Chapter 1:   Introduction

Operating Systems: What and Why?

What is Operating Systems?

The concept of operating system is pretty straightforward:
A piece of software that manages a computer, making computer's hardware resources accessible to software through a consistent set of interfaces.

An OS is usually designed for
1.Abstracting away the hardware

2.Providing a consistent set of interfaces

3.Creating over entire ecosystems

What is Operating Systems?

Some Concepts with Operating Systems

➢ Mac、Linux、Windows、Android、iOS

➢ 虚拟化
   ➢ 内存、cpu、设备、网络

➢ 分布式对象

➢ 分布式内存/文件
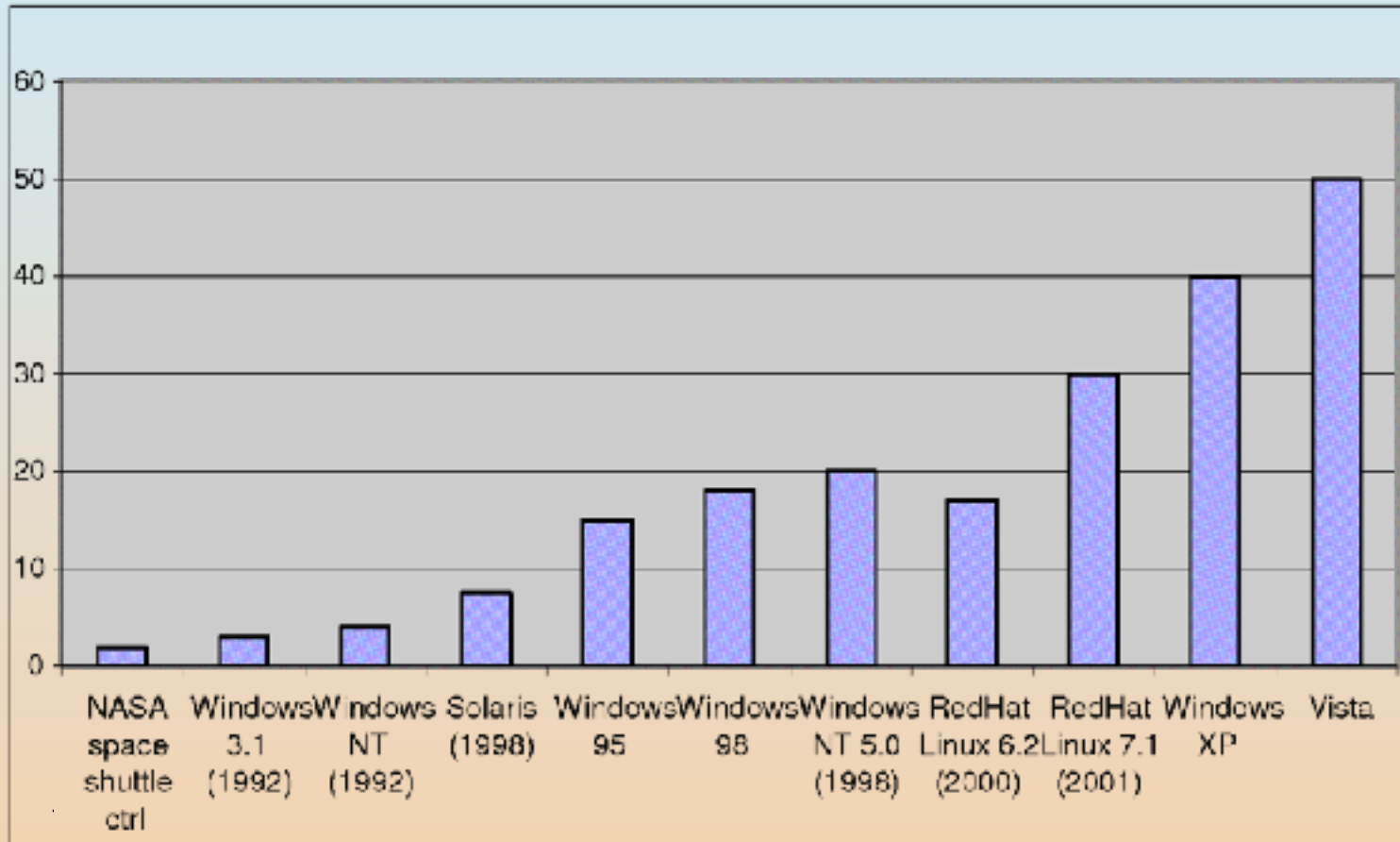
➢ 规模计算
   ➢ Mapreduce
   ➢ 数据中心

➢ 实时和多媒体

Why Study Operating Systems?

- Run the computer in an efficient manner

- How a program is structured so that an operating system can run.

- A big picture of how each layer of a computer is related to the other, from hardware to software.

- …...

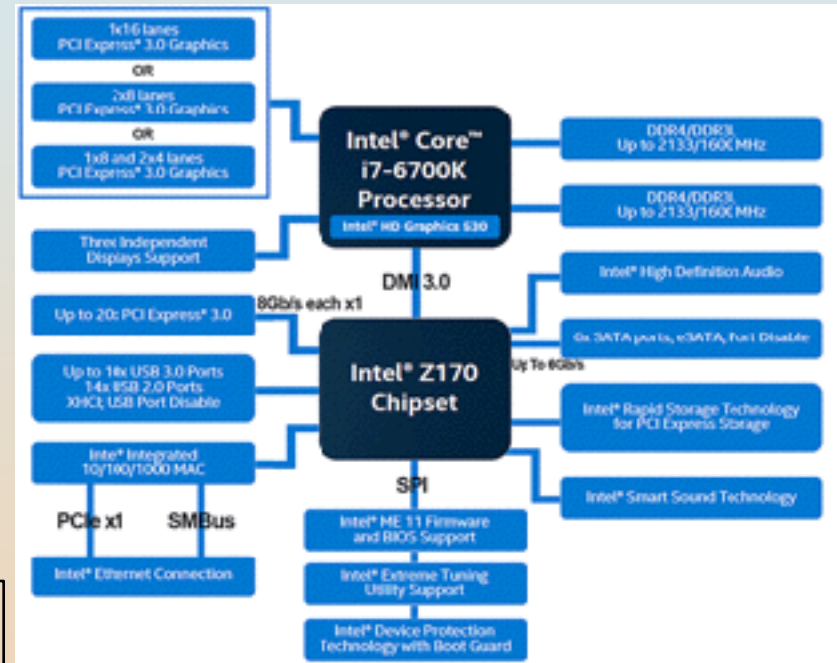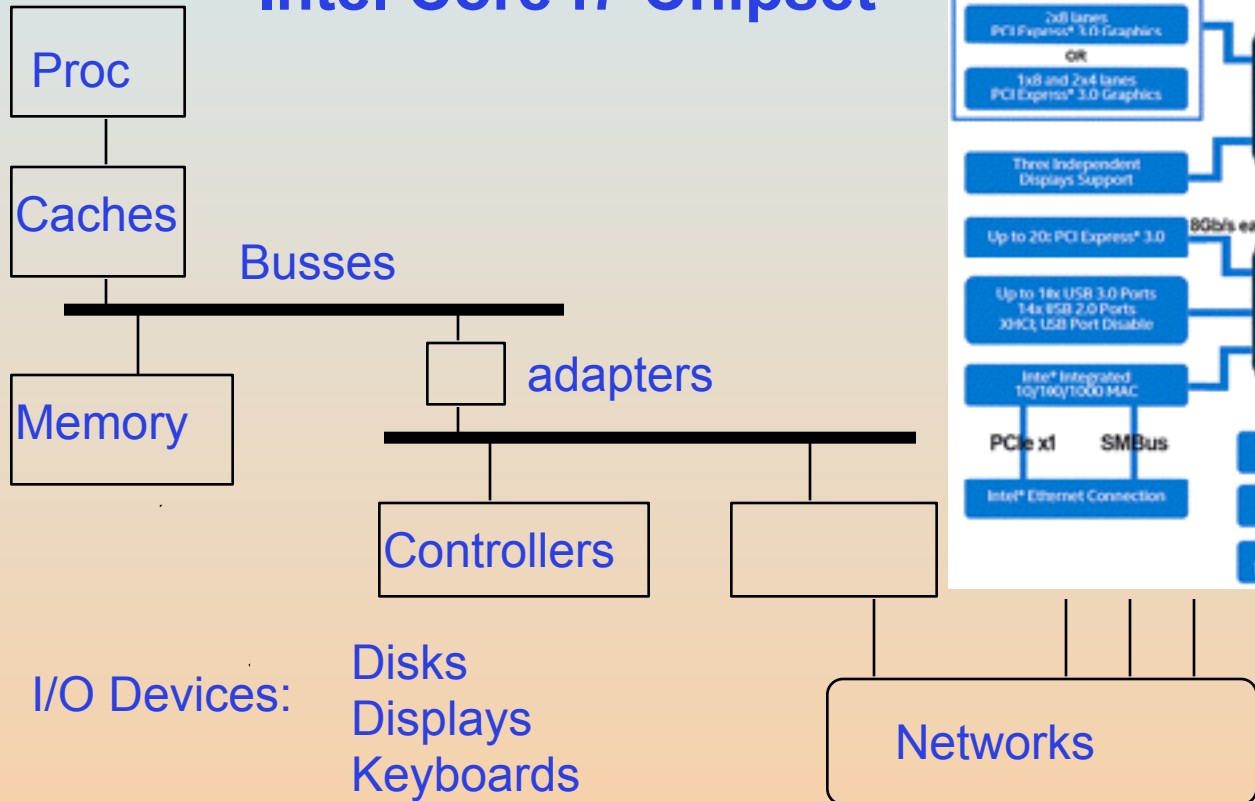授人以鱼，不如授人以渔

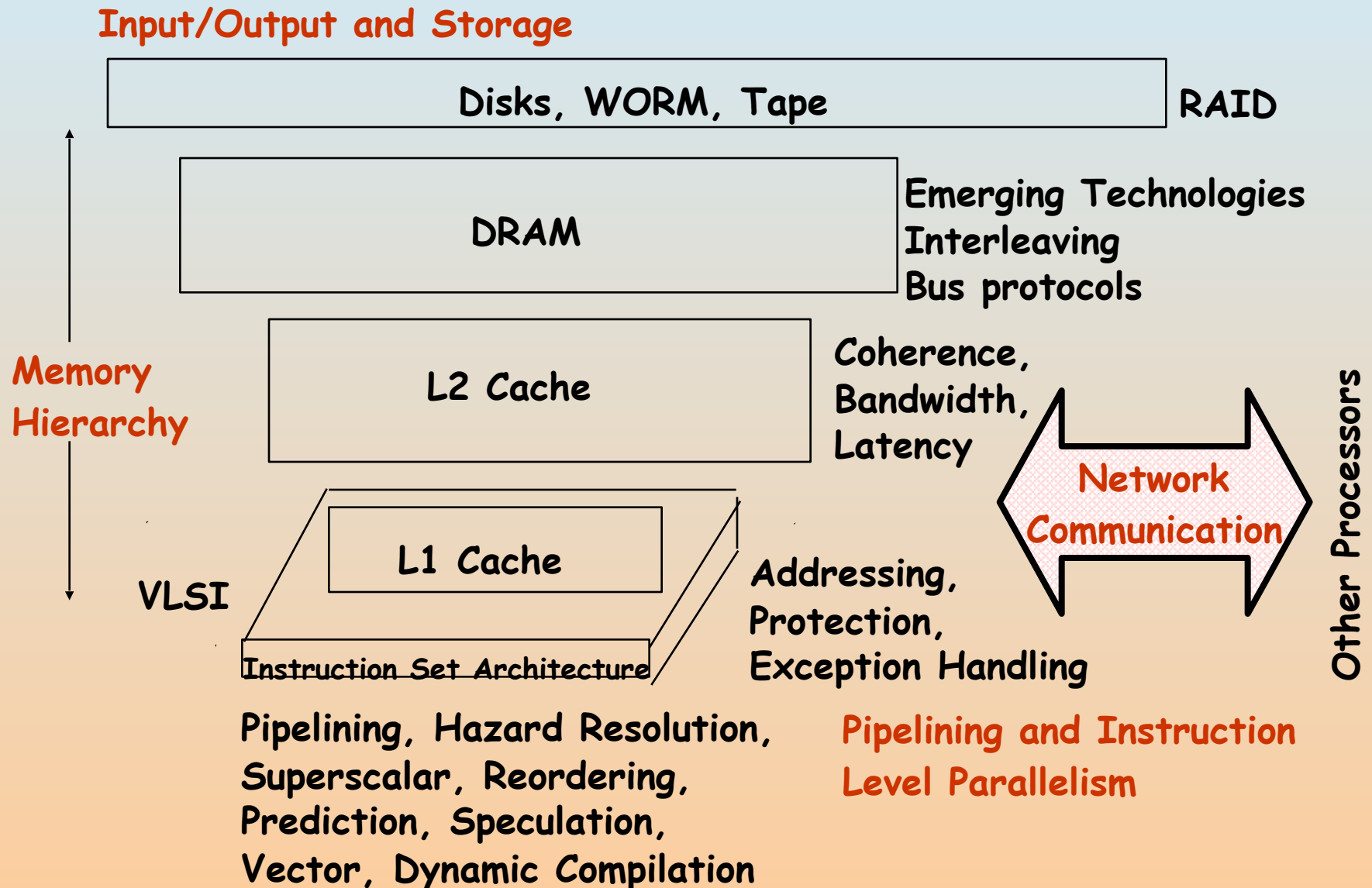# Increasing Software Complexity

From MIT's 6.033 course

Functionality comes with great complexity!

Intel Core i7 Chipset

Proc

Caches

Busses

Memory

adapters

Controllers

Networks

I/O Devices:
Disks
Displays
Keyboards

Sample of Computer Architecture Topics

Input/Output and Storage

| Disks, WORM, Tape | RAID |

Memory Hierarchy

| DRAM |

Emerging Technologies
Interleaving
Bus protocols

| L2 Cache |

Coherence,
Bandwidth,
Latency

VLSI

| L1 Cache |

Instruction Set Architecture

Addressing,
Protection,
Exception Handling

Network Communication

Other Processors

Pipelining, Hazard Resolution, Superscalar, Reordering, Prediction, Speculation, Vector, Dynamic Compilation

Pipelining and Instruction Level Parallelism
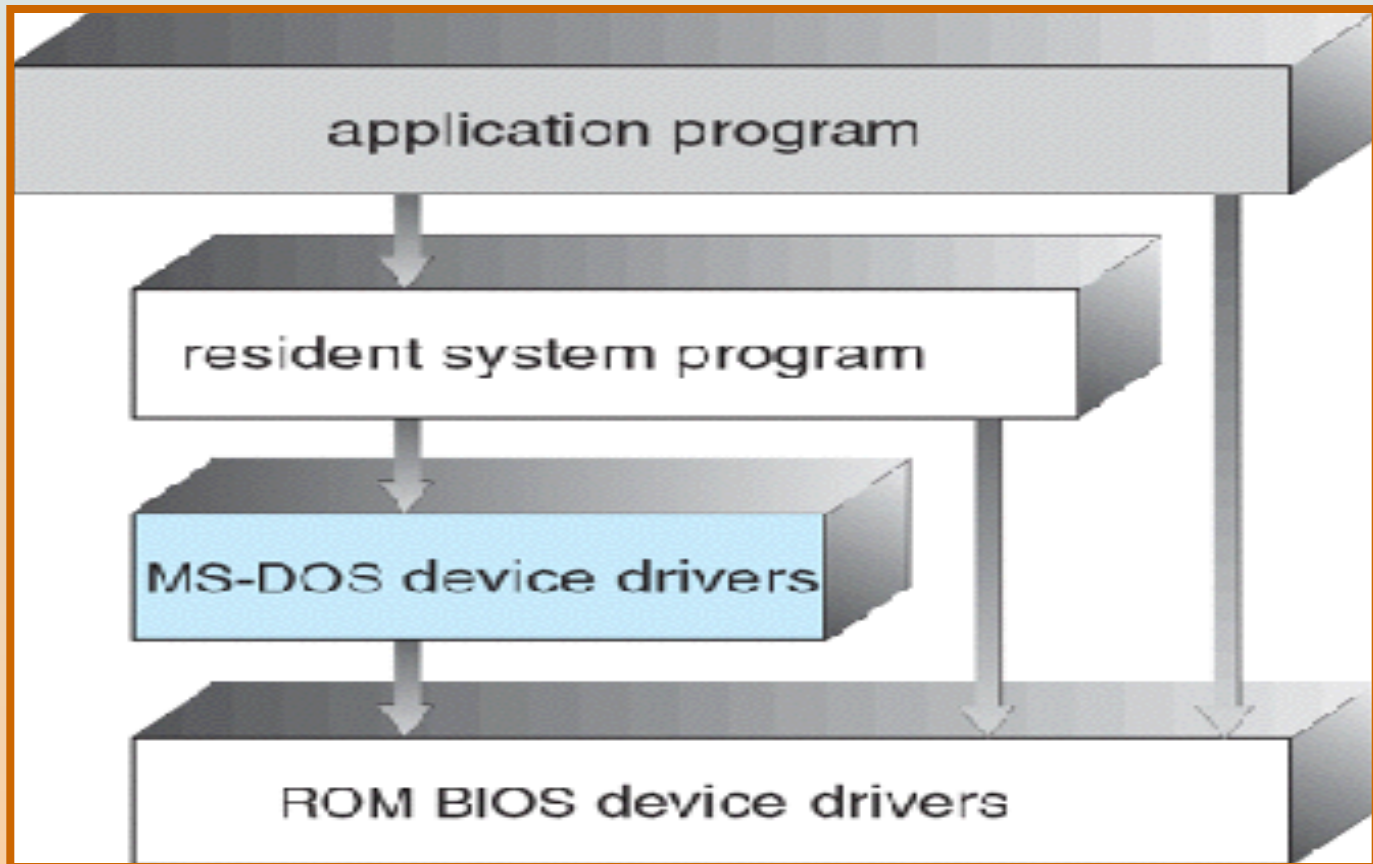
Operating Systems

- 中央处理机（CPU）

- 内存

- I/O设备（键盘、显示器、鼠标）

- 外部设备（打印机、扫描仪、MODEM 等）

- 外存设备（硬盘、软盘、光盘、磁带等）

What if we didn't have an Operating System?

- 人工操作
  - 用户独占全机
  - CPU等待人工操作

- 脱机输入/输出

What if only one application?

MS-DOS

What if only one application?

- 单道批处理系统

  - 自动性

  - 顺序性
  -
  - 单道性

  - 资源（cpu,内存,I/O设备）利用率?
  - 系统吞吐量?

More complex OS: Multiple Apps

- Multi-programming (多道程序)

- Problem: Run multiple applications in such a way that they are protected from one another

- Goal:
  - Keep User Programs from Crashing OS
  - Keep User Programs from Crashing each other
  - [Keep Parts of OS from crashing other parts?]

- (Some of the required) Mechanisms:
  - Address Translation
  - Dual Mode Operation

- Simple Policy:
  - Programs are not allowed to read/write memory of other Programs or of Operating System

Multi-programming (多道程序)

- 多道性

- 无序性

- 调度性

- 平均周转时间？

- 交互能力？

- 处理机/内存/I/O设备/文件/…管理？

Time-Sharing Systems–Interactive Computing

- The CPU is multiplexed among several jobs that are kept in memory and on disk (the CPU is allocated to a job only if the job is in memory)

- A job swapped in and out of memory to the disk

- On-line communication between the user and the system is provided
  - When the operating system finishes the execution of one command, it seeks the next "control statement" from the user's keyboard

  - 多路性
  - 独立性
  - 及时性
  - 交互性

Real-Time Systems

- Often used as a control device in a dedicated application such as controlling scientific experiments, medical imaging systems, industrial control systems, and some display systems
- Well-defined fixed-time constraints
- Real-Time systems may be either hard or soft real-time

- 实时控制
- 实时信息处理
- 可靠性

Real-Time Systems (Cont.)

- Hard real-time:
  - Secondary storage limited or absent, data stored in short term memory, or read-only memory (ROM)
  - Conflicts with time-sharing systems, not supported by general-purpose operating systems
- Soft real-time
  - Limited utility in industrial control of robotics
  - Integrate-able with time-share systems
  - Useful in applications (multimedia, virtual reality) requiring tight response times

Handheld Systems

- Personal Digital Assistants (PDAs)
- Cellular telephones
- Issues:
  - Limited memory
  - Slow processors
  - Small display screens

Migration of Operating-System Concepts and Features
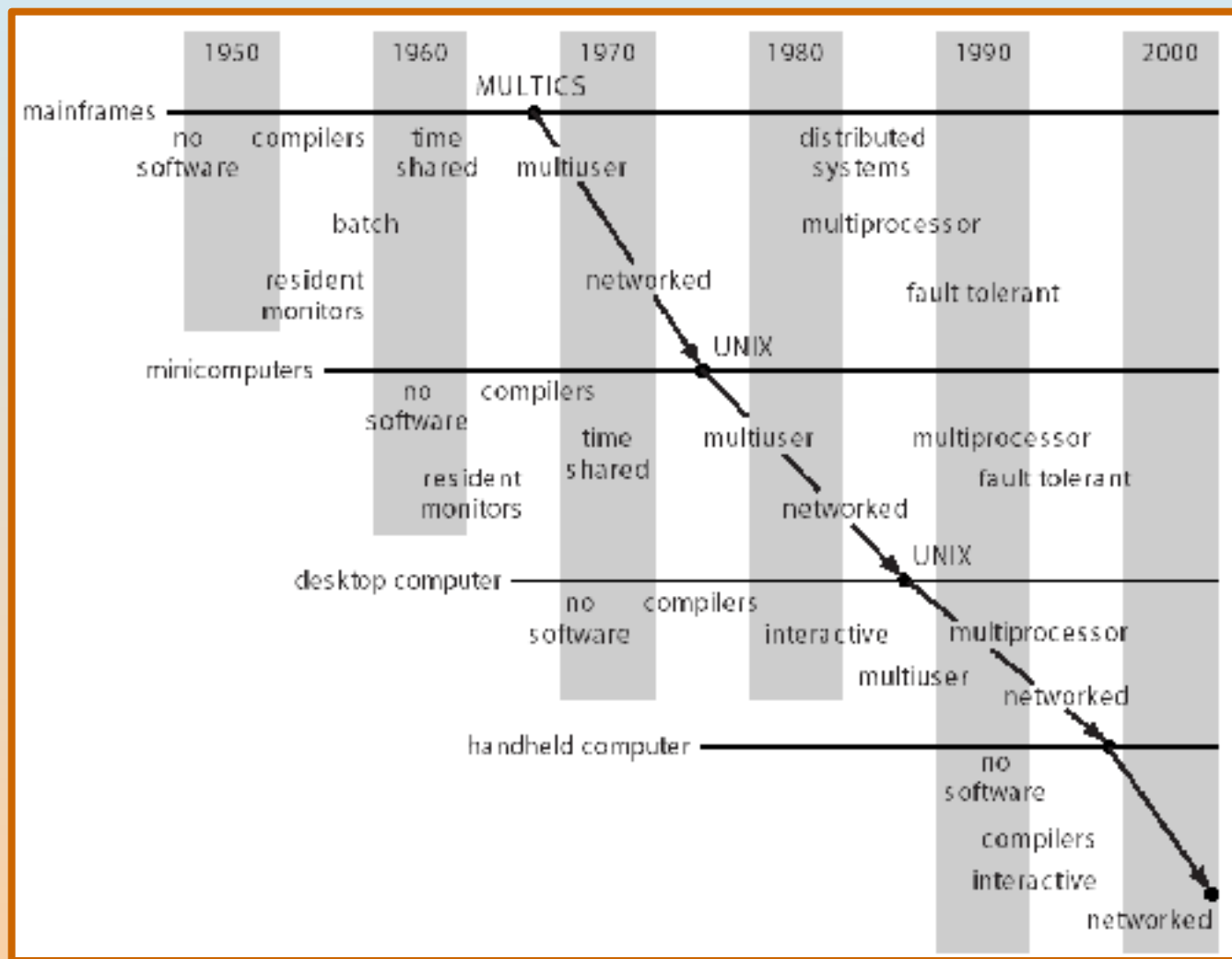
OS Characteristics

- 并发(Concurrence)

- 共享(Sharing)❓

- 虚拟(Virtual)

- 异步(Asynchronism)

Why Study Operating Systems?

- Learn how to build complex systems:
  - How can you manage complexity for future projects?

- Engineering issues:
  - Why is the web so slow sometimes? Can you fix it?
  - What features should be in the next mars Rover?
  - How do large distributed systems work? (Kazaa, etc)

Why Study Operating Systems?

- Buying and using a personal computer:
  - Why different PCs with same CPU behave differently
  - How to choose a processor (Opteron, Itanium, Celeron, Pentium, Hexium)? [Ok, made last one up]
  - Should you get Windows XP, 2000, Linux, Mac OS …?
  - Why does Microsoft have such a bad name?

- Business issues:
  - Should your division buy thin-clients vs PC?

- Security, viruses, and worms
  - What exposure do you have to worry about?