



**POLITECNICO**  
MILANO 1863



**PhD Course:**

***Planning and Resource Management  
Models in Wireless Networks***

**Ilario Filippini**

# Logistics

- **Web page:** <http://www.antlab.polimi.it/teaching-filippini/planning-and-resource-management-models-in-wireless-networks>
  - In alternative: [www.antlab.polimi.it](http://www.antlab.polimi.it) → Staff → Ilario Filippini → Teaching → Planning and Resource Management Models in Wireless Networks
- **About 8 classes of 3 hours each, all in "Aula 3B" room**
  1. Jan 26th 2pm-5pm
  2. Feb 1st 2pm-5pm
  3. Feb 2nd 2pm-5pm
  4. Feb 9th 2pm-5pm
  5. Feb 14th 2pm-5pm
  6. Feb 16th 2pm-5pm
  7. ~~Feb 21st 2pm-5pm~~
  8. Feb 23rd 2pm-5pm
  9. Feb 28th 2pm-5pm
  10. Mar 2nd 2pm-5pm
- **I'll inform you via email in case of changes**



# How the course will be carried out?

- **Slides to introduce topics**
- **Active participation and discussion**
- **Final presentation of a scientific papers**



# Final presentation

- **Reading, presenting and discussing a scientific paper**
- **Which paper?**
  - Assigned by the instructor
  - Proposed by you, after instructor's approval
- **A small and course-related research problem is fine as well**
- **When?**
  - After the last class of the course
  - On spontaneous agreement among at least 2-3 participants
    - Date, time and place fixed ad-hoc
    - Other participants can attend the presentation



# About me

- **Ilario Filippini**
  - [ilario.filippini@polimi.it](mailto:ilario.filippini@polimi.it)
  - 02 2399 3657
  - Room 335, third floor, Building 20
- **Assistant Professor at DEIB since 2011**
- **Research**
  - Advanced Network Technologies Lab
  - Research on Wireless Networks Planning and Resource Optimization since 2006
    - PhD thesis: Planning and Optimization of Heterogeneous Wireless multi-hop Networks in 2009



# Course Topics

- **Planning Cellular Networks:**
  - Everything has started from the Set Covering Problem
- **Meshed Wireless Networks:**
  - Dealing with Wireless Backbones
- **Networks for sensing:**
  - Connectivity and physical measurements
- **Resource management**
  - Scheduling and Routing
- **GT and Mechanism Design in Wireless Networks**
  - Example 1: Spectrum Allocation in CRNs
  - Example 2: AP Offloading in WCMNs
- **Advanced Aspects**
  - Joint planning and operation
  - Robust Routing
- **How to solve MILP models**
  - Modeling Languages and solvers
  - Instances and Results management
  - Heuristics for MILP



# Tools and Methodologies

- **Tools**

- Mathematical Programming and Optimization Theory
- Game Theory (a little)
- Mechanism design (even less)

- **Methodologies**

- Assuming little knowledge on Mathematical Programming
- Explaining typical problems to be faced in Wireless Networks
- Showing approaches, tools and suggestions to model and optimize



# Models and Optimization

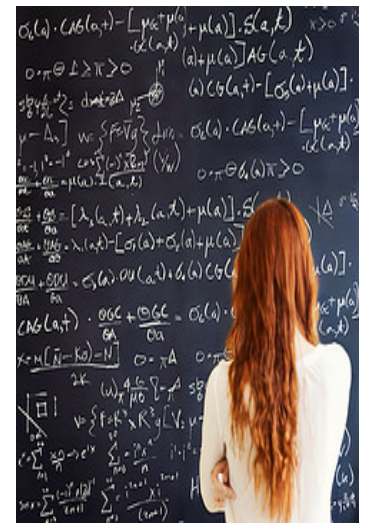
- **Optimization**
  - Fast and efficient tools to solve max/min problems over limited set of resources
  - Big classification of general problems with specific solution techniques
- **Modeling**
  - Way to formally and unambiguously describe a problem
  - Different domains: Mathematical programming models, Games, Auctions, etc.
- **Why is modeling important?**
  - Solving efficiency depends on how “well” you model the problem
  - Right problem with the right tool
  - Fitting a problem in a category of well-known problems allows to find easy ways to solve it





# Modeling

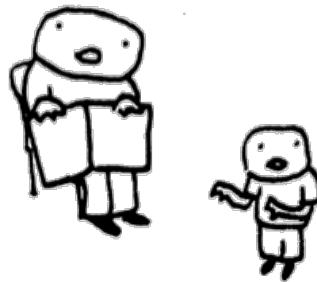
- **Is there a recipe for good modeling?**
  - No
- **Is there a book to learn modeling?**
  - Neither
- **Can we easily say a model is correct?**
  - Ehm... Guess!
- **So? Why are you there?**
- **Modeling is like inventing**
  - You need to know the field
  - You can benefit from seeing other inventions
  - You must use imagination



# Modeling in this course

- A (long) travel among Wireless Networks' most important issues
- Showcase of nice (!?!) tools to capture main aspects
- Exposition to many ways of modeling wireless networks behavior
- Discussion on potentials and limits
- **As for imagination...**

it's a book, use  
your imagination



what's imagination?  
is that an app?

