

SE524
Data-Based Systems Modelling
a.k.a. *System Identification*
MWF 11-12:20, 206 Transportation Bldg.

Instructor: Prof. Carolyn Beck, 104C Transportation Bldg., beck3@illinois.edu

Text: *System Identification*, by Torsten Söderström and Petre Stoica
available online: <https://user.it.uu.se/~ts/sysidbook.pdf>

TENTATIVE COURSE OUTLINE:

Reading	Topics	Lectures
Part 0:	Course Introduction	
Chap. 1 & App.s A & B	What is System Identification? Why? How? Review of fundamental probability and linear algebra concepts	Week 1 Weeks 1-3
Part 1:	Overview and Introductory Examples	
Chap. 2	LTI Systems; Impulse responses; Transfer functions	Weeks 3-4
Part 2:	Foundations of Parametric Methods	
Chap. 4	Linear Regression and Least-Squares	Weeks 4-6
Part 3:	Motivations and Models	
Chap. 6	LTI Models: Sets and Families of Models; State-Space Models; Identifiability (Optional) Spectra and Spectral Factorizations (Chap. 3)	Weeks 6-7
Part 4:	Parameter Estimation Methods	
Chap. 7	Least Squares and Optimal Predictors; Computational Approaches	Weeks 7-9
Chap. 8 and handout	Instrumental-Variables and Subspace Methods Maximum Likelihood and connections to Subspace Methods	Weeks 9-11
Part 5:	Practical Aspects	
Chap. 11	Model Structure Selection and Model Validation	Week 12
Chap.s 5 & 12	Experiment Design: Input and Output Signals	Week 13
Part 6:	Advanced Topics & Connections to ML	
Chap.s 9 & 10	Selection of topics from text and Journal Articles	Weeks 13-15

Assignments:

- Problems will be assigned and discussed on an every 2-3 week basis. Problem discussion sessions will be held during announced lecture hours; we will discuss solutions to the assigned problems as a class with students participating at the board. These problems will be of an analytical nature.
- A series of **3 projects** will be completed. The first 2 will be assigned by the instructor; the third may be proposed by the individual student with approval of the instructor. The projects will be data and coding based, and will use data sets from real experiments.
- Students will be required to read one journal article on an advanced system identification topic and give a 30 minute in-class presentation of the material in the article, which may incorporate both analytical and data/coding-based work. The instructor will post a list of pre-approved journal articles for this assignment.
- There will be a 3-hour in-class final at the conclusion of the course, based on the homework sets.
- A separate calendar will be posted indicating tentative dates for in-class lectures and homework sessions. Remaining dates will be released, or possibly supplemented with short recordings.

Course Grade Composition:

Item	% of grade
Homework Problem Sessions (participation)	5%
Data-Based Projects (3)	15% each
Journal Article Presentation	20%
Comprehensive Final	30%

Final Exam Date and Time: Default will be 8-11am, Wednesday, December 14th