Final Project Description

Due: In the box or folder outside my office or under the door of my office (4851 East Hall), by 10 a.m. on Friday, Dec. 20.

The final project should be submitted as a written (typed) report with at least 8 pages of double-spaced text and additional figures, tables, and references for a total length of perhaps 10-15 pages. The text should be well polished and focused. It can be on any academic topic that genuinely interests you and may use analytical techniques beyond those covered in class (so long as your approach is careful and scientific). It must, however, be consistent with the broad themes of the course. These include the following points:

1) **Focus on a major unsolved problem.** If you are data oriented, I recommend gathering data in your area of interest and determining the broadest trends, and then trying to model or otherwise understand these trends analytically. If you inclined toward theory, try to think deeply about what is fundamental to your field and about the direction your field needs to take to make progress, and then look within that space for something tangible that you can do. Remember that choosing the right problem is often over 60% of the work. Your report should include a substantial, specific explanation (more than a few sentences) about why the problem that you are trying to solve is important.
2) **Explore your data as a whole before reducing its complexity.** In working with large data sets, try to discern the most well defined relationships in the data as a whole with nonparametric approaches, creative ways of visualizing the data, and similar. Try to determine the most significant trends and the most well-defined relationships. The variation may not be Gaussian and the trends may not be linear. Your approach must allow for this.
3) **Remove unnecessary complexity from your model or models.** Because we are focused on mechanistic models, you are allowed to change the model to make it more analytically tractable. Seek to find a minimal system that exhibits the interesting behavior that you want to study.
4) **Be clever in your approach.** Clarify the nature of your problem and then learn the appropriate tools to solve it, even if they are not ones covered in the course. (For better or worse, this is representative of 'real life'.) For example, if you want to analyze an oscillation, try reexpressing it as a Fourier series. If you observe invariance across scales, attempt a renormalization-inspired approach. For either, see me if necessary. If every model you make for a given phenomenon shows highly similar global behavior, don't try to deduce which model is best by comparing how well they fit a given bit of data. Instead conclude robustness of the global behavior over the set of models you have considered.

The report should have an introductory section which explains the central problem and its significance, a methods section that gives the details of the work you did, and a discussion or conclusions section that interprets what you did with respect to the motivation in the introduction. There may also be other sections and subsections. I would suggest using LaTeX for the write-up, but it is not required. If you would like to discuss any of this with me, or talk about a specific project idea, contact me and we will find a time to meet.