1. **Overview of disk drives and file systems**
   * **Understanding persistent storage organization.**
2. **Disk drives**
   * **Types**:
     + Hard disk drive (**HDD**).
     + Solid-state drives (**SSDs**).
     + Plastic-covered **3 ¼ drives** (uncommon, but still relevant).
   * **Non-volatile** storage characteristics:
     + **Laptops: 2.5-inch drives.**
     + **PCs: 3.5-inch drives.**
   * **Interfaces**:
     + **IDE/PATA** (device0 and device1).
     + **SATA** (modern standard).
3. **Hard disk drive components**
   * **Platters, tracks, sectors, cylinders:**
     + **Data stored in tracks and sectors** (512 bytes/sector).
   * **Read/write heads driven by actuator motor.**
   * **Total disk capacity formula:**
     + (bytes/sector) × (sectors/track) × (tracks/surface) × (number of surfaces).
   * **Addressing formats:**
     + **CHS** (cylinder, head, sector).
     + **LBA** (logical block addressing).
4. **Hard disk interfaces**
   * **Common interface types:**
     + **PATA**, **SATA**, **IDE**, **EIDE**.
     + **Fibre** **channel**.
     + **SCSI**.
5. **Physical and logical hard disk structure**
   * **Special** **areas**:
     + Host-protected area (**HPA**).
     + Device configuration overlay (**DCO**).
   * **Partitions**:
     + Defined by **starting** **block** **and** **length**.
     + Difference between **partition (one disk)** and **volume (multiple disks).**
6. **SSD, USB, and flash memory drives**
   * **Flash memory:**
     + Form factors (**SD**, **microSD**).
     + Storage: **2GB to 64GB+.**
   * **USB drives:**
     + Includes **controller for direct USB connection**.
   * **SSD:**
     + Utilizes **flash** **memory** chips.
     + **Wear-levelling** mechanism.
7. **Optical storage (CD/DVD/Blu-ray)**
   * **CD-ROM: 700MB** storage capacity.
   * **DVD:** up to **4GB** (**8GB** double-sided).
   * **Blu-ray:** **25GB** (single-layer), **50GB** (dual-layer).
8. **RAID storage systems**
   * **Goal**: **spread storage** load across **multiple** **drives** as a **single** **volume**.
   * **Strategies**:
     + **Mirroring**.
     + **Striping**.
     + **Parity**.
   * **RAID** **levels**:
     + **RAID-0 (striping).**
     + **RAID-1 (mirroring).**
     + **RAID-5/6 (block-level striping with parity).**
     + **Combined levels (RAID 0+1, RAID 10, etc.).**
9. **File systems**
   * **Definition**: **Abstraction over disk partitions**.
   * **Windows file systems:**
     + **FAT (fat12, fat16, fat32).**
     + **NTFS:** supports **64-bit** clusternumbers.
   * **Linux file systems:**
     + **ext2, ext3, ext4, reiserfs, zfs.**
   * **Mac file systems:**
     + **hfs, hfs+**: utilizes **volume** **header**, **catalogue** **file**, extents overflow file, etc.
10. **Class exercise:**

* Find OS besides the ones discussed in the lecture and the associated

file system, as well as where are those OS used these days.

* **Android**
* **File System:** Ext4 (default), F2FS (optional for flash storage).
* **Usage:** Primarily used in smartphones, tablets, and some smart TVs.
* **ChromeOS**
* **File System:** Ext4 with encryption layers.
* **Usage:** Found in Chromebooks, designed for cloud-based applications.
* **FreeBSD**
* **File System:** UFS (Unix File System), ZFS.
* **Usage:** Popular in servers, networking appliances, and storage systems.
* **Solaris**
* **File System:** ZFS.
* **Usage:** Used in enterprise servers and data centers.
* **QNX**
* **File System:** QNX6FS.
* **Usage:** Embedded systems like automotive infotainment and industrial control.
* **Haiku OS**
* **File System:** BFS (Be File System).
* **Usage:** Hobbyist OS for personal computing.
* **AIX (IBM)**
* **File System:** JFS (Journaled File System).
* **Usage:** Enterprise servers and mainframes.
* **Minix**
* **File System:** Minix File System.
* **Usage:** Educational purposes and embedded systems.