



## ITEE PhD – Ad hoc Course Announcement

**Università degli Studi di Napoli Federico II**

**PhD Programme in Information Technology and Electrical Engineering**

<http://itee.dieti.unina.it>

**Module Title:**

**Virtualization technologies and their applications**

**Lecturer: Dr. Luigi De Simone**

DIETI, Università degli Studi di Napoli Federico II

Email: [luigi.desimone@unina.it](mailto:luigi.desimone@unina.it)

Web-page: <http://wpage.unina.it/luigi.desimone/>

**Bio:** Luigi De Simone (Ph.D.) received his MSc degree with honors in Computer Engineering in 2013, and the PhD degree in 2017 from the Federico II University of Naples, Italy, where he is currently a postdoctoral researcher. His research interests include fault injection testing, dependability benchmarking, virtualization reliability and its application to critical systems and cloud systems.

**Dates and venues (rooms are in DIETI Building 3A, via Claudio 21, Napoli)  
(Venue to be confirmed)**

Lesson	Date	Time	Venue
1 – Day 1	April 6, 2020	9:30 – 13:00	Meeting room (4.19), 4th floor
2 – Day 1	April 6, 2020	15:00 – 16:30	Meeting room (4.19), 4th floor
3 – Day 2	April 8, 2020	9:30 – 13:00	Meeting room (4.19), 4th floor
4 – Day 2	April 8, 2020	15:00 – 16:30	Meeting room (4.19), 4th floor
5 – Day 3	April 9, 2020	9:30 – 13:00	Meeting room (4.19), 4th floor
6 – Day 3	April 9, 2020	15:00 – 16:30	Meeting room (4.19), 4th floor
7 – Day 4	April 15, 2020	9:30 – 13:00	Meeting room (4.19), 4th floor
8 – Day 4	April 15, 2020	15:00 – 16:30	Meeting room (4.19), 4th floor
9 – Day 5	April 17, 2020	9:30 – 13:00	Meeting room (4.19), 4th floor
10 – Day 5	April 17, 2020	15:00 – 16:30	Meeting room (4.19), 4th floor
Assessment	April 30, 2020	9:30 – 13:00	Meeting room (4.19), 4th floor

**ECTS Credits: 4**

### Overview

This course will present advanced virtualization technologies used today for both research and industrial applications, including embedded systems, networking, and telecom equipments. The course will provide the students with the basis for developing experimental testbeds and novel systems with high-performance and reliability properties in their own research field. Every lesson consists of a first part on the overview of the specific virtualization technology, and a second part on a hands-on session to show how to use that technology



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in practice. At the end of the lesson, students are encouraged to start a discussion on why and how to adopt that virtualization approach in their research activities.

To earn the credits, at the end of the course students need to provide a good quality presentation about the potential application of virtualization in the context of their research field, with the current state-of-the-art. Student's presentations will take place in the last lesson. Details about the presentation format will be given during the course. The schedule of the presentations will be defined during the course.

### Content

**Day 1 – Virtualization and virtual machines:** Basic concepts of virtualization. Types of virtualization. Full-virtualization, hardware-assisted virtualization. CPU Virtualization. Memory virtualization. I/O virtualization.

*Technologies: KVM/Qemu. VMware. OpenStack platform.*

**Hands on session:** KVM/Qemu VM configuration. OpenStack.

**Day 2 – Para-virtualization:** Introduction to para-virtualization. Exokernel architecture. Para-virtualization vs. full-virtualization. Para-virtualized Disk and Network.

*Technologies: Xen. PVH.*

**Hands on session:** The Xen project.

**Day 3 – Container-based virtualization:** Introduction to containers. Containers vs. Virtual Machines. Kernel namespaces and cgroups.

*Technologies: LXD. Docker and Docker Swarm. Kubernetes. Microservices*

**Hands on session:** Docker and Docker Swarm; Example on High-Available testbed deployment.

**Day 4 – Virtualization for high-performance and reliable systems:** The Unikernel approach. Unikernel vs. Virtual Machine. Hypervisors and unikernels. Unikernels in telecom and network applications.

*Technologies: MirageOS. ClickOS. OSv. Intel DPDK.*

**Day 5 – Virtualization for real-time systems:** Virtualization in real-time systems. Real-time hypervisors. Hardware-assisted virtualization for real-time. Virtualization in IoT. Safety standards and virtualization.

*Technologies: Real-time KVM, RT-Xen. Jailhouse, NOVA hypervisors. PikeOS. LTZvisor. ACRN IoT hypervisor. WindRiver MILS hypervisor.*

**Day 6 – Assessment.** The lesson is dedicated to the final assessment.

Contacts for additional info: **Dr. Luigi De Simone** - tel. 081 7683820 – [luigi.desimone@unina.it](mailto:luigi.desimone@unina.it)

**Prof. Domenico Cotroneo** - tel. 081 7683820 – [cotroneo@unina.it](mailto:cotroneo@unina.it)