Independent Study: Data and Models

This course of study is designed in two parts. The first part will be an investigation into linear modeling and data analysis techniques. This will culminate into a project in dimensionality reduction called "Eigenfaces". The techniques used here are very general, and can be applied to almost any type of data set. We will also start to understand the nature of the "time series", and begin an investigation into the tools used to analyze time series in general and chaotic time series in particular.

The second part gets us into nonlinear modeling techniques. We will investigate the nature of the neural network, and use Matlab extensively to perform data analysis and modeling. Finally, an ending project will be chosen that incorporates many of the techniques learned throughout the semester.

Below is a core list of topics that we'll discuss over the course of the semester:

1. Part I: Linear Algebra and Linear Models

    (a) Linear Algebra fundamentals (Chapter 7 of Lay's "Linear Algebra and its Applications")

    (b) Least Squares applications.

    (c) Karhunen-Loeve Expansions (a.k.a. Principle Component Analysis) From course notes in Pattern Analysis.

    (d) Project: Eigenfaces

    (e) Time Series (Define and set up for the filters, Explain Ruelle and Takens' Embedology).

    (f) Linear Filters (Mostly from the Matlab Manual).

2. Part II: Feedforward Neural Networks (From the notes in Pattern Analysis and Matlab Manual. Might include material from "Neural Network Design" by Hagan, Demuth and Beale, 1996.

    (a) The three layer feedforward neural net.

    (b) Training and Error.

    (c) Neural Networks and Matlab.

    (d) Project.