1.3 The evolution and scope of OSs

OSs can be classified along two major dimensions. The first considers the evolution of OSs over time, as driven by advances in new hardware technologies. The second dimension places OSs into classes based on the main application environments.

The five generations of computer systems

The first digital computer systems, developed in the 1940's, used vacuum tubes to represent 0's and 1's. Due to the limited size, no OS support was provided. Since then, OSs have undergone a major evolution, driven by innovations in technology and the corresponding growth in user needs.

Moore's law, formulated by the scientist Gordon Moore, is the observation that the number of transistors in an integrated circuit doubles about every two years. This prediction has held steady since the mid 1960's until today.

Computer scientists divide computer systems roughly into 5 generations, each lasting between 10 - 15 years, and each associated with a major shift in hardware technology: vacuum tubes, transistors, integrated circuits (IC), microprocessors, and networks. Each major breakthrough led to the development of a new generation of computer system, which in turn required major advancements in OS capabilities.

Table 1.3.1: The 5 generations of computers.

Gen.	Enabling hardware technology	OS type	Defining characteristics
1	Vacuum tubes	None	All programming was done by experts in machine language without any support from an OS or any other system software.
2	Transistors replaced vacuum tubes as smaller and faster switches.	Batch OS	Programs were submitted in batches of punch cards. The role of the OS was to automate the compilation, loading, and execution of programs. Multiprogramming was developed, which allows the OS to schedule the execution of jobs to make more efficient use of the CPU and other resources.
3	Integrated circuits allowed the development of microchips to replace individual transistors.	Interactive multi-user OS.	Interrupts were developed to allow the OS to enforce time-sharing and to interact with keyboards and display terminals, also developed during the same period. Increased capacity and speed of memory and secondary storage devices imposed additional management tasks on the OS.
4	Very large scale integration (VLSI) allowed the placement of a complete microprocessor on a single chip, leading to the development of personal	Desktop and laptop OS.	The OS was responsible for all operations, starting from the initial booting, to multitasking, scheduling, interactions with various peripheral devices, and keeping all information safe. The emphasis was on user-friendliness, including the introduction of the GUI.

	computers (PCs).		
5	Networking hardware enabled the harnessing of the power of multiple computers.	OSs for supercomputers, distributed systems, and mobile devices.	The ability to create extremely powerful chips spawned several directions of development. Supercomputers combined large numbers of processors and made the OS and other software responsible for exploiting the increased computation power through parallel processing. Computer networks gave rise to the Internet, which imposed requirements of privacy and safety along with efficient communication. Wireless networks led to the development of hand-held devices, with additional demands on the OS.

Feedback?

PARTICIPATION ACTIVITY 1.3.1: Key technologies to drive new generations of computers.

1) The invention of transistors marks the transition to the _____ generation of computer systems.
   - (•) 2nd
   - ( ) 3rd
   - ( ) 4th

Correct

Transistors replaced vacuum tubes, thus marking the transition from the 1st to the 2nd generation.

2) The invention of integrated circuits marks the transition to the _____ generation of computer systems.
   - ( ) 2nd
   - (•) 3rd
   - ( ) 4th

Correct

Integrated circuits enabled the placement of many transistors on a single chip, thus marking the transition from the 2nd to the 3rd generation.

3) The invention of microprocessors marks the transition to the _____ generation of computer systems.
   - ( ) 2nd
   - ( ) 3rd
   - (•) 4th

Correct

Using VLSI, an entire processor could be placed on a single chip, thus marking the transition from the 3rd to the 4th generation.

Feedback?

PARTICIPATION ACTIVITY 1.3.2: Advances in OSs.

Associate the distinguishing OS features with the corresponding generations.

Select the definition that matches each term

1) No OS support.

Correct

1st generation

Computers used vacuum tubes and magnetic drums for storage to perform computations without any software support.

2) Batch processing, multiprogramming.
   - 2nd generation

Correct

Multiprogramming improved the throughput of jobs submitted in batches of punch cards.

3) Time-sharing, keyboard and display terminal support.
   - 3rd generation

Correct

Interrupts enabled time-sharing of the CPU among multiple users, who interacted with the system using keyboards and cathode-ray display terminals.

4) User-friendly GUI.
   - 4th generation

Correct

Microprocessors gave rise to the personal computer, which required an intuitive, easy-to-use interface even for the casual user.

5) Parallel and distributed computing.
   - 5th generation

Correct

Connecting multiple CPUs and memories into a supercomputer enabled high-performance computing. Connecting multiple computers into networks enabled internet commerce, information sharing, and social interactions.

Reset

Feedback?

Types of OSs

Given the omnipresence of computer systems in all aspects of life, different types of OSs are required for different purposes and environments. The requirements on the OS generally coincide with the size and complexity of the OS. The table lists typical OS types, ordered by size from largest to smallest.

Table 1.3.2: Common applications of various OS types.

Type of operating environment	Common application areas	Major emphases
Mainframe: a large central computer used by large organizations.	High-volume data processing in administration, banking, government.	High throughput, management of large storage.
Server: a large computer that responds to requests from individual clients.	Web and email processing, Internet commerce.	Fast response, security.
Multiprocessor: a system of multiple CPUs and memories interconnected by a fast network into a single parallel computer.	Scientific and other high-performance computations.	Fast interprocess communication and memory access. Data consistency.

Distributed system (multi-computer): a network of independent computers interconnected via a communication network.	Sharing of data and services, internet commerce.	Efficient and secure communication. Support for many types of applications and services.
Desktop or laptop: a personal computer.	Word processing, personal finance, access to Internet, games.	User-friendly interface. Intuitive organization of data and applications. Support for a variety of tasks without much technical knowledge of the inner functioning of the computer.
Hand-held device: small, portable, wireless-capable device for personal use.	Smartphones, tablets.	User-friendly interface. Easy integration of new applications. Support for microphone, speaker, camera, GPS, motion sensor, and other components.
Real-time system: a computer, frequently embedded in a larger electro-mechanical system, that must respond rapidly to external events.	Control of industrial processes, vehicle and aircraft control, audio and video transmission.	Scheduling to meet all deadlines. Reliability in life-critical applications.
Sensor network: collection of small, spatially distributed dedicated sensors communicating by wired or wireless connections.	Industrial, environmental, or military monitors. Wearable devices.	Minimize power consumption. Form ad-hoc connections and tolerate node failures.

Feedback?

PARTICIPATION ACTIVITY 1.3.3: Distinguishing features of different systems.

1) Mainframes are considered _____.
   - ○ supercomputers
   - ○ embedded computers
   - ◉ general-purpose computers

Correct
Mainframes are stand-alone systems that can be programmed to perform a wide variety of tasks.

2) An advanced aircraft is unlikely to have on board a _____.
   - ◉ mainframe computer
   - ○ real-time computer
   - ○ PC

Correct
Mainframes are too large for most aircraft to carry on board.

3) What multiprocessors and multi-computers (distributed systems) have in common is _____.
   - ○ the same type of applications
   - ○ the same type of interconnection

networks

- the ability to carry out operations in parallel

Feedback?

CHALLENGE ACTIVITY | 1.3.1: OS types.

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Jump to level 1

1 2 3

Select the best definition for each type of operating environment.

Hand-held device: Select

Desktop/laptop: Select

Real-time system: Select

1 2 3

Check Next

Feedback?

How was this section? Provide feedback