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# 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。



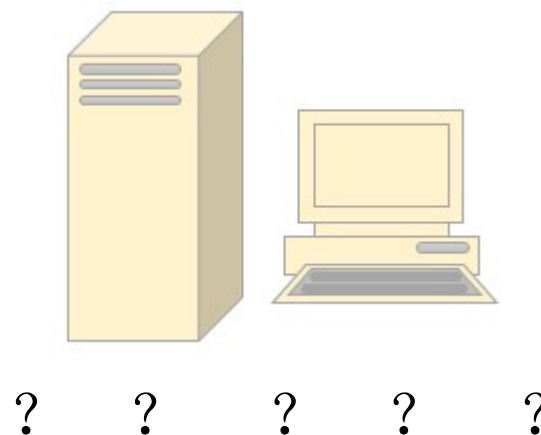
- Prepare: 3 questions
- What is OS?  
(Role, Definition, General architecture, and Design goal)
- Introduction of CS (from OS view)?
- History of OS
- Summary

# 3 questions



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



# CS & Von Neumann architecture



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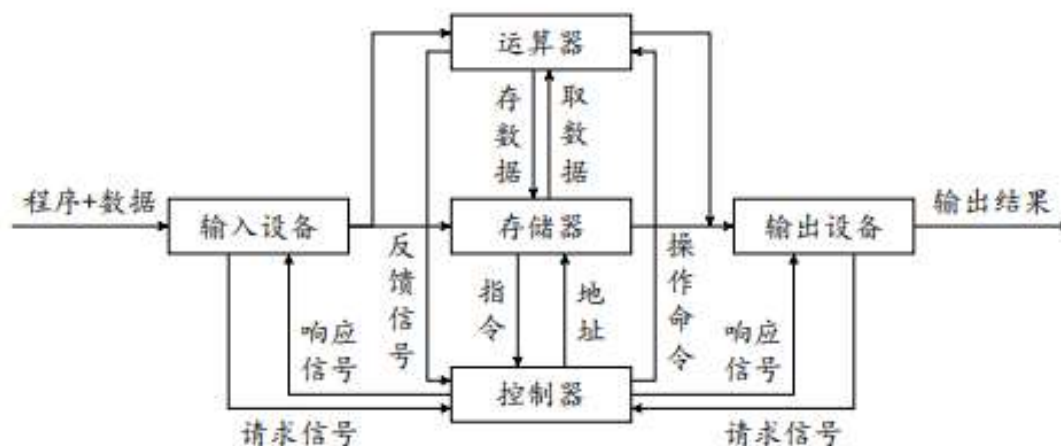
## ► 计算机

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



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- Q2: How a **computer system** up and running?

- System boot: Example, Linux system startup

typical operating systems 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”)

```
#include <stdio.h>

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

```
xlanchen@DESKTOP-L80I0DD: ~$ ls
helloworld helloworld.c
xlanchen@DESKTOP-L80I0DD: ~$ ./helloworld
Hello World!
xlanchen@DESKTOP-L80I0DD: ~$ ~
```

# What is OS?

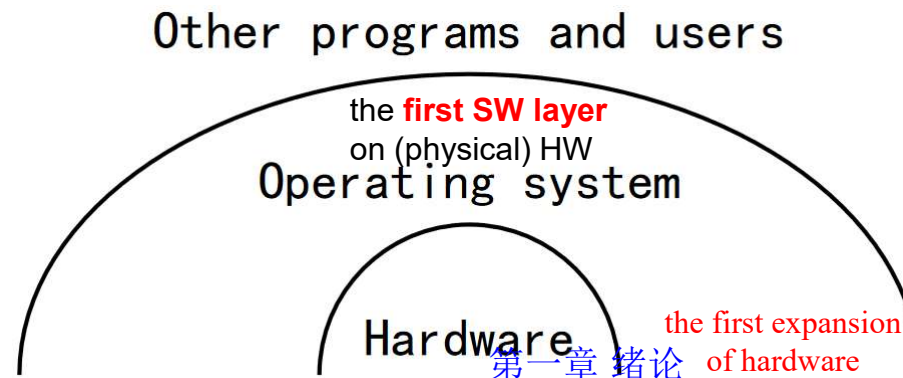


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- OS/CS is everywhere.



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

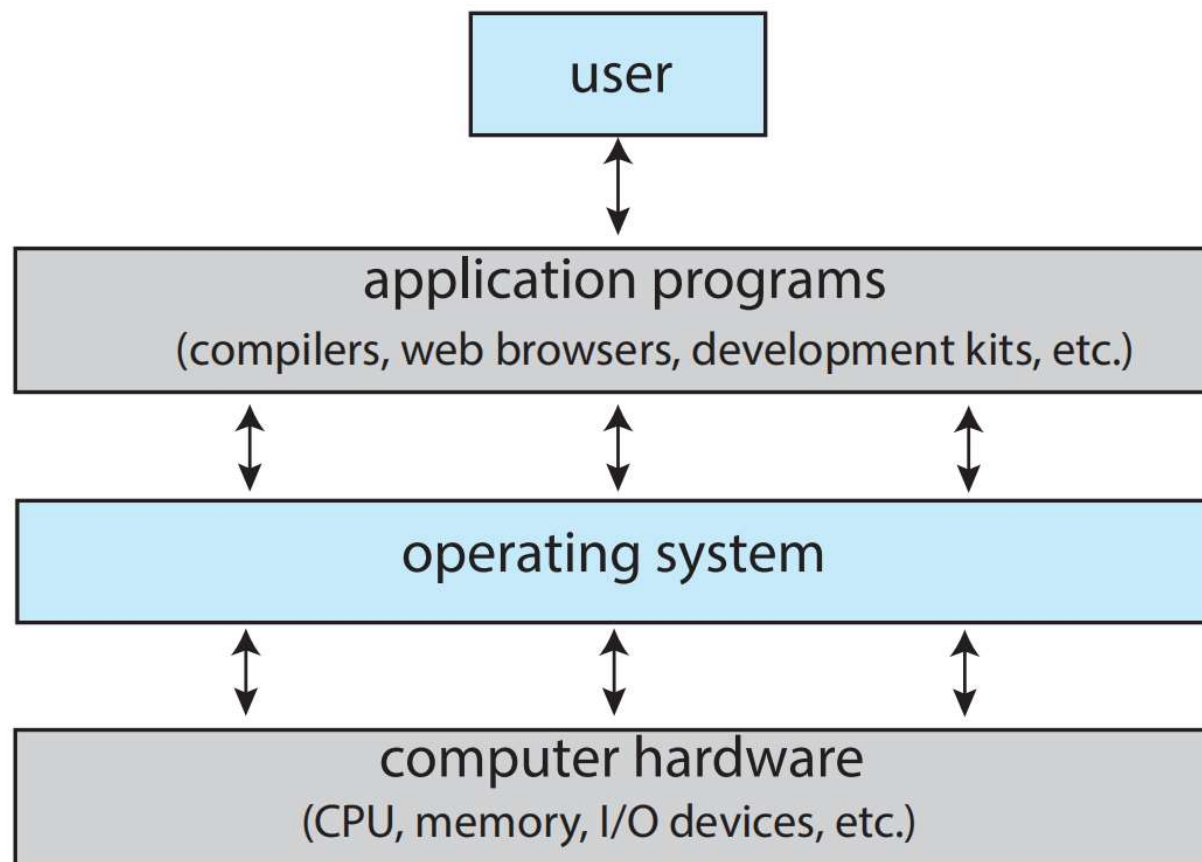




# What is OS?



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

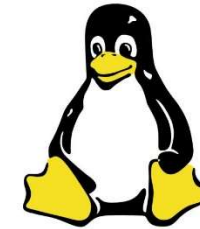
# What is OS?



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- What OSes do you know?

- Windows series, Unix series, SUN Solaris, FreeBSD, AppleMac OS, Linux series, ...



- A variety of real-time, non-real-time, embedded Oses
    - $\mu$ C/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，等等

# What is OS?



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- The role(作用) of OS in CS

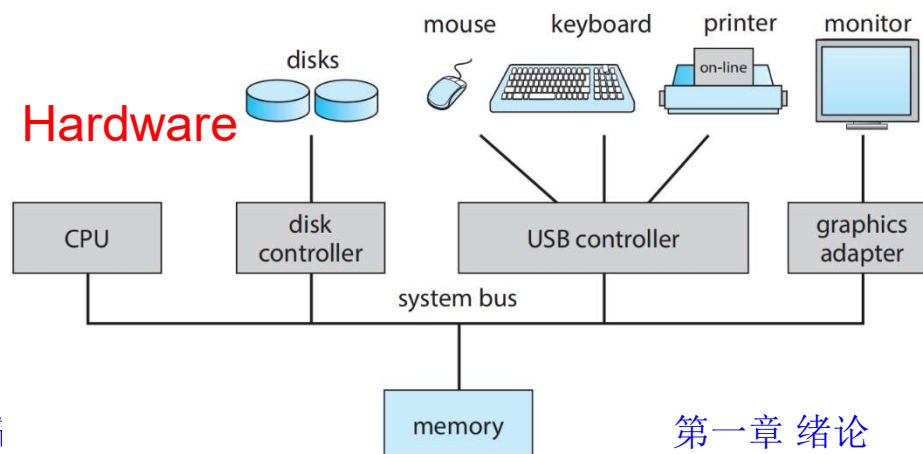


Different User has different opinion.

↓ User view

VS.

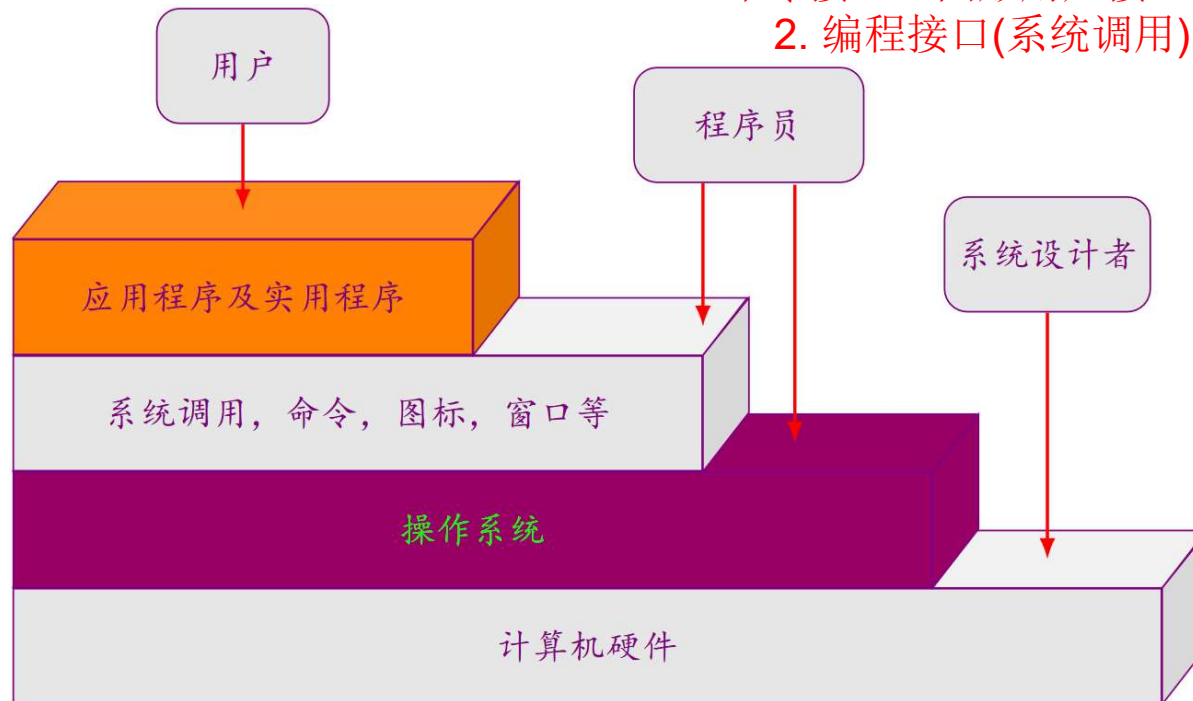
## Role of OS



↑ System view

- **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



- **System view**

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

- 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?



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- 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】。

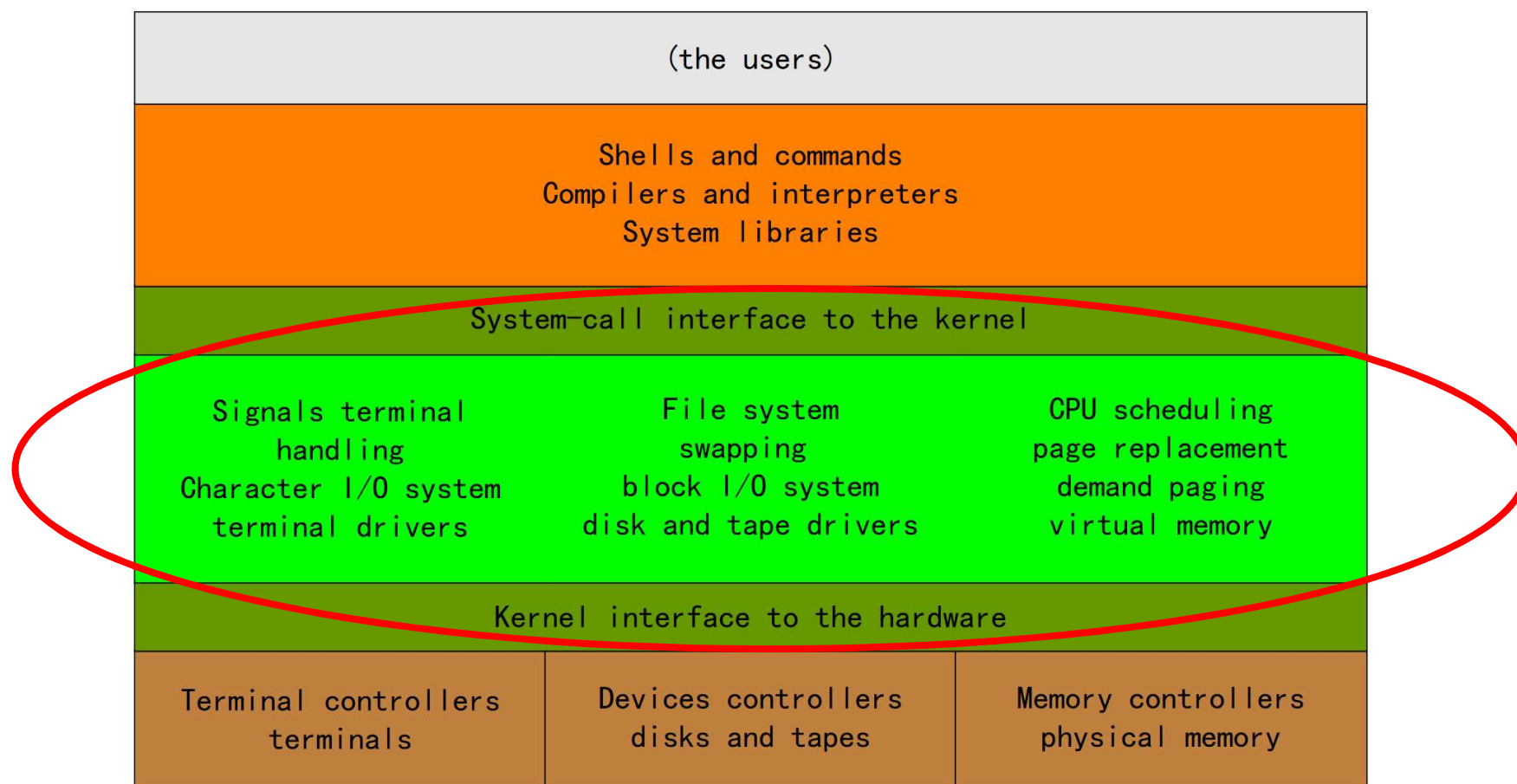
## Lines of OS Source code

- 以Linux为例，内核约1000~2000万行

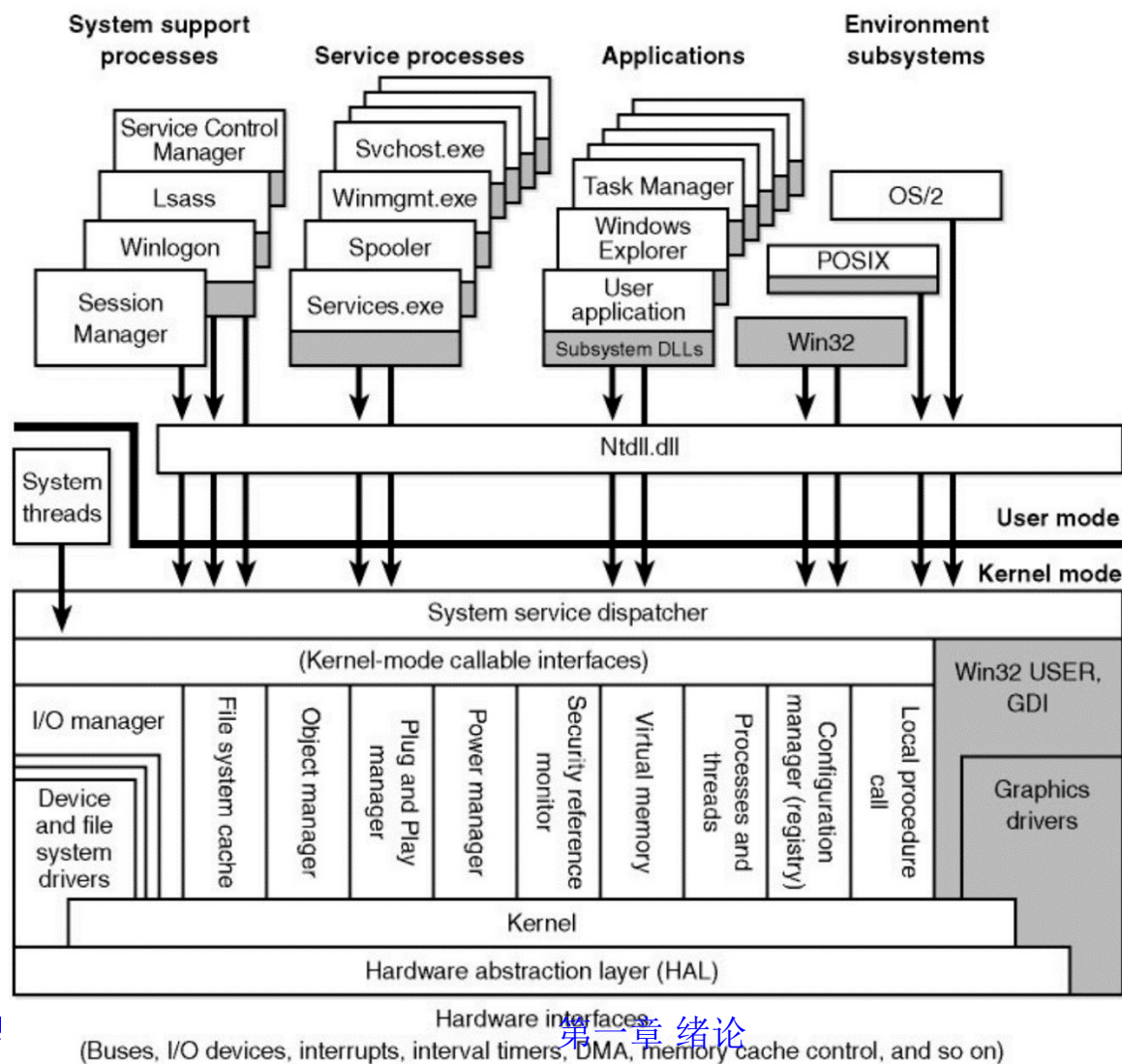
## Layered modularization (层次模型)

- 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

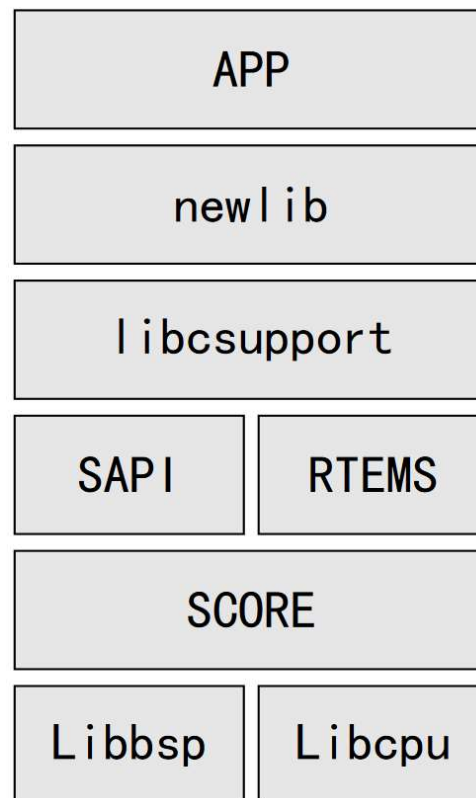
- 类UNIX操作系统的经典体系结构图



- 某版Windows的体系结构图



- 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 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



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

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## Q & A