中国科学技术大学
University of Science and Technology of China

011174.01: Operating System
操作系统原理与设计

Chapter 1: Instruction (overview)

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温馨提示：

为了您和他人的工作学习，
请在课堂上关机或静音。

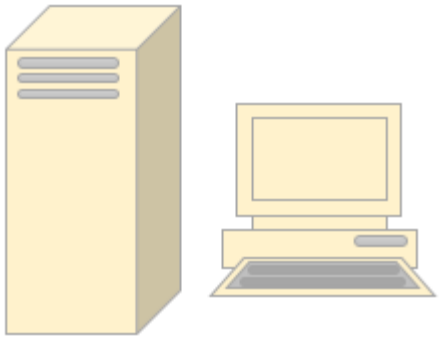
不要在课堂上接打电话。

Outline

- Prepare: 3 questions
- What is OS?
  (Role, Definition, General architecture, and Design goal)
- Introduction of CS (from OS view)?
- History of OS
- Summary

3 questions

- Q1：What is the **hardware** of a computer system?



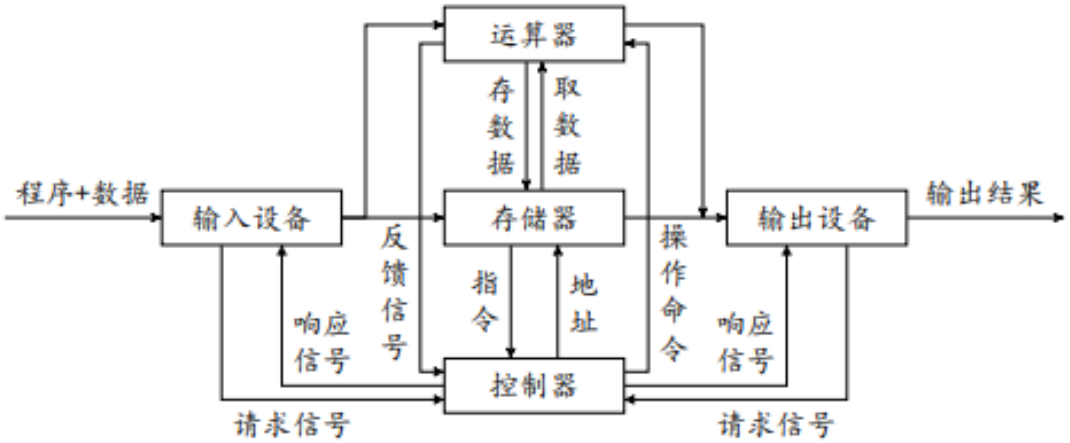
? ? ? ? ?

CS & Von Neumann architecture

- 计算机
  1. 不可编程的：强定制，高效
  2. 可编程的：灵活
     - 提供指令集，程序就是一个指令序列

冯·诺伊曼体系结构

- 五大部件：运算器、控制器、存储器、I/O设备
- 存储器与CPU相分离；指令存储与数据存储共享存储器



3 questions

- Q2: How a **computer system** up and running?
  - System boot: Example, Linux system startup

    typical operating sytems startup course

    Power-on→Bootstrap: BIOS→BootLoader: GRUB→OS: Linux

    Linux (Intel i386)

    Refer to appendix A of 《Understanding Linux Kernel》
    - →RESET pin of the CPU
    - cs:ip= 0xFFFF FFF0
    - ROM BIOS（基本输入输出系统）
  - What after startup?
    - Executes prearranged process, or
    - Waits for interrupt

  Modern OSs are **interrupt-driven(中断驱动的)**.

3 questions

- Q3: How a **program** up and running? (example: “hello world”)

```c
#include <stdio.h>

int main(void){
        printf("Hello World!\n");
        return 0;
}
```

```
xlanchen@DESKTOP-L8OIODD:~$ ls
helloworld  helloworld.c
xlanchen@DESKTOP-L8OIODD:~$ ./helloworld
Hello World!
xlanchen@DESKTOP-L8OIODD:~$ ~
```

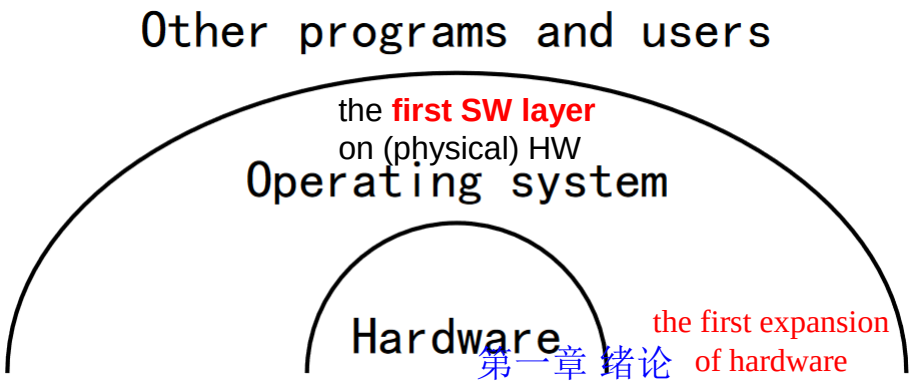
What is OS?

- OS/CS is everywhere.





- Components of **CS**:
  - Viewpoint 1: CS = HW + SW (+data)
  - Viewpoint 2: CS = HW + **OS** + APPs + Users



What is OS?

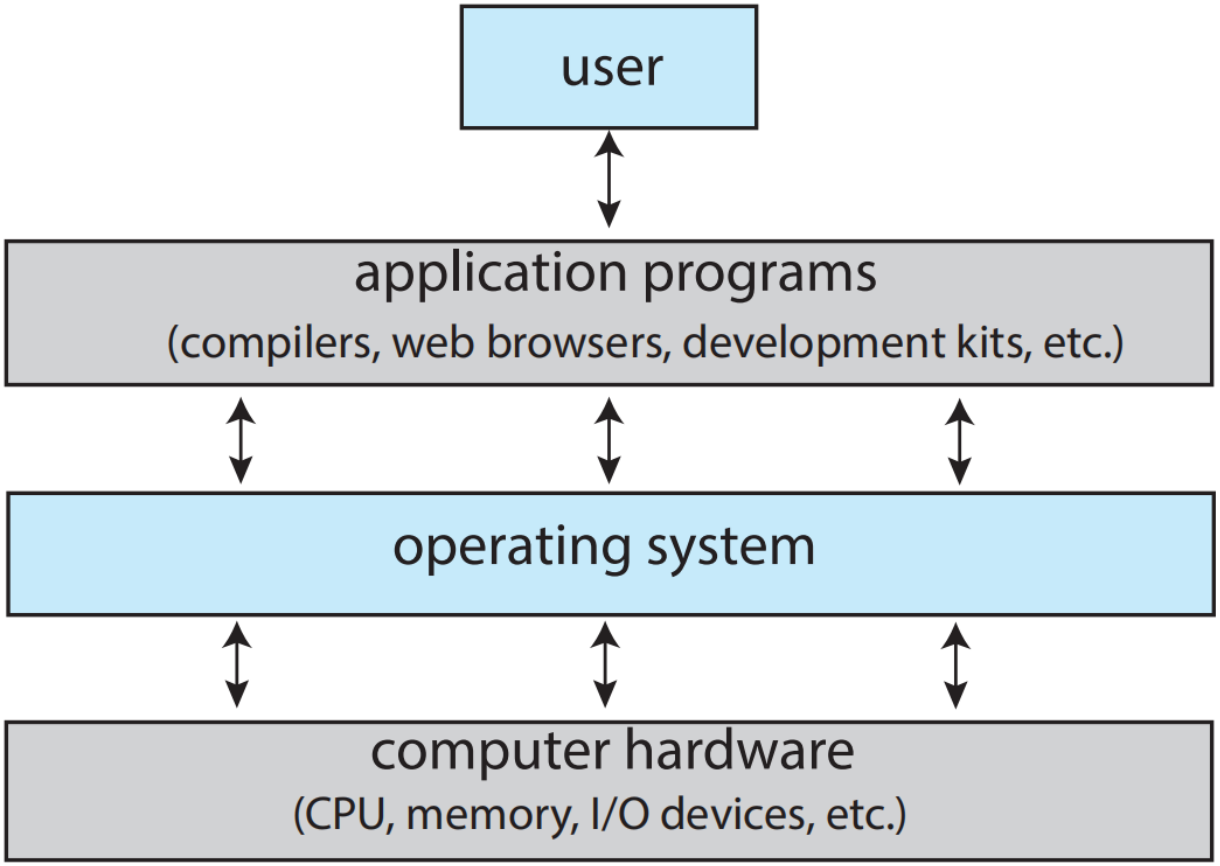
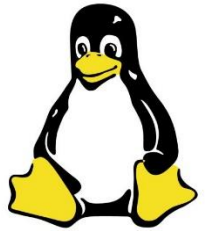


Figure 1.1 Abstract view of the components of a computer system.

What is OS?

- What OSes do you know?
  - Windows series, Unix series, SUN Sorlaris, FreeBSD, AppleMac OS, Linux series, ...



  - A variety of real-time, non-real-time, embedded Oses
    - μC/OS, RTEMS, VxWorks, QNX, PalmOS, iOS, ...
  - 各种网络操作系统、分布式操作系统、集群操作系统、并行操作系统
  - 各种研究型操作系统、教学/实验用操作系统，等等
  - 国产操作系统，如华为openEuler、银河麒麟，等等

What is OS?

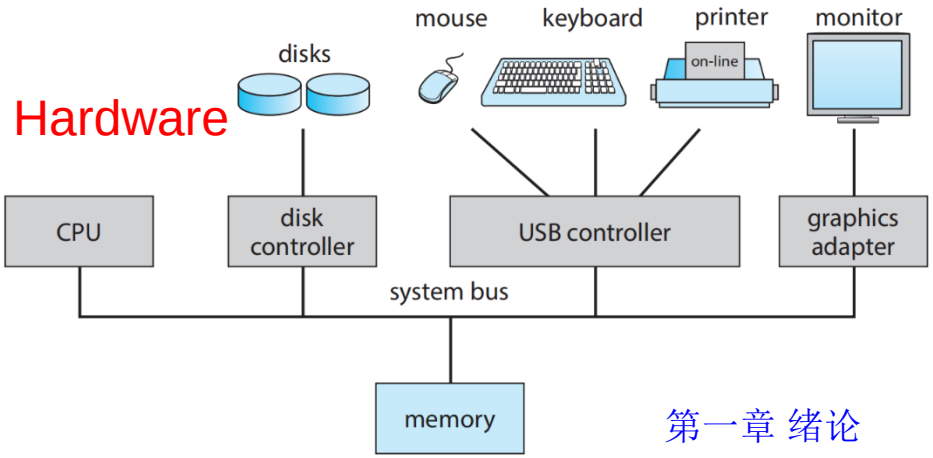
- **The role(作用) of OS in CS**

Different User has different opinion.

User view

VS.

Role of OS

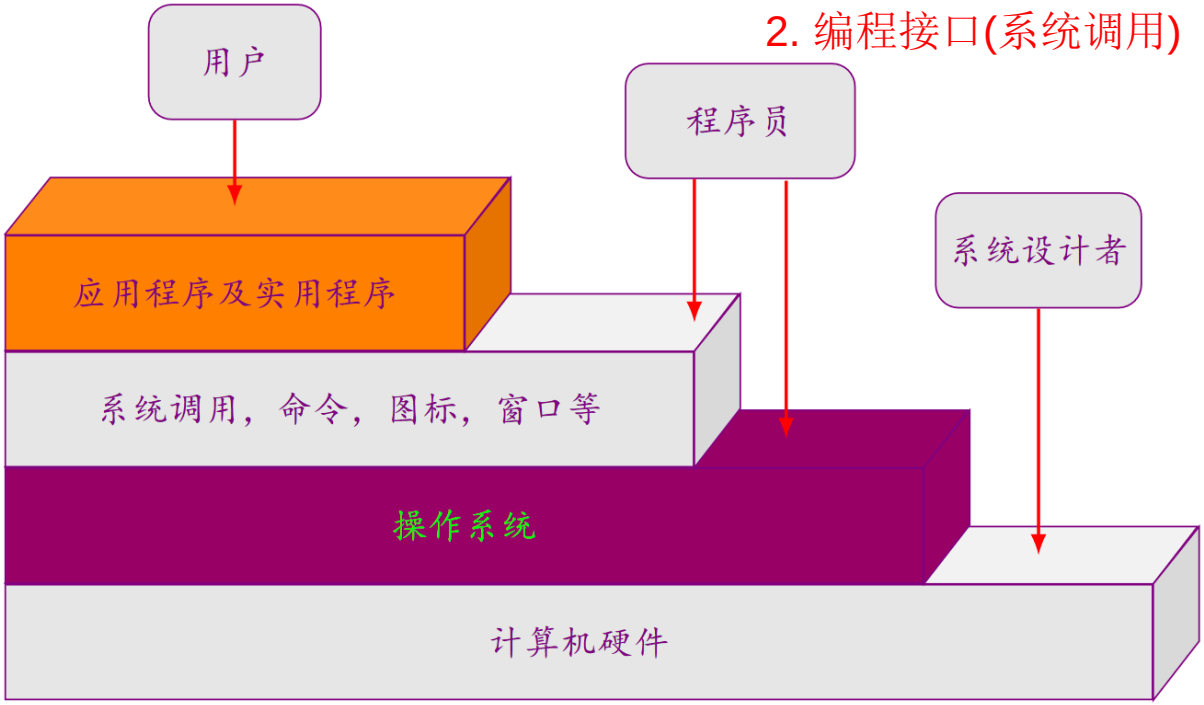


System view

Role of OS

- **User view**: (role1: interface 【汤】)

1. 命令接口、图形用户接口
2. 编程接口(系统调用)



Goals (expected):

- easy of use?
- performance?
- resource utilization?
- battery life?

Computers used:

- pc?
- mainframe or minicomputer?
- workstations and servers connected via networks?

- The user's view of the computer varies according to the interface being used.
- Some (embedded) computers have little or no user view

Role of OS

- **System view**
  - a resource allocator (role2【汤】)
    - Resources: processors, memory, IO devices and files;
  - a control problem.

Role of OS

- 补充：
  - 对操作系统作用的理解，有不同的观点【汤】。

1. 用户与计算机硬件系统之间的接口(interface)
   - 命令接口(Command Line Interface, CLI)、图形用户接口(Graphical User Interface, GUI)
   - 编程接口（系统调用接口(system call)）
2. 计算机资源的管理者(resource allocator)
   - 四类资源：处理机、存储器、I/O设备、文件
3. 扩充机器（或虚拟机Virtual Machine）(role3【汤】)
   - 虚拟机：覆盖了软件的机器
   - 层次性

What is OS?

- **What is OS? What OS do? Definition of OS.**

没有一个统一的、适用的定义！

1. An Operating System is a program that
   - Manages the computer hardware
   - Provides a basis for application programs
   - Acts as an intermediary between the computer user and the computer hardware
2. OS is a resource allocator that
   - Manages all resources
   - Decides between conflicting requests for efficient and fair resource use
3. OS is a control program that
   - Controls execution of programs to prevent errors and improper use of the computer

操作系统是一组控制和管理计算机软硬件资源、合理地对各类作业进行调度以及方便用户的程序的集合【汤】。

General structure of OS

Lines of OS Source code

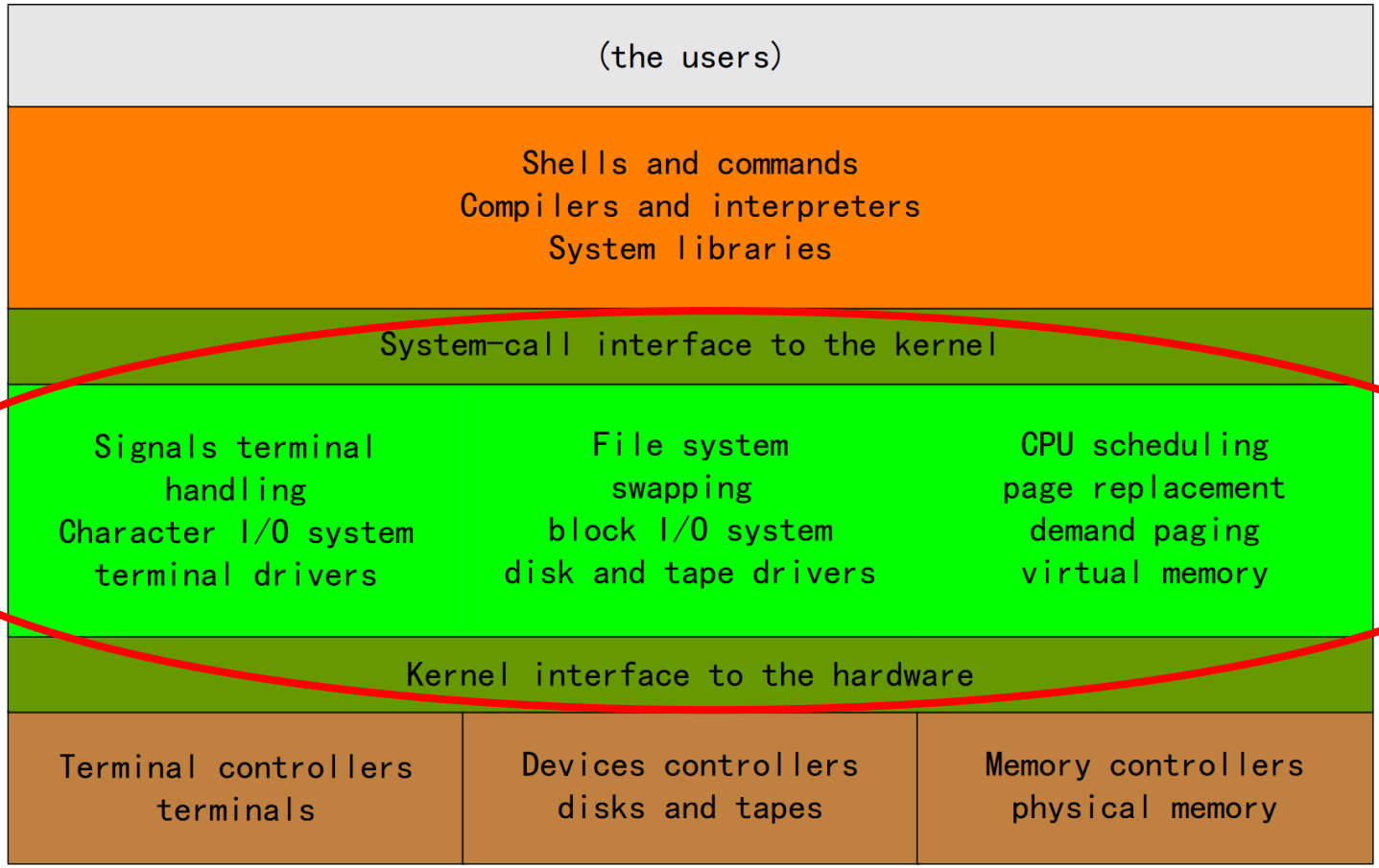
- 以Linux为例，内核约1000~2000万行

Layered modularization (层次模型)

- 一种经典的操作系统的结构模型 【汤】
  - 最高层：接口
  - 中间层：对对象进行操纵和管理的软件集合
  - 最底层：OS操纵和管理的对象，包括各类软硬件资源
- 以类Unix，某版Windows和嵌入式操作系统RTEMS为例

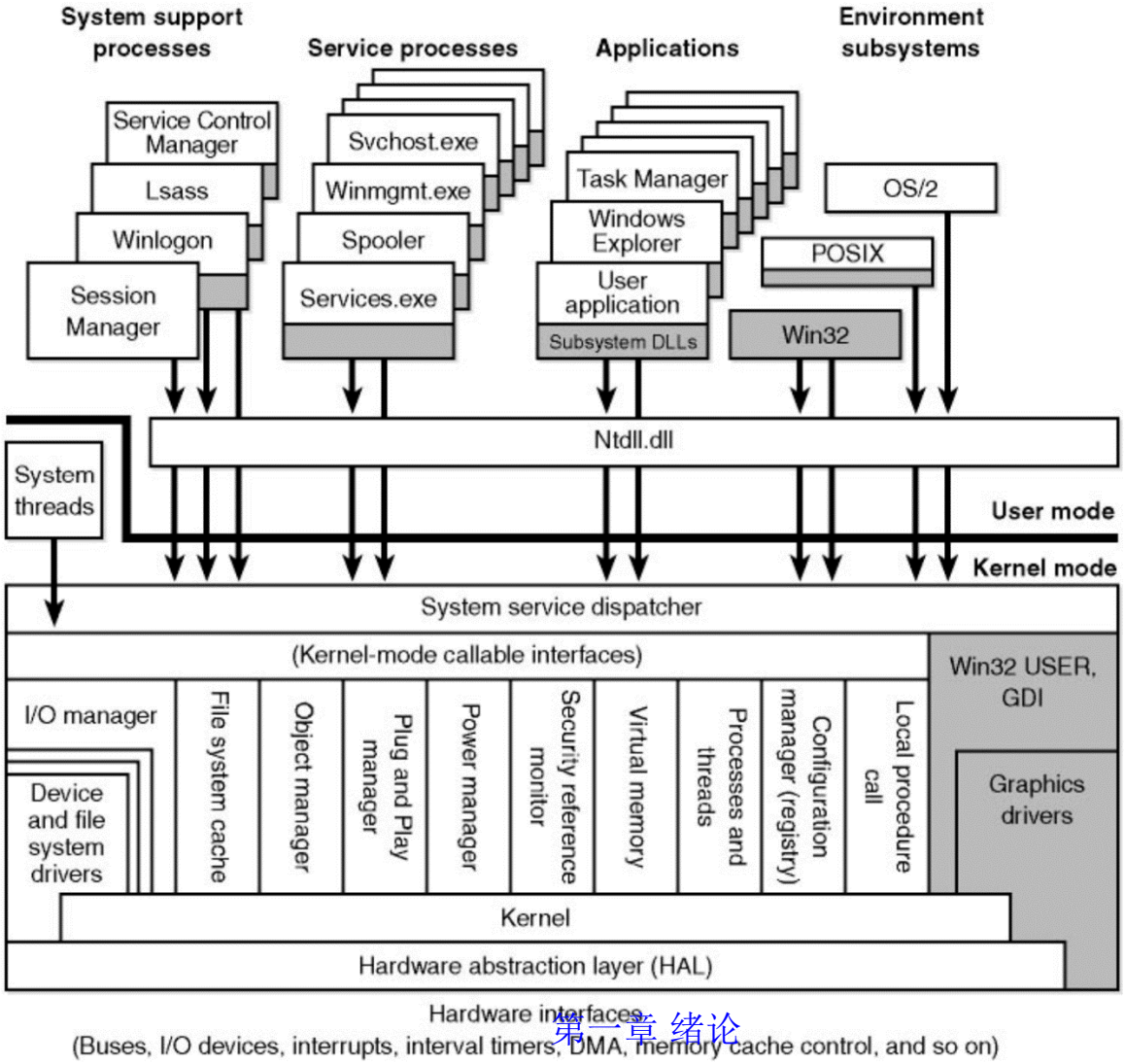
General structure of OS

- 类UNIX操作系统的经典体系结构图



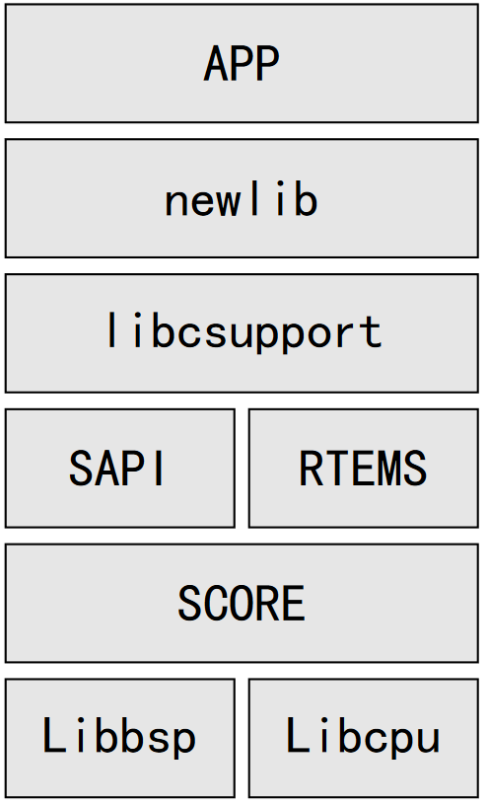
General structure of OS

- 某版Windows的体系结构图



General structure of OS

- RTEMS：一种微内核抢占式实时操作系统
  - https://www.rtems.org/
  - 最新版本5.1；4.0.0核心代码约9万行



Design of OS?

- **Design goal.**
  - 在计算机硬件上配置OS的（设计）目标有以下几点【汤】：
    1. convenience(方便性)
       - Execute user programs and make solving user problems easier
       - Make the computer system convenient to use
    2. Effectiveness(有效性)
       - Use the computer hardware in an efficient manner （提高软硬件资源的利用率）
    3. Extensibility(可扩充性)
       - 适应软硬件的发展需求
    4. openness(开放性)
       - 可移植性、互操作性
  - 方便性和有效性是操作系统最重要的两个目标。

Summary

- What is OS?
  - Role of OS.
  - Definition of OS.
  - General architecture of OS.
  - Design goal of OS.

Q & A