

Mathematical Foundations for Data Science for Engineers II

EGN 6446, 3 credit hours

Class Periods: TBD

Location: TBD

Academic Term: TBD

Instructor:

Rui Guo

Email Address

Office Phone Number

Office Hours: Days of week, hours available, office location

Teaching Assistants:

Please contact through the Canvas website

- TBA: Name of TA, email address, office location, office hours

Course Description

Understand and apply machine learning statistical models including functions of random variables, Monte Carlo, convergence, estimation, and hypothesis testing. Understand and apply optimization algorithms including constrained and unconstrained, first and second order, stochastic and gradient descent, and nonconvex.

Grading Scheme: Letter Grade

Statistical methods for modeling and analyzing structured data. Optimization algorithms typically encountered in applied machine learning. Case studies involving application of course topics.

Course Pre-Requisites / Co-Requisites

Math for Intelligent Systems

Course Objectives

Understand and apply machine learning statistical models including functions of random variables, Monte Carlo, convergence, estimation, and hypothesis testing. Understand and apply optimization algorithms including constrained and unconstrained, first and second order, stochastic and gradient descent, and nonconvex.

Materials and Supply Fees

None Required

Required Textbooks and Software

None Required

Recommended Materials

Wood, S. (2015), "Core Statistics", ISBN-10: 1107415047; available as free download from the author's webpage https://www.amazon.com/Core-Statistics-Institute-Mathematical-Textbooks/dp/1107415047/ref=sr_1_1?dchild=1&keywords=wood+core+statistics&qid=1588738063&sr=8-1

Wackerly, Mendenhall, Schaeffer (2008), "Mathematical Statistics with Applications", ISBN-10: 0495110817 https://www.amazon.com/Mathematical-Statistics-Applications-Dennis-Wackerly-ebook-dp-B00B7K7N7K/dp/B00B7K7N7K/ref=mt_kindle?_encoding=UTF8&me=&qid=1588738085

Course Schedule

Weeks	Topic	Quizzes and HWs	Exams
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Course Title, Prefix, and Number

Course Instructor and Academic Term

Page 1

1-2	Review: Basic Probability via Scientific Computing		
2-3	Functions of Random Variables and their Sampling Distributions		
3-4	Modes of Convergence (in probability and in distribution); laws of large numbers (LLN) and the Central Limit Theorem (CLT) and their practical implications and applications.	HW Due	
4-5	Point and Interval Estimation: Properties of Point Estimators and Methods of Estimation (with emphasis on MLE as the Bayesian maximum a posteriori (MAP) estimator under a flat prior).	HW Due	
5-6	Hypothesis Testing - main ideas and intuition; focus on p-values		
7-8	Linear Models and Estimation by Least Squares. Simple and multiple linear regression (matrix algebra approach).	HW Due	Exam 1 (emphasis on weeks 7-8 material)
10	Introduction of optimization in machine learning Unconstrained optimization: First and second order conditions, method of steepest descent		
11	Unconstrained optimization (continue): First and second order conditions, method of steepest descent Constrained optimization: Lagrangian formulation and KKT conditions		
12	Constrained optimization: Lagrangian formulation and KKT conditions First-order methods: Proximal gradient method and projected gradient descent	HW Due	
13	First-order methods: acceleration and line search Newton method for root finding and Newton method for function optimization Quasi-Newton methods (BFGS, LBFGS)		
14	Other optimization methods: Gradient-free method (Nelder-Mead method) and stochastic	HW Due	

	search methods (Simulated annealing)		
15	Other optimization methods: Optimization for nonconvex functions (multiple local minima) and Coordinate descent algorithm	HW due	Exam2: Take-home

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance Policy

Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (6)	100 each	15%
Quizzes (4)	100 each	15%
Midterm Exam	100	30%
Final Exam	100	30%
Review Paper	100	10%
		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 - 77.9	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:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

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.ua.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>

Campus Resources:

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 support, 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>.