

STAT 841 / CM 763

Statistical Learning - Classification

Term: Fall 2026

Class meetings: 4:00-5:20 p.m. (meeting days to be confirmed)

Location: MC 4042

Instructor: Ali Ghodsi

Instructor email: ali.ghodsi@uwaterloo.ca

Instructor office: M3 4009

Instructor office hours: Wednesdays, 1:00-2:00 p.m.

Teaching assistant: Nafisat Ibrahim

TA email: n4ibrahi@uwaterloo.ca

TA office hours: *To be announced*

Course outline notice: *Course content, topic order, assessment details, dates, deadlines, and other arrangements are tentative and may change. Any changes will be announced through the official course platforms.*

Course description

This course provides an in-depth study of classification, a central form of supervised learning in which a discrete outcome variable is predicted from observed inputs. Inputs may include images, text corpora, gene-expression measurements, financial time series, and other structured or high-dimensional data. The course develops the statistical foundations, computational methods, and modern advances underlying classification and pattern recognition.

Prerequisites

Graduate students: No formal prerequisite for students in Statistics, Computer Science, Electrical and Computer Engineering, or Systems Design Engineering. Students from other programs require the instructor's permission.

Course format

This course is delivered in person.

Materials and resources

Textbooks and references

There is no mandatory textbook. The following references cover substantial portions of the course:

- Trevor Hastie, Robert Tibshirani, and Jerome Friedman, *The Elements of Statistical Learning*.
- Christopher M. Bishop, *Pattern Recognition and Machine Learning*.
- Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*.

Assigned readings may also include research papers and instructor-provided notes. Lectures and posted materials define the course curriculum.

Course platforms

Platform	Primary role
Course website	Course materials, readings, schedules, instructions, and resources.
Piazza	Course communication, questions, announcements, and private feedback.
Learn	Submission dropboxes and grades.

Course website: <https://aghodsib.github.io/courses/stat841/>

Piazza: Access Piazza through the widget on the main course webpage.

Students are responsible for checking all official course platforms regularly.

Communication policy

All course communication with the instructor and teaching assistant should use Piazza. Use public posts for class-wide questions and private posts for personal matters, private feedback, or questions that reveal details of an assignment or project solution. Search existing posts before creating a new one, use a descriptive subject line and relevant tags, and keep posts concise and course-related.

Assessment and evaluation

Component	Description	Weight
Assignments	Four individual assignments at 12.5% each	50%
Paper presentation	Small-group presentation of a selected research paper	10%
Group final project	Research or applied classification project	40%
Total		100%

Assignments - 50%

There will normally be four individual assignments, each worth 12.5%. Assignments may include mathematical derivations, proofs, programming, data analysis, and computational experiments. To confirm authorship and understanding, a student may be required to explain part of a submission orally or complete a short individual quiz based on it. Inadequate demonstrated understanding may result in reduced or no credit for the affected work.

Paper presentation - 10%

Students will present a selected research paper in a small group. The final group-size limit, eligible venues, paper-selection procedure, presentation duration, and evaluation rubric will be announced. Every group member must participate and be prepared to answer questions.

Group final project - 40%

Students will complete a group project involving a substantive classification problem, method, or research question and submit a final report. Detailed requirements, milestones, group-size limits, presentation requirements, and evaluation criteria will be provided. The project must be new work for this course and may not reuse work submitted for another course.

Tentative assessment dates

Assessment	Release	Due
Assignment 1	Monday, September 28	Monday, October 19, 11:59 p.m.
Assignment 2	Monday, October 19	Monday, November 9, 11:59 p.m.
Assignment 3	Monday, November 9	Monday, November 23, 11:59 p.m.
Assignment 4	Monday, November 23	Monday, December 7, 11:59 p.m.
Paper presentation	Paper-selection process to be announced	Scheduled presentation date
Group final project		Monday, December 21, 11:59 p.m.

All dates are tentative and may change. Changes will be announced.

Late and missed work

Written assignments and final project

Provisional policy: work submitted within 24 hours after the deadline receives a 10% penalty on the earned mark; after 24 hours, the grade is zero. Confirm the final late-work, extension, and accommodation rules before publication.

Generative artificial intelligence

Generative AI may support learning unless an assessment states otherwise, but submitted work must reflect the student's own authorship and understanding. Substantive use must be disclosed, and students must verify all work, citations, code, and results. Generative AI is prohibited during oral or quiz-based verification. Unauthorized or undisclosed use may constitute an offence under Policy 71.

Tentative course plan

The order and emphasis may change in response to the pace, needs, and interests of the class.

Tentative topic	Illustrative coverage
Foundations and the Bayes classifier	Supervised learning, loss, risk, decision rules, Bayes error, and error rates
Gaussian and linear classifiers	LDA, QDA, covariance modelling, and discriminant functions
Linear and logistic models	Regression views of classification, likelihood, and optimization
Feature selection and representation	Feature selection, dimensionality reduction, and feature extraction
Evaluation and model selection	Validation, performance measures, complexity, and generalization
Nearest neighbours and metric learning	k-NN, scaling, local decision rules, learned distances, and embeddings
Support vector machines and kernels	Margins, soft margins, duality, kernels, and nonlinear boundaries
Naive Bayes and decision trees	Conditional independence, splitting criteria, pruning, and interpretation
Bagging and boosting	Random forests, variance reduction, adaptive boosting, and additive models
Radial basis function networks	Localized basis functions and classification
Neural networks and deep learning	Feedforward networks, backpropagation, regularization, and deep classifiers
Semi-supervised and emerging methods	Learning with unlabelled data, presentations, and selected research topics

Assignment screening and Turnitin

Turnitin or other plagiarism-detection software may be used to check the originality and source documentation of submitted work. Submissions to Turnitin are stored on a U.S. server. Students will receive notice of its use and available alternatives; requests for an alternative must be made in the first week or when the relevant assessment details are provided.

Waterloo Turnitin information: <https://uwaterloo.ca/academic-integrity/integrity-students/turnitin-and-ithenticate>

Academic integrity and University policies

Academic integrity

Waterloo community members are expected to promote honesty, trust, fairness, respect, and responsibility.

Office of Academic Integrity: <https://uwaterloo.ca/academic-integrity/>

Ideas, text, code, data, figures, and other intellectual property must be properly attributed. Plagiarism and other misconduct will be addressed under University policy.

Grievance

Students who believe a University decision was unfair or unreasonable should consult Policy 70 or the department's administrative assistant.

Policy 70: <https://uwaterloo.ca/secretariat/policy-70-student-petitions-grievances-and-requests>

Discipline

Students are responsible for understanding academic-integrity requirements. Questions about plagiarism, cheating, collaboration, or group work should be directed to the instructor, academic advisor, or appropriate associate dean.

Policy 71, Student Discipline: <https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71>

Appeals

Appeals of eligible decisions or penalties under Policies 70 and 71 are governed by Policy 72.

Policy 72, Student Appeals: <https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72>

Accessibility Services

Waterloo provides academic accommodations consistent with the Ontario Human Rights Code. Students who may require accommodation should register with AccessAbility Services promptly; registered students must activate accommodations for this course.

AccessAbility Services: <https://uwaterloo.ca/accessability-services/>

Contact: 519-888-4567, ext. 35082; access@uwaterloo.ca; Needles Hall North, first floor, Room 1401.

Mental health supports

Confidential counselling, workshops, and crisis support are available through Counselling Services.

Counselling Services: <https://uwaterloo.ca/campus-wellness/counselling-services/>

Phone: 519-888-4096.

Technical support

For Learn problems, contact learnhelp@uwaterloo.ca with your name, WatIAM ID, student number, and course. Support hours are Monday-Friday, 8:30 a.m.-4:30 p.m. Eastern Time.