

Operating Systems

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What this course is about

- ▶ What Operating Systems Do
- ▶ Computer-System Organization
- ▶ Computer-System Architecture
- ▶ Operating-System Operations
- ▶ Resource Management
- ▶ Security and Protection



Operating System Definition

- ▶ No universally accepted definition
- ▶ “Everything a vendor ships when you order an operating system” is a good approximation
 - ▶ But varies wildly
- ▶ “The one program running at all times on the computer” is the **kernel**.
- ▶ Everything else is either
 - ▶ a system program (ships with the operating system) , or
 - ▶ an application program.



What Operating Systems Do?

- ▶ Interface between user and hardware
- ▶ Control interactions between users and programs
- ▶ Provides a controlled and efficient environment for the execution of programs
- ▶ Provides mechanisms (functionality) and policies (rules) to manage the whole resources of the system



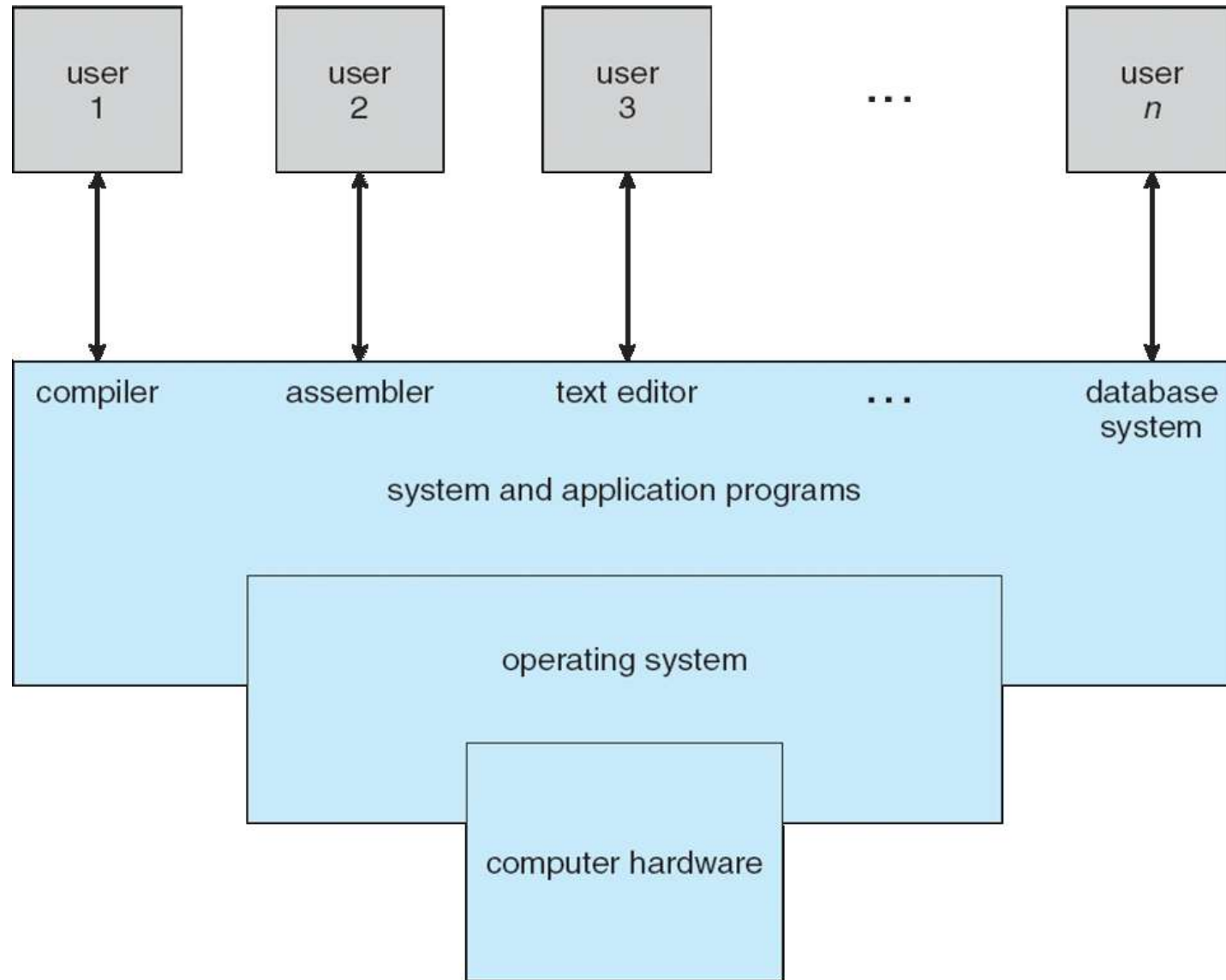
Computer System Components

Four main components in a computer system:

- ▶ **Hardware**
 - ▶ basic computing resources (CPU, memory)
- ▶ **Operating Systems**
 - ▶ Controls and coordinates the use of the hardware among the various application programs for the various users
- ▶ **Application programs**
 - ▶ Use system resources to solve problems or complete tasks
- ▶ **Users**
 - ▶ People, machines or other computers



Four Components of a Computer System



Operating Systems

- ▶ The term “OS” covers many roles
 - ▶ Because of myriad designs and uses of OSes
 - ▶ Present in toasters through ships, spacecraft, game machines, TVs and industrial control systems
 - ▶ Born when fixed-use computers for military became more general purpose and needed resource management and program control



Why Study Operating Systems?

- ▶ **Arguments against**

- ▶ “very few designers/implementers needed”
- ▶ “all I need to know is in the man pages”
- ▶ “I’ll stick to my favorite OS anyway”



Why Study Operating Systems?

- ▶ Crucial for understanding application-hardware interaction
- ▶ Growing need for OSs: mini-OSs in many environments, embedded systems...
- ▶ The study of general OSs includes important design and optimisation problems in computer science
- ▶ Achievement of flexibility, robustness, security, and performance, whilst keeping things as simple as possible



What this course is about?

- ▶ Understanding the general principles of OS design
 - ▶ focus on general-purpose, multi-user systems
 - ▶ emphasis on widely applicable concepts
 - ▶ stress on problems, solutions, and design choices
- ▶ This course is **not** about specific features of a particular OS: “how do I do X in operating system Y?”



What this course is about?

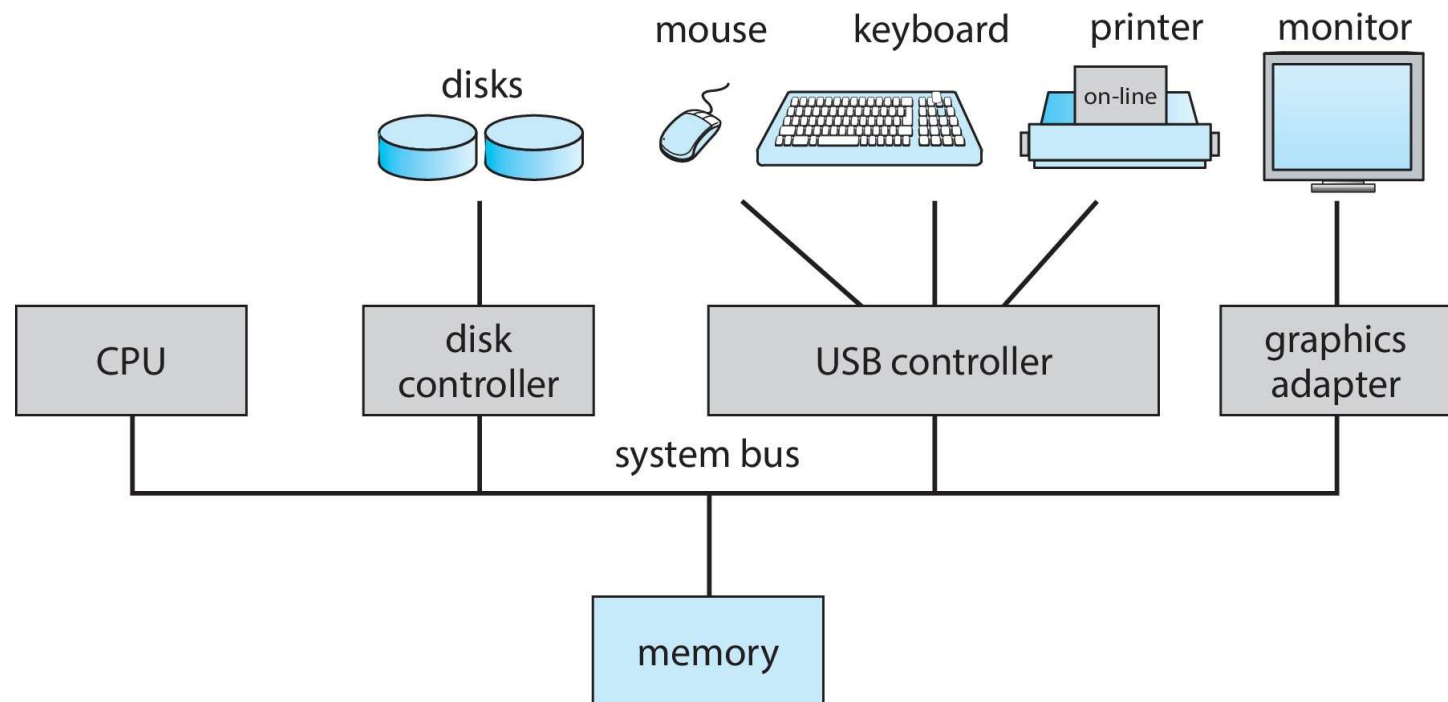
- ▶ To be able to identify core issues, elements, and techniques in any operating system
- ▶ To be able to design efficient solutions when faced with problems similar to the ones already seen



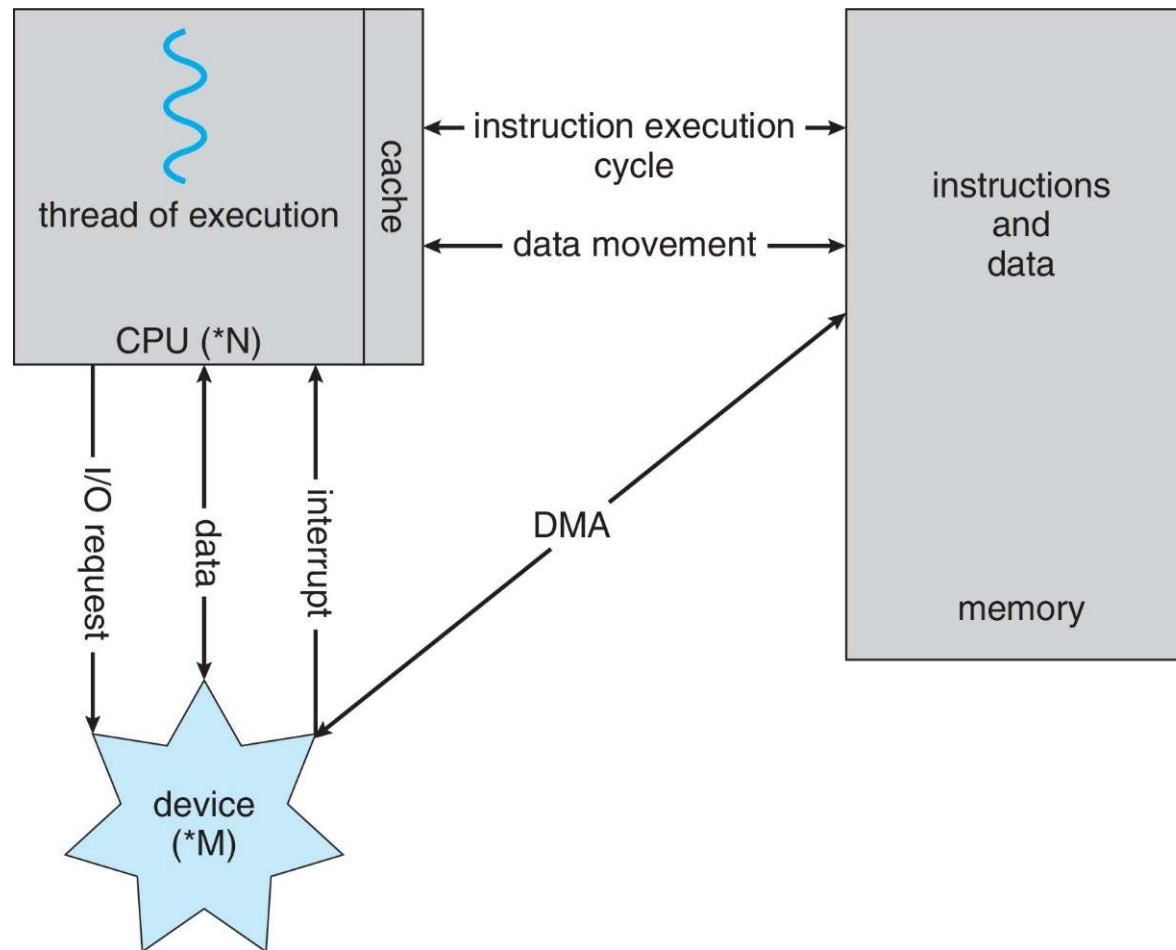
General Organization

▶ Computer-system operation

- ▶ One or more CPUs, device controllers connect through common **bus** providing access to shared memory
- ▶ Concurrent execution of CPUs and devices competing for memory cycles



How does a modern computer work



Source: Adapted from SGG's book

Operating System's View

- ▶ An OS performs two basically unrelated functions:
 - ▶ managing the hardware resources (resource manager)
 - ▶ extending the hardware functionality (virtual machine)



Virtual or Extended Machine View

- ▶ Often called top-down view or user's view
- ▶ Present a nice and simple view of the computer use:
 - ▶ hide low-level detail of programming the hardware (awkward to handle hardware directly)



Virtual or Extended Machine View

- ▶ Build layers of software that provide more and more functionality
- ▶ Make the user believe that there are more hardware resources than in reality



Resource Manager View

- ▶ Called bottom-up view or system's view
- ▶ A computer can be seen as a set of hardware resources for processing, storing and moving data
 - ▶ CPU
 - ▶ Memory
 - ▶ Input and Output (I/O) etc.



Resource Manager View

- ▶ In this view, the OS is there to provide an orderly and controlled allocation of those resources
- ▶ Performs functions like time & space multiplexing of resources allowing them to be share by multiple users

