POLITECNICO DI MILANO

Computing Infrastructures



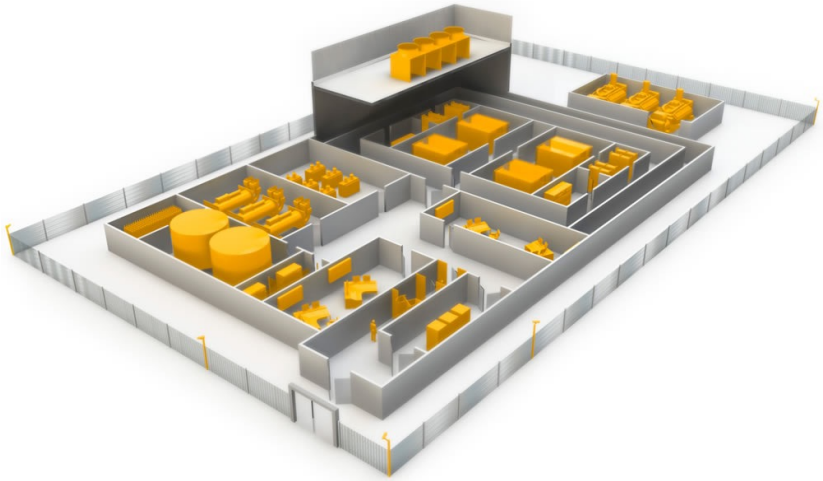


Course Introduction

Prof. Manuel Roveri, Gianluca Palermo,
Danilo Ardagna

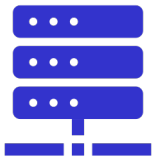
Introduction to the course

- Modern large-scale datacenters require the seamless integration of different components - applications, computation nodes, storage devices, and networks - into one computing infrastructure.



- The course covers the basics of current datacenters architectures, ranging from the analysis of the single components to the global infrastructure.

The topics of the course



A. HW Infrastructures:

- **System-level**: Computing Infrastructures and Data Center Architectures, Rack/Structure;
- **Node-level**: Server (computation, HW accelerators), Storage (Type, technology), Networking (architecture and technology)
- **Building-level**: Cooling systems, power supply, failure recovery

B. SW Infrastructures:

- **Virtualization**: Process/System VM, Virtualization Mechanisms (Hypervisor, Para/Full virtualization)
- **Computing Architectures**: Cloud Computing (types, characteristics), X-as-a service, Edge/Fog Computing
- **Machine and deep learning-as-a-service**

C. Methods:

- **Reliability and availability of datacenters** (definition, fundamental laws, RBDs)
- **Disk performance** (Type, Performance, RAID)
- **Scalability and performance of datacenters** (definitions, fundamental laws, queuing network theory)

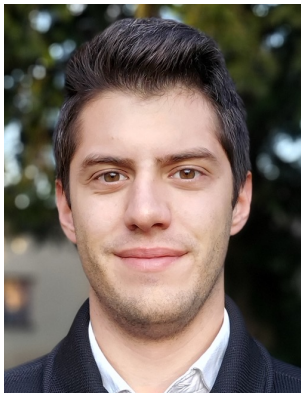
Lecturers

1. Prof. Danilo Ardagna
   - HW-SW infrastructure, performance
   - Dipartimento di Elettronica, Informazione e Bioingegneria
   - danilo.ardagna@polimi.it
   - http://ardagna.faculty.polimi.it

2. Prof. Manuel Roveri
   - Disks technologies, ML as a Service
   - Dipartimento di Elettronica, Informazione e Bioingegneria
   - manuel.roveri@polimi.it
   - http://roveri.faculty.polimi.it

Lecturers

3. Roberto Sala
   - Dependability
   - Dipartimento di Elettronica, Informazione e Bioingegneria
   - roberto.sala@polimi.it



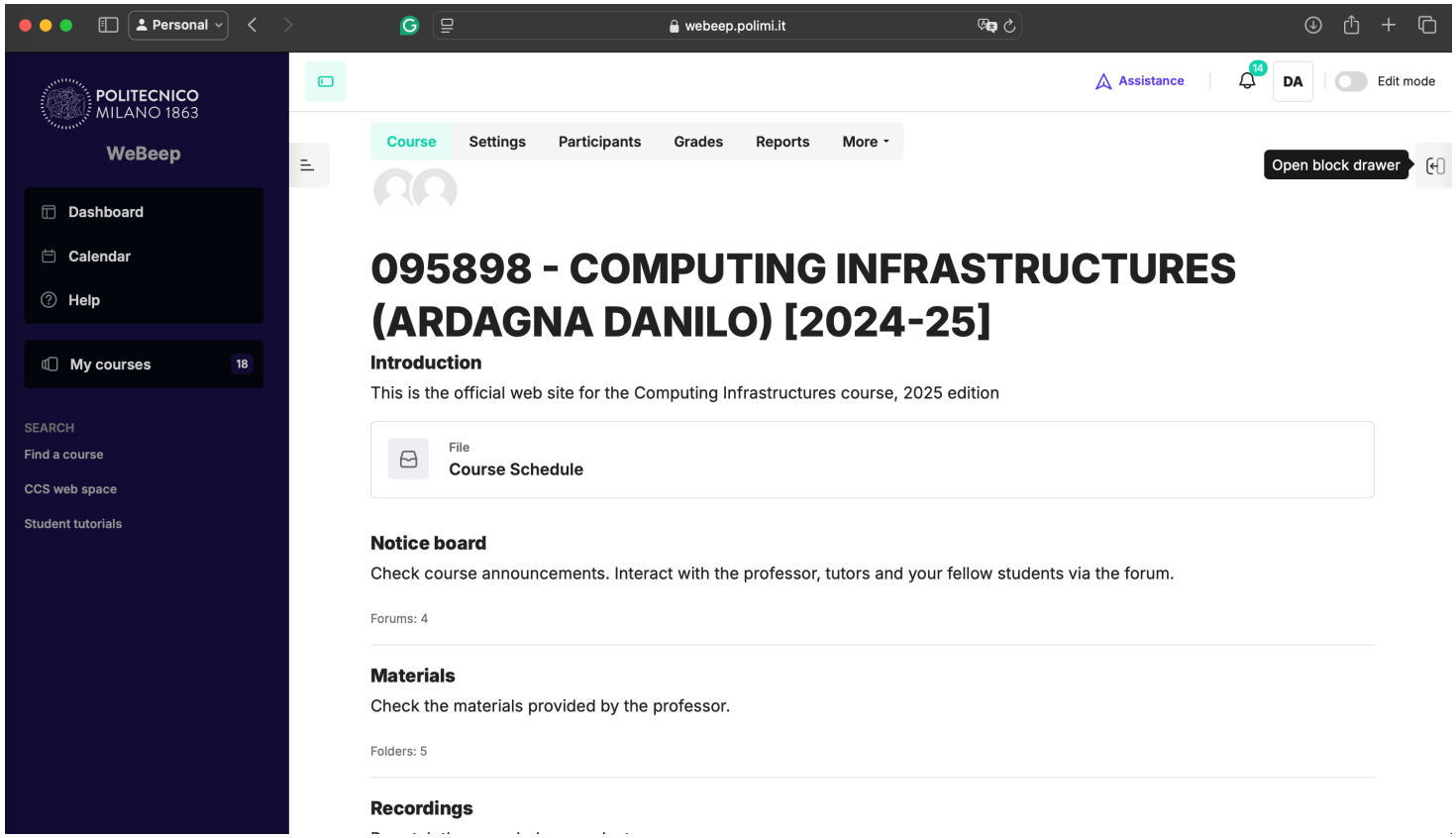
4. Prof. Marco Gribaudo
   - Disks dependability and performance exercises
   - Dipartimento di Elettronica, Informazione e Bioingegneria
   - marco.gribaudo@polimi.it

Course classrooms

	TLC, CS, MUS, BIO, MNGT [P-Z]
Monday	**14:15-16:15** 5.02
Tuesday	**12:15-14:15** 3.02

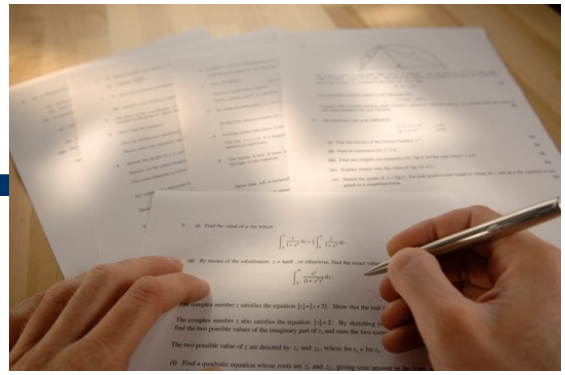
Materials

Slides of the course will be published on the WeBeep website



No streaming but recordings will be made available during the weekend

Evaluation

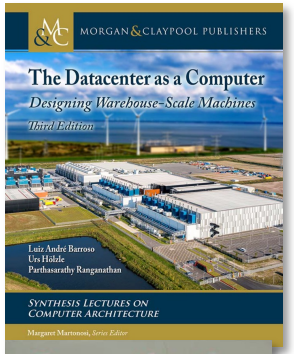


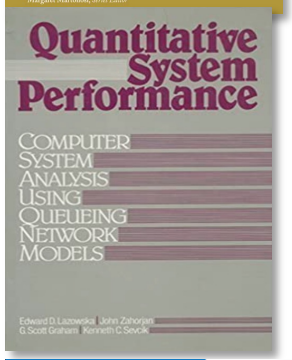
- The course will have a written exam
- The exam will consist in:
  - a set of exercises, i.e., simple problems to solve (similar to the ones that will be covered during the classes)
  - questions (True/False and open) dealing with more general topics covered by the course
- Closed book
- **Four questions** during the classes: **up** to **2** bonus **points** (0.5 points per quiz) valid **only for the first June call**
- Erasmus/mobility students: We follow the school directives
- Exercises and Exams will be made available
- Thesis about course topics will be made available
- Industry seminars

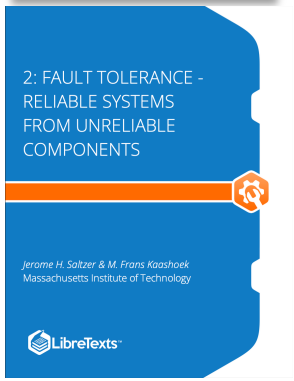
Bibliography

- Luiz André Barroso and Urs Hölzle, **The Datacenter as a Computer: Designing Warehouse-Scale Machines. 3rd Edition (2018)**
- Edward D. Lazowska, John Zahorjan,G. Scott Graham, Kenneth C. Sevcik, **Quantitative System Performance: Computer System Analysis Using Queueing Network Models. (Ch.1-6)**
- Jerome H. Saltzer & M. Frans Kaashoek. **Fault Tolerance - Reliable Systems from Unreliable Components**

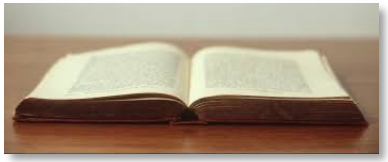
PDFs are freely available







Additional Material provided in WEBEEP



- **Further Readings:**
  - Caesar Wu and Rajkumar Buyya, **"Cloud Data Centers and Cost Modeling"**
  - James Smith and Ravi Nair, **"Virtual Machines - Versatile Platforms for Systems and Processes"**
  - Massimo Lazzaroni Loredana Cristaldi Lorenzo Peretto Paola Rinaldi Marcantonio Catelani **"Reliability Engineering: Basic Concepts and Applications in ICT"**
  - Giuseppe Serazzi, **"Performance Engineering: Learning Through Applications Using JMT"**