Welcome to CogSci 109

Modeling and Data Analysis

Instructional Team

- Instructor
  - **C. Alex Simpkins (csimpkin@ucsd.edu)**
- TA's
  - **Nick Butko (nbutko@cogsci.ucsd.edu)**
  - **Leo Trottier (leo@cogsci.ucsd.edu)**
  - **Slavic Bryskin (vbryksin@ucsd.edu)**

Motivation…

- In Cognitive Science, we consider questions regarding the nature of cognition
  - **In our department we focus on studying these questions through the *brain, behavior and computation***
  - **In other fields of science and engineering, one considers other questions**
  - **Complicated! In order to determine across individuals a reasonable response to these questions, one must be able to describe patterns which are beyond the subjectivity and mental limitations of the individual**
  - ***Therefore we use tools of modeling and data analysis***

What is modeling and data analysis?

- Data
  - **“Facts and statistics collected together for reference or analysis” (Webster’s Dictionary)**
  - **Can be recorded from any form, situation, or field of study**
  - **“Anything that exists, exists in some quantity, anything that exists in some quantity can be measured…” (Thorndike)**

What is modeling and data analysis? (continued)

- Analysis
  - "detailed examination of the elements or structure of something, typically as a basis for discussion or interpretation" (Webster's Dictionary)
  - "the part of mathematics concerned with the theory of functions and the use of limits, continuity, and the operations of calculus"(Webster's Dictionary)

What is modeling and data analysis? (continued)

- Modeling
  - "a system or thing used as an example to follow or imitate" (Webster's Dictionary)
  - "a simplified description, esp. a mathematical one, of a system or process, to assist calculations and predictions" (Webster's Dictionary)
  - ***Predictions*** - once you have a good model, you can use it to help answer fundamental questions by creating predictions of the specific cognition, behavior, etc you are studying, and compare predictions to reality

About our expectations of you

- This course does not assume that you lived every day programming since you took CogSci 18
- Assuming that you took the intro to programming or are taking concurrently, and so have some sense of what programming is, but do not necessarily remember all details
- We will review and define mathematical and programming concepts as we go
- It will require an open mind on your part and effort

Why this course is important for everybody

- No matter what you do in life, being able to take in information, organize it, do something with it, and then communicate with others is key
- These specific techniques are very basic to scientific research
- It is a language to speak and understand

Four main parts to course

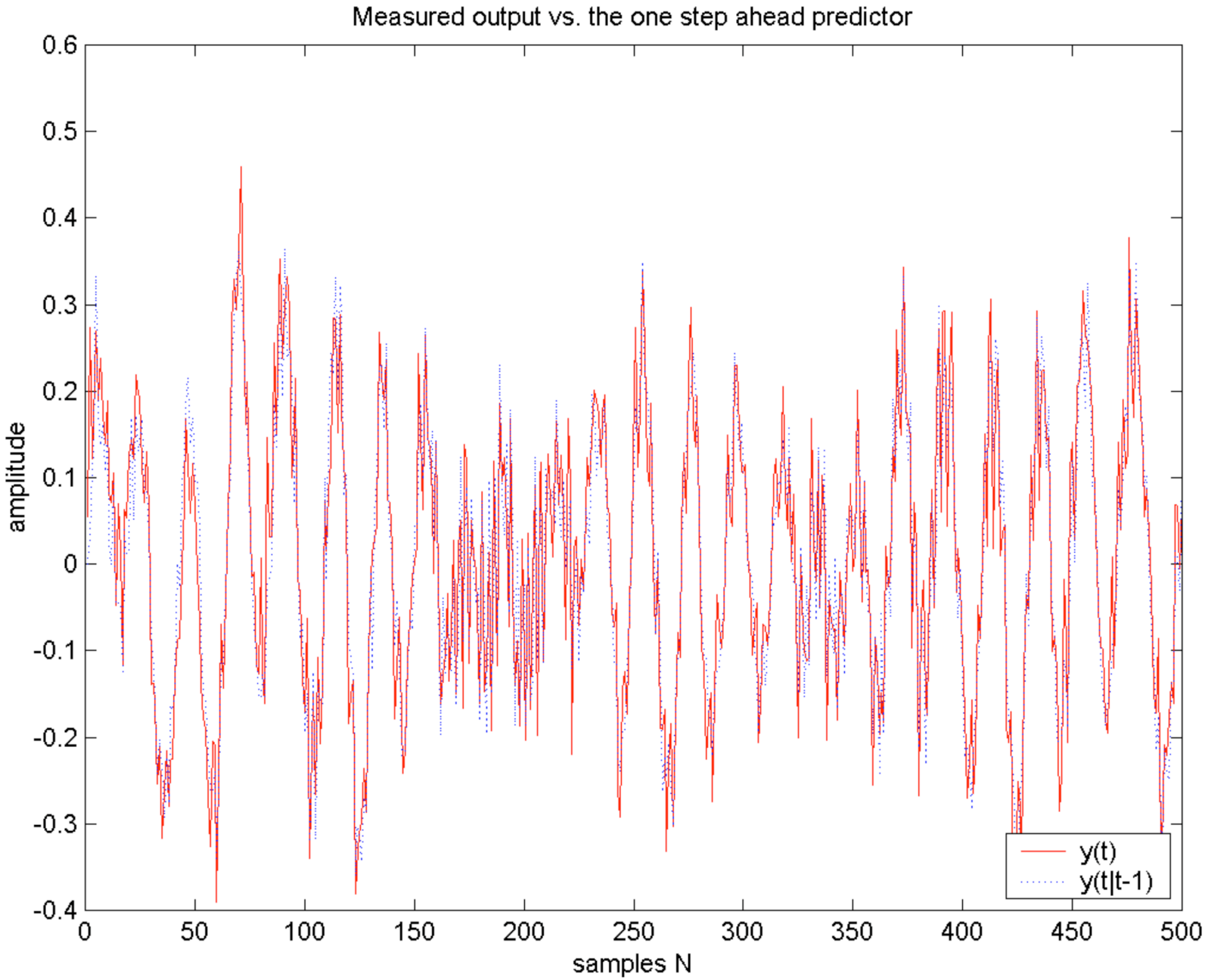
1. Data manipulation and processing
2. Extracting basic information from data and visualizing that info
3. Modeling the data and evaluating those models, data fits
4. presenting and communicating results

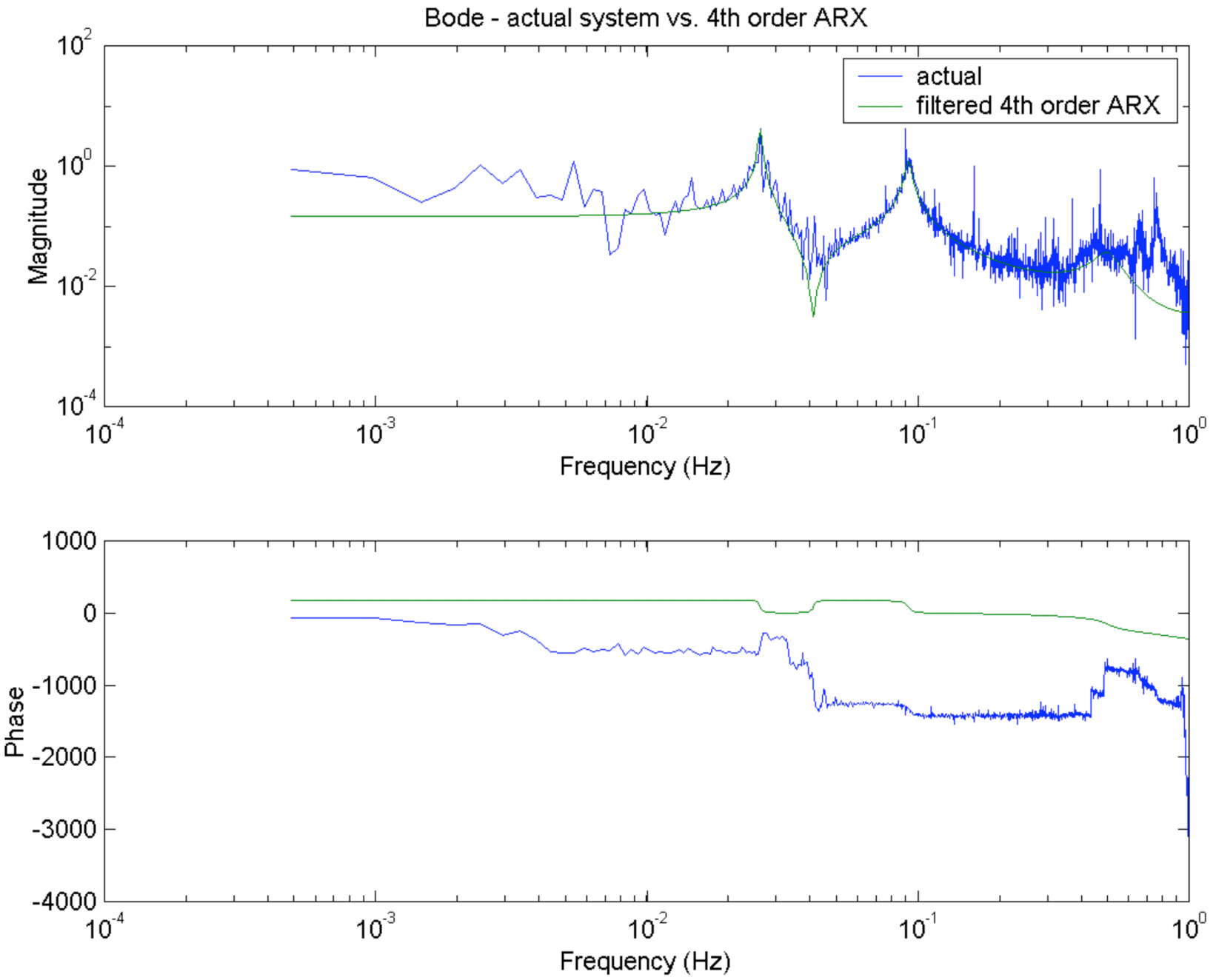
What you will be able to do by the end of this course

- Use Matlab and other tools
- Recognize, Categorize, and Manipulate data of various forms
  - **Load**
  - **Sort**
  - **Filter**
  - **Rearrange/size, etc**

What you will be able to do (continued)

- Extract basic information from that data
  - **Standard statistics (mean, median, mode, standard deviation, correlation, variance, covariance, etc)**
  - **Basic Hypothesis testing**
- Visualize the data from multiple perspectives
  - **2D plots**
  - **3D plots**
  - **Charts**
  - **Color plots/contour plots**
  - **Basic volume visualization**


Measured output vs. the one step ahead predictor
amplitude
samples N
y(t)
y(t|t-1)
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
0
50
100
150
200
250
300
350
400
450
500


Bode - actual system vs. 4th order ARX
actual
filtered 4th order ARX
Magnitude
Frequency (Hz)
Phase
Frequency (Hz)

What you will be able to do (continued)

- Create models from the data which approximate the behavior of the system
  - **Using linear and nonlinear methods of fitting models**
    - Least squares
    - Fminsearch
    - Gradient descent
  - **Multiple criteria for fit properties (goodness of fit, etc)**
  - **Perform basic simulations**

What you will be able to do (continued)

- Communicate results effectively
- Communicate with others
- Read and understand the literature, speak/understand the language
- Know how to look for more information
  - **Expand your knowledge**
  - **Where to go from here**
  - **Pitfalls to avoid**

Logistics of the course

- Course page
  - **http://maelabs.ucsd.edu/alex/pages/cogsci109_fa07**
- Grading (Fill the bucket ~ 1000pts)
  - **1 Midterm 20%**
  - **~7 Homeworks 50%**
    - Each week, due Mondays, turn in during class
  - **1 Final 30% (a portion takehome)**
  - **Possibly a group project (depends on time)**
  - **Bonus (TBA) - many opportunities to do well**

Logistics (Continued)

- Labs
  - **Discussions once a week (required attendance at the one you signed up for)**
  - **Review material from the week, hands on experience, Q&A, homework help**
- Office hours locations and dates/times TBA
  - **3 per TA and by appointment**
  - **5 for instructor and by appointment**
  - **Variety of times/days so everyone can go to at least some**
  - **We're here for you! We want to help!**

We want you to work together!

But…

- Please don't cheat!
- That said, we need to define what's ok, what's not
  - **On homeworks** - ***you are welcome to discuss material, homeworks and so on, but you must write your own code and write-ups (no copy and pasting)***
  - **On tests** - ***no collaboration, no information from external sources that are unapproved (no electronic internet or other devices), no discussion with anyone but TA's or instructor. They may give hints but not answers***
- Standard UCSD academic honesty policies also apply

A final word…

- We are all here to do our best to help you learn and succeed
- We all want this to be a positive experience for you that you can continue to gain from over the years to come

Matlab Demos and Introduction