CS3204 Assignment 4

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In this report, I will describe how I explored virtual machine technologies by testing a performance-sensitive application on my PC and on a virtual machine.

Application

The application I developed executes a matrix multiplication algorithm. In each iteration, it first generates two random matrices of length 2 and multiplies them together, and then repeats this process while iteratively increasing the length of the matrices until they reach a predefined limit. The execution time is recorded and printed to the console.

In the first iteration, the limit is 2, and it is then increased to 10, 100, 150, 1000 and 5000.

VM Software

I chose to install Oracle VirtualBox, as I had used it in the past. There are a number of advantages to using this virtual machine software:

- It is free to use.
- It has several features that make it easier to transfer information between the host and guest, such as shared folders and the shared clipboard.
- It supports Unattended Guest Installation, which makes it much easier to install supported operating systems on the virtual machine.

Specifications

Host Machine

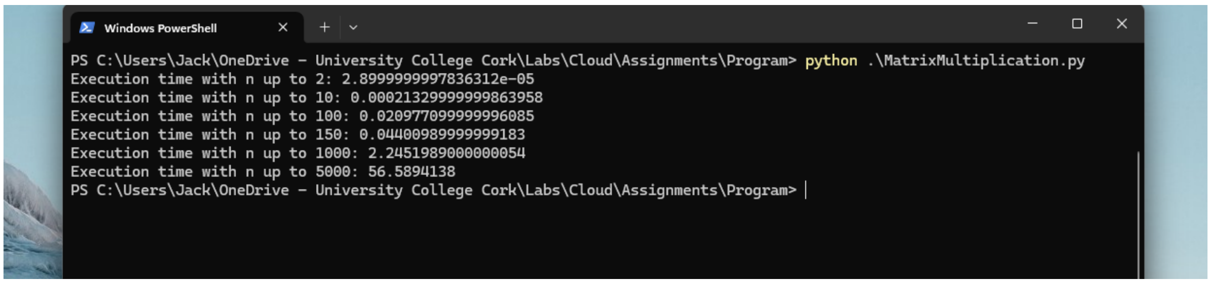
Host OS	Windows 11
System Type	x64-based PC
CPU	AMD Ryzen 3 3200G
RAM	16 GB
Storage	NVMe SSD

Virtual Machine

Guest OS	Debian 12 (Linux)
CPU Cores	2
RAM	6 GB

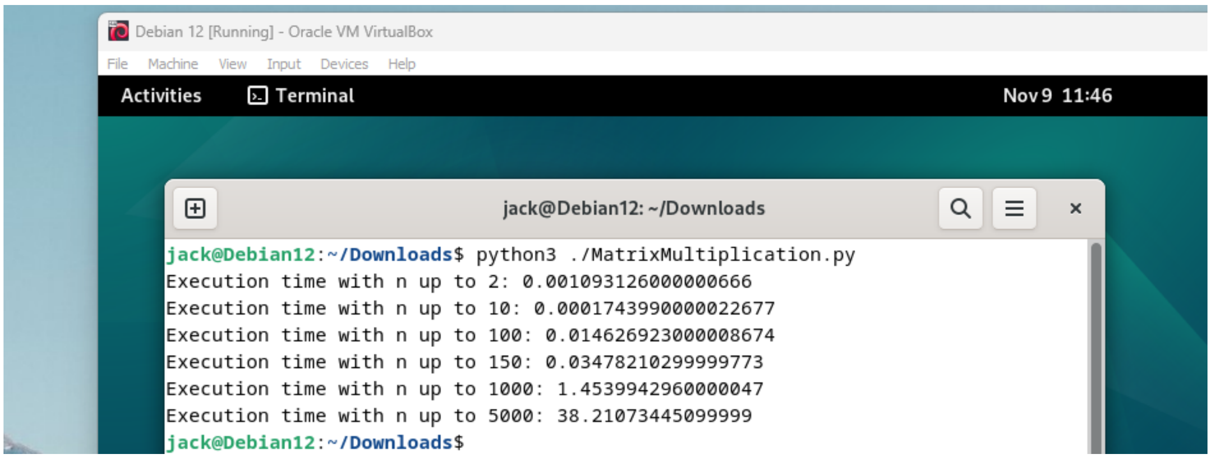
Results

Host Machine



```
PS C:\Users\Jack\OneDrive - University College Cork\Labs\Cloud\Assignments\Program> python .\MatrixMultiplication.py
Execution time with n up to 2: 2.8999999997836312e-05
Execution time with n up to 10: 0.00021329999999863958
Execution time with n up to 100: 0.020977099999996085
Execution time with n up to 150: 0.044009899999999183
Execution time with n up to 1000: 2.2451989000000054
Execution time with n up to 5000: 56.5894138
PS C:\Users\Jack\OneDrive - University College Cork\Labs\Cloud\Assignments\Program>
```

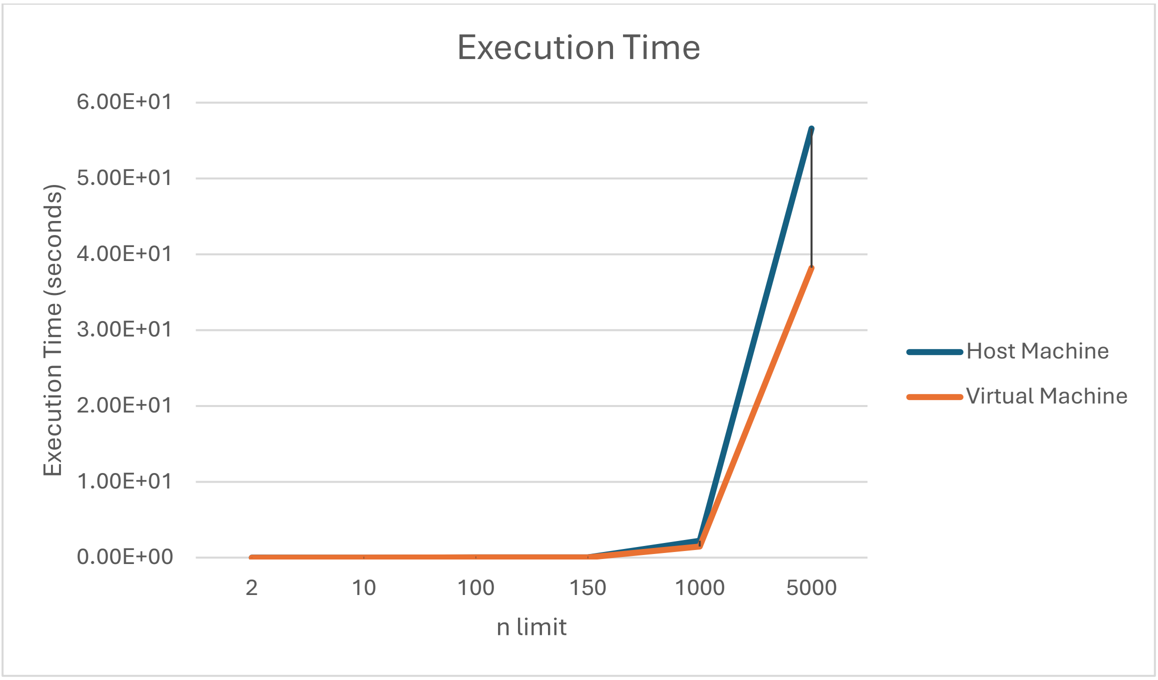
Virtual Machine

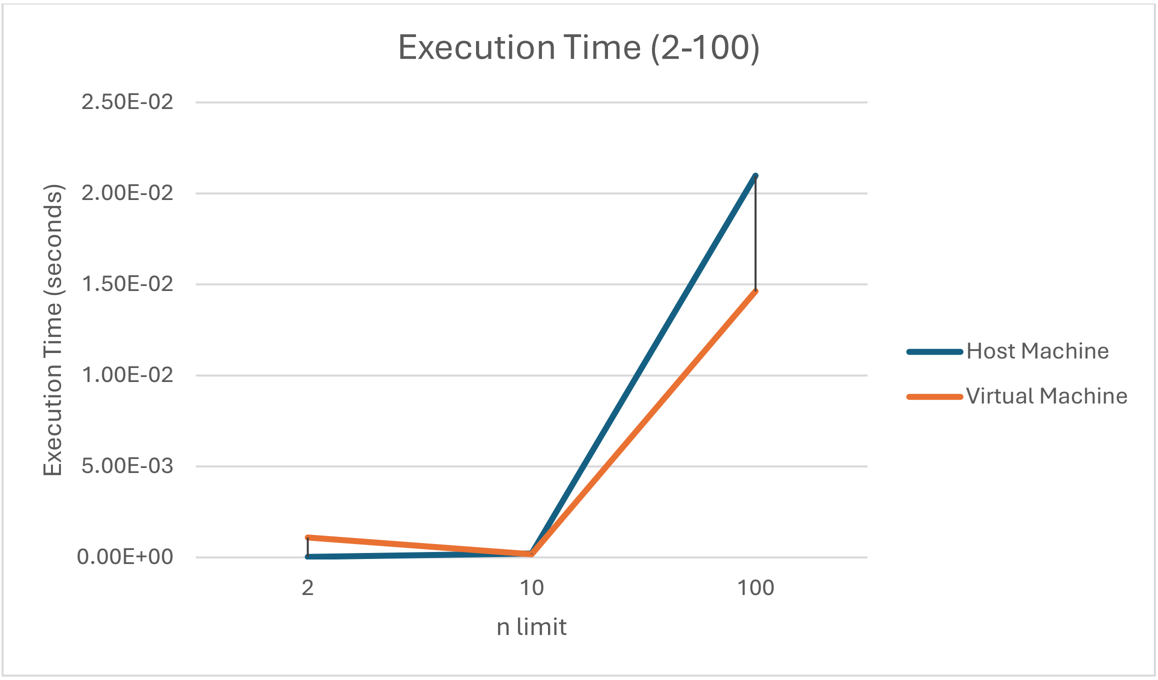

Debian 12 [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Nov 9 11:46
jack@Debian12: ~/Downloads

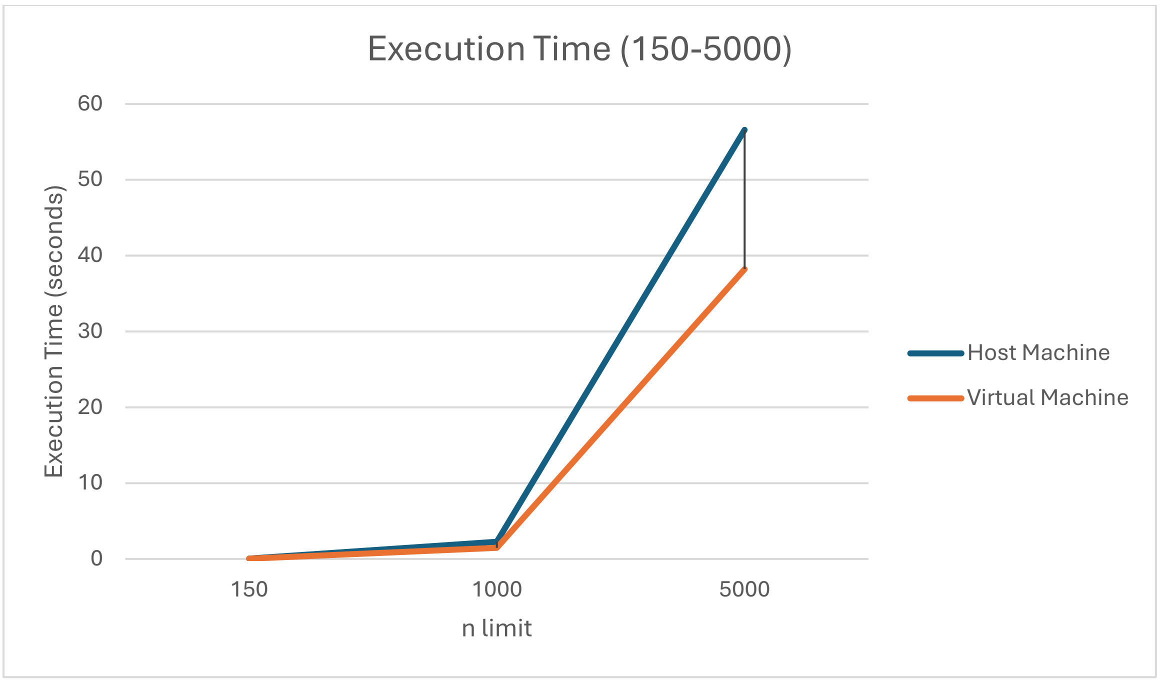
```
jack@Debian12:~/Downloads$ python3 ./MatrixMultiplication.py
Execution time with n up to 2: 0.001093126000000666
Execution time with n up to 10: 0.00017439900000022677
Execution time with n up to 100: 0.014626923000008674
Execution time with n up to 150: 0.03478210299999773
Execution time with n up to 1000: 1.4539942960000047
Execution time with n up to 5000: 38.21073445099999
jack@Debian12:~/Downloads$
```

Execution Time Comparison

n up to	Host Machine	Virtual Machine
2	2.8999999997836312e-05	0.001093126000000666
10	0.00021329999999863958	0.00017439900000022677
100	0.020977099999996085	0.014626923000008674
150	0.044009899999999183	0.034782102999999773
1000	2.2451989000000054	1.4539942960000047
5000	56.5894138	38.21073445099999






Execution Time (150-5000)
60
50
40
30
20
10
0
Execution Time (seconds)
150
1000
5000
n limit
Host Machine
Virtual Machine

Analysis

Interestingly, the execution time was generally lower on the virtual machine than on the host machine. This could be due to a variety of factors, such as differences in OS and Python implementation between the two environments, background processes running on the host system, or differences in how resources are allocated to a particular process in the two environments.

Reflections

When choosing a Linux distribution to install on the virtual machine, I considered several different options. I initially tried to install Fedora, as I had used it in the past, however, the system failed to boot.

I ultimately chose to install Debian 12, because of the relatively small download size for its ISO image, support for VirtualBox's unattended installation feature, and the selection of pre-installed software, such as Python.

I repeated my test a number of times after observing that the execution time was generally lower on the virtual machine, however, this continued to be the case.

From completing this task, I learned a lot about virtual machine technology. I gained insight into the process of creating a virtual machine and installing a guest OS, and I also familiarised myself with basic features of Linux.