Korea University International Summer Campus (KU ISC) 2021

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July 12, 2021 ~ August 5, 2021

ISC505 – Data-Driven Modeling

Ⅰ. Instructor

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Office Hours	:	By appointment

Ⅱ. Textbook

Required Textbook	:	Brunton SL, Kutz JN. Data-driven science and engineering: Machine learning, dynamical systems, and control. Cambridge University Press; 2019
Recommended Additional Readings	:	1. Ford W. Numerical linear algebra with applications: Using MATLAB. Academic Press; 2014 Sep 14. 2. Géron A. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. O'Reilly Media; 2019

Ⅲ. Course Description and Objectives

Introduction of fundamental mathematical techniques and theories for data-driven modeling. Topics to be covered include data reduction (using singular value decomposition and Fourier transform), sparse identification of nonlinear dynamics, compressed sensing, basics of machine learning, and model reduction. Common application areas include pattern extraction from spatiotemporal data, determination of optimal sensor placement, robust image recognition and reconstruction, reduced-order modeling, and more.

Learning Objectives:

- Establish a solid understanding of basic theories for data-driven modelling and control
- Develop a capability of building predictive models (using Matlab or Python) and designing experiments using data-driven approaches
- Compare pros and cons among different modeling approaches and choose the best approach meeting one's need

Ⅳ. Grading

Proposal	:	20%
Term project	:	40%

Assignments	:	30%
Participation	:	10%

Ⅴ. Class Outline

Date	Topic	Chapter	Remarks
July 12 (Mon)	Orientation Day (No Classes)		
July 13 (Tue)	Course overview / Introduction		
July 14 (Wed)	Linear Algebra (LA) using Matlab	Ref. 1	HW1 (LA)
July 15 (Thu)	Singular Value Decomposition (SVD) (1)	1	
July 16 (Fri)	SVD (2) / Fourier Transforms	1 & 2	HW1 (Ch 1, 2)
July 19 (Mon)	Sparsity and Compressed Sensing	3	HW2 (Ch 3)
July 20 (Tue)	Overview of Machine Learning	Ref.2	
July 21 (Wed)	Regression and Model Selection	4	HW3 (Ch 4)
July 22 (Thu)	Clustering and Classification	5	
July 26 (Mon)	Neural Networks and Deep Learning	6	
July 27 (Tue)	Data-driven Dynamical Systems	7	HW4 (Ch 5, 6, 7)
July 28 (Wed)	Linear Control Theory	8	Proposal due
July 29 (Thu)	Model Reduction / Data-driven Control	9, 10	HW5 (Ch 8, 9, 10)
Aug 2 (Mon)	Case studies		
Aug 3 (Tue)	Term project presentation (1)		Term project due
Aug 4 (Wed)	Term project presentation (2)		
Aug 5 (Thu)	/ Graduation Day		Grading