Mathematical Foundations for Data Science for Engineers I

EGN 5446, 3 credit hours
Class Periods: N/A
Location: N/A
Academic Term: N/A

Instructor:
Laura Cruz Castro, PhD
Email Address
Office Phone Number
Office Hours: Days of week, hours available, office location

Teaching Assistant/Peer Mentor/Supervised Teaching Student
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TBA: Name, email address, office location, office hours

Course Description
EGN 6445, 3 credit hours
Mathematical Foundations for Data Science for Engineers I is the first of a two-part series designed to equip students with the essential mathematical skills required in the rapidly evolving field of data science. This course lays a solid groundwork in the fundamentals of linear algebra, probability, and information theory, with a particular emphasis on their relevance and practical applications in data science. Students will delve into the core principles of these mathematical domains, exploring how they underpin various data science methodologies and techniques. By focusing on both theory and application, the course aims to provide a comprehensive understanding of the mathematical tools necessary for proficient data science practice, ensuring that students are well-prepared to tackle real-world data challenges. This course is ideal for engineers and other technical professionals seeking to enhance their data science capabilities through a robust mathematical foundation.

Grading Scheme: Letter Grade

Prerequisite
Undergraduate level statistics, linear algebra, and calculus are desired.

Course Objectives

Mathematical Foundations for data science is a course designed to explore three areas of mathematics that are critical to data science development and applications: linear algebra, probability theory, and information. In this course, you will learn some basic concepts in these three areas emphasizing the application of them in data science.
Linear algebra:

- *Remember how to operate basic linear algebra operations*
- *Understand basic linear algebra concepts that are useful to data science*
- *Analyze the usefulness of* linear algebra to analyze large data sets.

Probability theory:

- *Remember basic probability concepts*
- *Understand basic probability concepts and how they are useful to data science*
- *Analyze the use of probability and distributions in Data Science*

Information metrics:

- *Remember basic information metrics such as entropy, mutual information and KL divergence*
- *Understand basic information metrics such as entropy, mutual information and KL divergence*
- *Analyze information metrics and its use in modern data science*

Materials and Supply Fees

Required Textbooks and Software

- Linear algebra for data science (Sorin Mitran)
- Introduction to Probability for Data Science (Stanley H. Chan)
- Information Theory for Data Science (Changho Suh)
- Online Instructor Notes and Online Videos from multiple sources
- Python, or R

Commented [CM1]: @Catia S. Silva In case you need the links:
MITRAN: http://mitran-lab.amath.unc.edu/courses/MATH347DS/textbook.pdf
SUH: https://www.nowpublishers.com/article/BookDetails/9781638281146
CHAN: https://probability4datascience.com/TOC.html

Recommended Materials

- None

Course Schedule

Week	Date	Topic	HW	Exam	Book/Chapter/Materials
Week 1	Day 1	Intro to the course			Slides
Week 1	Day 2	Vectors and Matrices			Sorin Mitran/Chapter 1
Week 2	Day 1	Vectors and Matrices in Data Science	HW0		Sorin Mitran/Chapter 1
Week 2	Day 2	Linear Mappings			Sorin Mitran/Chapter 1
Week 3	Day 1	Vector Spaces	HW1		Sorin Mitran/Chapter 2
Week 3	Day 2	Vector Spaces			Sorin Mitran/Chapter 2
Week 4	Day 1	Data Information	HW2		Sorin Mitran/Chapter 3
Week 4	Day 2	Data Partitioning			Sorin Mitran/Chapter 3
Week 5	Day 1	Data Transformation	HW3		Sorin Mitran/Chapter 5
Week 5	Day 2	Data Efficiency			Sorin Mitran/Chapter 5
Week 6	Day 1	Exam Review	HW4		
Week 6	Day 2	Exam (Linear Algebra)		Exam I	
Week 7	Day 1	Intro to Probability			Stanley Chan/Chapter 1
Week 7	Day 2	Discrete random variables			Stanley Chan/Chapter 2
Week 8	Day 1	Discrete random variables			Stanley Chan/Chapter 2
Week 8	Day 2	Continuous random variables	HW 5		Stanley Chan/Chapter 3
Week 9	Day 1	Continuous random variables			Stanley Chan/Chapter 3
Week 9	Day 2	Joint distributions	HW 6		Stanley Chan/Chapter 4
Week 10	Day 1	Joint distributions			Stanley Chan/Chapter 4
Week 10	Day 2	Applications of distributions in DS	HW 7		Slides
Week 11	Day 1	Exam review			
Week 11	Day 2	Exam (Probability)		Exam 2	
Week 12	Day 1	Information theory (intro)			Changho Suh/ Chapter 1.1
Week 12	Day 2	Information theory (intro)			Changho Suh/ Chapter 1.1
Week 13	Day 1	Entropy	HW 8		Changho Suh/ Chapter 1.2
Week 13	Day 2	Mutual information and KL divergence			Changho Suh/ Chapter 1.3
Week 14	Day 1	Mutual information and KL divergence	HW 9		Changho Suh/ Chapter 1.3

Week 14	Day 2	Applications to data science			Changho Suh/ Chapter 1.3
Week 15	Day 1	Applications to data science	HW 10		Slides
Week 15	Day 2	Exam review			
Final's week	N/A	Exam (Information theory)		Exam 3	

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is encouraged but not required. Excused absences from tests must be in compliance with university policies in the Graduate Catalog and require appropriate documentation.
(https://gradcatalog.ufl.edu/graduate/regulations/)

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework	25%
Linear Algebra Test	25%
Probability Test	25%
Information Theory Test	25%
	100%

Grading Policy

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 – 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 – 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their

Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

University Honesty Policy
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment
The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.ufl.edu/.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://care.dso.ufl.edu.

On-Line Students Complaints*:* http://www.distance.ufl.edu/student-complaint-process.