

Introduction to the Course

Distributed Systems

Sistemi Distribuiti

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- 1 Distributed Systems: Why?
- 2 Distributed Systems: The Course



Next in Line...

- 1 Distributed Systems: Why?
- 2 Distributed Systems: The Course



Pervasive Computation & Interaction I

Nowadays, computational systems. . .

- . . . have become **pervasive**, since they are everywhere, and tend to affect every aspect of our everyday life and activity
- . . . are at the core of most (if not all) *artificial systems*, so that every principled discipline for modelling / engineering computational systems affects the modelling and engineering of almost every sort of artificial systems



Pervasive Computation & Interaction II

Pervasiveness of computations

- how many computational systems today in this room?
 - in our cars, at home, in the workplaces, in hospitals, in public places?
- we live immersed in a sort of *computational cloud*^a, where an incredible (and always increasing) number of computations are performed at every instant around us
 - **distributed**, *concurrent* computations
 - either controlled / triggered, or **autonomous** computations

^awe are not merely talking about Cloud Computing here



Pervasive Computation & Interaction III

Pervasiveness of interaction

- almost any computational system of today comes equipped with ICT technologies for **interacting** with other computational systems
- computational devices *continuously interact*
 - with humans
 - with each others
 - with the physical *environment* and its *resources*



Physical vs. Computational

The physical nature of artificial systems. . .

... adds complexity to computational components / systems

- in terms of **physical** *distribution*
- in terms of **temporal** *distribution*
- in terms of **unpredictability** of the scenarios



On the Notion of Distribution I

What is *spatially* distributed?

- computational units
- communication channels
- data / information / knowledge
 - along with their representations
- sensors, actuators, ...
 - the boundaries between the systems and the surrounding environment are topologically sparse



On the Notion of Distribution II

Spatio-temporal unity of systems is lost

- there is no longer a notion of *system time*, nor a system *location*
- system components, at different level of abstraction, are only *partially correlated*
 - temporally & spatially

A number of assumptions over systems no longer hold

- system **events** *no longer* constitute a totally-ordered set
 - generally speaking, partial ordering is the only feature
- admissible **interactions** among system components *no longer* depend on *compresence*
 - in space / time
 - within the same physical / virtual *topology*

Artificial Systems Nowadays I

Conceiving and constructing artificial systems. . .

- . . . nowadays means dealing with *distributed systems*
- whose core is represented by (distributed) *computational systems*
- which are to be *modelled* and *built*



Artificial Systems Nowadays II

Modelling distributed (artificial) systems. . .

- . . . involves new (theoretical) problems
- so, it requires new theoretical frameworks, models, abstractions, techniques
- mostly, computational ones
- ! it is one of the main objects of study of [computer science](#)



Artificial Systems Nowadays III

Building distributed (artificial) systems. . .

- . . . involves new (practical) problems
- so, it requires new technologies, infrastructures, methods, methodologies
- mostly, computational ones
- ! it is one of the main objects of study of **computer engineering**



Next in Line...

- 1 Distributed Systems: Why?
- 2 Distributed Systems: The Course**



Goals of the Course

Students of this course will...

- ... learn the *fundamental issues* of distributed systems
- ... re-think some of the most widely used *technologies* in nowadays distributed systems
 - **object-based** systems as a general trend in moving legacy models & technologies toward distributed systems
 - **web-based** and **mobile** systems as the most relevant case of today widespread *distributed, knowledge-intensive* systems
- ... take a look at some of the most promising *trends*
- ... experiment with *paradigms* and *technologies* for distributed computing and systems
 - **logic-based**, **agent-based** and **coordination-based** systems as general-purpose approaches for intelligent & pervasive systems

Material of the Course: Base Book

[Tanenbaum and van Steen, 2007a]

Tanenbaum, A. S. and van Steen, M. (2007)
Distributed Systems. Principles and Paradigms
Pearson Prentice Hall, Upper Saddle River, NJ, USA, 2nd edition.

[Tanenbaum and van Steen, 2007b]

Tanenbaum, A. S. and van Steen, M. (2007)
Sistemi Distribuiti
Pearson Education Italia, Torino, Italia, 2^a edizione.

This book represents a solid guide throughout the most “classic” part of the course—basics & issues

Material of the Course: Other Books I

[Coulouris et al., 2012]

Coulouris, G., Dollimore, J., Kindberg, T. and Blair, G. (2012)
Distributed Systems. Concepts and Design
Pearson

[Kshemkalyani and Singhal, 2011]

Kshemkalyani, A.D. and Singhal, M. (2011)
Distributed Computing. Principles, Algorithms, and Systems
Cambridge University Press

Material of the Course: Other Books II

[Birman, 2005]

Birman, K.P. (2005)

Reliable Distributed Systems. Technologies, Web Services, and Applications

Springer



Material of the Course: Slides

<http://apice.unibo.it/xwiki/bin/view/Courses/Sd1617Slides>

- slides will be available from the course web site
- along with any additional information—e.g., links, related literature, software, etc.



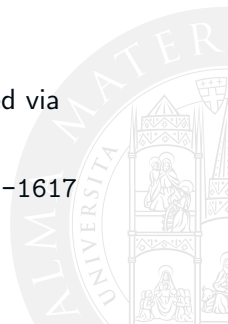
Timetable

<http://apice.unibo.it/xwiki/bin/view/Courses/Sd1617Schedule>

- Tuesday, h. 11-13, Lab 3 / Aula C, via Sacchi 3, Cesena
- Wednesday, h. 11-14, Room B, via Sacchi 3, Cesena

Any variation, extension, cancellation will be communicated via

- schedule page
- professor / students mailing list `andrea.omicini.SD-1617`



Organisation of the Course

Professors-students lists

- are provided by the ALMA MATER STUDIORUM
- mostly work
- are used here for *fast communication* from the professor

Please register *soon*...

- ... to the list `andrea.omicini.SD-1617`
- using password 1617SD
- ! like, say, [today](#)

Laboratory

<http://apice.unibo.it/xwiki/bin/view/Courses/Sd1617Lab>

- lab slides will be available from the lab web page
- along with any additional material—e.g., links, code, exercises

Lab classes will take place

- on (some) Tuesday, in Lab 3
- sometimes with the help of Dr. Ing. Stefano Mariani



Attitude toward the Course

Attending lessons is useful

- the topic is really general and rich of subtleties
- a lot of “implicit knowledge” is transferred orally

Material should be enough to pass the exam, anyway...

- ... for those who have problems attending lessons—like, worker students
- ... or, for those who just hate the professor's voice / face / slides / attitude / whatever

Exams I

Final exams

- consist by default of an oral discussion about the main themes of the course
- typically include some discussion of the lab exercises
 - “make it run and explain”
 - “slightly change the lab problem and make it run”
 - typically using your own portable, if available
- can be asked by at any time of the year, typically via email
 - then set according to the availability of the professor



Exams II

Projects

- a project can constitute an alternative path w.r.t. oral exam
- it should cover a specific topic of the course
- it may concern theoretical / technological / methodological aspects
- it may be developed by individuals or groups
- it has to be negotiated with the professor, in order to ensure
 - its focus on distributed systems, as well as
 - its feasibility in a reasonable amount of time

References



Birman, K. P. (2005).
Reliable Distributed Systems. Technologies, Web Services, and Applications.
Springer New York.



Coulouris, G., Dollimore, J., Kindberg, T., and Blair, G. (2012).
Distributed Systems. Concepts and Design.
Pearson, 5th edition.



Kshemkalyani, A. D. and Singhal, M. (2011).
Distributed Computing: Principles, Algorithms, and Systems.
Cambridge University Press.



Tanenbaum, A. S. and van Steen, M. (2007a).
Distributed Systems. Principles and Paradigms.
Pearson Prentice Hall, Upper Saddle River, NJ, USA, 2nd edition.



Tanenbaum, A. S. and van Steen, M. (2007b).
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