Instructor: Marta C. González, 1-153, Phone: 617-715-4140

Office Hours: Fridays 11-12 PM, after class or by appointment

Readings: PDFs of relevant book chapters and articles will be available on-line

Prerequisites:* 1.001 and 1.010 or any programming experience.

Course Outline:

Week 1: Opening
Sept 5:
- Course Goals and Motivation.
- Students presentation and expectations.

Week 2: Extracting Behavior from Human Digital Traces
Sept 9:
- No Classes

Sept 11:
- Behavioral data identifying structure in routine
  1. Article Behavioral Ecology and Sociobiology (Eagle et al)

Week 3: Extracting Behavior from Human Digital Traces
Sept 16:
- Matlab Exercises to determine Eigenbehaviours

Sept 18:
- Student Group Guided Activity: Review Eigenbehaviours

Week 4:
Sept 23:

*or permission of instructor
• No Classes

Sept 25:

• Visualization Class

Week 5: Characterizing Urban Population Density
Sept 30:

• Modelling Urban Growth

Sept 2:

• Density of Population Exercises

1. Chapter 1, Ben-Avraham and Havlin. Diffusion and Reactions in Fractals and Disordered Systems
3. P. Ball, Why Society is a Complex Matter: Meeting Twenty-first Century Challenges with a New Kind of Science (Chapter 9)

Week 6: Commuting
Oct 7:

• Student Group Guided Activity: Review of Density of Populations and Cities

Oct 9:

• Models of Commuting

1. Article PloS ONE (Simini et al.)

Week 7: Human Mobility
Oct 14:

• Student Group Guided Activity: Review Models of Commuting

Oct 16:

• Parsing Trajectories

1. Project Lachesis: Parsing and Modeling Location Histories.

Week 8: Human Mobility
Oct 21:

• Individual Mobility Patterns

Oct 23:

• Student Group Guided Activity: Review Individual Trajectories
1. Nature Article: Human Travel Patterns (Brochmann et al.)
2. Nature Article: Individual Travel Patterns (Gonzalez et al.)

Week 9: Human Mobility and Networks
Oct 28:

● Introduction to Networks

Oct 30:

● Student Group Guided Activity: Visualizing Trajectories

1. Processing.org documentation and examples.

Week 10: Networks Science
Nov 4:

● Networks Measures

Nov 6:

● Student Group Guided Activity: Review Network Models


Week 11: Networks Science
Nov 13:

● Spatial Networks

● Article EPJB "The Spatial Structures of Networks" (Gastner et al.)
● Review Physics Reports Spatial Networks (Marc Barthelemy)

Week 12: Network Science
Nov 18:

● Project Plan Presentations

Nov 20: Spatial Networks

1. Article EPJB "The Spatial Structures of Networks" (Gastner et al.)
2. Review Physics Reports Spatial Networks (Marc Barthelemy)

Week 13: Networks Science
Nov 25:

● Structure of the Air Transportation Network
Nov 27:

- Thanksgiving Day

1. Article PNAS: Air Transportation Networks (Guimera et al.)
2. Article PNAS: Weighted Networks (Vespignani et al.)

**Week 14: Networks Science**

Dec 2:

- Structure of Urban Movements: Polycentric Activity and Entangled Hierarchical Flows

Dec 4:

- Wrap-up and Questions about the project presentations


**Week 15: Projects Presentation**

Dec 9:

- Final Projects due

Dec 11:

- Final Projects due

**Evaluation**

Assignments (4x15%) .......................................................... 60%

1. HW1 Eigenbehaviours due 09/25
2. HW2 Density of Population 10/14
3. HW3 Human Travels, due 10/28
4. HW4 Networks Properties, due 11/13

Guided Activity ........................................................... 20%

1. Group 1 Eigenbehaviours, on 09/18
2. Group 2 Density of Population, on 10/07
3. Group 3 Commuting, on 10/14
4. Group 4 Human Trajectories, on 10/23
5. Group 5 Vizualizing Trajectories, on 10/30
6. Group 6 Networks Models, on 11/06

Project ................................................................. 20%
1. Project Plan Presentations, due 11/20 (%5)
2. Final presentation, due 12/09 & 12/11 (%5)
3. Final written report, due 12/07 (%10)

1. Project Option Eigenbehaviors: Jiang et. al Clustering Daily Patterns of Human Activities in the City.


3. Project Option Individual Mobility: Chaoming Song, et al., Limits of Predictability in Human Mobility, Science 327, 1018 (2010);

4. Project Option Individual Mobility: Nature Physics Article, Modelling the scaling properties of human mobility (Song et al.)

5. Project Option Individual Mobility: Unravelling Daily Mobility Motifs (Schneider et. al)

6. Project Option Population Density: Collective behavior in the spatial spreading of obesity (Makse et.al)

7. Project Option Population Desity: Laws of population growth (Stanley et. al)

8. Project Option Commuting: Article PNAS: Multiscale mobility networks and the spatial spreading of infectious diseases (Balcan et al.)

9. Project Option Networks and Mobility: Spatial Networks a Review (Marc Barthélemy)

10. Project Option: Networks and Mobility: Understanding metropolitan patterns of daily encounters (Axhausen et al.)

11. Project Option: Networks and Mobility: User Movement in Location-Based Social Networks (Leskovec et al.).


13. Project Option: Review Physics Reports Spatial Networks (Marc Barthelemy)

14. Project Option Networks: Article PRL ”Modeling Urban Street Patterns” (Barthélémy et al.)

15. Project Option Networks: Article PRL ”Networks and Cities: An information Perspective” (Rosvall et al.)

16. Project Option Networks: Article PRL ”Price of Anarchy in Transportation Networks” (Youn et al.)