



UNIVERSITÀ DI PISA  
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE  
Dottorato di Ricerca in Ingegneria dell'Informazione

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Doctoral Course

**“From Classical Distributed Systems to Cloud Computing”**

Prof. Tommaso Cucinotta  
Scuola Superiore Sant'Anna – Italy

Dr. Alessio Bechini  
University of Pisa – Italy

**Short Abstract:**

The landscape of computing systems has gone quite far since the flourishing of mainframes in the 50s, crossing a number of (r)evolutionary ages characterized by the availability of more and more computing power and better connectivity among nodes, up to the massively parallel & distributed nature of nowadays' data centers for enterprise applications, high-performance computing and cloud computing. The exploitation of complex hardware platforms made of multiple interconnected computing units has fostered the development of rigorous approaches in devising proper distributed algorithms to cope with the inherent problems of such a setting.

This course provides an overview of the challenges and solutions for building distributed systems, ranging from fundamental concepts about distributed algorithms, consistency and interaction paradigms, to the plethora of issues in building large-scale, fault-tolerant, distributed and replicated real-time cloud services with industrial-grade availability and spanning across thousands or even millions of machines worldwide. The course focuses on design, development, operation, and analysis of scalable software systems, covering also basic concepts on architectures of data-centre/cloud infrastructures.

**Course Contents in brief:**

- Distributed systems: models
  - Synchronous vs. asynchronous models
  - Precedence and causality
  - Unconventional models
- Distributed algorithms
  - Role of assumptions
  - Classical problems and solutions
- Support for distributed computations
  - CPU-intensive loads
  - Enterprise systems
  - Frameworks for data-intensive computing
- Cloud Computing
  - Basic concepts

- Scalability and elasticity in cloud systems
- Fault-tolerance and replication
- Real-time cloud services
- Operations, monitoring and devops engineering
- Platforms
  - Overview of existing cloud services & tools

**Total # of hours: 20**

### **References:**

- [1] Distributed Systems - Concepts and Design, G. Coulouris, J. Dollimore, T. Kindberg, G. Blair - Pearson, May 2011
- [2] Distributed Algorithms: An Intuitive Approach, W. Fokkink - MIT Press, Dec. 2013
- [3] Mastering Cloud Computing, Buyya & Vecchiola & Selvi, May 2013
- [4] Principles of Transaction Processing, 2<sup>nd</sup> Edition, Bernstein & Newcomer, July 2009
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### **CV of the Teacher**

Prof. Tommaso Cucinotta has a MSc in Computer Engineering from University of Pisa and a PhD from Scuola Superiore Sant'Anna. He spent more than 10 years at the Real-Time Systems Laboratory (ReTiS) of Scuola Superiore Sant'Anna carrying out research in security and smart-card based authentication, adaptive deadline-based scheduling in the Linux kernel for embedded, soft real-time and multimedia applications, temporal isolation in virtualized cloud services and novel OS designs for massively parallel and distributed systems. He has been MTS at Bell Labs in Dublin, carrying out industrial research on security and confidentiality, and real-time performance of cloud systems, with a focus on Telco applications. He has also been a Software Development Engineer in AWS DataBase Services in Dublin, Ireland, working on scalability and performance enhancements to the AWS DynamoDB NoSQL real-time data-base. Since 2016, he is back at the ReTiS of Scuola Superiore Sant'Anna as associate professor, holding a course on "Component-Based Software Design" within the MSc on Embedded Computing Systems jointly offered by Scuola Superiore Sant'Anna and University of Pisa.

Dr. Alessio Bechini is a researcher at Dipartimento di Ingegneria dell'Informazione, University of Pisa. He has carried out research in several domains of computer engineering, mostly focusing on concurrency and distribution issues in the target systems. Currently his interests are in frameworks for distributed big data analytics, and in bioinformatics as well. Since 2014 he has tenured the course "Concurrent and Distributed Systems" for the MSc degree in Computer Engineering at the University of Pisa.

### **Room and Schedule**

Room: *Aula Riunioni Dipartimento di Ingegneria dell'Informazione, Largo L. Lazzarino, Pisa – 6th floor*

Schedule:

- Day1 – March 1, 2017, from 9:30 to 11.30 (Bechini)
- Day2 – March 2, 2017, from 14:30 to 17.30 (Bechini)

- Day3 – March 3, 2017, from 14:30 to 17.30 (Bechini)
- Day4 – March 6, 2017, from 9:30 to 11.30 (Cucinotta)
- Day5 – March 7, 2017, from 14:30 to 16.30 (Cucinotta)
- Day6 – March 9, 2017, from 14:30 to 16.30 (Cucinotta Aula Riunioni via Caruso)
- Day7 – March 13, 2017, from 9:30 to 11.30 (Cucinotta)
- Day8 – March 14, 2017, from 14:30 to 16.30 (Cucinotta)
- Day9 – March 16, 2017, from 14:30 to 16.30 (Cucinotta)

Period: March 2017