

# MATH 677 — Mathematical Foundations for Data Science \*

TR 8:00-9:15am, Blocker Building, Room 117

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

**Office hours:** Tu 9:15-9:45am, We 8-8:30am, Th 1:30-2pm, and by appointment

**Course web page:** [www.math.tamu.edu/~foucart/teaching/notes/MFDS23](http://www.math.tamu.edu/~foucart/teaching/notes/MFDS23)

**Textbook:** None. Besides the online notes, 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:

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|------------|------------|
| • 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:**

W 01 (Aug 21-Aug 25)	Review of linear algebra	F 25: last day for add/drop
W 02 (Aug 28-Sep 01)	Review of linear algebra	
W 03 (Sep 04-Sep 08)	Solving linear systems	
W 04 (Sep 11-Sep 15)	Solving least squares problems	
W 05 (Sep 18-Sep 22)	Eigenvalues/vectors	
W 06 (Sep 25-Sep 29)	Singular values/vectors	
W 07 (Oct 02-Oct 06)	Perron-Frobenius theory	
W 08 (Oct 09-Oct 13)	Midterm	Oct 09-10: Fall break
W 09 (Oct 16-Oct 20)	Dynamic programming	
W 10 (Oct 23-Oct 27)	General optimization problems	
W 11 (Oct 30-Nov 03)	Convex programming	
W 12 (Nov 06-Nov 10)	Gradient descent, variations	
W 13 (Nov 13-Nov 17)	Linear programming	W 15: last day for Q-drop
W 14 (Nov 20-Nov 24)	Semidefinite programming	Nov 23-24: Thanksgiving break
W 15 (Nov 27-Dec 01)	Extras and Review	Th 30: last class
W 16 (Dec 04-Dec 08)	Final	F 8, 1-3pm

**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>.