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Special Topics on Management Science---Fundamentals of Optimization

Fall 2017; Wednesday 6~9pm, 1WP-204

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Office Hours: Tuesday and Friday 11~12pm

COURSE DESCRIPTION

We introduce basic concepts and tools in nonlinear optimization such as convexity, the Karush-Kuhn-Tucker optimality conditions, and duality. We then discuss various algorithms in the context of machine learning. These include gradient- and descent-based methods. Also, we touch on topics such as online and stochastic gradient methods.

COURSE MATERIALS (texts to be referenced)

Nonlinear Programming 2nd Edition by Dimitri P. Bertsekas, Athena Scientific, 2003

Optimization for Machine Learning edited by Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright, MIT Press, 2012

Convex Analysis by R. Tyrrell Rockafellar, Princeton University Press, 1970

Check Blackboard (blackboard.rutgers.edu) and your official Rutgers email account regularly.

LEARNING GOALS AND OBJECTIVES

This course is designed to help students develop skills and knowledge in the areas of mathematical programming and nonlinear optimization. These are acquired through in-class learning, homework exercises, and projects. Students who complete this course will demonstrate abilities to formulate real-life problems into optimization problems and apply optimization techniques to solve the problems.

PREQUISITES

Students need to have basic knowledge about calculus and linear algebra.

ACADEMIC INTEGRITY

I do NOT tolerate cheating. Students are responsible for understanding the RU Academic Integrity Policy (https://slwordpress.rutgers.edu/academicintegrity/wp-content/uploads/sites/41/2014/11/AI_Policy_2013.pdf)

I will strongly enforce this Policy and pursue *all* violations. On all examinations and assignments, students must sign the RU Honor Pledge, which states, "On my honor, I have neither received nor given

any unauthorized assistance on this examination or assignment.” Don’t let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

ATTENDANCE AND PREPARATION POLICY

Expect me to attend all class sessions. I expect the same of you. If I am to be absent, my department chair or I will send you notice via email and Blackboard as far in advance as possible. If you are to be absent, report your absence in advance at <https://sims.rutgers.edu/ssra/>. If your absence is due to religious observance, a Rutgers-approved activity, illness, or family emergency/death and you seek makeup work, also send me an email with full details and supporting documentation one week ahead of the occurrence.

For weather emergencies, consult the campus home page. If the campus is open, class will be held. Expect me to arrive on time for each class session. I expect the same of you. Expect me to remain for the entirety of each class session. I expect the same of you. Expect me to prepare properly for each class session. I expect the same of you. Complete all background reading and assignments. You cannot learn if you are not prepared. Expect me to participate fully in each class session. I expect the same of you. Stay focused and involved. You cannot learn if you are not paying attention.

CLASSROOM CONDUCT

Cell phones or any other course-unrelated electronic devices are banned from class.

EXAM DATES AND POLICIES

There are two exams in this course:

- Midterm Exam: October 25, closed book.
- Final Exam: December 13, closed book.

During exams, the following rules apply:

- You are allowed a one-page cram sheet (letter size, front and back) of your own handwriting.
 - If you have a disability that influences testing procedures, provide me an official letter from the Office of Disability Services at the start of the semester.
 - No cell phones or other electronics are allowed in the testing room.
 - Alternate seating; do not sit next to another student or in your usual seat.
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GRADING POLICY

Two homework assignments at 20 points each (40 points in total)

- One mid-term exam at 30 points
- One final exam at 30 points

The proposed letter grade assignment is as follows:

F	0—29.999
D	30—49.999
C	50—64.999
C+	65—69.999

B	70—84.999
B⁺	85—89.999
A	90—100

Please submit a pdf file of your HW answers to the Blackboard System. Late assignments will be penalized 20 points (on the 100 point scale) if turned in up to ONE week late. Assignments in excess of ONE week late will not be accepted. There will be no makeup exam, nor extra credit. Your final grade is not subject to negotiation.

If you feel I have made an error, submit your written argument to me within one week of receiving your final grade. Clarify the precise error I made and provide all due supporting documentation. If I have made an error, I will gladly correct it. But I will adjust grades only if I have made an error. I cannot and will not adjust grades based on consequences, such as hurt pride, lost scholarships, lost tuition reimbursement, lost job opportunities, or dismissals. Do not ask me to do so. It is dishonest to attempt to influence faculty in an effort to obtain a grade that you did not earn, and it will not work.

COURSE SCHEDULE (Tentative Course Progress)

Date	Coverage
September 6	1: Linear Algebra and Unconstrained Optimization
September 13	2: Optimality Conditions for Linear Constraints
September 20	3: General KKT Optimality Conditions
September 27	4: Zero-sum Game, Geometry, and Duality
October 4	5: Various Nonlinear Programming Methods
October 11	Problems and Review; HW1 due
October 18	6: Support Vector Machine
October 25	MID-TERM EXAM
November 1	7: Convexity and Related Properties
November 8	8: Conjugate and Convex Duality
November 15	9: Machine Learning and Convex Optimization
November 22	<i>No Class; Friday schedule due to Thanksgiving</i>
November 29	10: Online and Stochastic Gradient Methods
December 6	Problems and Review; HW2 due
December 13	FINAL EXAM

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law against Discrimination. <https://ods.rutgers.edu>

If you are a military *veteran* or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. <http://veterans.rutgers.edu/>

If you are in need of *mental health* services, please use our readily available services.
Rutgers University-Newark Counseling Center: <http://counseling.newark.rutgers.edu/>
[Rutgers Counseling and Psychological Services – New Brunswick: <http://rhscaps.rutgers.edu/>]

If you are in need of *physical health* services, please use our readily available services.
Rutgers Health Services – Newark: <http://health.newark.rutgers.edu/>
[Rutgers Health Services – New Brunswick: <http://health.rutgers.edu/>]

If you are in need of *legal* services, please use our readily available services: <http://rusls.rutgers.edu/>

If you are in need of additional *academic assistance*, please use our readily available services.
Rutgers University-Newark Learning Center: <http://www.ncas.rutgers.edu/rlc>
Rutgers University-Newark Writing Center: <http://www.ncas.rutgers.edu/writingcenter>
[Rutgers University-New Brunswick Learning Center: <https://rlc.rutgers.edu/>]