PKU Globex Julmester

Scientific Machine Learning: Blending Science with Data (3 Credits)

科学机器学习：融合科学与数据

(00333754)

Instructor	Andrew OOI, The University of Melbourne, Melbourne, Australia (a.ooi@unimelb.edu.au)	
Synopsis	Data driven techniques can be used to find models for engineering problems based on given data. However, it is usually common that the derived models do not perform well when used outside the parameter range used in the training data. In order to obtain better predictions, scientific knowledge of the problem needs to be introduced into the mathematical model. In this course students will learn to efficiently apply modern day artificial intelligence and machine learning tools to classical problems in engineering. There will be emphasis on blending scientific engineering domain knowledge with modern AI tools to arrive at an optimal solutions to engineering problems. In addition, we will also introduce students to methodologies for uncertainty quantification and how these techniques can be used to understand the sensitivities of the solutions to uncertainties in input parameters.	
Audience	Year 3 & 4 Undergraduate and Graduate Students	
Classroom	TBA	
Schedule	Class: 9-12 AM, M-F, July 6 – July 24, 2026	Total Contact Hours: 45
Objective	The main goal for this course is to arm students with data-driven tools that can be used to create mathematical models for simplified engineering applications. There will be an emphasis to blend scientific knowledge with data-driven techniques to ensure rigorous scientific principles is embedded into the model.	
Topics	1. Programming language is Julia (basic programs will be provided). Other programming languages, such as Matlab and Python, are also fine but are not supported 2. Basics of Uncertainty Quantification 3. Automatic Differentiation 4. Optimization 5. Introduction to Neural Network and regression. 6. Physics Informed Neural Network 7. Neural Ordinary Differential Equations	
Reference	Material will be provided during the course.	
Note	Students need to bring their own laptops for this course.	
Grading	Assignment 1 20% Assignment 2 30% Final exam 40% Attendance and discussion 10% Total 100%	

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Professor Andrew Ooi is an academic staff member in the Department of Mechanical Engineering at The University of Melbourne and Associate Dean (Academic) in the Melbourne School of Engineering. Prof Ooi graduated with a BEng in 1993 and PhD in 1997 from the University of Melbourne. Prior to his current appointment, Andrew worked at the Center for Turbulence Research (CTR) at NASA Ames, Stanford University and as a research scientist at the Defence Science and Technology Organisation (DSTO). His current research interests include numerical simulation and the application of artificial intelligence methodologies for fluid flow applications such as bluff body natural convection and multiphase flows.