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- MATH 4610

Virtual Machines

Question 1

Run the Linux OS as a virtual machine, or run the application in a containerized Linux environment (which is the same abstraction).

Question 2

A native system virtual machine has dedicated hardware to run the hypervisor, while a hosted system virtual machine runs a hypervisor as a process in the operating system.

Question 3

A virtual machine hosts an entire operating system and requires users to perform configuration if they want to run an application, whereas a Virtual Appliance is built to provide an easy plug-and-play virtual machine image built to run some specific software stack.

Question 4

In a large application sense, containerizing services into their own virtual machines allows for easier replication, scaling, and networking. Instead of running several smaller servers, one large server can host several applications in parallel. This provides a good seperation of concern. And, if one service goes down, the whole system does not go down with it.

Locally, it can help in development when targeting another operating system. Virtual machines can be used to verify builds without installing a whole other operating system.

Question 5

A virtual machine monitor is just another term for a hypervisor, so, see question 2.

Question 6

The three components of a virtual machine are:

1. The host
2. The virtualization layer
3. The guest

Virtualization

Question 1
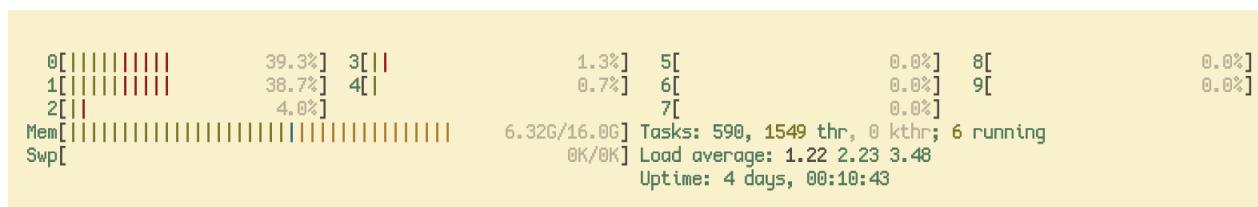
I use an Apple Silicon Mac which is based on the ARM architecture - so it's necessary to use [Multipass](), as native virtualization is *not available to us*.

```
10:12:59 with lizzy in ~/Homework/math4610 at armin on  main [?] on  v24.0.2 took 22.8s
→ sysctl -a | grep machdep.cpu
machdep.cpu.cores_per_package: 10
machdep.cpu.core_count: 10
machdep.cpu.logical_per_package: 10
machdep.cpu.thread_count: 10
machdep.cpu.brand_string: Apple M1 Pro
```

Question 2

One of the downsides of running a virtual machine, as opposed to a hosted virtual instance, is that local resources are used. On a laptop especially, this increases power draw, draining the battery. Additionally, the security of mind provided by "faster disaster recovery", as discussed in the article, is not as necessary for consumer applications on personal machines as servers. Finally, virtual machines are inherently slower in compute due to general overhead.

Question 3

```
  0[|||||||||        39.3%]  3[||              1.3%]  5[              0.0%]  8[              0.0%]
  1[||||||||||       38.7%]  4[|               0.7%]  6[              0.0%]  9[              0.0%]
  2[||                4.0%]                           7[              0.0%]
Mem[|||||||||||||||||||||||||||||||||||||||  6.32G/16.0G] Tasks: 590, 1549 thr, 0 kthr; 6 running
Swp[                                            0K/0K] Load average: 1.22 2.23 3.48
                                                        Uptime: 4 days, 00:10:43
```

Question 4

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Question 5

A native system virtual machine has dedicated hardware to run the hypervisor, while a hosted system virtual machine runs a hypervisor as a process in the operating system.

Question 6

1. Easier networking between "servers"
2. Efficient resource use

Question 7

A Virtual Appliance is built to provide an easy plug-and-play virtual machine image built to run some specific software stack.

Question 8

A Virtual Appliance would be desirable to eliminate maintenance and configuration overhead when running an application. In my own experience, I've used a form of virtual appliances - "Docker Containers", to easily spin up multiple versions of small services at work.

Question 9 What are 2 benefits of Virtualization?

See question 6.

Question 10

See question 4.

Question 11

See question 8.

Question 12 What are the three main types of virtualization?

1. Full virtualization
2. Para virtualization
3. OS-level virtualization

Question 13 What you should know about virtualization?

How to create a virtual machine, and maintain it.

Question 14 What is the weakness of virtualization?

Inherent overhead in all system operations.

Question 15 What are the six areas of virtualization?

Source: HiTechNectar

1. Application - run individual applications in a seperate environment than a host OS
2. Data - abstract exact location and formatting information away from retrieval of data
3. Desktop - hosts a desktop environment virtually on another machine (reminds me of mainframes).
4. Network - physical networking tools are abstracted into software resources
5. Server - division of a server into multiple guest operating systems
6. Storage - abstraction over multiple storage arrays into a single pool

Question 16 What is the biggest challenge in virtualization?

Resource distribution is a big one; it's difficult to keep track of several resources on a host machine and ensure a Virtual Machine accesses them correctly.

Question 17 What is the risk of using virtualization?

The biggest risk of using virtualization is sandbox escape vulnerabilities. Although mostly research and proof-of-concept, highly skilled engineers can theoretically craft exploits to escape the sandbox of the VM and directly mess with the host operating system.

Question 18

When (question 17) is trusted; sandboxing. Virtualization should supply no access to resources within the host operating system.