting (Module 8) & Ending (Module 10)

Students are expected to use the assigned readings, videos, and other materials throughout the quarter. Students will need to utilize additional sources that were not assigned by the professor. While stylized after an industry report, students are expected to employ APA formatting of citations, footnotes, and bibliography. Students must cite the sources of all ideas, facts, and information used that are not their own, even if they have put the information into their own words. Failure to do so is plagiarism, although the oversight is unintentional. To avoid plagiarism, check <https://library.cityu.edu/howto/apa-writing/avoid-plagiarism/>.

Team Project (TP) Report

The student will provide a report formatted based on a template provided by the instructor. Students are required to improve the writing iteratively and incrementally every week. The revision will always happen during a quarter. Students will add new required sections to the existing paper every week.

The final report is the culmination of applied research and activities conducted throughout the quarter. The final report/paper provides a detailed problem and its solution likely to be encountered by a company or organization described in a case study supplied by the student.

TP01 and TP02

Criteria	% of Grade
Structure	20%
Content	30%
Writing	30%
Reference	10%
Collaboration	10%
TOTAL	100%

TP03

	Criteria	Outcome	% of Grade
Data Science Principles and Practices (20%)			
1	Mathematics and Statistics for Machine Learning	Apply the mathematical and statistical fundamentals and issues associated with machine learning.	20%
Critical Thinking (60%)			
2	Issue	Issue is stated and described thoroughly so that it is understood fully.	20%
3	Evidence	Information is taken from source(s) appropriate to the scope with enough interpretation and evaluation to develop a comprehensive analysis or synthesis, and expert opinions are thoroughly scrutinized.	10%
4	Context and Awareness	Thoroughly analyzes assumptions and biases, carefully evaluating contextual relevance when presenting a position.	20%
5	Conclusions	Conclusions are logical and reflect an informed	10%

		evaluation of evidence and perspectives in priority order.	
Collaboration (20%)			
6	Teamwork	Works effectively on diverse, global and/or distributed teams.	10%
7	Knowledge of Cultural Frameworks	Demonstrates sophisticated understanding of the complexity of elements important to members of another culture in relation to its history, values, politics, communication styles, economy, or beliefs and practices.	5%
8	Openness to Cultural Differences	Demonstrates openness to the diverse population of students in STC programs, collaboratively and professionally communicates with team members to form a collective decision and provide resolutions to the challenges that arise.	5%
	TOTAL		100%

Team Project (TP) Presentation

The student will report on the research outcomes, development, or other project efforts to an academically appropriate committee in a public forum. The nature of the presentation content will determine the specific makeup of the audience. The student will choose the format of the presentation, in consultation with the advisor. The layout and design must be appropriate and adequate to represent the outcomes of the effort. While students must make some form of a visual presentation, the presentation of the results may include publishing in a refereed publication, publication in a trade or popular magazine or journal, broadcast in an appropriate medium, or, in exceptional cases, limited dissemination within a closed community. Each presenter will have 15 minutes for presentation and 5 minutes for questions and answers. Each presenter must keep the total presentation time limit strictly.

Criteria	% of Grade
Structure	20%
Visual Presentation	30%
Verbal Quality & Engagement	30%
Collaboration	20%
TOTAL	100%

COURSE POLICIES

Course policies on topics such as Late Assignments, Participation, and Professional Writing are found Content → Syllabus, Schedule, and Course Team → Course Policies in the online course menu. Students are responsible for reviewing and applying these policies while enrolled in this course.

UNIVERSITY POLICIES

Students are responsible for understanding and adhering to all of City University of Seattle's academic policies. The most current versions of these policies can be found in the [University Catalog](#) that is linked from the CityU Web site.

Antidiscrimination

City University of Seattle and its staff and faculty are committed to supporting our students. We value equity, diversity, and inclusion as a way of life as well as the educational opportunities it provides. City U will not tolerate any form of discrimination based on race, color, ethnicity, sexual orientation, gender identification, socioeconomic status, or religious values. If you have experienced any discrimination based on any of the above, we encourage you to report this to the University. Please report this to your instructor. If you do not feel safe reporting this to your instructor, please report to Interim Provost or to the Vice President of Student Affairs, Dr. Melissa Mecham.

Non-Discrimination & Prohibition of Sexual Misconduct

City University of Seattle adheres to all federal, state, and local civil rights laws prohibiting discrimination in employment and education. The University is committed to ensuring that the education environment is bounded by standards of mutual respect and safety and is free from discriminatory practices.

In the U.S., the University is required by Title IX of the Education Amendments of 1972 to ensure that all of its education programs and activities do not discriminate on the basis of sex/gender. Sex include sex, sex stereotypes, gender identity, gender expression, sexual orientation, and pregnancy or parenting status. Sexual harassment, sexual assault, dating and domestic violence, and stalking are forms of sex discrimination, which are prohibited under Title IX and by City University of Seattle policy. City University of Seattle also prohibits retaliation against any person opposing discrimination or participating in any discrimination investigation or complaint process internal or external to the institution. Questions regarding Title IX, including its application and/or concerns about noncompliance, should be directed to the Title IX Coordinator. For a complete copy of the policy or for more information, visit <https://www.cityu.edu/about-cityu/student-right-to-know/> or contact the Title IX Coordinator.

In Canada, in compliance with the British Columbia Human Rights Code, the Alberta Human Rights Act, WorksafeBC, and the Workers' Compensation Board of Alberta, the University believes that its environment should always be supportive and respectful of the dignity and self-esteem of individuals. Discrimination, harassment and bullying conduct, whether through person to person behaviors or via electronic communications such as email or social media is not acceptable and will not be tolerated. As an educational institution, it is our responsibility to cultivate an environment of excellence, equity, mutual respect and to recognize the value and potential of every individual. The University will take all necessary steps to meet or exceed the requirements of the law to prevent discrimination, harassment and bullying. The Respectful Workplace Policy for the prevention of discrimination, harassment and bullying policy and procedure can be found

at <https://www.cityu.edu/discover-cityu/about-cityu/> under the Policies section or at <https://www.cityuniversity.ca/about/>.

Title IX Statement

City University of Seattle and its faculty are committed to supporting our students and seeking an environment that is free of bias, discrimination, and harassment. If students have encountered any form of sexual misconduct (e.g., sexual assault, sexual harassment, stalking, domestic or dating violence), we encourage them to report this to the University. If a student speaks with a faculty member about an incident of misconduct, that faculty member must notify CityU's Title IX coordinator and share the basic fact of the experience. The Title IX coordinator will then be available to assist students in understanding all the options and in connecting students with all possible resources on and off campus.

To view CityU's sexual misconduct policy and for resources, please visit the [Title IX](#) and [Campus Safety](#) pages in the my.cityu.edu portal.

Religious Accommodations

Washington state law requires that City University of Seattle develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The University's policy, including more information about how to request an accommodation, is available in the University Catalog. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request Form found on the student dashboard in the my.cityu.edu student portal.

Academic Integrity

Academic integrity in students requires the pursuit of scholarly activity that is free from fraud, deception and unauthorized collaboration with other individuals. Students are responsible for understanding CityU's policy on academic integrity and adhering to its standards in meeting all course requirements. A complete copy of this policy can be found in the [University Catalog](#) under *Student Rights and Responsibilities* on the page titled *Academic Integrity Policy*.

Attendance

Students taking courses in any format at the University are expected to be diligent in their studies and to attend class regularly.

Regular class attendance is important in achieving learning outcomes in the course and may be a valid consideration in determining the final grade. For classes where a physical presence is required, a student has attended if they are present at any time during the class session. For online classes, a student has attended if they have posted or submitted an assignment. A complete copy of this policy can be in the [University Catalog](#) under *Student Rights and Responsibilities* on the page titled *Attendance*.

Final Assignments Due Date

Final assignments for each class at CityU must be due on or before the final date of the course as indicated in the university's course information system. Due dates that extend beyond the final date of the course may negatively impact tuition funding for students.

SUPPORT SERVICES

Disability Services Accommodations Statement

Students with a documented disability who wish to request academic accommodations are encouraged to contact Disability Support Services to discuss accommodation requests and eligibility requirements. Please contact Disability Support Services at disability@cityu.edu or 206.239.4752 or visit the [Disability Support Services](#) page in the my.cityu.edu portal. Confidentiality will be observed in all inquiries. Once approved, information about academic accommodations will be shared with course instructors.

Library Services

CityU librarians are available to help students find the resources and information they need to succeed in this course. Contact a CityU librarian through the [Ask a Librarian service](#), or access [library resources and services online](#), 24 hours a day, seven days a week.

Online Tutoring

CityU students have access to free online tutoring offered through Brainfuse, including writing support, from certified tutors 24 hours a day, seven days a week. Visit the [Brainfuse](#) page on the my.cityu.edu portal for more information.