THE CHINESE UNIVERSITY OF HONG KONG
Print Course Catalog Details

Academic Org: Dept of Computer Sci & Engg – Subject: AI: Systems & Tech

Course: AIST3030 **Course ID:** 014169 **Eff Date:** 2022-07-01 **Crse Status: Active** **Apprv. Status:** Approved **[**New Course**]**

Numerical Optimization **數值優化**

This course provides students with the analytical and programming skills required for applying standard optimization algorithms to engineering and AI problems. The syllabus covers basic topics on optimization including the theory of unconstrained and constrained optimization, dual optimization tasks, linear programming, convex optimization, line search methods, trust-region methods, gradient descent, and Newton's method.

本科爲學生提供將標準優化算法應用於工程和人工智能問題所需的分析和編程技能。 課程大綱涵蓋優化的基本主題，包括無約束和約束優化理論、對偶優化任務、線性規劃、凸優化、線搜索方法、信任域方法、梯度下降和牛頓法。

Grade Descriptor:

A

EXCELLENT – exceptionally good performance and far exceeding expectation in all or most of the course learning outcomes; demonstration of superior understanding of the subject matter, the ability to analyze problems and apply extensive knowledge, and skillful use of concepts and materials to derive proper solutions.

有關等級說明的資料，請參閱英文版本。

B

GOOD – good performance in all course learning outcomes and exceeding expectation in some of them; demonstration of good understanding of the subject matter and the ability to use proper concepts and materials to solve most of the problems encountered.

有關等級說明的資料，請參閱英文版本。

C

FAIR – adequate performance and meeting expectation in all course learning outcomes; demonstration of adequate understanding of the subject matter and the ability to solve simple problems.

有關等級說明的資料，請參閱英文版本。

D

MARGINAL – performance barely meets the expectation in the essential course learning outcomes; demonstration of partial understanding of the subject matter and the ability to solve simple problems.

有關等級說明的資料，請參閱英文版本。

F

FAILURE – performance does not meet the expectation in the essential course learning outcomes; demonstration of serious deficiencies and the need to retake the course.

有關等級說明的資料，請參閱英文版本。

Equivalent Offering:
Units: 3 (Min) / 3 (Max) / 3 (Acad Progress)
Grading Basis: Graded
Repeat for Credit: N
Multiple Enroll: N
Course Attributes:

Topics:

COURSE OUTCOMES

Learning Outcomes:

At the end of the course of studies, students will be able to:
1. Formulate optimization problems belonging to certain optimization categories for engineering and AI tasks
2. Apply and analyze optimization algorithms for linear programming, convex optimization, and nonlinear programming tasks
3. Implement the instructed optimization algorithms in Python

Course Syllabus:

Weeks 1-2: Introduction to optimization, Review of basic calculus and linear algebra
Week 3: Types of optimization problems: constrained/unconstrained optimization, linear/nonlinear programming
Week 4: Convex functions and convex/non-convex optimziation tasks
Week 5: Theory of unconstrained optimization and optimality conditions
Week 6: Dual optimization and KKT conditions
Weeks 7-8: Line search methods and gradient descent algorithm, convergence of gradient methods

Weeks 9-10: Trust-region methods and Newton's method, convergence of Newton's method
Weeks 11-12: Algorithms for constrained optimization problems, projected gradient methods, interior point methods
Week 13: Optimization in machine learning: linear/logistic regression and deep learning problems

Assessment Type:

Examination	: 65%
Homework or assignment	: 30%
Participation	: 5%

Feedback for Evaluation:

1. Quiz and examinations
2. Course evaluation and questionnaire
3. Question-and-answer sessions during class
4. Student consultation during office hours or online

Required Readings:

nil

Recommended Readings:

1- J. Nocedal, and S. Wright, "Numerical Optimization", Springer Science & Business Media, 2006
2- G. Calafiore and L. El Ghaoui, "Optimization Models", Cambridge university press, 2014.
3- S. Boyd and L. Vandenberghe, "Convex Optimization" Cambridge university press, 2004
4- S. Boyd and L. Vandenberghe, "Introduction to applied linear algebra: vectors, matrices, and least squares", Cambridge university press, 2018.
5- D. Bertsekas, "Nonlinear Programming", Athena Scientific, 2016

OFFERINGS

1. AIST3030 — Acad Organization=CSD; Acad Career=UG

COMPONENTS

LEC : Size=30; Final Exam=Y; Contact=3
TUT : Size=30; Final Exam=N; Contact=1

ENROLMENT REQUIREMENTS

1. AIST3030

Enrollment Requirement Group:
Pre-requisite: ENGG1120 or ENGG1130 or ESTR1005 or ESTR1006 or MATH1510
Not for students who have taken AIST3010 or ESTR3112 or ESTR3114

New Enrollment Requirement(s):
Pre-requisite = ENGG1120 or ENGG1130 or ESTR1005 or ESTR1006 or MATH1510

Exclusion = AIST3010 or ESTR3112 or ESTR3114

CAF

eLearning hrs for blended cls	0
No. of micro-modules	0
Research components (UG)	0%

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