Introduction to Cloud Computing Report

Lab 1: Fundamentals of Virtualization Technology and Cloud Computing Applications

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Introduction to Cloud Computing
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I. Objective

The objective of this lab is to help students understand virtualization technology and its applications in modern computing systems. By learning and practicing with virtual machines (VMs) and the basic concepts of virtualization, students will gain proficiency in:

- Understanding the basic concepts of virtualization, including hypervisors and virtual machines.

- Learning how to configure and enable virtualization technology, and understanding the benefits and drawbacks of using virtual machines.

- Understanding the characteristics of VM isolation, portability, and other features, as well as their applications.

II. Lab Content

1. Check and enable processor virtualization technology (Intel VT-x or AMD-V).

2. Discuss the reasons behind the success of cloud computing and list the pros and cons of cloud services.

3. Study and answer the following questions related to virtualization technology:

   - What is a hypervisor?
   - What is a virtual machine (VM)?
   - What are the benefits of virtualization technology?
   - What are the use cases of virtualization technology?
   - What is the guest operating system in virtualization?
   - What does virtual machine isolation mean?
   - What are the benefits of virtual machine portability?
   - What is the purpose of cloning a virtual machine?

III. Results

1.Virtualization Technology

In this lab, the first step was to check if the processor supports Intel/AMD virtualization technology and enable Intel VT-x virtualization technology in BIOS.

To check support:

Windows: Open Task Manager → Performance tab → CPU → Virtualization If shown as "Enabled" or "Disabled", your processor supports virtualization. If not shown, your processor might not support it.

To enable in BIOS:

Restart your computer and press the BIOS key (e.g., Del, F2, F10, F12). Find options like Advanced → CPU Configuration → Virtualization Technology. Set Intel Virtualization Technology (VT-x) or AMD-V to Enabled. Save and exit (usually F10).

Checking Virtualization Support

To check if a processor supports virtualization technology:

- For Windows systems: Open **Task Manager** → Navigate to the **Performance** tab → Select **CPU** → Check the **Virtualization** status.
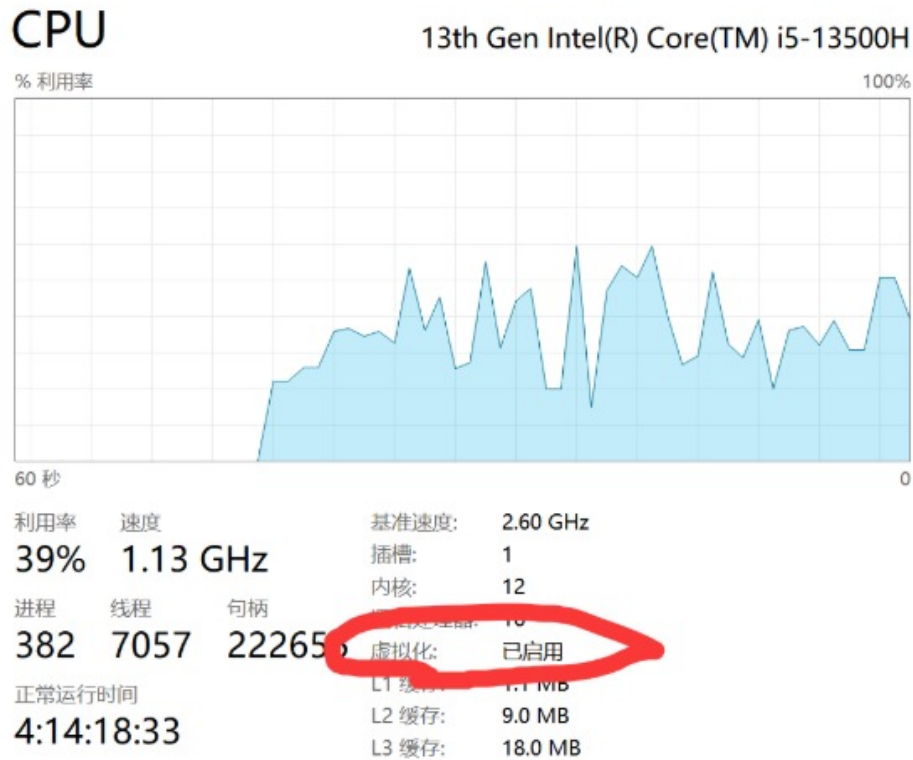
Figure 1: Task Manager CPU Virtualization Status

Take this screenshot of the CPU Performance page in Windows Task Manager as an example: in the hardware information section at the bottom of the interface, you can clearly see the status display corresponding to "Virtualization" (marked with a red circle in the image). This method allows you to quickly confirm whether virtualization support is enabled for the current processor (the 13th Gen Intel Core i5-13500H).

BIOS Configuration Steps

To enable virtualization in BIOS (if supported):

1. Restart the computer and press the BIOS key (e.g., Del, F2, F10, F12).

2. Navigate to options like **Advanced → CPU Configuration → Virtualization Technology**.

3. Set **Intel Virtualization Technology (VT-x)** or **AMD-V** to **Enabled**.

4. Save changes and exit (typically by pressing F10).

2. The cloud is almost everywhere in our lives now. What do you think are the fundamental reasons behind its success? Name three pros and three cons of cloud.

(1) Fundamental reasons for success

Reason	Explanation
Cost Optimization	Shifts IT spending from high upfront Capital Expenditure (CapEx) to flexible Operating Expenditure (OpEx), eliminating costs for hardware procurement and maintenance.
Elasticity & Scalability	Automatically and quickly adjusts computing resources (storage, processing power) based on real-time demand, preventing resource waste or shortages.
Ubiquitous Access	Allows users to access data and applications from any device and location via the internet, strongly supporting mobile and remote work scenarios.

Table 1: Fundamental Reasons for Cloud Success

(2) Three pros of cloud

Pro	Detail
Reduced IT Management Burden	Cloud providers handle infrastructure maintenance, software updates, and security patches, allowing organizations to focus on core business.
Rapid Deployment	New services or applications can be launched in minutes or hours, significantly accelerating time-to-market compared to traditional on-premises setup (weeks/months).
Disaster Recovery & Backup	Offers redundant storage and backup solutions across geographically distributed data centers, enhancing data reliability and business continuity.

Table 2: Three Pros of Cloud

(3) Three cons of cloud

Con	Risk
Dependency on Internet	Cloud services are unavailable if internet connectivity is interrupted or poor, impacting critical business operations.
Security & Privacy Risks	Data stored on third-party servers may face threats like unauthorized access, data breaches, or compliance issues with regional regulations (e.g., GDPR).
Vendor Lock-in	Migrating data or applications between different cloud providers can be costly and complex due to incompatible technology stacks, APIs, or service models.

Table 3: Three Cons of Cloud

3. What is the primary function of a hypervisor in virtualization?

A hypervisor (VMM) creates, manages, and isolates multiple virtual machines on one physical host. It enables:

- Resource allocation (CPU, memory, storage)

- Isolation between VMs

- Hardware abstraction to run different operating systems (OSs) on one host

4. What is a Virtual Machine (VM)?

A VM is a software-based emulation of a physical computer. It runs its own guest operating system and applications, managed by a hypervisor that shares physical resources (CPU, memory, storage, network) among VMs.

5. What are the benefits of using virtual machines?

Benefit	Explanation
Resource Efficiency	Multiple VMs share the host machine's physical hardware, significantly reducing costs for physical servers, power, and data center space (Server Consolidation).
Isolation & Security	Failures, crashes, or malware in one VM do not spread to other VMs or the host system, enhancing overall system stability and data security.
Flexible Testing & Development	Developers can quickly create isolated environments with different OS versions or configurations for testing applications without affecting the host system.
Easy Backup & Recovery	VMs can be saved, cloned, or exported as portable image files, allowing for quick backups and fast restoration to a previous working state.
Legacy Application Support	Outdated applications or software requiring older operating systems can run securely within a VM, avoiding compatibility issues with modern host OSs.
Scalability	Virtual machines can be easily scaled up or down based on the requirements, providing the flexibility to adapt to varying workloads without the need for physical hardware changes.
Cost-Effectiveness	By running multiple VMs on a single host, organizations can consolidate servers, reducing hardware expenses, maintenance costs, and the energy required to run physical servers.

Table 4: Benefits of Virtual Machines

6. List five use cases of virtual machines.

- **Software Development & Testing:** Utilizing VMs to simulate various operating systems and network environments for comprehensive application testing and debugging.

- **Server Consolidation:** Reducing the physical server count by running multiple virtual server instances (VMs) on a single physical host, lowering hardware and operational costs.

- **Education & Training:** Deploying standardized, pre-configured VM environments for students and trainees, ensuring a consistent and safe learning platform.

- **Cloud Computing Services (IaaS):** Serving as the core technology for Infrastructure-as-a-Service, allowing cloud providers to offer virtualized computing resources (virtual servers) on demand.

- **Legacy System Migration:** Running outdated or critical business applications that rely on obsolete operating systems within a VM, ensuring business continuity without maintaining old physical hardware.

7. In virtualization, what is the guest operating system?

Question: In virtualization, what is the guest operating system?

- a) The main operating system running on the physical machine

- b) The operating system installed on a virtual machine

- c) The operating system running on a remote server

- d) The operating system running on a mobile device

Answer: b) The operating system installed on a virtual machine

A virtual machine is a virtual computer, and the guest operating system is the system you install and use on this virtual computer (for example, if you run a Linux virtual machine on your Windows computer, then Linux is the guest operating system).

8. What does virtual machine isolation mean?

Question: What does virtual machine isolation mean?

- a) Virtual machines can communicate directly with the physical hardware.

- b) Virtual machines share the same resources and cannot be isolated.

- c) Virtual machines run independently and are isolated from each other and the host system.

- d) Virtual machines can only be accessed locally.

Answer: c) Virtual machines run independently and are isolated from each other and the host system.

9. What is the benefit of virtual machine portability?

Question: What is the benefit of virtual machine portability?

- a) It allows virtual machines to communicate with each other easily.

- b) It ensures faster boot times for virtual machines.

- c) It allows virtual machines to be moved between different physical machines with compatible hypervisors.

- d) It reduces the need for hardware virtualization.

Answer: c) It allows virtual machines to be moved between different physical machines with compatible hypervisors.

10. What is the purpose of cloning a virtual machine?

Cloning creates an exact, ready-to-use copy of an existing Virtual Machine (VM), including its operating system, applications, configurations, and data. This avoids the time-consuming process of manually installing and setting up a new VM from scratch.

Common use cases for cloning include:

- **Rapid Deployment:** Quickly scaling up services or creating multiple identical environments using a pre-configured template (the original VM).

- **Testing and Debugging:** Using clones to test software updates, patches, or new features without risking the stability of the original production VM.

- **Disaster Recovery:** Keeping cloned VMs as reliable backups; if the primary VM fails, the clone can be activated immediately to restore services.

- **Consistent Environments:** Ensuring all team members (e.g., developers, testers) work on identical, standardized VM environments, eliminating configuration differences.