MATH 677 — Mathematical Foundations for Data Science *

TR 8:00-9:15am, Blocker Building, Room 149

Instructor: Simon Foucart, 502D Blocker Building, foucart@tamu.edu

Office hours: Tu 9:15-9:45am, We 8-8:30am, Th 3:30-4pm, and by appointment

Course web page: `www.math.tamu.edu/~foucart/teaching/notes/MFDS22`

Textbook: None, but the following resources might be useful:

- *Linear Algebra and Learning from Data*, by Strang. SIAM.
- *Matrix Methods in Data Mining and Pattern Recognition*, by Eldén. SIAM.
- *Mathematics for Machine Learning*, by Deisenroth, Faisal, and Ong. CUP.
- *Foundations of Data Science*, by Blum, Hopcroft, and Kannan. CUP.

Course Description: Linear systems; least squares problems; eigenvalue decomposition; singular value decomposition; Perron–Frobenius theory; dynamic programming; convex optimization; gradient descent; linear programming; semidefinite programming; compressive sensing.

Prerequisites and Restrictions: Grade C or better in MATH 304, MATH 309, MATH 311, MATH 323, or equivalent.

Exams: There will be one midterm exam and one final exam.

Homework: Homework is an integral part of the course. In particular, it will contain some programming exercises chosen to illustrate the concepts and techniques expected to be mastered. Homework problems will be assigned weekly, some of which will be graded. The graded problems will be collected at the beginning of class on the due date. Late homework will not be accepted. You are encouraged to come and see me during my office hours to obtain some help on particular questions, provided you made a genuine attempt to solve them.

Grading: Grades are based on the work shown, not on what was intended or implied. Excessively sloppy, poorly justified and disorganized work cannot be given full credit, even if the correct answer appears. The final grade is assigned according to the following scheme:

- Homework   50 points
- Midterm   50 points
- Final   100 points

The point scale used to determine the final letter grade is

F: 0–99,   D: 100–119,   C: 120–139,   B: 140–159,   A: 160-200.

Make-ups will only be given in case of university excused absences or in exceptional circumstances (illness, injury, etc.), which should be documented. The instructor's prior approval is necessary.

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*this syllabus is a general plan for the course; deviations announced in class may be necessary

Tentative schedule:

Week 01 (Aug 22-Aug 26)	Review of linear algebra	Th 25: first class
Week 02 (Aug 29-Sep 02)	Review of linear algebra	Tu 30: last day for add/drop
Week 03 (Sep 05-Sep 09)	Solving linear systems	
Week 04 (Sep 12-Sep 16)	Solving least squares problems	
Week 05 (Sep 19-Sep 23)	Eigenvalues/vectors	
Week 06 (Sep 26-Sep 30)	Singular values/vectors	
Week 07 (Oct 03-Oct 07)	Perron-Frobenius theory	
Week 08 (Oct 10-Oct 14)	Midterm	Oct 10-11: Fall break
Week 09 (Oct 17-Oct 21)	Dynamic programming	
Week 10 (Oct 24-Oct 28)	General optimization problems	
Week 11 (Oct 31-Nov 04)	Convex programming	
Week 12 (Nov 07-Nov 11)	Gradient descent, variations	
Week 13 (Nov 14-Nov 18)	Linear programming	F 18: last day for Q-drop
Week 14 (Nov 21-Nov 25)	Semidefinite programming	Nov 24-25: Thanksgiving break
Week 15 (Nov 29-Dec 02)	Compressive sensing	
Week 16 (Dec 05-Dec 09)	Review	Tu 6: last class
Mo, Dec 12, 1:00-3:00pm	Final	

Attendance Policy: Attendance is not compulsory, but regular attendance is expected — it is in fact essential if you want to do well in the course. Classes to be missed due to religious holidays must be communicated to me during the first week. You are required to arrive on time and stay the length of the class. If you do not attend a class, you are responsible for any announcement made, any material covered, and any additional topic introduced during this class. Office hours cannot be used for this purpose.

Electronic Etiquette: Laptops and tablets are for note-taking only. Cell phones must absolutely be put on silent mode, left closed, and put away. If you have a family emergency and need to take a call during class, I shall be notified in advance so that a special arrangement can be made.

Academic Honesty: *"An Aggie does not lie, cheat, or steal or tolerate those who do."*
See `http://aggiehonor.tamu.edu` for more information.

Americans with Disabilities: 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 contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit `http://disability.tamu.edu`.