

10. 教学内容 Course Contents (如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.)	
Section 1 导论 Introduction	非光滑函数的极小化、图像处理和数据科学中的应用、鞍点公式 Minima of non-smooth functions, Applications in image processing, Applications in the data sciences, Saddle-point formulations
Section 2 凸分析-次微分 Convex analysis -subdifferentials	凸性和(凸)函数的性质、次微分的定义以及简单例子、次微分集的性质、方向导数、次微分计算、最优性条件 Convexity and properties of (convex) functions, Subdifferentials and examples, Properties of the subdifferential set, Directional derivatives, Computing Subgradients, Optimality conditions
Section 3 共轭函数 Conjugate functions	共轭函数与双共轭函数、共轭算子的运算法则和例子、卷积下确界、共轭函数的次微分 Conjugate functions and the biconjugate, Conjugate calculus rules and examples, Infimal convolution and subdifferentials of conjugate functions
Section 4 光滑性与强凸性 Smoothness and strong convexity	Lipschitz 光滑性、强凸性、光滑性与强凸性的联系 smooth functions, Strongly convexity, Smoothness and strong convexity correspondence
Section 5 近端算子 The proximal operator	近端算子的存在性与唯一性、近端算子的例子、近端算子的运算法则、指示函数的近端算子、投影、Prox 第二定理、Moreau 包络 Existence, uniqueness and examples of the proximal operator, Prox calculus rules, Prox of indicators—orthogonal projections, The second prox theorem, The Moreau envelope, Prox of indicators—orthogonal projections, The second prox theorem, the Moreau envelope
Section 6 近端梯度算法和块近端梯度算法 The proximal gradient method and the block proximal gradient method	近端梯度算法简介、不同设定下的近端梯度算法的收敛性分析、循环块近端梯度算法、随机块近端梯度算法 The proximal gradient method, Convergence analysis of the proximal gradient method, The cyclic block proximal gradient method, The randomized block proximal gradient method
Section 7 交替方向乘子算法 ADMM	交替方向乘子算法 ADMM
11. 课程考核 Course Assessment	

(①考核形式 Form of examination; ②. 分数构成 grading policy; ③ 如面向本科生开放, 请注明区分内容。
If the course is open to undergraduates, please indicate the difference.)
小测验、平时作业 (30%), 期中考试 (20%), 期末考试 (50%)
Quiz, Assignments (30%), Mid-Term Test (20%), Final Exam (50%)

12. 教材及其它参考资料

Textbook and Supplementary Readings

Textbooks

1、 A Beck, First-Order Methods in Optimization, SIAM, 2017

Supplementary Readings:

1、 J. Nocedal and Stephen J. Wright, Numerical Optimization, Springer, 1999

2、 B Mordukhovich and Nam, An easy path to convex analysis and applications 2015