

## Basic Computing concepts

### Servers and data centers

A **server** is a specialized computer that provides data, services, or resources to other computers (called clients) over a network. Servers typically have more powerful hardware than desktops, including more memory, multiple CPUs, redundant power supplies, and extra network interfaces. Common types of servers include **web servers**, **database servers**, and **mail servers**.

A typical example is a **web application**:

- A client browser sends a request (using a URL).
- The web server receives the request and passes it to the web application.
- The web application requests its data from a database server.
- The database server returns the data.
- The web server sends the final webpage back to the client.

Servers are physically located in **data centers**, which are secure facilities designed to host computing equipment. Data centers contain servers, storage systems, networking devices, cooling systems, and power protection (like UPS units). They are built to keep equipment safe and running reliably.

There are two main models for data center ownership:

- **On-premises model:** The organization owns and manages its own data center, hardware, software, and staff.
- **Cloud model:** A cloud provider owns the data center, handles all hardware and maintenance, and customers pay to use the provider's computing resources.

The cloud model reduces the need for organizations to buy and manage physical infrastructure, offering more flexibility and scalability compared to traditional on-premises setups.

### Virtual Machines (VMs)

A **virtual machine (VM)** is a **software-based computer** that runs inside a physical computer (called the **host**) using **virtualization software**, known as a **hypervisor**. The hypervisor allocates the host's resources- CPU, memory, storage, and network- to one or more VMs. Each VM can run its **own operating system and applications**, and multiple VMs can run on a single host simultaneously.

## Benefits of VMs

- **Cost savings:** Run multiple operating systems on one physical machine without buying new hardware.
- **Efficiency:** Multiple VMs increase the utilization of a single host and handle different workloads.
- **Reusability & portability:** VM images can be copied or moved to other hosts, making it easy to duplicate or back up computing environments.

## VMs in the Cloud

- VMs are the **fundamental computing unit in cloud environments**.
- They enable **self-service**, **pay-as-you-go** pricing, and **scalability**.
- Example: **Amazon EC2** allows users to provision virtual servers quickly, control computing resources fully, and scale capacity up or down as needed.

## Software development life cycle

The Software Development Life Cycle (SDLC) is a structured process used to build, improve, and maintain software in an organized way. It consists of seven phases:

1. **Plan** - Identify the problem, define project goals, and determine the resources needed. This phase results in a project plan.
2. **Analyze** - Gather and document detailed requirements in a Software Requirements Specification (SRS), which is later approved by the customer.
3. **Design** - Translate requirements into a technical blueprint. Multiple design approaches are proposed and evaluated before selecting the best option.
4. **Develop** - Write the actual code following the design specifications and organizational standards.
5. **Test** - Validate that the software works as expected and fix defects. This includes unit, integration, performance, and security testing.
6. **Implement** - Deploy the completed application into the production environment for users.
7. **Maintain** - Monitor and update the application through corrective, adaptive, perfective, and preventive maintenance.

The SDLC repeats throughout an application's lifetime to support updates, fixes, and improvements.

**Key points:**

- A server provides data or services to other computers.
- A data center houses an organization's computing and networking equipment.
- Hardware virtualization enables the creation of virtual machines (VMs), forming a core part of cloud computing.
- Virtualization separates the operating system and applications from physical hardware, making computing flexible, efficient, and scalable.
- The SDLC ensures disciplined, high-quality software development through its seven defined phases.