

**Course 1.204 From Human Mobility to Transportation Networks**  
**Fall 2011**  
**1:00 - 2:30 PM, Room: 1-132**

---

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

**Office Hours:** Fri. 10:00-11:00 AM or by appointment

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

**Prerequisites:\*** 1.001 and 1.010

**Course Outline:**

Week 1

Sept 7:

- Course Goals and Motivation. Students presentation and expectations.
  - Road map of the course
1. Article: Rhythms of social interaction: messaging within a massive online network (Scott Golder, Dennis Wilkinson, and Bernardo Huberman)

Week 2

Sept 12:

- Behavioral data identifying structure in routine

Sept 14:

- Matlab Exercises to determine Eigenbehaviours
1. Article: Eigenbehaviors: identifying structure in routine (Nathan Eagle & Alex Sandy Pentland)

Week 3

Sept 19:

- Fractals

Sept 21:

- Matlab Exercises Fractals
1. Book: Chapter 1, Ben-Avraham and Havlin. Diffusion and Reactions in Fractals and Disordered Systems
  2. Article: Geographic routing in social networks (David Liben-Nowell, Jasmine Novak, Ravi Kumar, Prabhakar Raghavan, and Andrew Tomkins)

Week 4

Sep 26:

- Continuous Time Random Walk and the Dollar Bill Experiment.

Sep 28:

- Exercises in Perl to parse GPS Trajectories.

---

\*or permission of instructor

1. Nature Article: Human Travel Patterns (Brochmann et al.)
2. IFOCOM2006: Extracting a mobility model from real user traces. (M. Kim, D. Kotz and S. Kim)
3. **Project Option:** Project Lachesis: Parsing and Modeling Location Histories.

## Week 6

Oct 3:

- Analyzing Individual Travel at Large Scales.

Oct 5:

- Exercises Analyzing Trajectories.

1. Nature Article: Understanding individual human mobility patterns (González et al.)
2. Science Article: Limits of Predictability in Human Mobility (Song et al.)
3. **Project Option:** Nature Physics Article, Modelling the scaling properties of human mobility (Song et al.)

## Week 7

Oct 17:

- Introduction to Complex Networks

Oct 19:

- Exercises Complex Networks

1. Review Physics Reports Spatial Networks (Marc Barthélémy)
2. Optional Reading: Review Physics Reports "Complex Networks: Structure and Dynamics" (Boccaletti et al.)
3. Optional Reading: Review of Modern Physics "Statistical mechanics of complex networks" (Albert et al.)

## Week 8

Oct 24:

- Properties of Complex Networks

Oct 26:

- Distinguished Engineering and Science Speakers Seminar Series László Barabási.

1. Review Physics Reports Spatial Networks (Marc Barthélémy)
2. Optional Reading: Review Physics Reports "Complex Networks: Structure and Dynamics" (Boccaletti et al.)
3. Optional Reading: Review of Modern Physics "Statistical mechanics of complex networks" (Albert et al.)

## Week 9

Oct 31: Exercises Networks

- 

Nov 2: Modelling Transportation Networks (Air Transportation)

- 

1. Article PNAS: "The Architecture of complex weighted networks" (Barrat et al.)
2. Article PNAS: "The worldwide air transportation network" (Guimerá et al.) **Project Option:** Finding and evaluating community structure in networks (M. E. J. Newman and M. Girvan) Optional: Nature Article, Functional cartography of complex metabolic networks (Roger Guimera & Lus A. Nuñez Amaral)

## Week 10

Nov 7:

- Exercises Air Transportation Networks

Nov 9:

- Modelling Spatial Networks

1. Article PRE "The Spatial Structures of Networks" (Gastner et al.)
2. **Project Option:** Article PRL "Modeling Urban Street Patterns" (Barthélemy et al.)
3. **Project Option:** Article PRL "Networks and Cities: An information Perspective" (Rosvall et al.)
4. **Project Option:** Article PRL "Price of Anarchy in Transportation Networks" (Youn et al.)

### Week 11

Nov 14:

- Exercises Fitting Power Laws

Nov 16:

- Presentations of Papers and Work Projects

1. Article PLoS ONE: "Commuting in a Polycentric City" (Roth et al.)
2. **Project Option:** Environment and Planning B "The structure of Inter-Urban traffic: A weighted network analysis" (De Montis et al.)

### Week 12

Nov 21:

- No Classes (Project Preparation)

Nov 23:

- No Classes (Project Preparation)

### Week 13

Nov 28:

- Measuring Commuting (Gravity Model)

Nov 30:

- Commuting Networks

1. Book: Chapter 5, Modelling Transport, Ortúzar and Willumsen.
2. Article Science: Synchrony, Waves, and Spatial Hierarchies in the Spread of Influenza (Viboud et al.)
3. Article PNAS: Multiscale mobility networks and the large scale spreading of infectious diseases (Balcan et al.)

### Week 14

Dec 5:

- Final Projects due

Dec 7:

- Final Projects due

## Evaluation

In-class Participation (Especially Reading Connections) .....5%

Assignments ( $5 \times 15\%$ ) .....75%

1. HW1 Eigenbehaviours, due 09/24
2. HW2 Fractals, due 10/05
3. HW3 Human Trajectories, due 10/19
4. HW4 Characterizing and Modelling Networks, due 11/02
5. HW5 Papers Review and Project Ideas, due 11/16

Project .....20%

1. Final presentation, due 12/07 (%10)
2. Final written report, due 12/14 (%10)