AMATH 563 Spring Quarter 2019

Schedule and Homework Write Ups

Schedule of Lectures

Lecture 1 (4/1): Regression 1: Linear and nonlinear curve fitting
Lecture 2 (4/3): Regression 2: Over- and under-determined systems, regularization
Lecture 3 (4/5): Model selection 1: Interpolation and extrapolation
Lecture 4 (4/8): Model selection 2: Pareto fronts and parsimony
Lecture 5 (4/10): Model selection 3: Cross validation and information criteria
Lecture 6 (4/12): Model Discovery 1: ODEs
Lecture 7 (4/15): Model Discovery 2: PDEs
Lecture 8 (4/17): Model Discovery 3: Time-delay Embeddings
Lecture 9 (4/19): Data Assimilation 1: Introduction to data and models
Lecture 10 (4/22): Data Assimilation 2: The Kalman filter
Lecture 11 (4/24): Data Assimilation 3: Applications of data assimilation
Lecture 12 (4/26): Data-driven approximations 1: Dynamic mode decomposition
Lecture 13 (4/29): Data-driven approximations 2: Koopman theory
Lecture 14 (5/1): Data-driven approximations 3: Time-delay embeddings
Lecture 15 (5/3): Machine learning 1: Supervised versus unsupervised learning
Lecture 16 (5/6): Machine learning 2: Overview of unsupervised algorithms
Lecture 17 (5/8): Machine learning 3: Overview of supervised algorithms
Lecture 18 (5/10): Neural networks 1: The perceptron
Lecture 19 (5/13): Neural networks 2: Multilayer networks and activation functions
Lecture 20 (5/15): Neural networks 3: Backprop algorithm and Stochastic gradient descent
Lecture 21 (5/17): Neural networks 4: Deep convolution networks
Lecture 22 (5/20): Neural network 5: neural networks for dynamical systems
Lecture 23 (5/22): Randomized linear algebra 1: Extraction of low-rank structure
Lecture 24 (5/24): Randomized linear algebra 2: Algorithms and applications
Lecture 25 (5/29): Networks 1: Network definitions and concepts
Lecture 26 (5/31): Networks 2: Network inference techniques
Lecture 27 (6/3): Networks 3: Probabilistic graphical models
Lecture 28 (6/5): Network 4: Probabilistic graphical models
WORKSHOP (6/6 - 6/7): Physics Informed Machine Learning Workshop, **UW Campus**

NOTE 1: Memorial day is 5/27.

NOTE 2: No live lectures 4/3, 4/10, 4/12, 4/24, 4/29, 5/20. So please don't show up to class. Instead, the lectures will be posted online.

Grading and Homework Write Ups

Your course grade will be determined from your homework (two thirds) and final project (one third). There will be N homeworks over the quarter. Each of the homework sets will be part of your final grade, each is equally weighted (1/N%). This homework should be written as if it were an article/tutorial being prepared for submission. I expect a high level of professionalism on these reports.

You should pick a project to pursue by the end of April (you can work with up to 2 other people). This final report is worth 1/3 of your grade (with the N homeworks worth 2/3 of your grade). The final report should have the same format as the homework submissions, but there will be no page limit.

The following is the expected format for homework submission:

MAXIMUM NUMBER OF PAGES: 6 (plus additional pages for attaching your MATLAB code: Appendix B)

Title/author/abstract Title, author/address lines, and short (100 words or less) abstract.
Sec. I. Introduction and Overview
Sec. II. Theoretical Background
Sec. III. Algorithm Implementation and Development
Sec. IV. Computational Results
Sec. V. Summary and Conclusions
Appendix A MATLAB functions used and brief implementation explanation
Appendix B MATLAB codes

I will grade based upon how completely you solved the homework as well as neatness and little things like: did you label your graphs and include figure captions. EACH HOMEWORK IS WORTH 10 POINTS. Five points will be given for the overall layout, correctness and neatness of the report, and five additional points will be for specific things that the TAs will look for in the report itself. We will not tell you these things ahead of time as a good and complete report should have them as part of the explanation of what you did. For example, in the first homework, the TAs may look to see if you talked about the fact that you must rescale the wavenumbers by 2*pi/L since the FFT assumes 2*pi periodic signals. This is a detail that is important, so it would be expected you would have it. If you do, you get the point, if not, then you miss a point.

NOTE 1: The report does not have to be long. But it does have to be complete.

NOTE 2: This report is not for me, it is for you! Specifically, for the future you. So write a nice report so that you could reproduce the results if you need the methods addressed here in another year or more.

NOTE 3: The homework (as PDFs) will be turned in via the canvas class website.

A few things should be kept in mind when generating your reports:

1. Use a professional grade word processor (Latex or MSword, for example)
2. For equations: Latex already does a nice job, but in Word, use Microsoft Equation Editor
3. Label your graphs. Include brief figure captions. Reference the figure in the text.
4. Figures should be set flush with the top or bottom of a page.
5. Label all equations.
6. Provide references where appropriate.
7. All coding should be shuffled to Appendix A and B. Reference it when necessary.
8. Always remember: this report is being written for YOU! So be clear and concise.
9. Spellcheck.