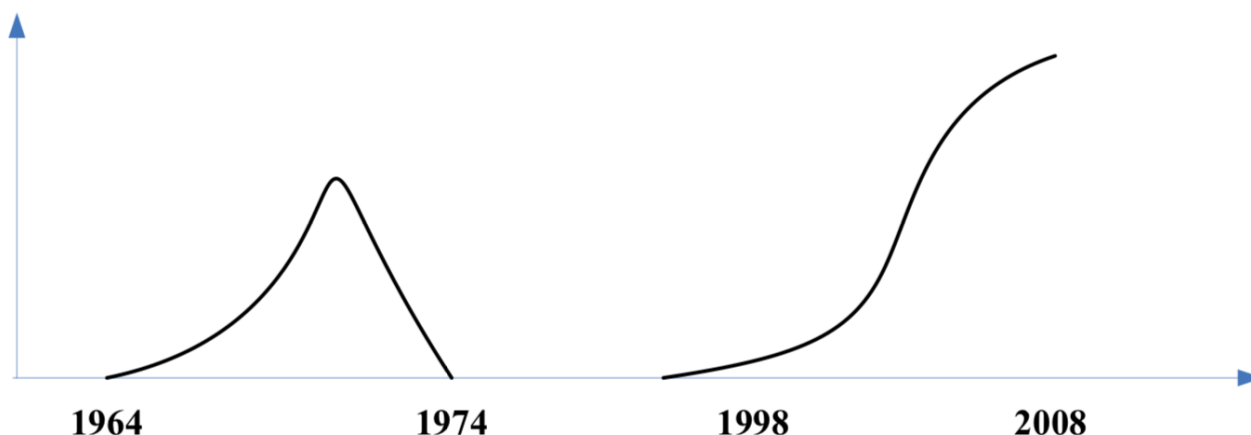


Chapter 1: Introduction

以史为鉴，可以知兴替

Why the Revival of Virtualization

- Modern OS/Hardware cost-down brings new problem
 - popularity -> utilization efficiency
 - complexity -> vulnerability
- One application running per machine
 - simplicity 减少系统崩溃和入侵带来的影响
 - 带来硬件需求增加，资源利用率低的问题，增加管理和能源负担
- Why Revival?
 - 资源复用
 - 隔离、安全
 - Encapsulation
 - 可移植性
 - 可靠性、独立性



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
 - 分布式
 - 数据中心
- 实时和多媒体

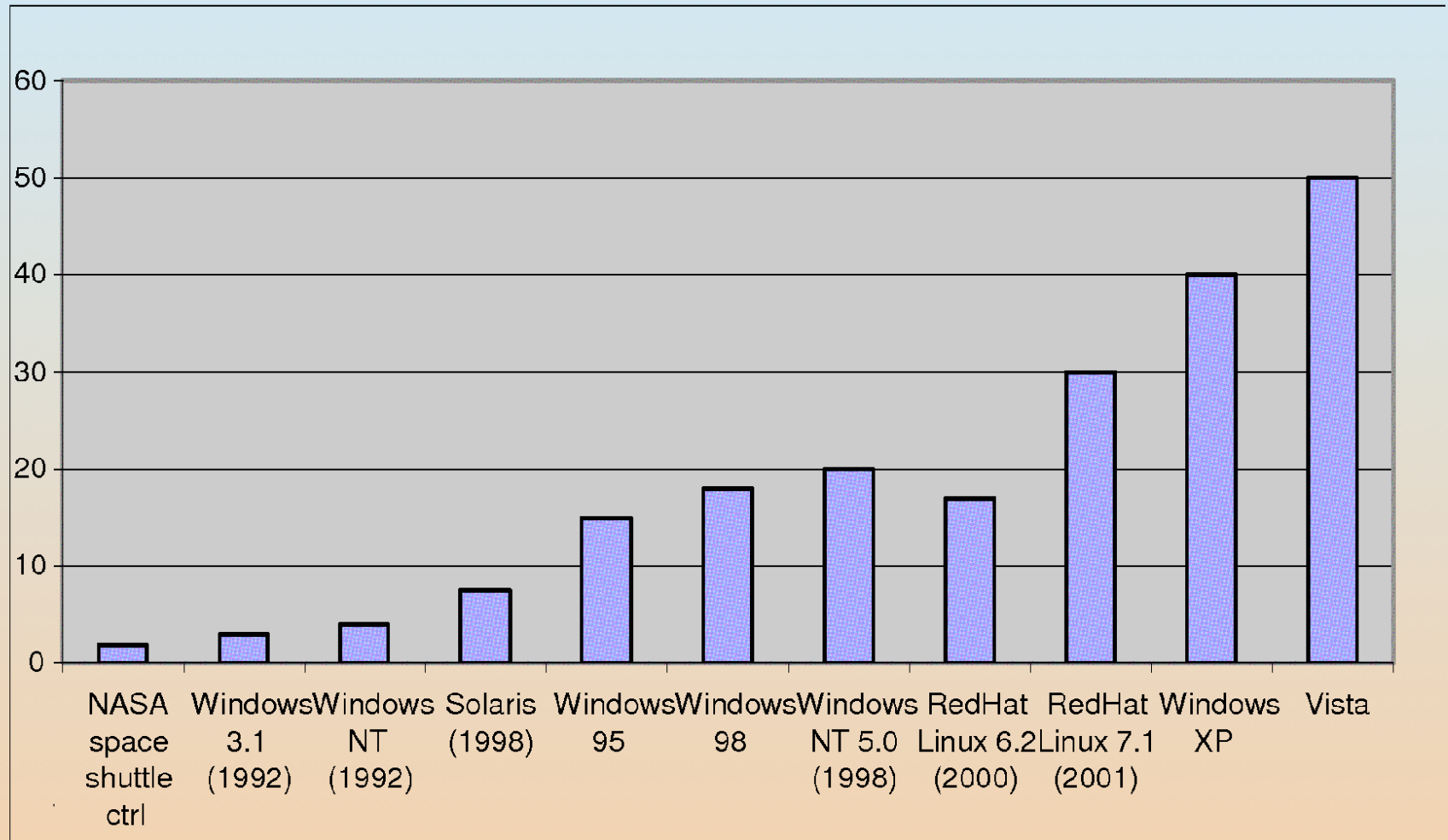
Why Study Operating Systems?

- 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

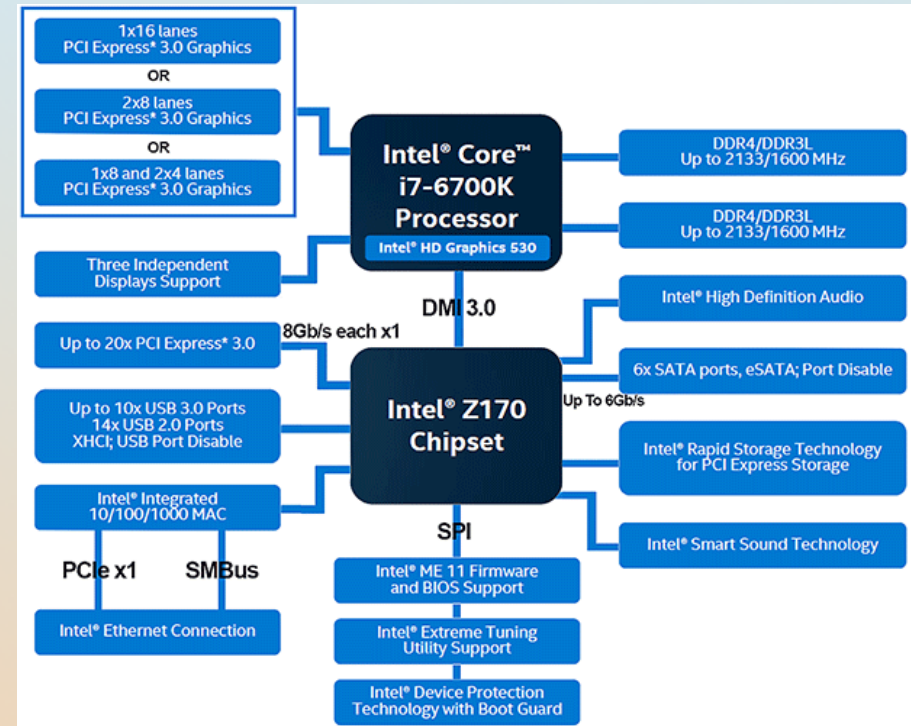
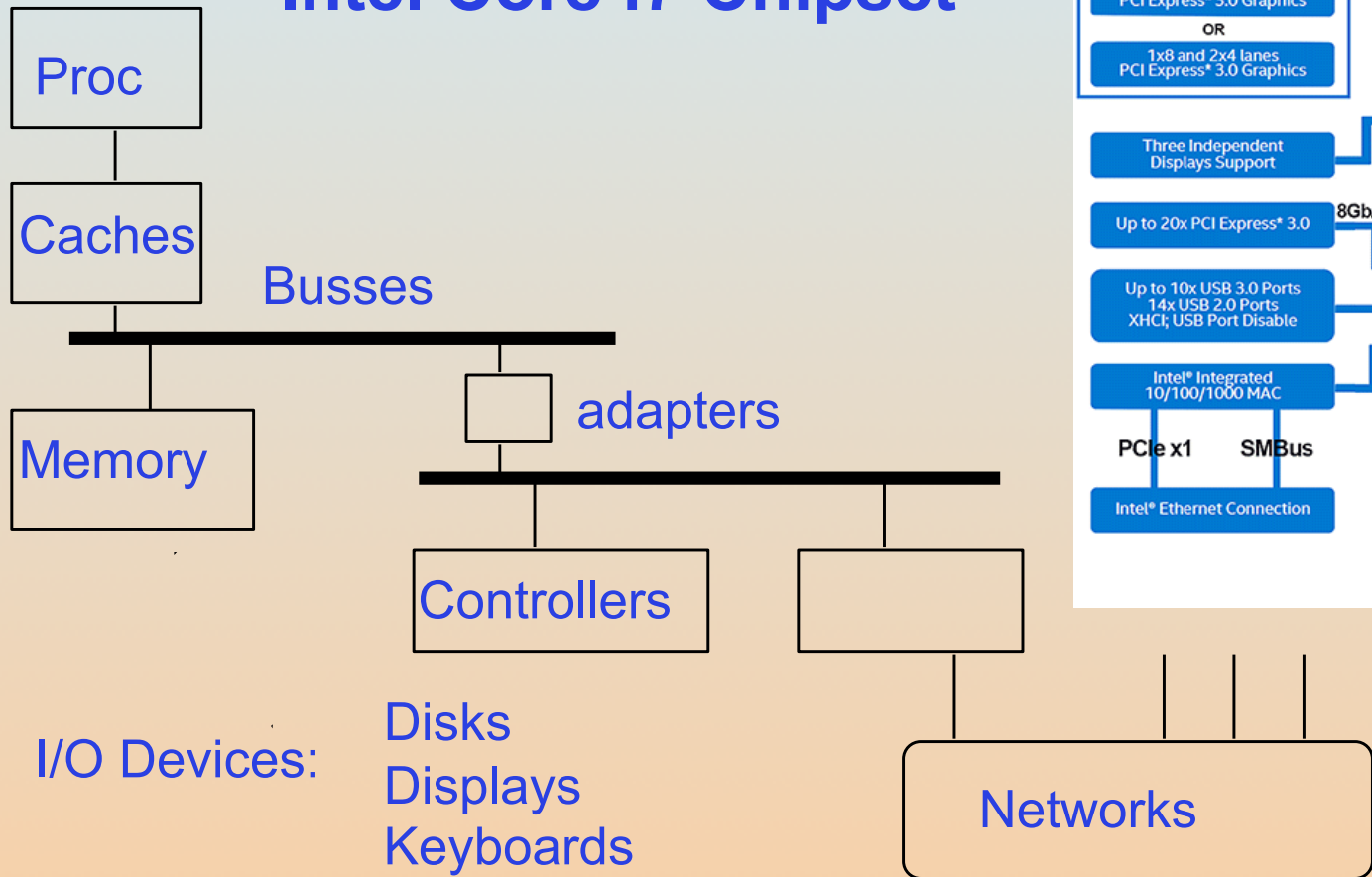
Millions of lines of
source code



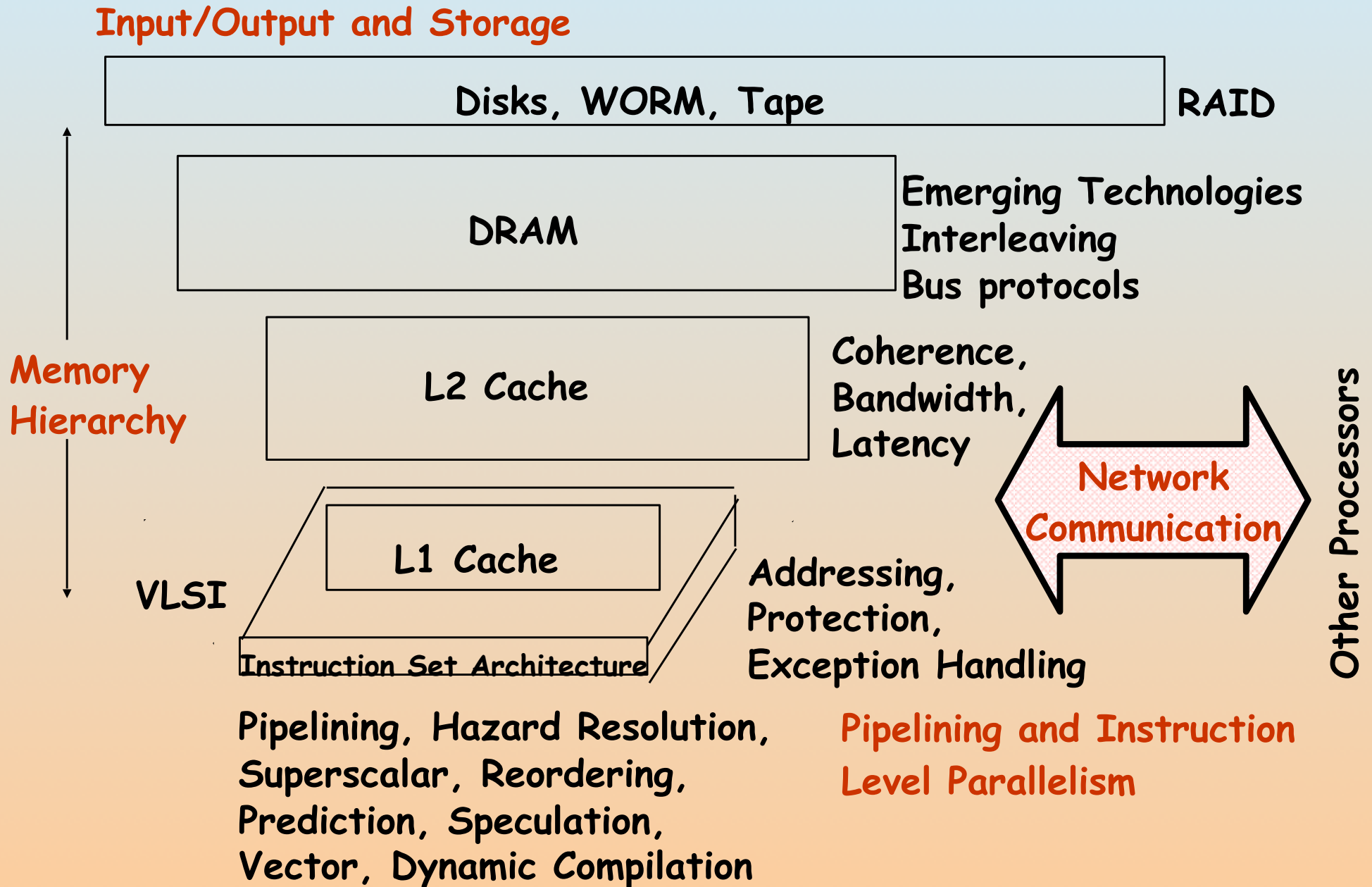
From MIT's 6.033 course

Functionality comes with great complexity!

Intel Core i7 Chipset



Sample of Computer Architecture Topics

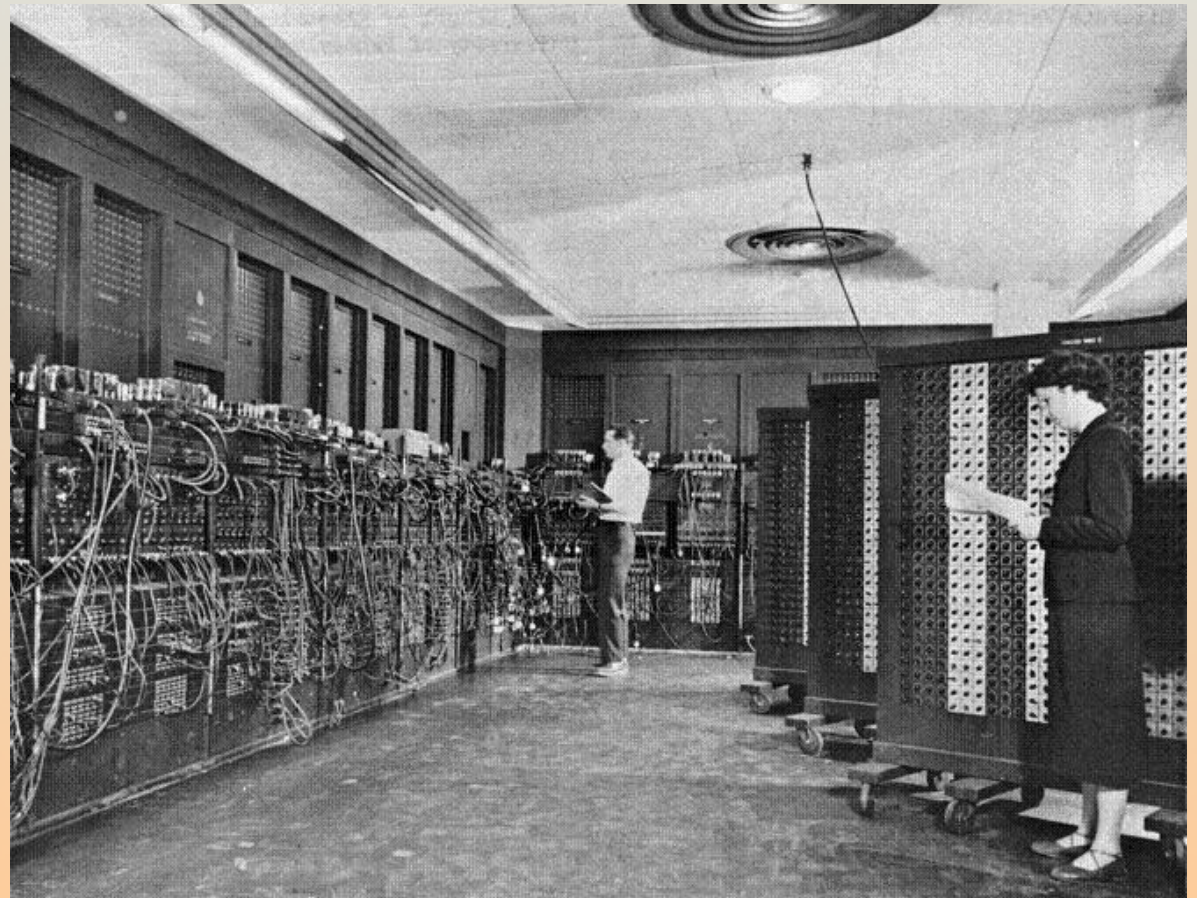


Operating Systems

- 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）

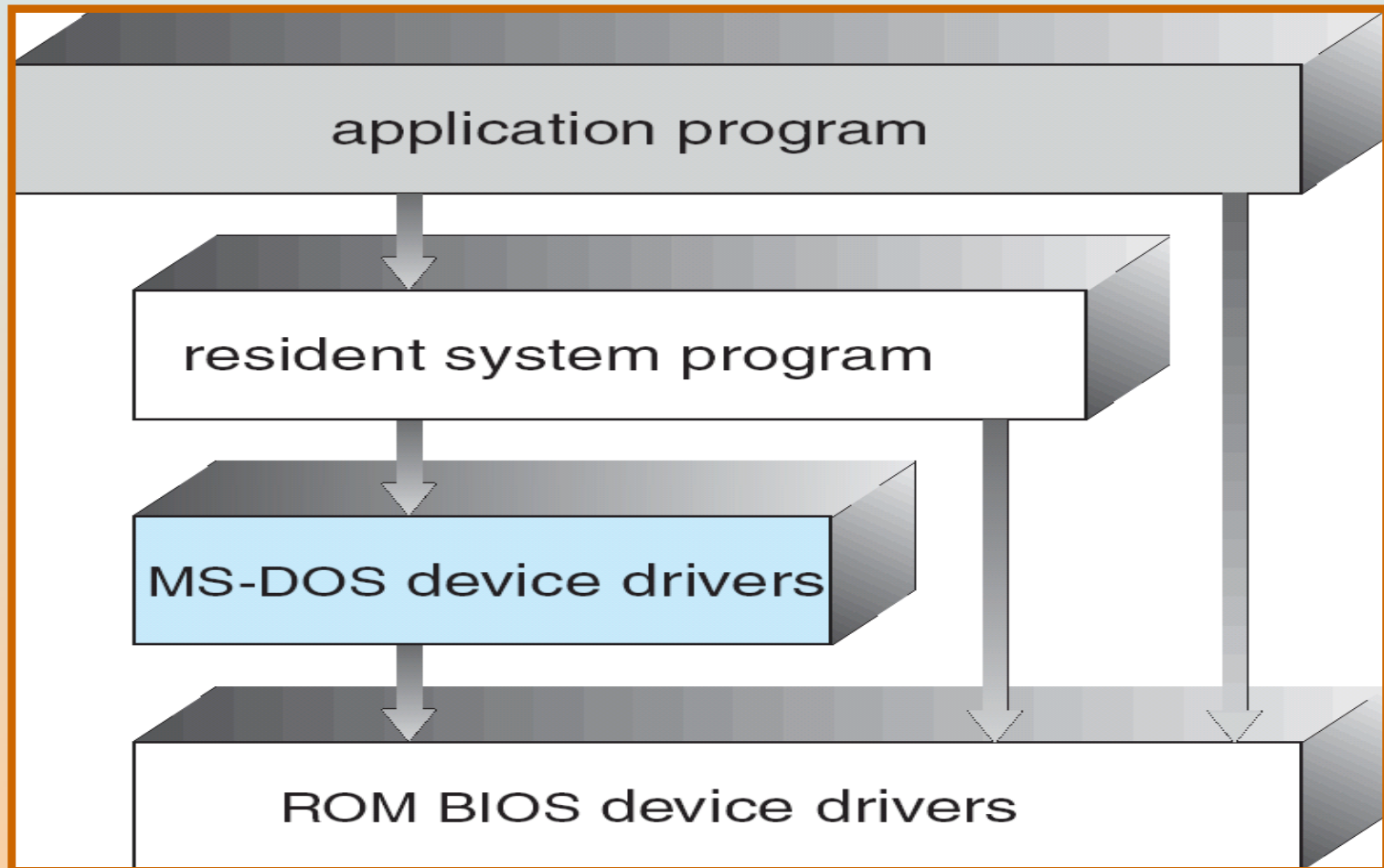
What if we didn't have an Operating System?

- 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

Linux & China

- 国家维度：
 - Linux内核贡献度超过1%的国家，美国第一，中国第二
- 公司维度：
 - 华为对Linux的贡献度排在第三位
 - 安卓开源社区的EROFS文件系统

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?