Optimization – MATH 5348.001
Department of Mathematics and Statistics
Fall 2020

A. COURSE INFORMATION
   Course number/section: MATH 5348.001
   Class meeting time: MWF 11:00 AM – 11:50 AM
   Class location: CI-102
   Course Website: https://bb9.tamu.edu

B. INSTRUCTOR INFORMATION
   Instructor: Dr. Kelum Gajamannage
   Office location: CI-352
   Office hours: TR 10:00 AM – 12:30 PM. All the office hours are conducted online
                through WebEx. The WebEx access information will be delivered later.
   Telephone: (361) 825-2479. Leave a voice mail if not answered.
   E-mail: kelum.gajamannage@tamucc.edu
   Appointments: E-mail me to make appointments outside of the announced office hours

C. COURSE DESCRIPTION
   Catalog course description
   Unconstrained optimization, necessary and sufficient conditions for solutions, basic
   algorithms. Constrained optimization, KKT conditions, linear programming, convex
   programming, algorithms.

D. PREREQUISITES AND COREQUISITES
   Prerequisites
   MATH 4301

   Corequisites
   None.

E. REQUIRED TEXTBOOKS, READINGS, AND SUPPLIES
   Required textbooks (electronic copies are available for free)
   • Jorge Nocedal and Stephen J. Wright, Numerical Optimization, Second edition,
     Springer 2006.
   • Stephen Boyd and Lieven Vandenberghe, Convex Optimization, First edition,
   • Stephen Boyd, Neal Parikh, Eric Chu, Borja Peleato, and Jonathan Eckstein,
     Distributed Optimization and Statistical Learning via the Alternating Direction Method

   Optional textbook(s) or other references
   None.
Supplies
None.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes, students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

At the end of the course, students will be able to:
- Identify and classify different optimization problems.
- Identify applications that require optimization techniques.
- Select through an adequate analysis of the characteristics of the problem, the appropriate necessary and sufficient optimality conditions for different classes of unconstrained optimization problems.
- Describe, evaluate, and use the different components of line search techniques and trust region methods to generate descent direction algorithms.
- Evaluate the advantages and disadvantages of the numerical methods and algorithms for unconstrained problems (including steepest descent, Newton and Quasi-Newton, conjugate gradient, etc.) to solve different classes of unconstrained optimization problems.
- Identify different constrained optimization problems. Their advantages and disadvantages.
- Describe adequate necessary and sufficient optimality conditions for some constrained optimization problems.
- Describe and apply numerical methods for simple constrained optimization problems.

G. INSTRUCTIONAL METHODS AND ACTIVITIES

Instructional method: Lectures.
Activities: Homework and Exams.

The class uses lecture format encouraging student participation and discussion. The general lectures introduce ideas, methods, and algorithms and provide proofs of the fundamental results. Assignments will contain problems from the textbooks and other resources. Students may do presentations on alternative methods and algorithms to those presented in class. Students will write code in Python for optimization algorithms and they will also use well established code to solve problems.
H. MAJOR COURSE REQUIREMENTS AND GRADING

The methods of evaluation and the criteria for grade assignments are:

- All the homework will contribute 30% to the course grade. Homework consists theoretical questions, questions related to applications, and numerical implementations of methods. Office hours are a great opportunity to ask questions about homework. Late homework may be excused if you discuss the cause of being late with the instructor. Otherwise, 10% of the score will be reduced in each day after the due date.

- Midsemester Exam contributing 30% to the course grade is schedule to be on 10/14 that covers materials taught from the first day of the class until 10/7.

- The Final exam is comprehensive and contributes 40% to the course grade which is scheduled by TAMUCC.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Contribution to the course grade</th>
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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>30%</td>
</tr>
<tr>
<td>Midsemester Exam</td>
<td>30%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>40%</td>
</tr>
</tbody>
</table>

Note:- This course may require you to pay and use Examity® for proctoring your exams.

Grading scale

Consider that, first I will roundup your final score to the nearest integer. Then, 
A = 90.00 – 100%,
B = 80.00 – 89%,
C = 70.00 – 79%,
D = 60.00 – 69%,
F = below 60%.

I. COURSE CONTENT/SCHEDULE

Note:- This schedule is tentative. Changes in this course schedule may be necessary and will be announced to the class by the Instructor.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
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<tbody>
<tr>
<td>8/17</td>
<td>Review of calculus optimization.</td>
</tr>
<tr>
<td>8/24</td>
<td>Properties of convexity.</td>
</tr>
<tr>
<td>8/30</td>
<td>Convex functions, properties.</td>
</tr>
<tr>
<td>9/7</td>
<td>The Newton method.</td>
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<tr>
<td>9/14</td>
<td>Necessary and sufficient conditions.</td>
</tr>
<tr>
<td>9/21</td>
<td>Overview of algorithms.</td>
</tr>
<tr>
<td>9/28</td>
<td>Line searches, step length, descent directions.</td>
</tr>
</tbody>
</table>
10/5 Rate of convergence. Modifications of Newton method.
10/12 **Midsemester Exam.**
   Trust region methods. Cauchy point algorithms.
10/19 Local and global convergence.
10/26 Conjugate gradient method.
11/2 Nonlinear conjugate gradient.
11/9 Basic of constrained optimization.
11/16 Non-convex optimization.

J. **COURSE POLICIES**

**COVID-19**

Face Coverings—Face coverings (cloth face covering, surgical mask, etc.) must be properly worn in all non-private spaces including classrooms, teaching laboratories, common spaces such as lobbies and hallways, public study spaces, libraries, academic resource and support offices, and outdoor spaces where 6 feet of physical distancing is difficult to reliably maintain. Extra masks will be made available if needed.

**Proctoring**

This course may require you to pay and use Examity® for proctoring your Midsemester Exam and Final Exam. Please refer to [https://iol.tamucc.edu/onlinetesting_students.html](https://iol.tamucc.edu/onlinetesting_students.html) for more information.

**Grades**

All questions concerning grades must be resolved within one week.

**Attendance**

Attendance is not assessed towards the final grade. However, attending class is a fast way of learning the material than trying to catch up on missed material solely from the book.

**Late homework**

10% of penalty per day will be imposed on late homework.

**Missed Exams**

If you have to miss (or have missed) an exam, it is your responsibility to contact me no later than the day of the exam. For missed final exam, due to an acceptable excuse, the university rules about I (Incomplete) grades will apply and the make-up is at the instructor's convenience early in the next long semester.

K. **COLLEGE AND UNIVERSITY POLICIES**

- **Academic Integrity (University)**

University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct
or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. **Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course.** Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Please consult the Academic Calendar ([http://www.tamucc.edu/academics/calendar/](http://www.tamucc.edu/academics/calendar/)) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C0.03, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is required to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C0.03, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at [http://academicaffairs.tamucc.edu/rules_procedures/assets/13.02.99.c0.03_student_grade_appeals.pdf](http://academicaffairs.tamucc.edu/rules_procedures/assets/13.02.99.c0.03_student_grade_appeals.pdf) For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the
College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

  If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

  [http://disabilityservices.tamucc.edu/](http://disabilityservices.tamucc.edu/)

- **Civil Rights Complaints**
  Texas A&M University-Corpus Christi is committed to fostering a culture of caring and respect that is free from discrimination, relationship violence and sexual misconduct, and ensuring that all affected students have access to services. For information on reporting Civil Rights complaints, options and support resources (including pregnancy support accommodations) or university policies and procedures, please contact the University Title IX Coordinator, Sam Ramirez (Samuel.ramirez@tamucc.edu) or Deputy Title IX Coordinator, Rosie Ruiz (Rosie.Ruiz@tamucc.edu) x5826, or visit website at [Title IX/Sexual Assault/Pregnancy](http://disabilityservices.tamucc.edu/).

  **Limits to Confidentiality.** Essays, journals, and other materials submitted for this class are generally considered confidential pursuant to the University's student record policies. However, students should be aware that University employees, including instructors, are not able to maintain confidentiality when it conflicts with their responsibility to report alleged or suspected civil rights discrimination that is observed by or made known to an employee in the course and scope of their employment. As the instructor, I must report allegations of civil rights discrimination, including sexual assault, relationship violence, stalking, or sexual harassment to the Title IX Coordinator if you share it with me.

  These reports will trigger contact with you from the Civil Rights/Title IX Compliance office who will inform you of your options and resources regarding the incident that you have shared. If you would like to talk about these incidents in a confidential setting, you are encouraged to make an appointment with counselors in the University Counseling Center.

- **Statement of Academic Continuity**
In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. OTHER INFORMATION

- **Academic Advising**
The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

**GENERAL DISCLAIMER**
I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.