南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	凸优化算法 Algorithms for convex optimization
2.	**授课院系 Originating Department**	数学系　　Department of Mathematics
3.	**课程编号 Course Code**	MAT7028
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业选修课 Major Elective Courses
6.	**授课学期 Semester**	
7.	**授课语言 Teaching Language**	中文 Chinese
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation& Contact （For team teaching, please list all instructors）**	何炳生教授；张振助理教授 Bingsheng He, Professor; Zhen Zhang, Assistant Professor
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	

11.	**授课方式 Delivery Method**	**讲授 Lectures**	**习题/辅导/讨论 Tutorials**	**实验/实习 Lab/Practical**	**其它(请具体注明) Other（Please specify）**	**总学时 Total**
	学时数 Credit Hours					

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA103b 线性代数 I MA103b Linear algebra I.
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	
14.	其它要求修读本课程的学系 Cross-listing Dept.	

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

Optimization problems arising from big data problem, dimension reduction, machine learning, image processing and etc, can be translated and/or relaxed to a large scale structured convex optimization. This course is devoted for the students interested in solving practical large optimization problems in the different areas of science and technology.

For solving the large scale problems, it is recognized that the first order algorithms is practical and relative effective. The alternating direction method of multipliers (ADMM) is a benchmark for solving a linearly constrained convex minimization model with a two-block separable objective function. In this course, we will introduce the new development of the ADMM-like methods, both in theoretical convergence, and the practical implementations and applications.

最优化理论与方法是运筹学与计算数学的交叉学科。近 20 年来, 信号处理, 图像恢复, 机器学习等信息技术领域以及统计学、数据科学中涌现了大量的优化问题. 有效地求解这些问题, 是当今一些世界一流应用数学家关切的课题, 也是应用数学的一个新的研究热点。

数据科学中大规模计算问题的很大一部分可以归结为（或松弛成）一个可分离算子的凸优化问题. 由于问题规模大, 传统的优化求解方法往往难以凑效. 根据问题的结构特点, 设计简单易行的一阶分裂算法已渐成学界共识。

变分不等式是运筹学中许多问题的一种统一表述模式. 经济活动中的最优平衡问题、政策性调控问题, 都可以用变分不等式来描述. 最优化和变分不等式有着紧密的联系. 凸优化的一阶最优性条件就是一个单调变分不等式. 在变分不等式的框架下考虑凸优化的求解方法, 就像微积分中用导数求一元二次函数的极值, 常常会带来很大的方便。

本课程中介绍凸规划的分裂收缩算法, 始终追求简单统一的原则， 都纳入统一的框架. 统一框架揭示方法之间的内在联系, 简化算法的收敛性证明, 又能对设计新的算法, 提高算法效率提供指导性帮助.

16. **预达学习成果 Learning Outcomes**

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

Section 1	Introduction for convex optimization and monotone variational inequality	6 Hours
Section 2	Projection and contraction methods for monotone variational inequalities	6 Hours
Section 3	Customized Proximal Point Algorithms and Relaxed PPA for linearly constrained optimization.	6Hours
Section 4	Alternating direction methods of multiplies for structured convex optimization	6 Hours
Section 5	New developments of ADMM	6 Hours
Section 6	Study of the Convergence rate of the splitting methods	6 Hours
Section 7	ADMM-like methods for multi-blocks linearly constrained convex optimization	6 Hours
Section 8	Splitting contraction in a unified framework.	6 Hours

18. 教材及其它参考资料 **Textbook and Supplementary Readings**

自编教材， 主要内容取自 (http://math.nnju.edu.cn/~hebma)上《凸优化和单调变分不等式的收缩算法》

EnglishVersion: (http://maths.nnju.edu.cn/~hebma) Lectures of 'Contraction Methods for Convex Optimization and Monotone Variational Inequalities'

参考书籍： Stephen Boyd and Lieven Vandenberghe， Convex Optimization

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance				
课堂表现 Class Performance				
小测验 Quiz				

课程项目 **Projects**				
平时作业 **Assignments**				
期中考试 **Mid-Term Test**				
期末考试 **Final Exam**		60%		
期末报告 **Final Presentation**				
其它（可根据需要改写以上评估方式） **Others (The above may be modified as necessary)**		Programming (40%)		

20. 记分方式 **GRADING SYSTEM**

课程审批 REVIEW AND APPROVAL

21. **本课程设置已经过以下责任人/委员会审议通过**
This Course has been approved by the following person or committee of authority
