

The Hong Kong University of Science and Technology (Guangzhou)

UG Course Syllabus Template

[Course Title] Mathematics for Data Science

[Course Code] DSAA 2088

[No. of Credits] 3

[Any pre-/co-requisites] Linear Algebra, Applied Statistics, Machine Learning or Deep Learning or Data Mining

[Exclusions] AIAA2711 Mathematics for AI

Name: Ningning Ding

Email: ningningding@hkust-gz.edu.cn

Office Hours: Wed. 4:30-5:00 PM, W2-508 (Please make an appointment by sending email)

Course Description

Topics include: advanced linear algebra, advanced geometry (e.g., manifold), vector calculus, advanced mathematics models (regression, latent-variable model) etc. Also includes topics related to discrete mathematics (e.g., enumeration techniques, basic number theory, logic and proofs, recursion and recurrences, probability theory and graph theory. The approach of this course is specifically computer science application oriented.)

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Have a fundamental understanding of advanced mathematics knowledge, such as advanced linear algebra and advanced geometry.
2. Understand and evaluate advanced mathematical models for Data Science problems.
3. Analyze and critique the Data Science applications of the mathematics knowledge.
4. Design and select different mathematical tools to model data problems in application areas.
5. Communicate effectively to convey scientific knowledge.
6. Develop a broad interest in both mathematics and data science.

Weekly Schedule and Weekly ILOs

Week	Topics	Content
------	--------	---------

1	Analytic Geometry	Apply geometric concepts and representations to formulate and analyze data-related problems.
2	Matrix Decompositions	Understand common matrix decomposition methods and their mathematical properties.
3	Matrix Decompositions	Apply matrix decompositions to solve and analyze Data Science problems.
4	Vector Calculus	Apply matrix decompositions to solve and analyze Data Science problems.
5	Probability and Distributions	Understand fundamental probability concepts and commonly used probability distributions.
6	Probability and Distributions	Apply probability distributions to model and analyze uncertainty in Data Science problems.
7	Midterm	Demonstrate understanding and application of mathematical concepts covered in Weeks 1–6.
8	Propositional Logic: The Logic of Compound Statements	Construct and analyze logical statements using propositional logic.
9	The Logic of Quantified Statements	Interpret and formulate mathematical statements using predicates and quantifiers.
10	Properties of Functions	Analyze functions and their key properties relevant to mathematical modeling.
11	Properties of Relations	Analyze relations and identify their fundamental mathematical properties.
12	Analysis of Algorithm Efficiency	Analyze and compare algorithm efficiency using asymptotic notation.
13	Regular Expressions and Finite-state Automata	Construct and analyze regular expressions and finite-state automata for pattern representation.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date (the date has not been determined)
Homework	20%	TBD
Mid-Term test	40%	TBD
Final examination	40%	TBD

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework	ILO-1, ILO-2, ILO-3, ILO-4, ILO-5, ILO-6	These tasks are intended to evaluate students' abilities, comprehension, and commitment to learning (ILO 6), as well as their understanding and application of mathematical tools to model data-related problems (ILO-1, ILO-2, ILO-3, ILO-4, ILO5).

Mid-Term test	ILO-1, ILO-2, ILO-3, ILO-4, ILO-5	The mid-term exam will be utilized to evaluate students' understanding of advanced mathematical concepts and their ability to apply these concepts to model data-related problems (ILO-1, ILO-2, ILO-3, ILO-4, ILO5).
Final exam	ILO-1, ILO-2, ILO-3, ILO-4, ILO-5	The final exam will also be utilized to evaluate students' understanding of advanced mathematical concepts and their ability to apply these concepts to model data-related problems (ILO-1, ILO-2, ILO-3, ILO-4, ILO5).

Grading Rubrics

Each assignment is graded out of a total of 100 points. For delayed homework submission, a deduction will be applied, unless strong justifications are provided. 1-3 Days Late: 10% of the total possible points will be deducted from the score. 4-7 Days Late: 20% of the total possible points will be deducted. More than 7 Days Late: The assignment will not be accepted and will receive a score of zero.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Exhibits a thorough understanding of the subject matter, showcasing expertise in problem-solving and a high degree of creativity in thinking. Demonstrates excellent performance in both conceptual understanding and computational tasks, with approaches and solutions to advanced mathematics knowledge that are completely, almost completely, or roughly completely correct.
B	Good Performance	Demonstrates a good knowledge and understanding of the main subject matter, along with competence in problem-solving and the ability to analyze and evaluate issues. Shows good performance in conceptual understanding of advanced mathematics knowledge, with good, satisfactory, or inadequate computational skills.
C	Satisfactory Performance	Exhibits adequate knowledge of core subject matter, demonstrates competence in addressing familiar problems, and shows some ability for analysis and critical thinking. Achieves satisfactory performance in conceptual understanding of advanced mathematics knowledge, with an adequate, weak, or inadequate level of computational skills.
D	Marginal Pass	Demonstrates threshold knowledge of core subject matter and basic problem-solving skills. Exhibits potential for further development in the discipline. Performance is marginal, indicating a lack of understanding and a low level of computational skills.

F	Fail	Exhibits insufficient understanding of the subject matter and lacks the necessary problem-solving skills. Shows limited capacity for critical or analytical thinking and demonstrates minimal effort in pursuing learning goals. Overall performance is unsatisfactory, with no evidence of understanding.
---	------	--

Course AI Policy

A. In exams, calculators will possibly be allowed. On the other hand, use of any other tool (including, but not limited to, AI tools, internet, mathematical software, etc.) is **strictly prohibited**.

B. In all the other parts of the course, use of tools is **not prohibited**.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include, for instance, strength and weakness, suggestion for further thoughts, and areas for improvement. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy

If a student has an unforeseen, uncontrollable, and unavoidable reason, resubmitting work or reassessment opportunity will be considered. In such a case, the student is expected to contact the instructor immediately, but no later than within five working days, for further details.

Required Texts and Materials

Mathematics for Machine Learning (<https://mml-book.github.io/>)

Mathematics for Computer Science (<https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/pages/readings/>)

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST(GZ)'s Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Regulations for Academic Integrity and Student Conduct for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

[Optional] Additional Resources

[List any additional resources, such as online platforms, library resources, etc.]