CS 791: Special Topics in Convex Optimization

3 credits (Lecture 3 + Lab 0)

Course Information

- MoWe 2:30PM - 3:45PM
- Place: PE 102
- Office hours: MoWe 10:00am – 11:30am, please make an appointment before you come
- Instructor: Dr. Lei Yang
- Email: leiy@unr.edu
- Phone: 775-682-6872
- Office: SEM 212
- Course homepage: WebCampus

Required Textbook:

S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004.

Supplemental References:

- *Ben-Tal and A. Nemirovski, Lectures on Modern Convex Optimization: Analysis, Algorithms, and Engineering, SIAM, 2001*
- *D. Bertsekas and J. N. Tsitsiklis, Parallel and Distributed Computation: Numerical Methods. 1st Edition, Prentice Hall, 1989*
- *Matlab and the CVX optimization environment will be used for analysis and programming synthesis. CVX can be downloaded from Stanford University*

Catalog Course Description:

Linear algebra and convex optimization. Vector spaces, matrix algebra, linear programming, Lagrange multipliers, Karush-Kuhn-Tucker (KKT) conditions, and duality theory, and algorithms for convex optimization. Newton's method, gradient and steepest descent methods. Algorithms for unconstrained, equality constrained, and inequality constrained problems, which include interior point methods. Applications to approximation and data fitting and some geometric problems. Applications to signal processing, communications, and control systems. Background in linear algebra necessary to be successful in this course.

Prerequisites:

Students are expected to know linear algebra, advanced calculus and basic knowledge of Matlab. However, previous exposure to optimization is NOT required.

Graduate Student Outcomes and Course Outcomes:

The course outcomes are skills and abilities students should have acquired by the end of the course. These outcomes determine how the general CSE Graduate Student Outcomes apply specifically to this course. All CSE Graduate Student Outcomes are listed in the next subsection and those relevant to this course are identified in the following Table.

CSE Graduate Student Outcomes	Course Outcomes	Assessment Methods/Metrics
a	Students are capable to understand and apply state of the art methods in convex optimization.	Project.
b	Students are better prepared to analyze a problem and use appropriate optimization methods to solve it.	Project, paper reviews.
c	Students must be able to design and conduct experimental validation for a computational approach to an optimization problem, and interpret the results to assess the performance of the method.	Project, paper reviews, paper presentations.

CSE Graduate Student Outcomes:

a. An ability to apply engineering research and theory to advance the art, science, and practice of the discipline
b. An ability to analyze a problem, and identify, formulate and use the appropriate computing and engineering requirements for obtaining its solution.
c. An ability to design and conduct experiments, as well as to analyze and interpret data

Course Topics:

1. History, context, and applications
2. Vector spaces, matrix algebra and decompositions
3. Least squares
4. Linear programming
5. Convex sets, functions and optimization
6. Duality, Lagrange multipliers, KKT conditions
7. Approximation and fitting problems
8. Newton's method
9. Interior point methods
10. Subgradient methods
11. Applications to signal processing, communications, and control problems.

Assignments, Examinations and Grading:

Grading will be based on two exams, quizzes, individual programming projects, and homework assignments. There will be several quizzes in class. Homework assignments will be collected for grading. There will be one midterm and one comprehensive final. The questions asked in the quizzes and exams will be based on the lectures, quizzes, and homework assignments.

Late Submission and Make-up Exams Policy:

- Late assignments will incur strict penalties. Assignments turned in after the due date and time will be graded as late. The penalty for late assignments will be 20%. No assignments will be accepted 24 hours after the assigned deadline.
- Discussion of assigned problems is not only allowed but also encouraged. However, each student is expected to turn in his/her own write-up.
- All exams (quizzes, midterm and the final exam) are to be treated as individual and not collective efforts, unless explicitly indicated otherwise.
- There will be no make-up exams. There will be NO exceptions, unless there is a real emergency (e.g., car accident), an excused (e.g., medical) absence, or an exemption has been granted by the instructor in advance. For more details, see the Class Absence Policy (UAM 3,020).

Grading Structure

Component	Percentage
Attendance + Participation	5%
Quizzes	10%
Homework	10%
Project	35%
Midterm Exams	40%

- Grade Scale
- 93 - 100 A
- 90 - 92.99 A-
- 86 - 89.99 B+
- 83 - 85.99 B
- 80 - 82.99 B-
- 76 - 79.99 C+
- 73 - 75.99 C
- 70 - 72.99 C-
- 66 - 69.99 D+
- 63 - 65.99 D
- 60 - 62.99 D-
- < 60 F

Course Policies:

- Students are expected to attend, and be on time, for every class. This demonstrates professionalism and consideration for your fellow students and your Instructor. Students who miss class and/or are late for class may experience an impact on their grade by missing classroom activities and/or quizzes
- Students are expected to turn in all assigned materials in a timely manner.
- Students are expected to demonstrate professionalism and courtesy by either silencing or turning off all cell phones and/or other alarm or audible indicator devices
- The Instructors reserve the right to add to, and/or modify any of the above policies as needed to maintain an appropriate and effective educational atmosphere in the classroom

and the laboratory. In the case that this occurs, all students will be notified in advance of implementation of the new and/or modified policy.

Statement on Academic Dishonesty: "Cheating, plagiarism or otherwise obtaining grades under false pretenses constitute academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include filing a final grade of "F"; reducing the student's final course grade one or two full grade points; awarding a failing mark on the coursework in question; or requiring the student to retake or resubmit the coursework. For more details, see the University of Nevada, Reno General Catalog."

Statement of Disability Services: "Any student with a disability needing academic adjustments or accommodations is requested to speak with the Disability Resource Center (Pennington Student Achievement Center, Suite 230) as soon as possible to arrange for appropriate accommodations."

Statement on Audio and Video Recording: "Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may be given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded."

Statement for Academic Success Services: "Your student fees cover usage of the Math Center (784-4433 or www.unr.edu/mathcenter/), Tutoring Center (784-6801 or www.unr.edu/tutoring-center), and University Writing Center (784-6030 or http://www.unr.edu/writing-center). These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign of a responsible and successful student."

Safe Learning Environment: The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX Office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit: http://www.unr.edu/equal-opportunity-title-ix.