

Laboratory Goals / Objectives

Students will investigate the virtual machine and container technologies used in clouds, by creating virtual machines and containers on their own laptops/desktops. Timing the execution of an application in the virtual machine and the container environments will give an indication of the differences between VMs and containers.

Introduction

Cloud resources, including software, are rented to customers on a pay-as-you-use model. The virtual machine and container technologies increase the use of cloud hardware resources while creating a secure environment for running monolithic and distributed applications. However, both technologies add another software layer that has an impact on performance. The exception is when bare metal servers are used and the hypervisor runs as a light operating system.

This laboratory work aims to achieve several purposes:

1. get students acquainted with the virtual machine and the container technologies;
2. develop simple applications and run them in the virtual machine and container environments, timing their execution duration;
3. assess the differences including in terms of execution performances of applications between the two technologies;
4. write up and return an individual report (pdf file) on Canvas by the deadline.

Lab Work

In order to achieve the goals indicated above, the following tasks will be carried out during a period of four weeks:

1. **Group creation and set-up of the group collaborative environment.** As students use computers running different operating systems, it is advisable to create groups based on the OS in use. For example, students using Ubuntu can create small groups – 3 or 4 people. There can be more groups using the same OS. The same is recommended for students using MacOS or Windows. It is possible to work individually as well. The group is important for stimulating a collaborative learning process. You can share your knowledge and skills and achieve progress quicker. A collaborative environment will allow you to communicate among group members and store content useful to the group members – create an archive.
This task can take one week.

2. **Download and install VM and container software.** The second task is to create the working environment on your computer. Run the tutorials and test VirtualBox or other hypervisor of your choice and Docker.
This task can start earlier, during the first week, but should complete by the end of the 2nd week.

You can use the info at <https://www.howtogeek.com/196060/beginner-geek-how-to-create-and-use-virtual-machines/#:~:text=A%20virtual%20machine%20app%20creates,on%20your%20current%20operating%20system>

for an introduction and links to hypervisor software.

You can download VirtualBox from www.virtualbox.org

You can download Docker from www.docker.com

For MacOS, you can download VMware Fusion from <https://www.vmware.com/products/fusion.html>

3. **Develop one or more application to run in the VM or container.** You may already have applications that you want to test into these environments. However, one simple application that you can test is matrix multiplication ($n \times n$): you give a value to n , for example 30, and the application will iteratively create the matrices (random values) from $n = 2$, multiply them, then increment n and repeat the computing process up to $n = 30$. You should also determine the execution time. It would be interesting to use libraries.
This task can take one week.

4. **Report the results.** Although you will work together with your group peers, the report should be your own, presenting your results and analysis. The report should include an introduction, not longer than one page, to the VM and container technologies. The experience you personally gained when installing and testing the VM and container technologies and the application(s) you run will be much appreciated.

This last task should be completed before the lab deadline, at the end of the fourth week.

Submission

Return your results including **screenshots**, in a **pdf** file, by the deadline.

This lab is worth 10 marks.