Operating Systems

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Jinghui Zhong

Associate Professor

Education & Work Experience

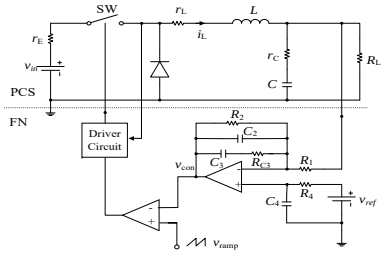
- 2001-2005， Sun Yat-Sen University，B. Sc.
- 2005-2007， Sun Yat-Sen University ，M. Sc.
- 2009 -2012，Sun Yat-Sen University ，Ph.D
- 2013-2016.6， NTU， Research Fellow
- **2016.7-Now，** SCUT， Associate Professor

I'm constantly looking for prospective graduate students, expected to work on CI, ML, and ABM.

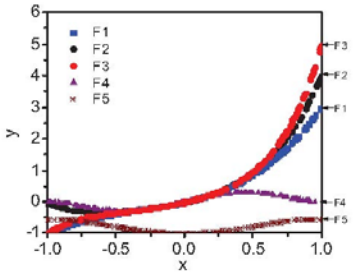
Research Interests:

- Computation Intelligence: Genetic Programming, etc.
- Machine Learning：Gaussian Process, Deep Learning, etc.
- Agent-based Modelling.

Scheduling Optimization



Circuit Design Optimization



Data Regression

Agent-based Modeling (demo)

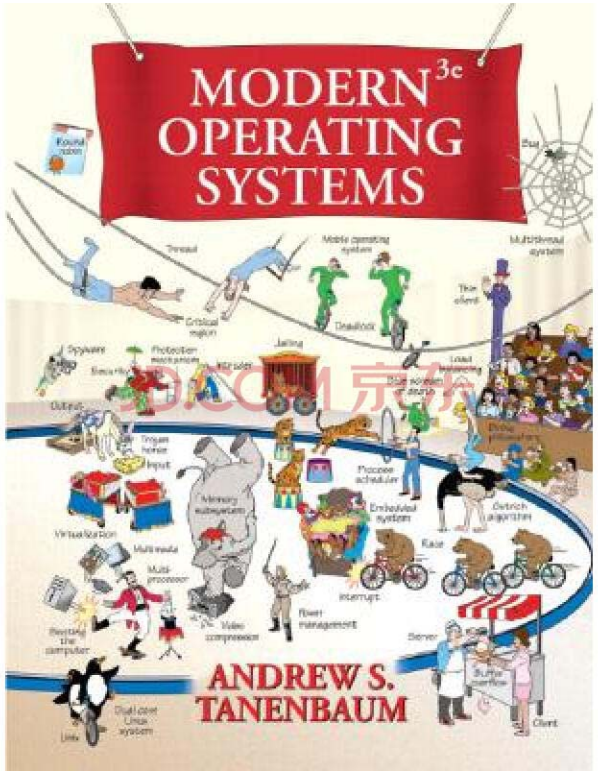
Speech Analysis (demo)

Course Schedule

- **Textbook:**

Modern Operating System

Andrew S. Tanenbaum, 4th.



- **Time:**

48 hours @ lecture theater

16 hours @ lab

Lab: When?

Course Schedule

- **Chinese students:**

Experiment:10%; Presentation: 5%; Poster 5%;

Attendance & Homework: 10%;

Final exam (close-book): 70%

- **Oversea students:**

Experiment:20%; Presentation: 10%; Poster:10%

Homework & Attendance: 20%;

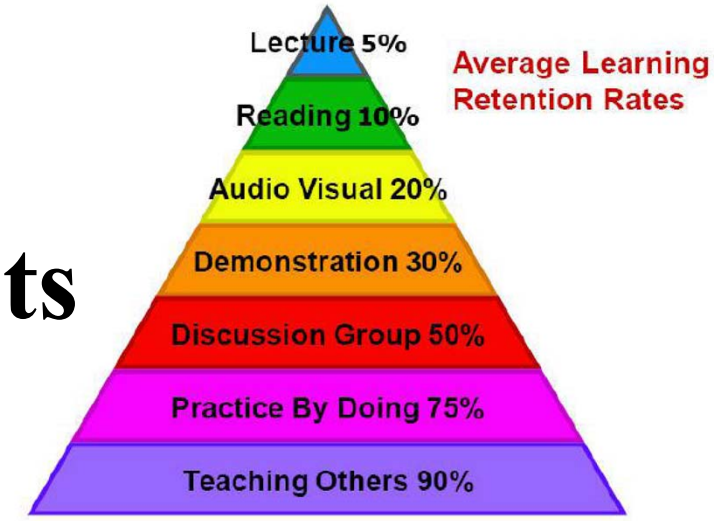
Final exam (close-book): 40%;

How to get textbook?

Ebook can be downloaded from :https://jinghuizhong.com/teaching/

Group & Resources

- **WeChat Group**
- **Slides:** https://jinghuizhong.com/teaching/
- **Grouping**
  Each group: 3~4 students



Source: National Training Laboratories, Bethel, Maine

信息安全研究 第3卷 第8期 2017年8月
Journal of Information Security Research Vol.3 No.8 Aug. 2017

高度重视 Windows 10（政府版）问题 自主创新发展国产操作系统

□ 倪光南

Pay Serious Attention to National Security Issue in Windows 10 (Government Edition), Develop Creative China-Made OS

Ni Guangnan

当前，中国的“太湖之光”登上世界超级计算机顶峰，高铁走向一带一路，北斗系统紧追GPS，墨子卫星开创量子实验新记录，然而我国桌面操作系统95%以上的市场仍被Windows所占据。最近《人民日报》在微博中写到：“从Windows到iOS，再到安卓，我们的操作系统在哪里？没有核心技术，必然受制于人。”开发操作系统所需的经费与研制超级计算机等相比并不多，尚未研制成功的问题出在我们的决心不够，措施不力，也存在着某些干扰。

2013年12月20日，习近平总书记在中国工程院一份建议上的批示指出："计算机操作系统等信息化核心技术和信息基础设施的重要性显而易见，我们在一些关键技术和设备上受制于人的问题必须及早解决。要着眼国家安全和长远发展，抓紧谋划制定核心技术设备发展战略并明确时间表，大力发扬'两弹一星'和载人航天精神，加大自主创新力度，经过科学评估后选准突破点，在政策、资源等各方面予以大力扶持，集中优势力量协同攻关实现突破，从而以点带面，整体推进，为确保信息安全和国家安全提供有力保障"。习近平总书记的这个批示为发展操作系统等网络信息核心技术指明了路线和方向，我们应当认真学习和贯彻，坚定不移地发展国产操作系统，确保国家安全。

中国应如何发展操作系统

由于中国的科技人力资源世界第一，软件人才极为优秀，软件水平也不受工业基础制约，我国软件业理应比其他行业更容易追赶发达国家，然而这些优势不但没用好，反而受到了干扰。

在开放的环境下，发展我国桌面操作系统可能采取的途径如下。

1）引进但必须安全可控

回顾历史，从1994年中文版Windows进入中国市场，20多年里中国花费了上千亿元购买Windows，让它占据了中国95%以上的桌面市场，然而中国并没有取得Windows任何相关的知识产权，只培养出一些Windows操作员、熟悉Windows平台的程序员，并没培养出任何Windows的专家（除微软雇员外）。实践证明，钱和市场换不来核心技术。现在Windows 10（政府版）尚未通过网络安全审查，说明它达不到"引进但必须安全可控"的要求，这条路走不通。

4）依靠自身力量自主创新

目前，我国桌面操作系统正是沿着这条途径发展的，同时也依托 Linux 开源软件，实施引进消化吸收再创新。通过此途径，我国软件人才有更广阔的用武之地，我国安全可控水平可以不断提高，能更好地抵御“永恒之蓝”这类网络武器的攻击，这才是发展国产桌面操作系统的正确道路。当前要排除 Windows 10（政府版）的干扰，因为国产 Linux 操作系统是安全可控国产信息技术体系的核心，而政府采购市场是国产 Linux 系统的根据地，如果这个根据地被 Windows 10占了，那等于国产体系被人挖了墙脚，我们在过去一二十年里辛苦培育起来的国产 CPU、国产其他软硬件以至整个技术体系都会统统垮台。由此可见，我们要高度重视 Windows 10（政府版）问题，坚定地走自主创新发展操作系统的道路。

倪光南

中国工程院院士，中国科学院计算技术研究所研究员，著名计算机专家，中国电子学会云计算专家委员会副主任，中关村可信计算联盟技术委员会副主任，中国智能终端操作系统产业联盟技术委员会主任，一直从事计算机及其应用领域的研究与开发，曾参与我国自行设计的第一台计算机的研制。主要研究方向为开放源代码的 Linux 操作系统、基于国产 CPU 和 Linux 的网络计算机等。

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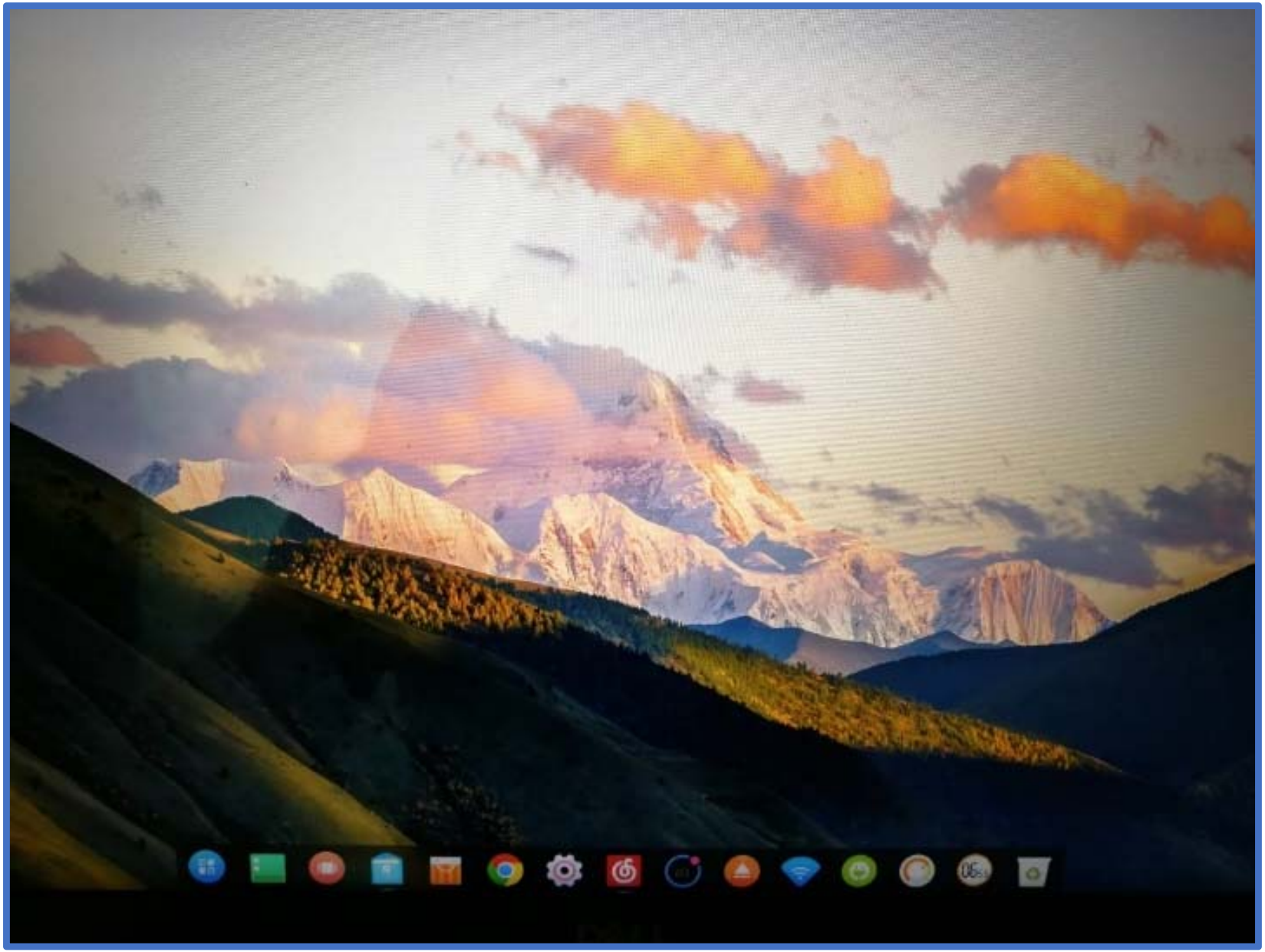
At the beginning of 2014, the only domestic Red Flag Linux system was officially bankrupt.
Where is the future of domestic operating systems?



Deepin OS is the most active Linux distribution in China. Deepin provides a stable and efficient operating system for all, emphasizing security, ease of use and beauty.

中央政府采用国产操作系统

The Central Government Adopts the Domestic Operating System

国家税务总局 2019 年的信息化产品入围成交名单出炉，其中在操作系统方面，中兴新支点的桌面操作系统和服务器操作系统均成功入围。

如今中央政府采购日趋正规化，对于入围产品提出了更严格的要求，中兴新支点操作系统能够成功入围，证明国产操作系统已经具备实力。

而笔者也曾体验过中兴新支点操作系统，对电脑配置的要求不高，开机迅速，运行起来也比较流畅。软件方面，常用软件也不少，办公有自带的办公软件，也有 WPS 和 PDF 阅读器，也兼容大部分打印机；社交聊天和工作交互有 QQ、微信和钉钉，浏览器、影音软件、作图软件等等都有了，一般用户的办公已经不成问题。

中兴新支点国产操作系统

除了 Windows，不是没有可用的操作系统，不是没有 Windows 就不行，我们也不盲目自信，目前国产操作系统和 Windows 的差距还大，特别是配套的软硬件，希望国内厂商能给予国产操作系统更多的支持！

最近的国际关系走势不明朗，关于发展国产操作系统的呼声越来越高，更多人了解到了国产操作系统的存在，纷纷支持、试用、提建议。让国产操作系统的发展迎来了空前的机遇，而如今中兴新支点操作系统又中央政府采用，是让国产操作系统迎来更大的机遇。

国产操作系统

中国工程院院士倪光南早前就曾建议，要用国产操作系统逐步替代 Windows，以降低对外国技术的依赖。值得欣慰的是，如今中兴新支点操作系统获国家税务总局采用，证明了国家已经开始支持国产操作系统。国产操作系统应抓住机遇，发展壮大，迎来更广泛的应用！

华为鸿蒙“冲刺”

文/李 娜

鸿蒙，中国神话传说的远古时代，传说在盘古昆仑山开天辟地之前，世界是一团混沌的元气，这种自然的元气叫做鸿蒙，因此把那个时代称作鸿蒙时代，后来此一词也常被用来泛指称远古时代。

华为鸿蒙系统（HongmengOS或HomonOS、HMOS），是华为开发的自有操作系统。2012年，华为开始规划自有操作系统“鸿蒙”。2019年5月17日，由某教授领导的华为操作系统团队开发了自主产权操作系统——鸿蒙。

2019年5月24日，国家知识产权局商标局网站显示，华为已申请“华为鸿蒙”商标，申请日期是2018年8月24日，注册公告日期是2019年5月14日，专用权限期是从2019年5月14日到2029年5月13日。

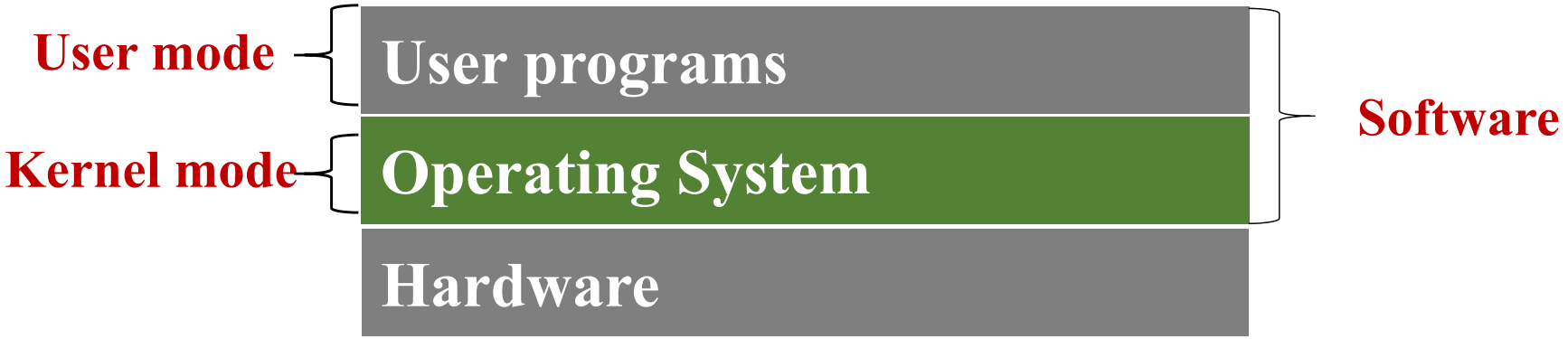
华为OS将打通手机、电脑、平板、电视、汽车、智能穿戴，(将这些设备)统一成一个操作系统。且该系统是面向下一代技术而设计的，能兼容全部安卓应用的所有Web应用。若安卓应用重新编译，在华为OS操作系统上，运行性能提升超过60%。

Course Schedule

- Introduction (chapter 1)
- Processes and Threads (chapter 2)
- Deadlocks (chapter 6)
- Memory management (chapter 3)
- File Systems (chapter 4)
- Input /Output (chapter 5)

What is Operating System (OS)

- **A computer = Hardware + OS + User Programs**



- **The distinct features of OS**
  - Run in kernel mode;
  - Has complete access to all hardware;
  - Can execute any instruction the machine is capable of executing;
  - Huge, complex, long-lived;

- **Two major tasks of OS.**

  To provide abstractions and to manage resources

OS as an Extended Machine

- **Programs in machine language level are primitive and difficult to write and interpret.**

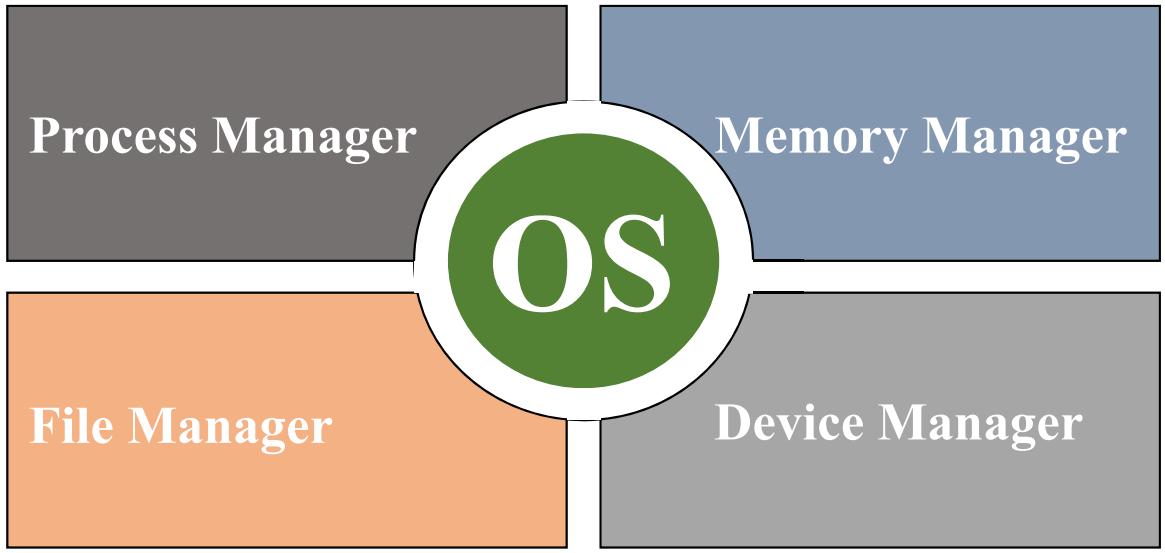
Example: reading data from floppy disk requires to know 16 commands, 13 input parameters, 23 return status and error fields ….

- **OS hides the implementation details and provides user programs with nice and standard abstractions.**

- **A standard "Virtual Machine" across different physical machines.**

OS as a Resource Manager

- **A computer contains many resources.**
  – e.g. CPU, memory, disk, keyboard, mouse, printer, speakers, microphone, etc.
- **OS effectively allocates resources to support multi-users and multi-programming.**



Operating System is a manager.

OS as a Resource Manager

- **Time multiplexing: Different programs or users take turns using a resource.**

  Example: CPU.

  Issues: Who goes next and for how long?

- **Space multiplexing: Each program or user gets part of a resource.**

  Example: memory and disk.

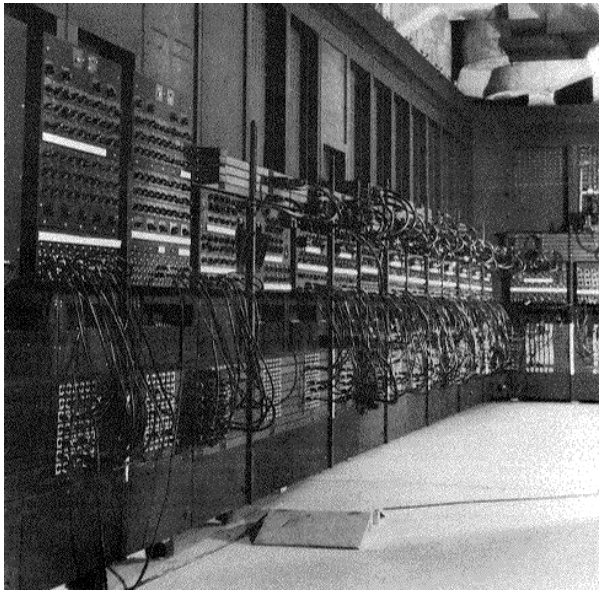
  Issues: fairness, protection, and so on.

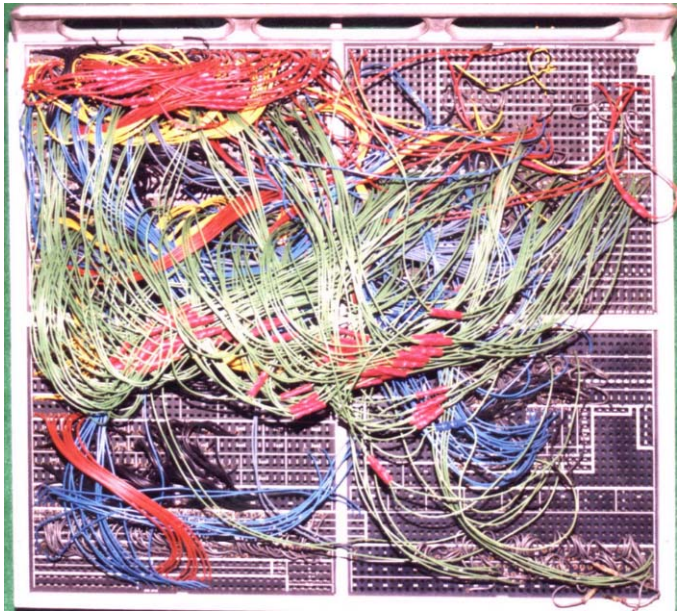
History of Operating Systems

1945	1955	1965	1980
First generation Vacuum tubes, plug boards	**Second generation** transistors, Batch systems	**Third generation** ICs and multiprogramming	**Fourth generation** Large Scale Integration personal computers workstations
Using machine language, or worse; **No OS**; Numerical calculations.	FORTRAN or assembler language; FMS and IBSYS OS; Scientific calculations.	FORTRAN ,assembler, **C**, Pascal, Prolog, etc; OS/360, UNIX; Dos scientific calculations & some applications	C, C++, java, C#, R, PHP, etc. Windows, Linux, Mac, etc. scientific calculations & wide applications.

The First Generation (1945–55) — Vacuum Tubes and Plugboards

- No programming language, all programming works were done in absolute machine language, or even worse;
- No operating system;
- All problems were numerical calculations.





The Second Generation (1955–65) — Transistors and Batch Systems

- **Languages:**

  Fortran, assembly language.

- **Typical operating systems:**

  FMS (Fortran Monitor System), IBSYS.

- **Problems to be solved:**

  Scientific and engineering calculations.

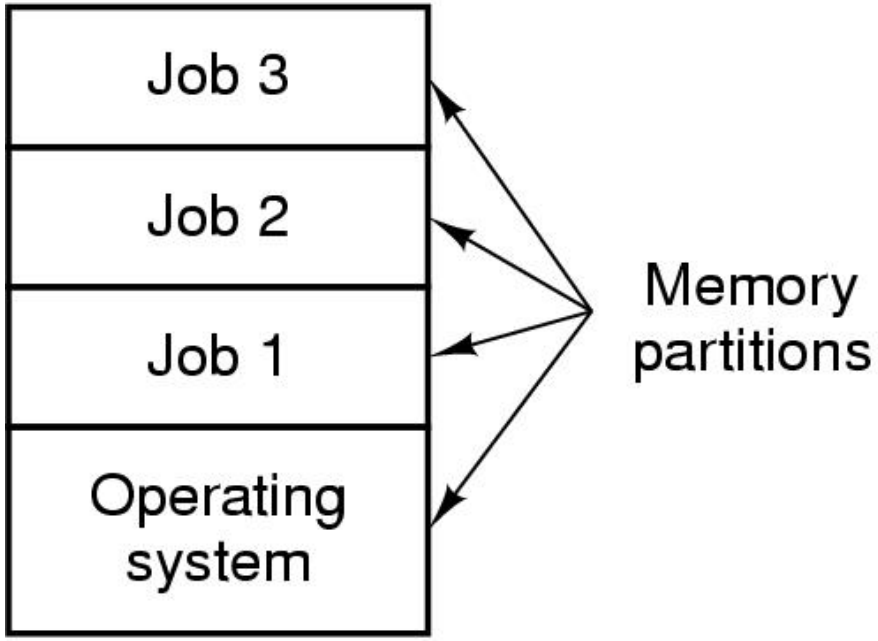
The Third Generation (1965–1980) — ICs and Multiprogramming

- The use of ICs (Integrated Circuits).
- IBM System/360:
- Operating System: OS/360, MULTICS, UNIX

processor unit

The Third Generation (1965–1980) — ICs and Multiprogramming

- **Multiprogramming:** Allow multiple programs run in memory simultaneously.



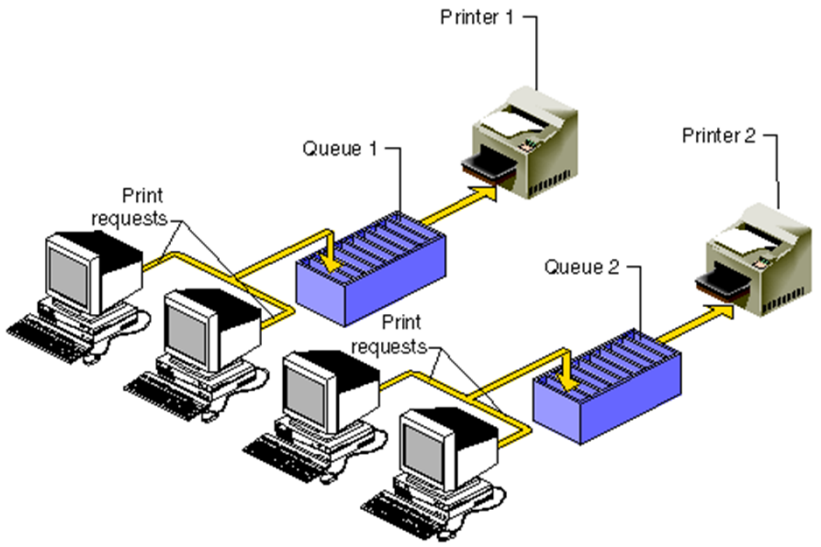
Goal — Keep CPUs and I/O devices busy.

The Third Generation (1965–1980) — ICs and Multiprogramming

- **Spooling (simultaneous peripheral operation on line)**

In spooling, a high-speed device like a disk interposed between a running program and a low-speed device involved with the program in input/output.

Example: Instead of writing directly to a printer, outputs are written to the disk. Programs can run to completion faster; and other programs can be initiated sooner when the printer becomes available, the outputs may be printed.



The Third Generation (1965–1980) — ICs and Multiprogramming

- **Timesharing: Allow multiple users to use a computer simultaneously.**

-- A variant of multiprogramming technique;
-- Each user has an on-line terminal;
-- The computer system must respond quickly.

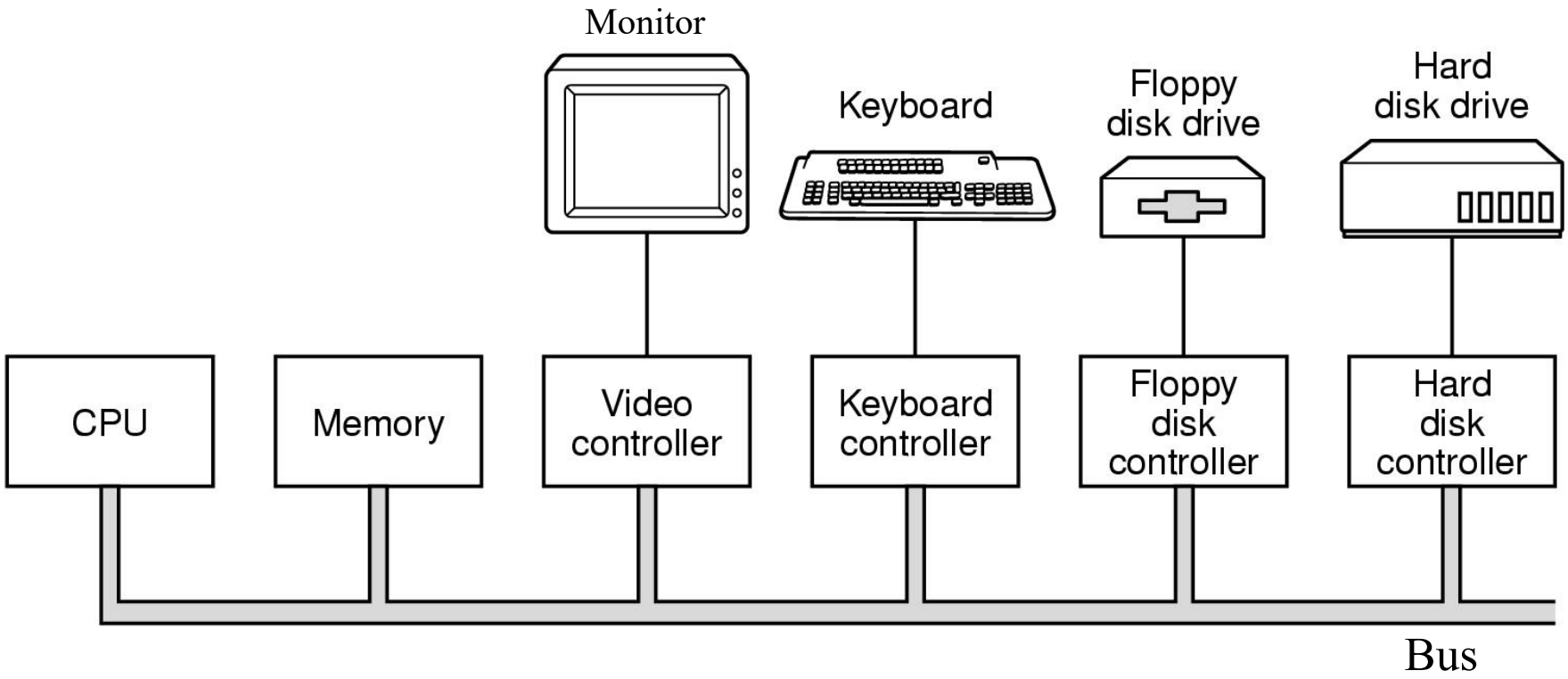
- CTSS (Compatible Time Sharing System)

- MULTICS (→UNIX→MINIX→LINUX)

The Fourth Generation (1980–Present) — Personal Computers

- With the development of LSI (Large Scale Integration) circuits, chips, operating system entered in the personal computer and the workstation age.
- Microprocessor technology evolved to the point that it becomes possible to build desktop computers as powerful as the mainframes of the 1970s.
- Windows, Unix, Linux, GUI,…

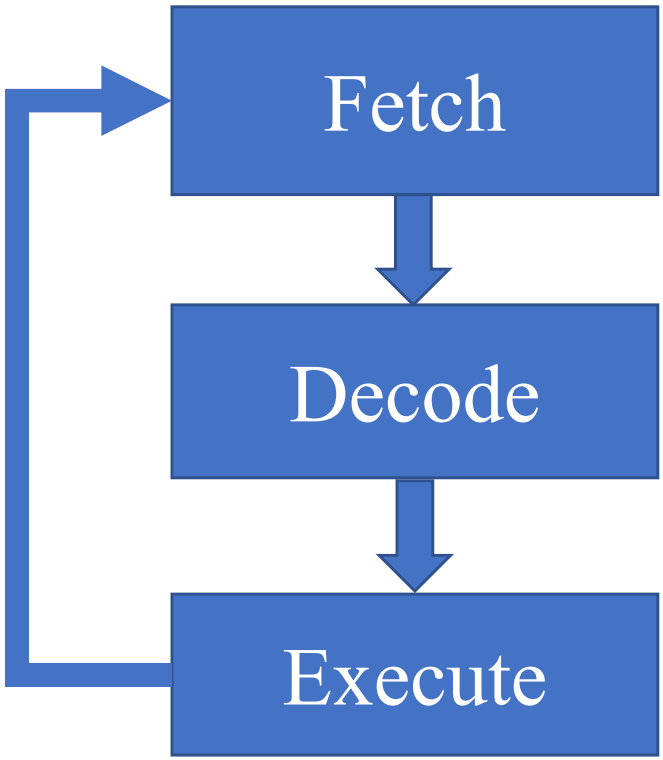
Computer Hardware Review



The CPU, memory, and I/O devices are connected by a bus and communicate with one another over it.

Processor

- **Fetch-decode-execute cycle**



Fetch instruction from memory to instruction register (IR), the program counter (PC) points to the next instruction.

The instruction presented in the IR is interpreted by the decoder.

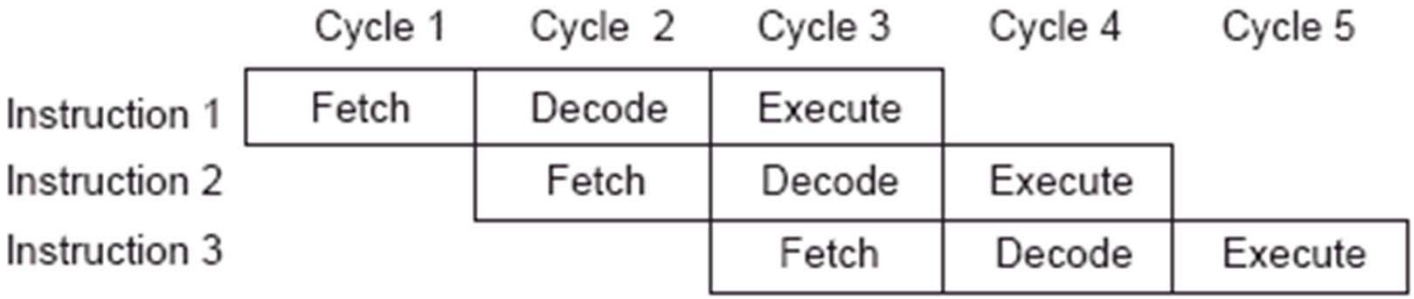
The function of the instruction is performed. If the instruction involves arithmetic or logic, the Arithmetic Logic Unit is utilized.

Registers in Processor

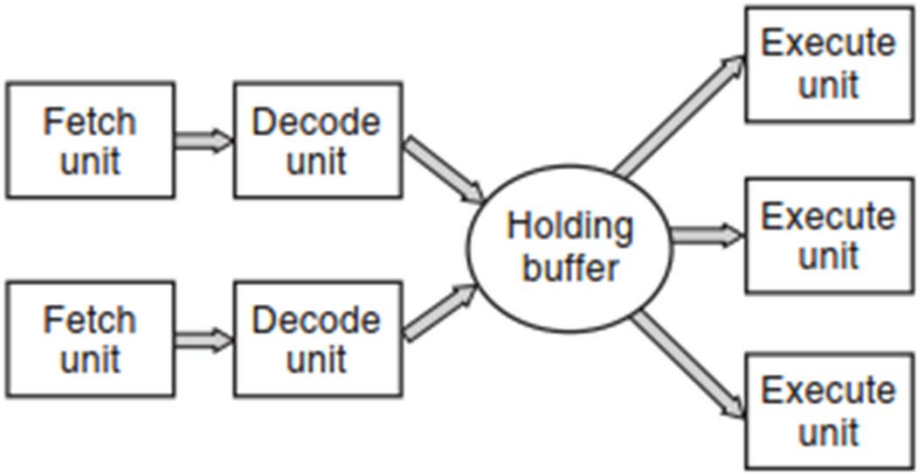
- Each CPU has a set of instructions.
- General registers
- Program counter
- Stack pointer
- Program Status Word (PSW)
- When a program stops, the values in all registers are stored.

Processor

- **Pipeline**

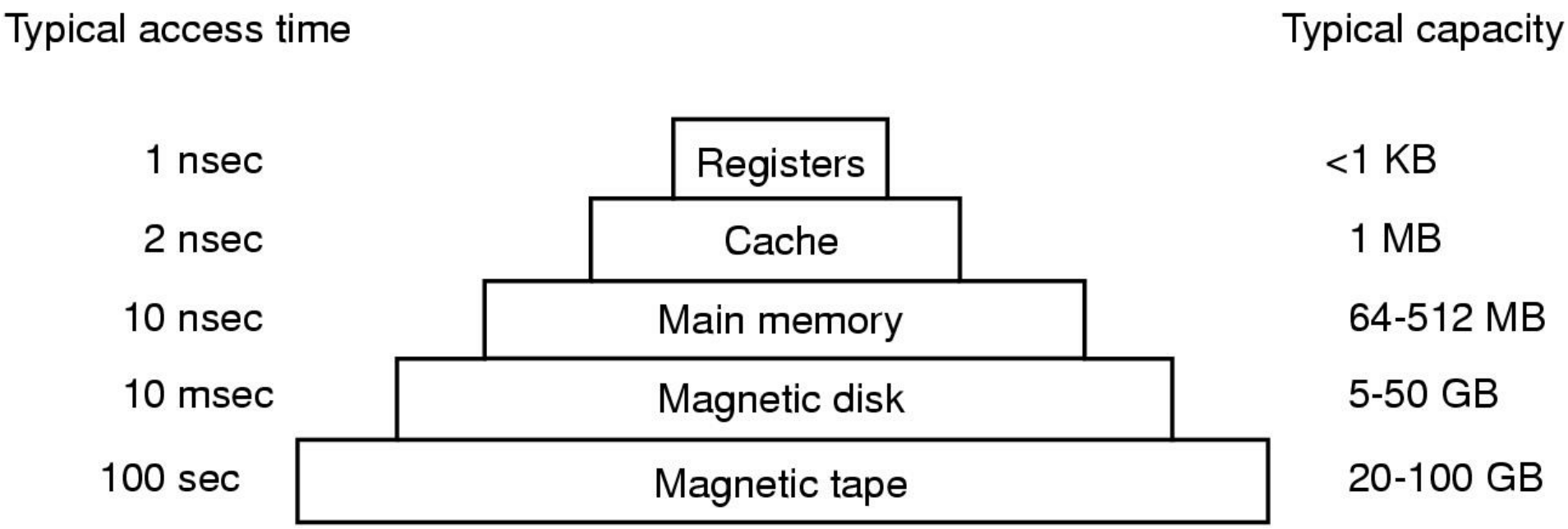


- **Superscalar CPU**



Multithreaded and Multicore Chips

Memory



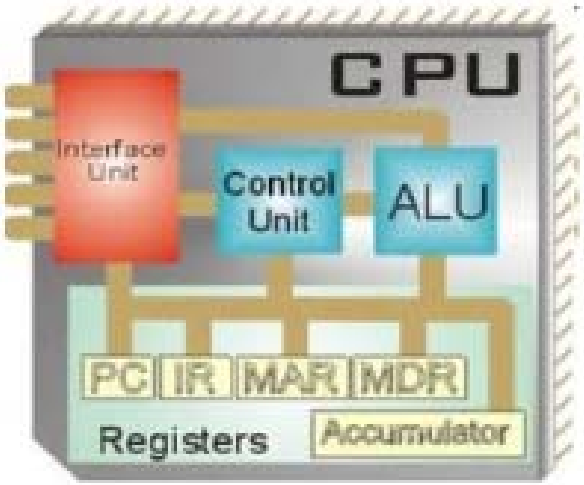
A typical memory hierarchy

Registers

- Registers are a group of circuits used for memory addressing, data operation and processing.
- They are made of the same material as the CPU, thus there is no delay in accessing them;
- Their capacity is small:

  32 x 32 bits for 32-bit CPU,

  64 x 64 bits for 64-bit CPU.

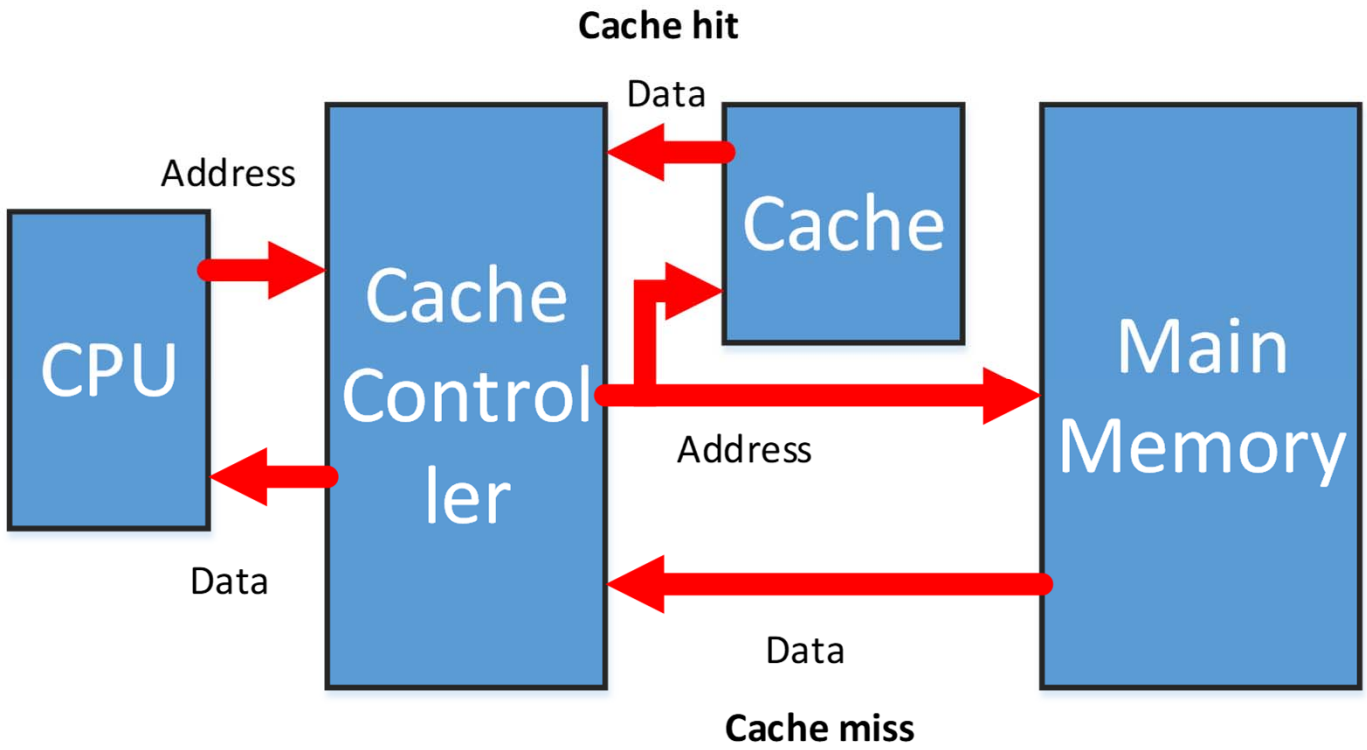


- Examples:

  General register, Accumulator register, PC, IR

Cache

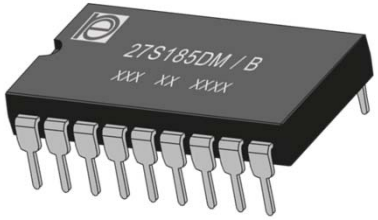
- Cache hit and Cache miss.
- L1 cache and L2 cache;
- Access to the L1 cache is faster than the L2 cache.



Main Memory

- RAM (Random Access Memory)

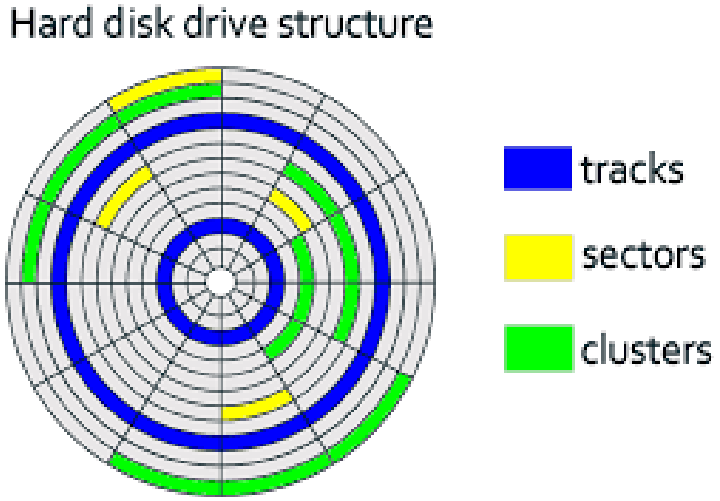
- ROM (Read Only Memory)

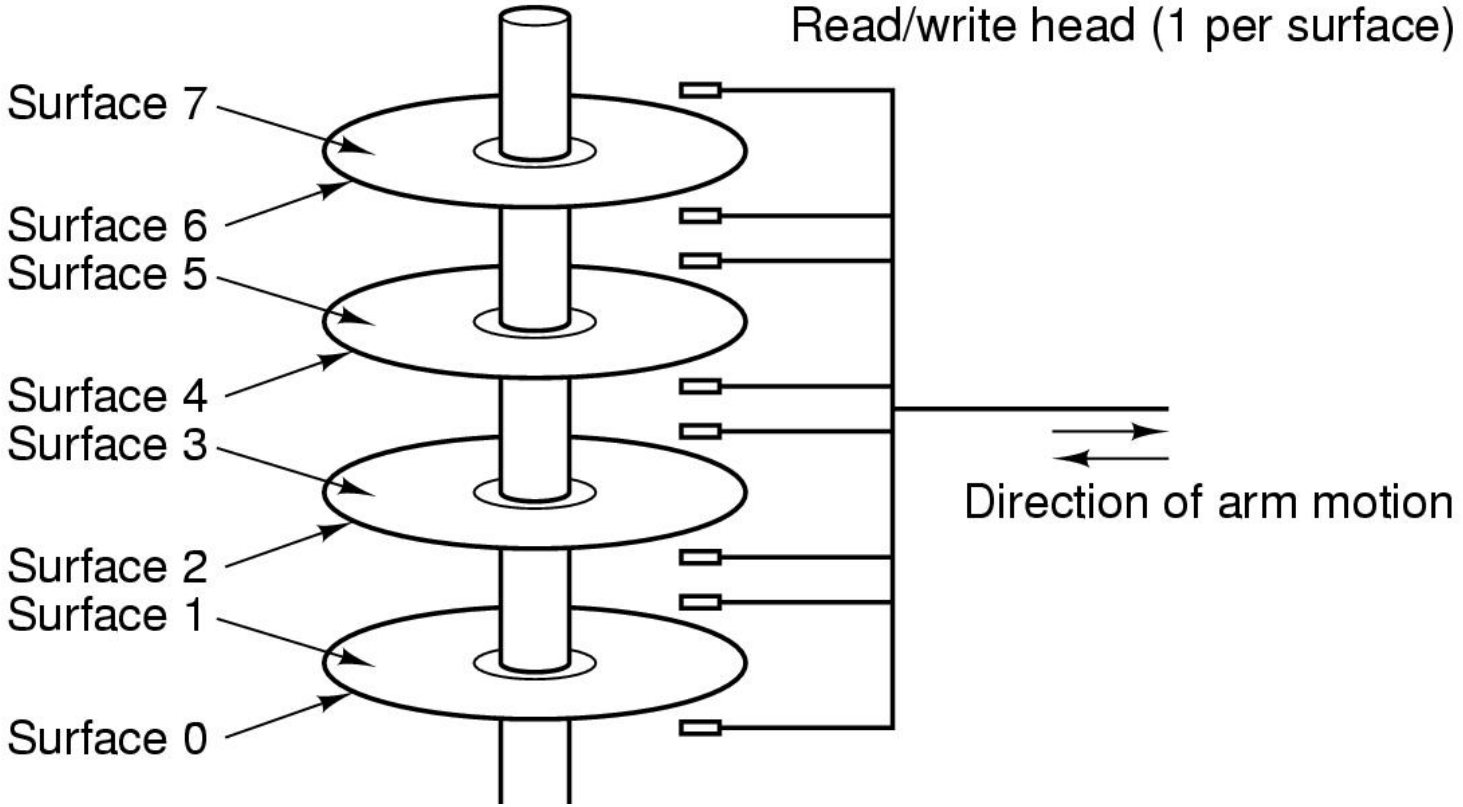


- EEPROM (Electrically Erasable PROM)

Disks

- The structure of a disk drive.
  - 512 bytes per sector
- The access speed of disk is low.





I/O Devices

- **Device driver**

-- A software that talks to a controller, giving it commands and accepting responses.
-- Each OS should has a version of device driver.

- **Three ways to put a driver into kernel.**

-- Relink the kernel and reboot the system; (UNIX)
-- Make entry file and reboot and load it; (WINDOWS)
-- Accept and install it without rebooting the system. (USB)

I/O Devices

- **Three ways to do input/output.**

-- Busy waiting

User program → system call → driver →
The driver starts the I/O and sits in a tight loop to see if it is done.
I/O done → driver return → return to caller.

-- Interrupt

User program → system call → driver→
The driver starts the I/O and ask it to given an interrupt when it is finished. → return → block the caller → run another program.

-- DMA

Allows certain hardware subsystems to access main memory independently of the CPU.

The Operating System Zoo

- Mainframe operating systems： OS/390
- Server operating systems： UNIX, Windows 2000, Linux
- Multiprocessor operating systems: Windows and Linux.
- Personal computer operating systems：

  Windows 98, 2000, XP, Macintosh, Linux
- Real-time operating systems：

  Hard real-time system: the action absolutely must occur at a certain moment, e.g, E-Cos
- Embedded operating systems： PalmOS, Pocket PC for PDA
- Smart card operating systems： Java Virtual Machine (JVM)