DSAA4086 Course Syllabus

Course Title: Introduction to Optimization

Course Code: DSAA 4086

No. of Credits: 3

Prerequisites: DSAA 2011 OR DSAA 2012 OR AIAA 3111

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Course Description

This course introduces fundamental theory and techniques of optimization. Topics include linear programming, unconstrained optimization, and constrained optimization. Numerical implementations of optimization methods are also discussed.

Intended Learning Outcomes (ILOs)

1. Be equipped with fundamental knowledge of optimization.
2. Develop an understanding of basic optimization algorithms and their implementations.
3. Set up optimization models for application problems.
4. Solve optimization problems independently.
5. Implement some algorithms using software such as MATLAB or Python.
6. Communicate using correct mathematical terminology.

Weekly Schedule and Weekly ILOs

Week	Topics	Weekly ILOs
1	Introduction	ILO1
2	Convex sets and convex functions	ILO1
3	Optimization problems, convex problems, and linear programming	ILO1, ILO3, ILO6
4	Optimality conditions	ILO1, ILO4, ILO6
5	Duality	ILO1, ILO4, ILO6
6	Approximation and classification	ILO3, ILO6
7	Neural networks and other applications	ILO3, ILO6
8	Overview of algorithms and implementation	ILO2, ILO5
9	Gradient method	ILO2, ILO4
10	Newton's method	ILO2, ILO4
11	Quasi-Newton methods	ILO2, ILO4
12	Newton's methods with equality constraints	ILO2, ILO4
13	Interior-point methods	ILO2, ILO4

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
Homework	15%	week3 – week13
Mid-Term examination	25%	week 6
Final examination	40%	TBA
Project	20%	week 15

* 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	ILO1,ILO2,ILO3,ILO4, ILO5, ILO6	This task assesses students' ability to understand and apply optimization concepts (ILO1), implement and use core algorithms (ILO2, ILO5), formulate optimization models for applications (ILO3), solve problems independently (ILO4), and present solutions clearly with correct mathematical terminology (ILO6).
Mid-Term	ILO1, ILO4, ILO6	This task assesses students' understanding of key concepts covered in the first half of the course (ILO1), their ability to solve optimization problems independently under time constraints (ILO4), and their clarity in mathematical reasoning and communication (ILO6).
Final examination	ILO1, ILO2, ILO3, ILO4, ILO6	The task assesses students' overall mastery of optimization theory and algorithms (ILO1, ILO2), ability to formulate models and analyze application problems (ILO3), solve both standard and unfamiliar problems independently (ILO4), and communicate solutions clearly using correct notation (ILO6).
Project	ILO1,ILO2,ILO3,ILO4, ILO5, ILO6	The project assesses students' ability to model and solve a practical optimization problem (ILO1, ILO3, ILO4), apply appropriate algorithms with numerical implementation (ILO2, ILO5), and communicate methods and results effectively in a report (ILO6).

Grading Rubrics

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of optimization taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of optimization and their applications.
B	Good Performance	The student has mastered most concepts and computational techniques of optimization taught in the course, yet the understanding of some challenging concepts may not be deep enough for further studies on related advanced subjects.
C	Satisfactory Performance	The student meets the minimum expectation of the instructor, has acquired some basic computational techniques of the subject, yet some concepts were not clearly understood.
D	Marginal Pass	The student is only able to recall some fragments of topics and is able to complete some of the easiest computations.
F	Fail	The student does not have sufficient understanding of even some fragments of topics, and is not even able to complete some of the easiest computations.

Course AI Policy

Students may consult any person (including the instructor, TA, classmates, or friends) for ideas and hints on homework, but they must write up the solutions themselves. Students must list the persons and references they have consulted for their homework.

The use of generative AI tools is allowed. They are considered “persons” and must therefore be listed. However, please note that, at the current stage of AI development, responses to problems in advanced courses are not particularly reliable. Students should be critical of AI-generated responses and should not blindly copy them for their homework.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include brief comments on overall performance and constructive suggestions for improvement. Students who have further questions about the feedback, including marks, should consult the instructor or TA within five working days of receiving it.

Resubmission Policy

Resubmission opportunities, if applicable, will follow principles of fairness and academic integrity. All conditions and deadlines will be communicated via Canvas.

Reference Books

(1) An introduction to optimization, Edwin K. P. Chong, Stanislaw H. Zak, 4th edition, Wiley, 2013

(2) Convex optimization, Stephen Boyd, Lieven Vandenberghe, Cambridge University Press, 2004

(3) Numerical Optimization, Jorge Nocedal, Stephen J. Wright, 2nd edition, Springer, 2006

(4) Nonlinear Programming, Dimitri P. Bertsekas, 3rd edition, Athena Scientific, 2016

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.