



Lahore University of Management Sciences

PHY 603 Machine Learning for Physics

Fall 2023

To understand how to navigate course outlines, consult: How to Use a Course Outline (<http://surl.li/gpvuw>)

Instructor	Muhammad Faryad
Room No.	9-119A
Office Hours	TBA in Class
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Course URL (if any)	
Support Services	LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here (https://advising.lums.edu.pk/#supportservices)

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	1:15 hours
Lab/Tutorial per week	Nbr of Session(s) Per Week		Duration	

Course Distribution	
Core	
Elective	Elective

COURSE DESCRIPTION
Machine learning offers a new paradigm for computational problems in physics. This course will give students a hands-on experience on neural networks and other machine learning algorithms for solving problems in physics. This will also introduce students to an emerging field of scientific machine learning where scientific principles like conservation of different quantities guide the design of neural networks.

COURSE PREREQUISITE(S)
Computational Physics for both UG and Grad

Class Learning Outcomes
Students will learn how to <ol style="list-style-type: none">1- Develop programs for basic neural networks2- Use basic neural networks packages for regression and classification problems3- Use neural network for forward and inverse problems in physics

Grading Breakup and Policy
Assignment(s): 30% Midterm I: 20% Midterm II: 20% Final Project: 30%



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COURSE OVERVIEW			
Modules	Topics	Recommended Readings	Objectives/ Application
1	Basic Neural Networks, Function Approximation, Gradient Descent Methods		
2	Supervised and Unsupervised Learning, Regression and Classification		
3	Representation Learning, Principal Component Analysis, Encoders		
4	Graph Neural Networks, Operator Approximation		
5	Inverse Problems in Physics, Solution of Differential Equations		
6	Sampling Theory, Central Limit Theorem, Applications to Deep Learning		

Textbook(s)/Supplementary Readings

There is no specific textbook. However, following material will be helpful to consult:

1. Tanaka, Tomiya, Hashimoto, Deep Learning and Physics, Springer, 2021.
2. Goodfellow, Bengio, Courville, Deep Learning, MIT Press, 2016.
3. Lecture Notes by Andrew Ng
4. https://pad.gwdg.de/s/2021_AdvancedMachineLearningForScience#

Campus supports & Key university policies

Campus Supports

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources (<https://advising.lums.edu.pk/advising-resources>), etc. To view all support services, their specific role as well as contact information click here (<https://advising.lums.edu.pk/#supportservices>).

Academic Honesty/Plagiarism

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) Academic and Intellectual Integrity (<http://surl.li/gpvwb>), and 2) Understanding and Avoiding Plagiarism (<http://surl.li/gpvwo>).

LUMS Academic Accommodations/ Petitions policy

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (<https://rb.gy/8sj1h>)

LUMS Sexual Harassment Policy

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated.



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To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. *For more information: Harassment, Bullying & Other Interpersonal Misconduct: Presentation (<http://surl.li/qpvwt>)*