

# 2016 Network Science IGERT Boot Camp

**Dates:** 6 September -- 16 September 2016

**Location:** Network Science Lab, Bldg 434, Rm 122

A two-week course, held just before the start of the academic year, meant to introduce and refresh skills around programming, software, and data.

## **Staff/Mentors:**

- Dr. Ben Best, PhD Duke
- Yi Ding, PhD student, Computer Science
- Dr. Luca Foschini, PhD UC Santa Barbara
- Minh Hoang, PhD student, Computer Science
- Alex Jones, PhD student, Computer Science
- Arlei Lopes da Silva, PhD student, Computer Science
- Wenjun Mei, PhD student, Mechanical Engineering
- Shadi Mohagheghi, PhD student, Electrical and Computer Engineering
- Steven Munn, PhD student, Electrical and Computer Engineering

## **Project Presentations (delivered the last day of camp):**

- **Modeling Disease Propagation over Networks**  
Trainees: Isaac Mackey, Jacob Fisher, Taom Sakal  
Mentor: Shadi Mohagheghi
- **Is it What You Publish, or Who You Publish With?**  
Trainees: Furkan Kocayusufoglu, Freddy Hopp, Xiaoming Duan  
Mentor: Yi Ding
- **Bikeshare Projects: A Bayesian Network Approach**  
Trainees: Pedro Cisneros, Rachel Redberg, Devin Cornell  
Mentor: Minh Hoang
- **Ship Routing to Avoid Whale Strikes with Least Cost Routes**  
Trainees: David Grimsman, Christina Awadalla  
Mentor: Ben Best

## Schedule

Mon, Sept 5	Tues, Sept 6	Weds, Sept 7	Thurs, Sept 8	Fri, Sept 9
Labor Day	9:30 Program Overview, Prof. John Mohr (Sociology)  11:00 Lab Resources  1:30 Project Pitching	9:30 Lecture: <i>Reproducible            Science Tools</i>  11:30 Break for lunch  Afternoon: Projects	9:30 Lecture: <i>Everything Data</i>  11:30 Lunch with Prof. Francesco Bullo (Mech Engr)  Afternoon: Projects	9:30 Lecture: <i>Probability &amp;            Statistics</i>  11:30 am Break for lunch  Afternoon: Projects

Mon, Sept 12	Tues, Sept 13	Weds, Sept 14	Thurs, Sept 15	Fri, Sept 16
9:30 Lecture: <i>Linear Algebra</i>  11:30 Lunch with Prof. Ambuj Singh (Com Sci)  Afternoon: Work on projects	9:30 Lecture: <i>Graph Algorithms</i>  11:30 Break for lunch  Afternoon: Work on projects	9:30 Lecture: <i>Machine Learning</i>  11:30 Lunch with Prof. Susan Cassels (Geography)  Afternoon: Work on projects	9:30 Projects  11:30 Break for lunch  Afternoon: Projects	9:30 Presentations

### Introduction to Bootcamp / IGERT Program Overview

Date: Tues, September 6 Time: 9:30 am -- 11:30 am Instructors: John Mohr Format: Panel, meet-and-greet	Goals/Outline:  Panel discussion and overview of the boot camp. Each of the panelists will discuss his research. We will also discuss the IGERT program.  Immediately following the talk, the participants will receive an introduction to the lab resources with a tutorial on accessing machines.
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### 1. Reproducible Science Tools

<p>Date: Weds, September 7  Time: 9:30 am -- 11:30 am  Instructor: Ben Best  Format: lecture</p>	<p>Module Goals/Outline: <a href="#">day02.ipynb</a></p> <ul style="list-style-type: none"> <li>● Data Science</li> <li>● Versioning with Git &amp; Github</li> <li>● Python using Jupyter Notebook</li> <li>● Python Basics</li> <li>● Graphs with Python *</li> <li>● Reading Tabular Data with Pandas *</li> </ul> <p>* time permitting</p>
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## 2. Everything Data

<p>Date: Thursday, September 8  Time: 9:30 am -- 11:30 am  Instructor: Luca Foschini  Format: lecture</p>	<p>Module Goals/Outline:</p> <ul style="list-style-type: none"> <li>● What is data? Data representation in a computer</li> <li>● Native data types in Python: integer, list, dict, numpy arrays, pandas</li> <li>● From simple to complex: text, time series, networks, geometric objects</li> <li>● Discuss complexity of manipulation of these objects.</li> <li>● Load and visualize different datasets on Python</li> </ul>
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## 3. Probability & Statistics

<p>Date: Friday, September 9  Time: 9:30 am -- 11:30 am  Instructor: Minh Hoang  Format: lecture</p>	<p>Module Goals/Outline:</p> <ul style="list-style-type: none"> <li>● Basic probability and combinatorics.</li> <li>● Bernoulli trials. Expectation. Variance.</li> <li>● Significance, confidence intervals, and p-values</li> </ul>
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#### 4. Linear Algebra for Networks and Graphs

Date: Mon, September 12  
 Time: 9:30 am -- 11:30 am  
 Instructor: Wenjun Mei  
 Format: lecture

Module Goals/Outline:

- Matrix Theory (Discrete-Time Linear, Row-Column Stochastic Matrices, PF Theorem)
- Graph Theory (Paths and Connectivity, Weighted Digraphs, Algebraic Graph Theory, Irreducible and Primitive Matrices, Laplacian Matrix in mechanical/electrical systems, Connectivity and Laplacian, Incidence Matrix)
- Averaging Systems

#### 5. Graph Algorithms

Date: Tues, September 13  
 Time: 9:30 am -- 11:30 am  
 Instructor: Arlei Lopes da Silva  
 Format: lecture

Module Goals/Outline:

- Overview
- Shortest paths
- Maximum flow
- Traveling Salesman Problem

#### 6. Intro to Machine Learning

Date: Weds, September 14  
 Time: 9:30 am -- 11:30 am  
 Instructor: Arlei Lopes da Silva  
 Format: lecture

Module Goals/Outline:

- Overview of machine learning
- Support Vector Machines
- Expectation-Maximization