



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

Doctoral Course

“High Performance Computing: Architectures and Systems”

Dr. Vassilis Papaefstathiou
Institute of Computer Science (ICS)
Foundation for Research and Technology – Hellas (FORTH)
Heraklion, Crete, Greece

Short Abstract:

This series of lectures will cover High-Performance Computing (HPC) architectures and provide a systems hardware perspective. The lectures revolve around three axes: the processing elements, the memory system and the interconnection networks at the system level. The lectures will present high-performance out-of-order processors, vector processors and GPUs, high performance memory systems (e.g. HBM, HMC) and interconnection network architectures.

The course will have a 1h discussion introduced by Sergio Saponara, University of Pisa, and **Vassilis Papaefstathiou**, FORTH, regarding the dissemination to PhD community of the global vision of the H2020 European Processor Initiative (EPI), part of the EuroHPC JU roadmap, involving 27 European partners (including FORTH and University of Pisa)

Course Contents in brief:

- Introduction to EPI and HPC (3h)
- High-Performance Processors: Out-of-Order CPUs, Vector, GPU (6h)
- Memory Systems for HPC (4.5 h)
- Interconnection Network Architectures for HPC (4.5 h)

Total # of hours of lecture: 18

References:

- [1] John Paul Shen, Mikko H. Lipasti. Modern Processor Design: Fundamentals of Superscalar Processors. 2013
- [2] Timothy G. Rogers, Tor M. Aamodt, and Wilson Wai Lun Fung. General-Purpose Graphics Processor Architectures. 2018
- [3] William Dally and Brian Towles. Principles and Practices of Interconnection Networks. 2003

CV of the Teacher

Dr. Vassilis D. Papaefstathiou (male) is a Researcher at the Institute of Computer Science, FORTH. He received his Ph.D. in Computer Science (2013) from the University of Crete. From 2001 to 2003 he worked on IC design and verification in ISD S.A. and collaborated closely with STMicroelectronics on industrial SoC designs. From 2005 to 2013 he was a Research Engineer in the CARV Lab, ICS-FORTH. From 2014 to 2016 he was a Postdoctoral Researcher at Chalmers University of Technology, Sweden. Since October 2016 he is with FORTH. He is also an Adjunct Instructor at Computer Science Department (CSD), University of Crete (UoC) where he teaches the following courses: Digital Circuits Lab, Computer Systems Architecture, Digital Circuits Design Lab using EDA Tools.

Vassilis has been heavily involved in several EU-funded research projects (EPI, EuroEXA, ExaNest, ExaNoDe, ECOSCALE, EuroServer, ERC MECCA, SHARCS, ENCORE, SARC, UNISIX, SIVSS) and has designed several FPGA-based hardware prototypes for multicore architectures and high-performance interconnects. His research interests are on Parallel Computer Architecture, High-Performance Computing, High-Speed Interconnects, Low-Power Datacenter Servers, and Storage Systems, with particular emphasis on cross-layer design and optimization. [<https://sites.google.com/site/papaef/>]

Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule:

N.	Lesson
1	Introduction to HPC High-Performance Processors: Out-of-Order CPUs
2	High-Performance Processors: Vector, GPU
3	Memory Systems for HPC
4	Interconnection Network Architectures for HPC