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

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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 (Microsoft Team link: https://teams.microsoft.com/l/team/19%3a2c573aa270584a238e1ab13b7beb7ee0%40thread.tacv2/conversations?groupId=c6c64730-20ce-4738-9944-f3a26ff9dd47&tenantId=2fcfe26a-bb62-46b0-b1e3-28f9da0c45fd)

Lesson	Date	Time	Venue
1	**April 6, 2020**	**10:00 – 12:00**	**Virtual room (Microsoft Teams)**
2	**April 7, 2020**	**15:00 – 17:00**	**Virtual room (Microsoft Teams)**
3	**April 8, 2020**	**10:00 – 12:00**	**Virtual room (Microsoft Teams)**
4	**April 9, 2020**	**15:00 – 17:00**	**Virtual room (Microsoft Teams)**
5	**April 15, 2020**	**10:00 – 12:00**	**Virtual room (Microsoft Teams)**
6	**April 17, 2020**	**15:00 – 17:00**	**Virtual room (Microsoft Teams)**
7	**April 23 , 2020**	**15:00 – 17:00**	**Virtual room (Microsoft Teams)**
8	**April 24, 2020**	**15:00 – 17:00**	**Virtual room (Microsoft Teams)**
9	**April 29, 2020**	**15:00 – 17:00**	**Virtual room (Microsoft Teams)**
10	**April 30, 2020**	**15:00 – 17:00**	**Virtual room (Microsoft Teams)**
Assessment	**May 15, 2020**	**9:30 – 13:00**	**Virtual room (Microsoft Teams)**

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 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

Lesson 1 and 2 - 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.

Lesson 3 and 4 - Para-virtualization. Introduction to para-virtualization. Exokernel architecture. Para-virtualization vs. full-virtualization. Para-virtualized Disk and Network.
Technologies: Xen. VirtIO. Vhost.
Hands on session: The Xen project.

Lesson 5 and 6 - 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.

Lesson 7 and 8 - 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.

Lesson 9 and 10 - 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.

Assessment. The lesson is dedicated to the final assessment.

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