

Exercise Sheet 10

Complete before tutorial on Thursday, April 30th

Learning goals

Be able to

- Distinguish the three types of hypervisors.
- Explain virtualization-like technologies from the lecture and how they differ from virtual machines.
- Explain how virtualization is implemented.
- Explain containers

Exam preparation

Exercise 1. Take a look at the instructions and old exams at <https://larsrohvedder.com/teaching/dm510-26/res> and <https://larsrohvedder.com/teaching/dm510-26/plan>. If time permits in the exercise session, recap course materials by discussing exercises in the old exams.

Chapter 18

Exercise 2. Describe the three types of traditional hypervisors.

Exercise 3. Dual-/Multi-booting refers to the mechanism that a computer has several operating systems installed on different partitions of the hard drive and the user can choose the operating system in the bootloader. Name situations where dual-booting or VMMs are better suited.

Exercise 4. Describe four virtualization-like execution environments, and explain how they differ from “true” virtualization.

Exercise 5. Why are VMMs unable to implement trap-and-emulate-based virtualization on some CPUs? Lacking the ability to trap and emulate, what method can a VMM use to implement virtualization?

Exercise 6. Consider the following environments:

- A traditional computer without virtualization
- A type-1 VMM
- A type-2 VMM
- A Docker container
- An emulator

Explain for each of the following use cases, how well each of the four environments are suited for it:

- A scientific simulation (CPU bound high-performance application)
- Testing the effects of a program suspected to be malicious
- A video game
- Testing your modifications to the Linux kernel
- A webserver for a sporadically visited website

Exercise 7. Suppose that for load balancing reasons a cloud application should be moved from an overloaded server to another less busy server. Consider the following approach:

- The application is asked gracefully to save its data on the hard drive and to terminate. This data is copied to the other server and the application is started again there.
- Live migration.

Compare the two approaches.

Exercise 8. When building the Linux kernel, you can choose between different target architectures. For the Raspberry Pi, for example, you chose ARM64, since this is the CPU architecture of the Raspberry Pi. One of the other possible target architectures is UM, which stands for User Mode Linux.

Read the introduction (Section 1) of: https://www.kernel.org/doc/html/v5.9/virt/uml/user_mode_linux.html

Explain what User Mode Linux is and compare it to the virtualization(-like) technologies from the lecture. Explain how they differ and what they have in common with User Mode Linux.

Exercise 9. What is Docker? What is a Docker image? What is a Docker container?

Exercise 10. Imagine a hypothetical “container-based” operating system, where each application (web browser, text editor, etc.) is distributed as a Docker container. Of such an operating system concept, name two advantages and name two disadvantages. Judge whether this would be a feasible concept.