Mathematical Modelling for Computer Networking

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Mathematical Modelling for Computer Networks

- Networking systems such as the Internet are becoming versatile, complex and indispensable in our lives
- Mathematical methods to model, analyse and design of vast and complex computer networks and their protocols have become increasingly important
- The course aims at giving a network engineer an appreciation of the role of (some of) these techniques in the design of modern computer networks

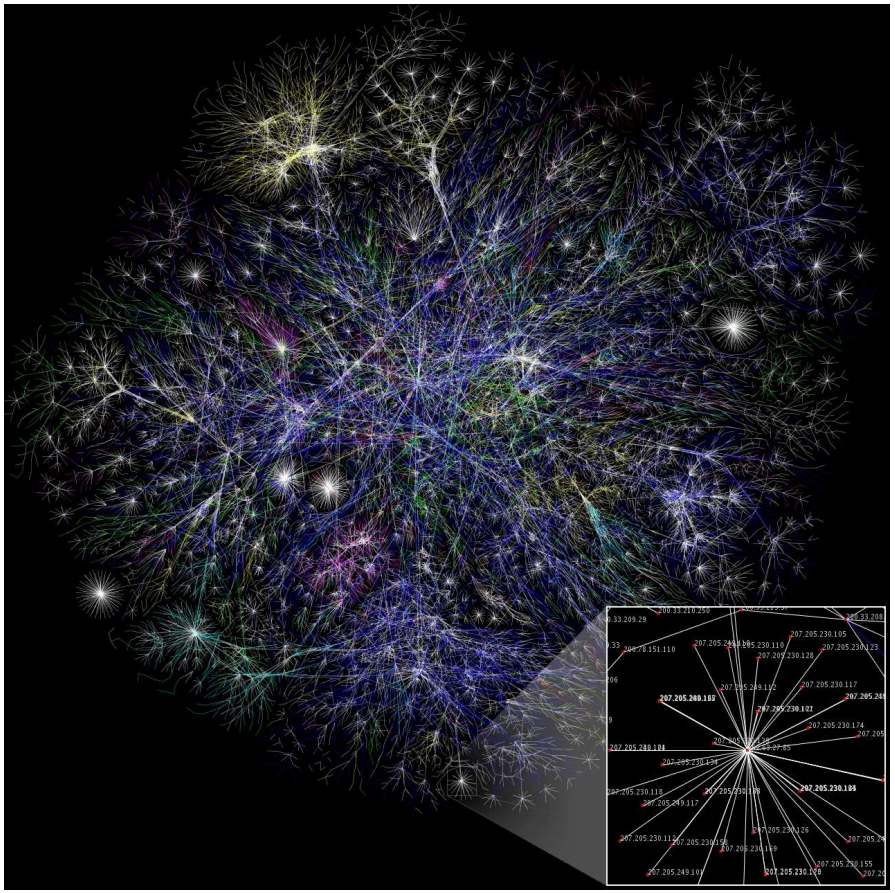
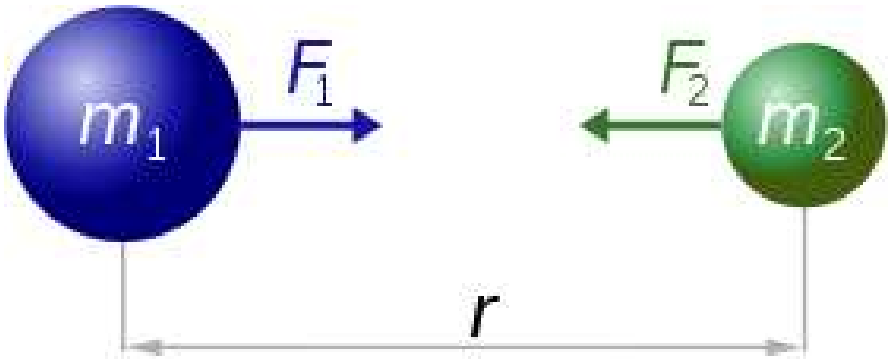


Figure: Visualization of the various routes through a portion of the Internet (Wikipedia)

Newton's laws: An example of a Mathematical Model

- Newton's laws of mechanics: a foremost mathematical model
- Model is simple and powerful
- Modelling as an abstraction
- A good model
  - Easy to analyze
  - Make predictions that can be verified by experiments/observations
- Kepler's planetary laws as consequences of Newtons laws of mechanics



$$F_1 = F_2 = G\frac{m_1 \times m_2}{r^2}$$

Figure: Newton's Law of Gravitation

Feynman on The Principle of Science

- The principle of science, the definition almost, is the following: The test of all knowledge is experiment. Experiment is the sole judge of scientific truth. But what is the source of knowledge? Where do the laws that are to be tested come from? Experiment, itself, helps to produce these laws, in the sense that it give us hints. But also needed is imagination to create from these hints the great generalizations to guess at the wonderful, simple, but very strange pattern beneath them all, and then to experiment to check again whether we made the right guess.

Mathematical Methods for Computer Networks

- New optional course
- 2 Cr Course
- Course Duration: Six weeks
- Masters and Research level students
- Prerequisites: A first course in Data Communication and (or) Computer Networks. A Basic familiarity with Calculus, Probability theory and Algebra

Structure of the Course: Modules

- Convex Optimization and Congestion Control (3 lectures)
- Markov Chains and Multiaccess Protocols (3 lectures)

Teaching and Assessment Methods

- Lecture classes: one, 2hrs class per week
- Exercise classes: one, 2 hrs class per week
- Exam: Multiple choice type and short answer type
- Course exam (max. 50 points available, min. 25 points required for passing)
- Active participation in the weekly exercises that may give max. 10 points.
- A passing grade requires at least 30 points in total.

Approach in the main lectures

- We study a networking problem by introducing its mathematical model
- The objective is to show the correspondence between networking concepts and mathematical model
- The focus is on intuition, insight, motivation that underlie the correspondence
- Prior familiarity with mathematical details is not necessary
- We develop the mathematics in the exercise meetings
- Please ask questions during the lectures!
- Lecture notes and slides will be continuously updated to improve readability
- Check the announcements in the course page for the latest info in the course