

Fundamentals of Computational Mathematics: Assignment #1

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Elsa Schutfort

Hardware Virtualization in Scientific Computing

1. Verify that the computer you are using for the class is able to handle hardware virtualization. Along with the apps/commands needed to determine whether or not hardware virtualization is enabled, include a screenshot that shows the computer is hardware virtualization enabled. Use something like SnipSketch or the equivalent Apple screen shot app.

Solution:

I'm using a 2020 MacBook Air with an M1 chip. M1 chips handle virtualization workloads without the need for specific hardware virtualization settings. As a result, there's no requirement to enable hardware virtualization on MacBooks with M1 chips, as it's inherently supported.

There is no need to enable virtualization on M1 - the hardware is capable of running these workloads out of the box. VirtualBox doesn't run on Apple Silicon. Dec 14, 2020



Stack Exchange

<https://apple.stackexchange.com/questions/how-to-en...>

How to enable hardware virtualization on MacBook Pro 2020 ...



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2. Write a few sentences about the downside of running virtual computers on your laptop or desktop. Do not use ChatGPT or other AI application. After writing your answer to this question, run a request into ChatGPT to see what the bot finds. Compare your answer to the response from ChatGPT.

Solution:

My response:

Running virtual machines on your laptop or desktop has its drawbacks. One significant downside is the resource allocation challenges. Virtual Machines use the physical machines' resources like memory and CPU. If your virtual machine is using a large amount of memory or CPU, it could lead to slow performance or loss of information. Additionally, there's a risk of losing work if the virtual machine's configuration isn't properly saved. However, it's worth noting that most Hypervisors have management tools that can manage this problem.

ChatGPT's response:

Running virtual computers on your laptop or desktop can have several downsides. Firstly, it can significantly tax your computer's hardware resources, such as CPU, RAM, and storage, leading to decreased performance for both the host and virtual machines. This can result in slower overall system responsiveness, longer boot times, and increased power consumption.

Additionally, virtualization often requires a fair amount of technical expertise to set up and manage properly. Configuration errors or compatibility issues can lead to instability or crashes in both the host and virtual machines, potentially causing data loss or system downtime.

Running multiple virtual machines simultaneously can also create security risks. If not properly isolated, a security breach in one virtual machine could potentially affect others on the same system, compromising sensitive data or applications.

Lastly, the cost can be a downside, as you may need to purchase licenses for virtualization software or allocate substantial storage space for virtual machine files, which can quickly eat up available disk space on your computer. Overall, while virtualization offers many benefits, it's essential to be aware of these downsides and carefully consider your needs and resources before implementing it on your laptop or desktop.

Comparing responses:

My response aligns with ChatGPT's response until the final paragraph. ChatGPT's mentions that the potential cost of using virtual machines is a downside. I think it's important to note that the cost of virtual machines, whether through licensing or buying time from AWS or VMware, often proves to be more cost-effective than investing in multiple physical computers, especially when you require multiple virtual machines for various tasks.

3. Provide a screen shot of the resources available on your physical computer. How many cores, speed, and so on. You can find the information in the About tab in the Updates and Security section on the computer. Use a screen shot of the popup window.

Solution:

```
elsaschutfort@Elsas-MacBook-Air ~ % sysctl -a | grep machdep.cpu
machdep.cpu.cores_per_package: 8
machdep.cpu.core_count: 8
machdep.cpu.logical_per_package: 8
machdep.cpu.thread_count: 8
machdep.cpu.brand_string: Apple M1
```

4. What are the benefits of virtualization, and what is one situation where you would want to use a VM instead of a physical machine?

Solution:

Benefits of virtualization:

Virtualization offers numerous advantages, including cost savings. Virtualization reduces costs by reducing expenses like hardware, data center footprint, and electricity consumption.

Situation where you would want to use a VM instead of a physical machine:

A specific situation where opting for a Virtual Machine (VM) over a physical machine is preferable is when dealing with resource-intensive computational tasks. For instance, when approximating certain mathematical functions, like calculating a derivative at a point where the function exhibits erratic behavior or rapid changes, a VM can efficiently allocate and manage the necessary computational resources, such as memory and processing power.

5. What is the difference between a native system virtual machine and a hosted system virtual machine?

Solution:

Native system virtual machines are where virtualization began and is ran directly on the host machine. Whereas Hosted System Virtual Machines are one layer higher than Native VMs, hosted VMs run within a Host operating system environment.

6. What are 2 operational benefits of virtualization?

Solution:

Two operational benefits of virtualization are isolation, beneficial for running untrusted Operating Systems or untrusted application, and automation of installation process from OS to Applications.

Deploying Virtual Machines (VMs)

1. Suppose you are running a Windows machine, but you have a program that needs to run in a Linux environment. How can you run the program while still technically using your Windows machine?

Solution:

To run a program requiring a Linux environment on your Windows machine, you can utilize a virtual machine. This allows you to execute the program within a Linux environment while technically still using your Windows machine.

2. What is the difference between a native and a hosted virtual machine monitor (hypervisor)?

Solution:

The difference between a native and a hosted virtual machine monitor (hypervisor) lies in their operational context. A native hypervisor operates directly atop hardware as a control program for operating systems, whereas a hosted hypervisor runs within an existing operating system environment and serves as a control program for other operating systems.

3. What is the difference between a virtual machine and a virtual appliance?

Solution:

A virtual machine is essentially a simulated computer system that runs software programs as if it were a physical machine. A virtual appliance is a specific type of virtual machine that comes preconfigured with all the necessary software components to fulfill a particular purpose. The primary distinction between the two is that a virtual appliance simplifies the deployment and management of software stacks by eliminating the need for manual installation, configuration, and maintenance, ultimately reducing complexity and associated costs.

4. What are the associated benefits of using virtualization software? Give a few examples of each benefit.

Solution:

Using virtualization software offers several associated benefits, including cost savings, efficiency gains, and operational enhancements. For example, by consolidating multiple virtual machines on a single physical server, organizations can reduce hardware costs and energy consumption. Additionally, virtual machines can install OS's in minutes whereas on physical machines installing OS's can take hours. Additionally, virtualization software streamlines operational processes, facilitating easier management, backup, and disaster recovery, thereby enhancing overall efficiency and resilience.

5. Do virtual machines have different IP addresses?

Solution:

Yes, virtual machines have unique IP addresses because they possess virtual network interfaces that enable them to operate independently.

6. What are the three components of virtual machines?

Solution:

The three components of virtual machines are the CPU, memory, and network resources.