



Computing Infrastructures



POLITECNICO DI MILANO



Course Introduction

Prof. Manuel Roveri, Gianluca Palermo,
Danilo Ardagna

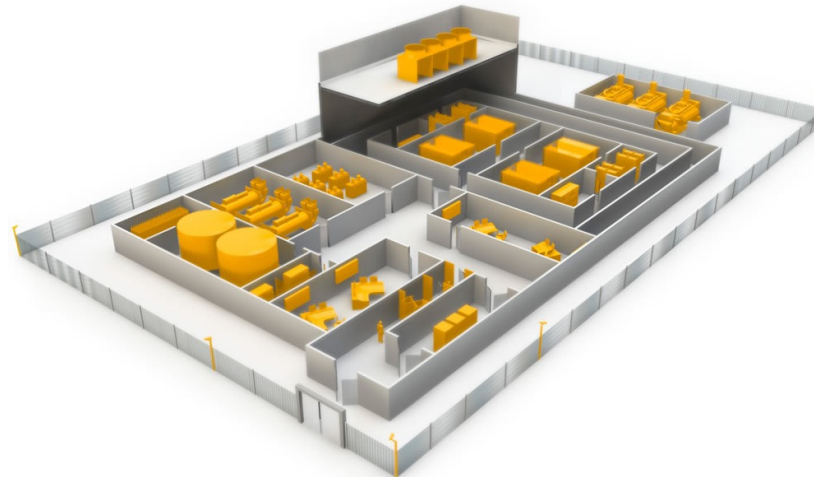


Introduction to the course

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



Google Cloud



- 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)



1. Prof. Danilo Ardagna

- HW-SW infrastructure, performance
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2. Prof. Manuel Roveri

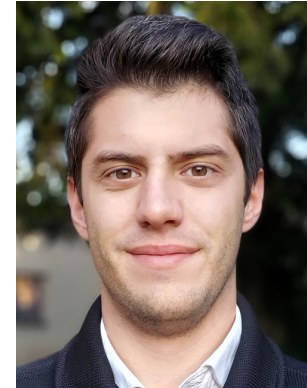
- Disks technologies, ML as a Service
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3. Roberto Sala

- Dependability
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4. Prof. Marco Gribaudo

- Disks dependability and performance exercises
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	TLC, CS, MUS, BIO, MNGT [P-Z]
Monday	14:15-16:15 5.02
Tuesday	12:15-14:15 3.02



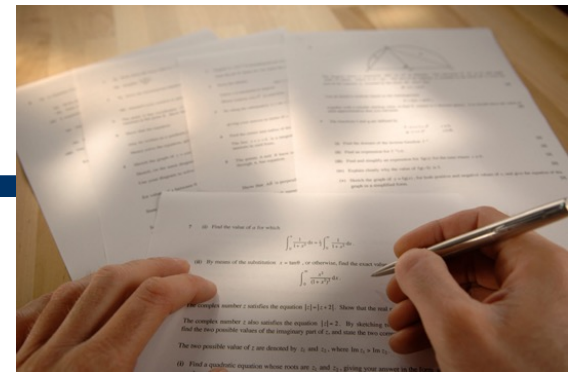
Slides of the course will be published on the WeBeep website

The screenshot shows a web browser window with the URL `webeep.polimi.it`. The page is for a course titled **095898 - COMPUTING INFRASTRUCTURES (ARDAGNA DANILO) [2024-25]**. The left sidebar is dark blue and contains the Politecnico Milano 1863 logo, the WeBeep logo, and navigation links: Dashboard, Calendar, Help, and My courses (18). Below these are search options: Find a course, CCS web space, and Student tutorials. The main content area has a top navigation bar with links: Course, Settings, Participants, Grades, Reports, and More. Below this is a course title and an introduction section stating: "This is the official web site for the Computing Infrastructures course, 2025 edition". A file upload section shows a file named **Course Schedule**. Below this are sections for **Notice board** (with 4 forums), **Materials** (with 5 folders), and **Recordings**.

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

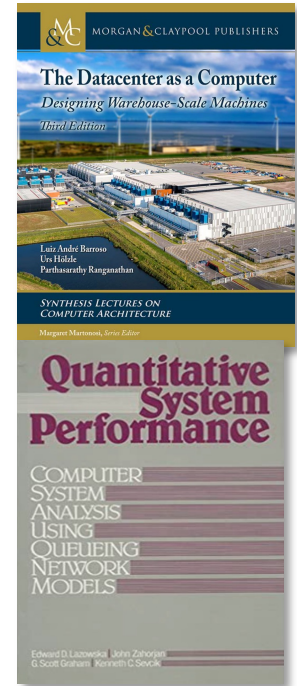


Bibliography

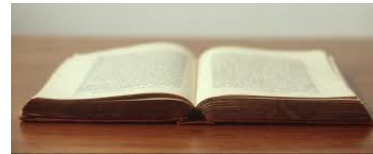
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- Luiz André Barroso and Urs Hölzle, **The Datacenter as a Computer: Designing Warehouse-Scale Machines**. 3rd Edition (2018)
- Edward D. Lazowska, John Zahorjan, G. Scott Graham, Kenneth C. Sevcik, **Quantitative System Performance: Computer System 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”

2: FAULT TOLERANCE -
RELIABLE SYSTEMS
FROM UNRELIABLE
COMPONENTS

Jerome H. Saltzer & M. Frans Kaashoek
Massachusetts Institute of Technology

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