Fundamentals of Communication Networks

Prof. Antonio Capone
Teacher

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  - Martedì 14.00-15.30
Exams

- Written and oral exam
  - 4 Numerical exercises
  - 1 Set of questions
  - Oral exam if written score $\geq 15$
Reference books:

Teaching material (2)

- Other books
  - Fred Halsall, “Data Communications, Computer Networks, and Open Systems” Addison-Wesley
  - Behrouz A. Forouzan, TCP/IP protocol suite, McGraw-Hill
  - Douglas E. Comer, *Internetworking with TCP/IP*, Addison-Wesley
Teaching material (3)

- Lecture slides
- Other material and links
- Course web site
Fundamentals of Communication Networks

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(Office hours: please check this page for information and updates)

Fundamentals of Communications Networks (5 credits) is a mandatory course assigned by the admission committee of the master of science in Telecommunication Engineering to students with limited background in basic networking.

News

! Course starts on March 12, 2014

EXAMS (2013-2014):

Dates:

• TBA

EXAM RESULTS (AA 2013-2014):

• TBA
Course objective

- Provide you the basics of computer networks
- Present you the “building blocks” of the Internet

This basic knowledge is fundamental for the advanced topics covered by most of the other courses of the MSc program.
Background

Software applications exchange information with remote applications for communicating they use: The INTERNET.

Communications uses physical media and are subject to rules (protocols).

We will deal with:
- How to support communications
- Protocols used at different layers
- Network infrastructures
Probability Theory

- In addition to Communication Networks, the course provides also the basics of probability theory.
- This is instrumental to some advanced course of networking like Traffic Theory, but also to other courses of the study program.
Course program

Basics of probability theory

- Probabilities
  - Definitions
  - Uniform spaces
  - Conditional spaces
  - Bayes’ Formulas
  - Statistical independence

- Random Variables
  - Spaces with infinite outcomes
  - Continuous Random Variables
  - Discrete Random Variables
  - Moments of a pdf
  - Conditional distributions and densities
  - Vectorial Random Variables
  - Functions of Random Variables
Course program

- Functional models
  - Protocols
  - Communication services
  - Stack models and main functions

- Physical layer
  - Multiplexing
  - Multiple access
  - Transport networks

- Link layer
  - Framing
  - Error control
  - Retransmission
  - Flow control
  - Link protocol example (HDLC)
Course program

- Local Area Networks
  - Random access
  - Ethernet
  - Bridging
- Internet architecture
- Network layer: IP
  - Addressing
  - Forwarding and routing
  - Control protocols
  - Routing protocols
Course program

- Transport layer
  - UDP
  - TCP

- Application layer
  - Name management: DNS
  - File transfer: FTP
  - Web Browsing: HTTP
  - E-mail: (SMTP)
  - Peer-To-Peer applications

- Private networks
  - Private addressing
  - Tunnels
  - NAT

- MPLS
- IPv6
Introduction

Fundamentals of Communication Networks
A bit of history
The born of the Internet: 60s

- **1961**: Kleinrock – shows the effectiveness of packet switching with queuing theory

- **1967**: Lawrence Roberts designs ARPAnet (Advanced Research Projects Agency)

- **1969**: first network node IMP (Interface Message Processor) di ARPAnet at UCLA
The born of the Internet: 70s

- **1972:**
  - NCP (Network Control Protocol) the first Internet protocol
  - First email application
  - ARPAnet has 15 nodes

- **1970:**
  - ALOHAnet radio packet network at Univ. of Hawaii

- **1974:**
  - Cerf and Kahn – design internetworking (network of networks) principles

- **1976:**
  - Ethernet is designed in the Xerox labs

- **1979:**
  - ARPAnet has 200 nodes
The born of the Internet: 80s

- 1982: SMTP for email is defined
- 1983: TCP/IP suite replaces NCP
- 1983: DNS is defined for mapping of names and addresses
- 1985: FTP protocol
- 1988: congestion control of TCP
- New national networks: Csnet, BITnet, NSFnet, Minitel
- 100,000 hosts
First applications

- Telnet
- Email
- FTP
The born of the Internet: 90s

- **1990**: ARPAnet is discontinued
- **1991**: NSF allows commercial use of NSFnet
- First 90s: Tim Berners-Lee invents the web at Cern in Genève
- **1994**: First browser Mosaic, then Netscape
- End of 90s: explosion of commercial use of the Web
The born of the Internet: 2000s

2000s:
- New “killer applications”: instant messaging, P2P file sharing, IP Telephony, social networks
- Network security
- Billions of users
- Link speeds up to few Gbps
The born of the Internet: 10s

10s - today:
- Mobile internet
- iPhone
- Android
- Application markets
World is small
## Internet vs mobile networks

**Per 100 inhabitants**

- **96** mobile subscribers
- **16** fixed lines
- **39** internet users
- **10** fixed-broadband
- **29** mobile-broadband

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*Source: ITU*

*Data: 2012*