LAB 1 REPORT

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CS3204, Cloud infrastructure and services

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1. WORK ENVIRONMENT AND APPLICATIONS USED

For the assignments of the lab exercises, I used my laptop with an installation of the Windows 10 operating system, an Oracle VirtualBox virtual machine with an installation of Lubuntu 22.04.3 (a lightweight flavour of Ubuntu), as well as the Docker Desktop app (using the WSL2 backend) and the official Ubuntu image, version 22.04.3.

To test execution times, I used a matrix multiplication program. It is worth noting that both operating systems used the same version of Python for execution (3.10.12).

The application code and screenshots can be found in the following repository: https://github.com/GalFajon/cloudcomputinglab1

The screenshots in the repository were taken after already completing the table of execution times and were taken with several applications running in the background. Their results differ from the table.

2. VIRTUALIZATION AND CONTAINERS

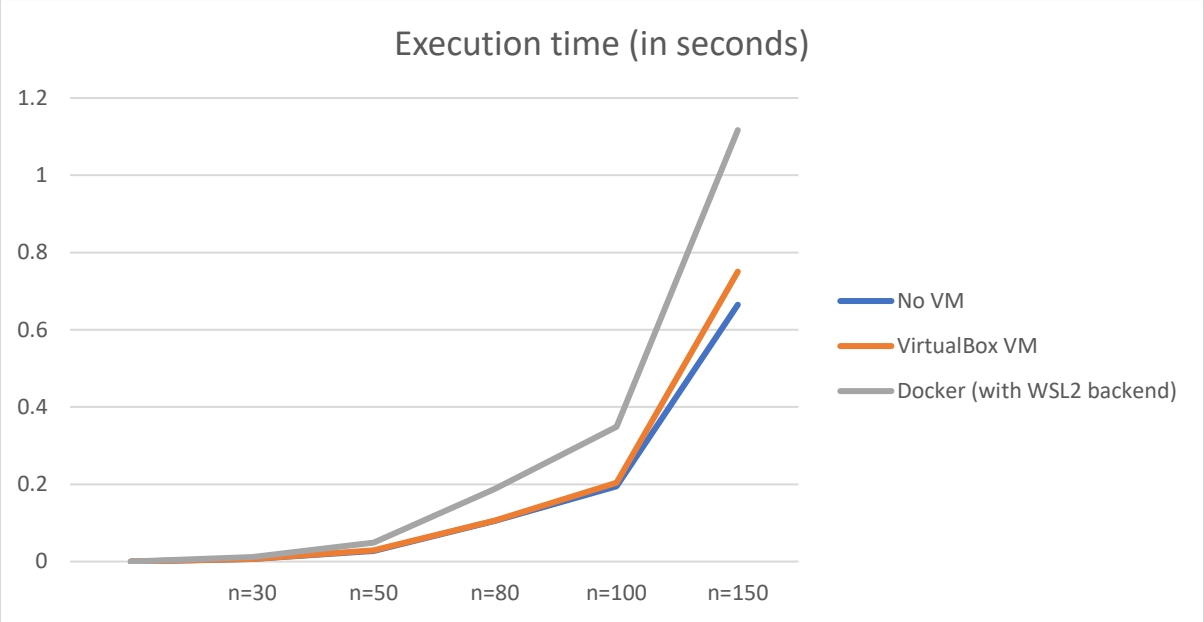
A virtual machine is a simulated machine running within a hypervisor, an environment that allows the host OS to imitate the functionality of whatever OS is installed on the visor as well as the hardware of the virtual machine. This allows a single host machine to potentially run several operating systems with different assigned hardware resources. The simulated machines do not have direct access to hardware resources, creating a large execution overhead.

Containers, on the other hand, do not virtualize the hardware of the machine and share the host operating system kernel and use it to run an application using the software libraries and environment variables that are necessary. They use features of the host operating system to isolate their processes and control the amount of resources they use. Resource limits for containers are soft, meaning they can expand the amount of resources they can use quickly if other containers are not using them.

3. EXECUTION RESULTS

When analysing the execution times of the program, I got the following results:

Execution time (in seconds)	No VM	VirtualBox VM	Docker container (with WSL2 backend)
n=30	0.006998777	0.006443024	0.011445761
n=50	0.027053356	0.028741837	0.049228907
n=80	0.105044365	0.105819225	0.187860966
n=100	0.194957256	0.203652859	0.348770618



An interesting thing to observe here is that the execution time of the Docker container is marginally worse than that of the VM. This is because Docker containers on Windows operating systems work under an extra layer of virtualization, as Docker uses WSL2, a lightweight Linux virtual machine built into Windows to create and run containers. This causes additional execution overhead. If the same container were to be run on a native Linux installation, it is safe to assume its execution times would be better than those of the virtual machine, as the container could run natively on the Linux operating system. The best execution time came from running the program on the host machine without any virtualization.

4. WHAT I LEARNED

In this lab, I learned how to configure a virtual machine on the windows operating system, as well as install images and run Docker containers using the Docker desktop app.