

Advanced Operating Systems (SS'26) – Exercise 03: Cloud Computing and Virtualization

Task 1: The Economy of Cloud Providers

In most cases, the term cloud computing refers to the use of services offered by dedicated cloud providers. What makes the concentration of digital services with a couple of large companies attractive? How do these companies leverage their size to create a competitive line of products?

Task 2: Advantages and Drawbacks of Outsourcing Computations to Cloud Providers

When evaluating the services offered by public cloud providers, potential customers have to consider several aspects. Not for every use case, a deployment of applications with cloud providers may be a feasible approach.

- a) What are the benefits of using the services offered by cloud providers?
- b) What risks are entangled with cloud deployments?
- c) Which use cases are a suitable target for a deployment with a cloud provider? Think of the following use cases: an online shop, the digital infrastructure of a hospital, and a government service for filing in pension claims.
- d) When aiming at improving the trustworthiness of cloud-based services, what mechanisms come to your mind?

Task 3: The Anatomy of Lightweight Virtual Machines

During the preparation of this exercise, you have read the paper “Firecracker: Lightweight Virtualization for Serverless Applications” by Alexandru Agache et. al. This paper describes `Firecracker`, a solution for a lightweight virtual machine monitor. `Firecracker` is a product with high industrial impact. For instance, it is currently in use with Amazon Web Services, one of the largest cloud providers in the world.

- a) What was the motivation for developing `Firecracker`? In particular, what are the implications of the serverless application model for the OS and the virtualization infrastructure of cloud providers?
- b) Why did the engineers behind `Firecracker` refuse to deploy existing isolation mechanisms used in cloud data centers?
- c) How does `Firecracker` differ from standard virtual machine monitors?
- d) What are the performance properties of `Firecracker`? Does it trade off security for performance? What do you think about the performance evaluation?