Syllabus and Information for Math 61DM
Modern Mathematics: Discrete Methods

Fall 2018

Instructors Jacob Fox, jacobfox@stanford.edu,
Office: Building 380, Room 384-X

TA: Sheela Devadas, sheelad@stanford.edu,
381-L

Time: Monday-Friday, 9:30am - 10:20am

Location: Building 380, Room 380-W
The linear algebra lectures on Tuesdays and Thursdays during the first six weeks are in room 380-C and joint with Math 61C

Office hours:
Mondays 2:00pm - 5:00pm (Jacob)
Wednesday 4:00pm - 5:30pm (Sheela)
Thursdays 6-7pm on Oct. 4, 11 and 4:30-5:30pm after (Sheela)
Friday 10:30am - 12:00pm (Sheela)

Proof Sections: Thursdays 4:30pm-6:00pm for first 3 weeks

Prerequisites: Score of 5 on the AP Calculus BC exam, or permission from the instructor.

General: Math 61DM is designed to give a rigorous freshman introduction to linear algebra and discrete mathematics

Textbooks: "An introduction to multivariable mathematics" by Leon Simon (Required)

Note: An electronic version (pdf eBook) is provided by the publisher at

http://www.morganclaypool.com/doi/abs/10.2200/S00147ED1V01Y200808MAS003

(no charge to Stanford students-SUNet ID required; you will also be able to use this link when you are off-campus, but for that you first need to configure your browser as described in http://www-sul.stanford.edu/apcproxy/index.html)

"Thirty-three Miniatures: Mathematical and Algorithmic Applications of Linear Algebra"

by Jiři Matoušek (Required)

Note: An electronic version (pdf) is available for free at

http://kam.mff.cuni.cz/~matousek/stml-53-matousek-1.pdf

Grades: Mid-term 1: 20%, Mid-term 2: 20%, Homework 30%, Final exam: 30%

Objective: To learn and appreciate linear algebra and discrete mathematics

Suggestions: Class participation and discussion are highly encouraged. Please feel free to ask appropriate questions before, during, or after class.

Course page: stanford.edu/~jacobfox/61DM

Homework: 10 homeworks (two in week 2, one each later week)

The homework problems form an integral part of the course; they are easily the most reliable check of your progress in assimilating the material in a manner which is sufficiently deep to allow you to solve problems which are at least one level removed from routine application of definitions and formulae. While it is quite O.K. (and even encouraged) for you to discuss the problems in general terms with your peers, it is expected that what you hand in is your own work.

Announcements:

You should routinely check the "current announcements" on the course page, since this provides you with the latest information relating to any aspects of the course (e.g. corrections to homework, arrangements for mid-terms, notes or corrections concerning material covered in the lectures, etc.).

Honor Code:

Please be sure you are aware of the requirements of the Stanford Honor Code and your responsibilities under the code.

Tentative Schedule:

Week 1
9/24 Lecture 1: Continuous and Discrete Mathematics, S 1.1, Appendix A Lec. 1

9/25 Lecture 2: Counting and Fibonacci numbers, M 1 and 2

9/26 Lecture 3: Linear algebra: Fields, vector spaces S 1.1, 1.2, HO algebra, vector spaces

9/27 Lecture 4: Linear algebra: Vector spaces, subspaces, inner products, linear dependence S 1.2, 1.3, HO inner products

9/28 Section: Meet with TA, Generating function

Week 2
10/1 Lecture 5: Inclusion-Exclusion Principle, HO Inclusion-Exclusion
Homework 1 due

10/2 Lecture 6: Linear algebra: Gaussian elimination S 1.4

10/3 Lecture 7: Clubs of Odd and even towns M 3

10/4 Lecture 8: Linear algebra: Bases S 1.5

10/5 Meet with TA, Homework 2 due

Week 3
10/8 Lecture 9: Same-size intersections and applications M 4

10/9 Lecture 10: Linear algebra: linear maps, matrices S 1.6, 3.6 HO Vect. sp.

10/10 Lecture 11: Adjacency matrices of graphs and counting cliques M10

10/11 Lecture 12: Linear algebra: rank-nullity S 1.7 HO Vector spaces

10/12 Meet with TA, homework 3 due, **Add/drop deadline 5pm**

Week 4
10/15 Lecture 13 Error correcting codes M 5

10/16 Lecture 14: Linear algebra: Inner products, orthocomplements S 1.8 HO

Inner products,
Midterm 1 7pm-8:30pm

10/17 Lecture 15: Error correcting codes M 5

10/18 Lecture 16: Linear algebra: Inhomogeneous systems S 1.9, 1.10

10/19 Meet with TA, homework 4 due

Week 5
10/22 Lecture 17: Odd distances M 6

10/23 Lecture 18: Linear algebra: Permutations, multilinear maps S 3.1, HO: Multilinear

10/24 Lecture 19: Two distance sets M15

10/25 Lecture 20: Linear algebra: Determinants S 3.2

10/26 Meet with TA, homework 5 due

Week 6
10/29 Lecture 21: Inverses S 3.3, 3.4

10/30 Lecture 22: Packing complete bipartite graphs M 8

10/31 Lecture 23: Linear algebra; Gram-Schmidt, Orthonormal basis S 3.5

11/1 Lecture 24: Medium-Size Intersection Is Hard To Avoid M17

11/2 Meet with TA, homework 6 due

Week 7
11/5 Lecture 25: Borsuk conjecture M 18

11/6 Lecture 26: Equiangular lines M 9

11/7 Lecture 27: Checking Matrix Multiplication M 11

11/8 Lecture 28: Tiling a rectangle by squares M 12

11/9 Meet with TA, homework 7 due

Week 8
11/12 Lecture 29: Finite field Kakeya problem M 25,
Midterm 2 7pm-8:30pm

11/13 Lecture 30: Joints HO Joints

11/14 Lecture 31: Cap sets 1 HO Cap Sets

11/15 Lecture 32: Cap sets 2 HO Cap Sets, **Withdraw deadline 5pm**

11/16 Meet with TA, homework 8 due

Thanksgiving Week
11/19 Thanksgiving recess, no classes
11/20 Thanksgiving recess, no classes
11/21 Thanksgiving recess, no classes
11/22 Thanksgiving recess, no classes
11/23 Thanksgiving recess, no classes

Week 9
11/26 Lecture 33: Shannon capacity M28

11/27 Lecture 34: More Linear Algebra: Spectral theorem S 3.7

11/28 Lecture 35: Spectral graph theory: Introduction, HO spectral graph theory

11/29 Lecture 36: Spectral graph theory: Three Petersens are not enough M 13

11/30 Meet with TA

Week 10
12/3 Lecture 37: Spectral graph theory: Highly regular graphs M 14

12/4 Lecture 38: Spectral graph theory: Friendship theorem, HO Friendship

12/5 Lecture 39: Spectral graph theory: Expanders and the spectral gap
HO Expanders

12/6 Lecture 40: Finish!

12/7 Meet with TA

Finals week
Final exam

Students with Documented Disabilities
Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible (and at least 2 weeks before an exam) since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: http://oae.stanford.edu).

Affordability of Course Materials
Stanford University and its instructors are committed to ensuring that all courses are financially accessible to all students. If you are an undergraduate who needs assistance with the cost of course textbooks, supplies, materials and/or fees, you are welcome to approach me directly. If would prefer not to approach me directly, please note that you can ask the Diversity & First-Gen Office for assistance by completing their questionnaire on course textbooks & supplies: http://tinyurl.com/jpqbarn or by contacting Joseph Brown, the Associate Director of the Diversity and First-Gen Office (jlbrown@stanford.edu; Old Union Room 207). Dr. Brown is available to connect you with resources and support while ensuring your privacy.