



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Distributed Systems

2324-2-E3101Q112

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#### Aims

Students will know the characteristic properties, communication models and reference organizations of concurrent, client-server, and peer-to-peer distributed systems. They will be able to develop simple distributed applications in Web/Internet environments.

#### Contents

Concepts, models and architecture of concurrent and distributed systems. Fundamentals of design and behavior of distributed systems, with specific reference to the Web and the Internet.

#### Detailed program

1. Basic concepts: definition and characteristic properties; client-server and peer-to-peer models; Software architectures (layers vs tiers); naming, identifier, and address (URI e DNS);
2. Basic technologies  
Socket TCP/IP: client-server and application protocols. Client/server and peer-to-peer models.  
Communication by procedure call: Remote Procedure Call (RPC) and Remote Object Invocation (Java RMI).
3. Web Applications  
Web Foundations (URI & HTTP) HTTP request/response. Web applications:  
servlet/JSP Pattern MVC. Client Web: Browser: Rich Interface Applications (Ajax).  
Web services: REST and Web API.
4. Dynamic Web applications  
Introduction to JavaScript and AJAX techniques. Sample web applications: basic JavaScript examples,

- debugging, dynamic web page modification, remote services invocation
5. HTML5 & CSS as a model for data representation and presentation. XML/ JSON as a model for data transfer RDF as a data model for the semantic web, simple mashups.
  6. Concurrent programming: synchronization and monitors. Models based on shared memory multi-thread programming in Java. Hints of finite-state automata modeling.

## Prerequisites

Principles of Object-Oriented programming in java and Junit tests (Programming 2); Process and Interprocess Communication (Network and Operating Systems); TCP/IP protocol (Networks and Operating Systems); Markup languages (XML and HTML), related manipulation tools, and Finite State Automata (Languages and Computability)

## Teaching form

The course includes theoretical and exercises lectures integrated by individual study activities with e-learning support. Individual and group laboratory activities to develop simple distributed systems and Web applications will be also part of the course.

Teaching language: Italian

## Textbook and teaching resource

On the e-learning site are available :

- slides of the lessons in pdf format.
- further material (articles to complete the reference texts, links to online resources, exercises to be carried out).
- equipment and solutions for exercises carried out in the laboratory.

Textbooks:

Distributed Systems: Principles and Paradigms - 2nd edition, Andrew S. Tanenbaum and Maarten van Steen, Pearson - Prentice Hall, 2007.

Already adopted in the course of Networks and Operating Systems:

Reti di calcolatori e internet – Un approccio top-down 4a Edizione, James F. Kurose, Keith W. Ross Addison Wesley – 2008, ISBN 9788871924557  
Chapter 1, 2

A. Silberschatz, P. Baer Galvin, G. Gagne, Sistemi operativi - Concetti ed esempi, 8/Ed. 2009, ISBN 9788871925691  
Chapter 3, 4, 6, 7, 16

## **Semester**

Second semester

## **Assessment method**

Examination: separate written test and optional oral exam -> up to 30 points

Laboratory -> up to 4 points

**The test deals with:**

**(a) questions on the concepts presented**

**(b) requests for reasoning and deduction**

**(c) resolution of exercises that require the development of a solution to an assigned problem**

### **Written test in the laboratory**

Phase 1: Fixed-choice questions. Admission to a second phase with 50% of correct answers.

Phase 2: Mixed questions (essay or fixed choice with comments)

The exam is passed with a score  $\geq 18/30$

### **Oral exam (optional)**

It consists on the restitution of written tests with discussion, and any additional questions at the teacher's discretion.

### **Laboratory**

Evaluation: final project -> up to 4 points (optional)

### **In itinere tests (replace exam)**

First test: Closed questions

Second test: Closed questions + mixed questions

Whoever has scored  $\geq 18/30$  in the first test is admitted to the second test. There are no recovery tests.

It is possible to make additional work projects (optional, evaluated)

FINAL VOTE = EXAMINATION (+ optional work project)

## **Office hours**

Prof. De Paoli: Thursday from 10:00 to 12:00 or by appointment by writing to [flavio.depaoli@unimib.it](mailto:flavio.depaoli@unimib.it)

Prof. Ciavotta: Tuesday from 12:30 to 14:30 by appointment.

Questions and discussions on teaching topics can be posed using the forums in e-learning.

## **Sustainable Development Goals**

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