Lecture1 Process

PART 1: Process Concept

What is Operating System?

An interface between users and hardware - an environment "architecture";

用户和硬件之间的接口，环境“架构”;

Allows convenient usage; hides the tedious stuff;

使用方便;隐藏乏味的东西;

Allows efficient usage; parallel activity, avoids wasted cycles;

允许高效使用;并行活动，避免浪费周期

Provides information protection; 提供信息保护;

Gives each user a slice of the resources; 为每个用户提供资源的一部分;

Acts as a control program. 充当控制程序。

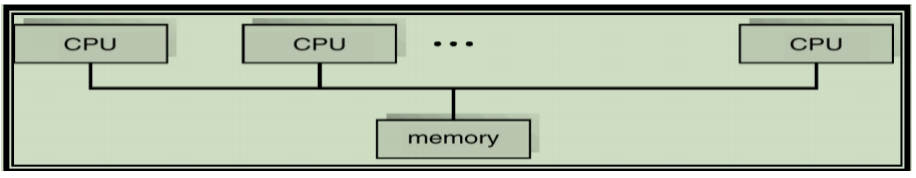
Characteristics of Operating Systems:

1. **Time Sharing**: multiprogramming environment that's also interactive.

   分时: 同时也是交互式的多进程环境。

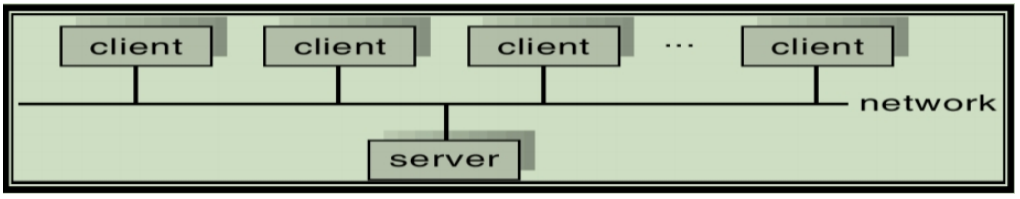
2. **Multiprocessing** - Tightly coupled systems that communicate via shared memory. Used for speed improvement by putting together a number of off-the-shelf processors.

   多处理: 通过共享内存进行通信的紧密耦合系统。通过将许多现成的处理器组合在一起来提高速度。



3. **Distributed Systems**: - Loosely coupled systems that communicate via message passing. Advantages include resource sharing, speed up, reliability, communication.

   分布式系统: 通过消息传递进行通信的松散耦合系统。优点包括资源共享、加速、可靠性、通信。



4. **Real Time Systems**: Rapid response time is main characteristic. Used in control of applications where rapid response to a stimulus is essential.

   实时系统: 快速响应时间是主要特点。用于控制对刺激的快速响应至关重要的应用。

What is doing in OS

1. Process Management,
2. Memory management,
3. File System Management,
4. I/O System Management,
5. Protection and Security
6. 过程管理,
7. 内存管理,
8. 文档系统管理,
9. I/O系统管理,
10. 保护与安全

Process Management: *Starting and stopping programs and sharing the CPU between them.*

启动和停止进程并在它们之间共享 CPU。

Concept 进程概念

- **Process** = **a program in execution**; process execution must progress in sequential fashion

  正在执行的进程;流程执行必须按顺序进行 (进程可以理解为一个程序的一次执行过程)

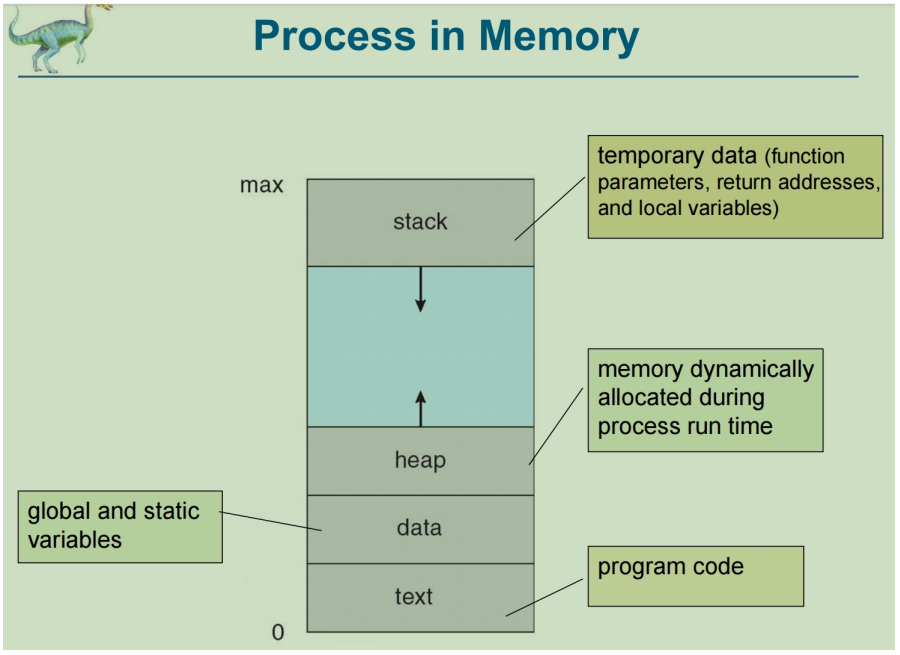
- An operating system executes a variety of programs 操作系统执行各种进程
- A **process** is considered an '**active**' entity **进程**被视为“**活动**”实体
- A **program** is considered to be a **'passive'** entity (stored on disk (executable file))

  程序被视为**“被动”**实体（存储在磁盘上（可执行文档））

  程序段、数据段、PCB三部分构成了一个**进程实体（进程映像）**。一般情况下，进程实体就是进程。严格来说是不一样的，**进程实体是静态的，进程是动态的**。

Program becomes process when executable file loaded into memory

进程在可执行文档加载到内存中时成为进程



Process State 进程状态

As a process executes, it changes **state** 当进程执行时，它会更改**状态**

The state of a process is defined in part by the **current activity of that process.**

进程的状态在一定程度上由该进程的**当前活动定义**。

前三个是基本状态

· **new**: The process is being created 运行态: 正在创建进程 【基本状态】

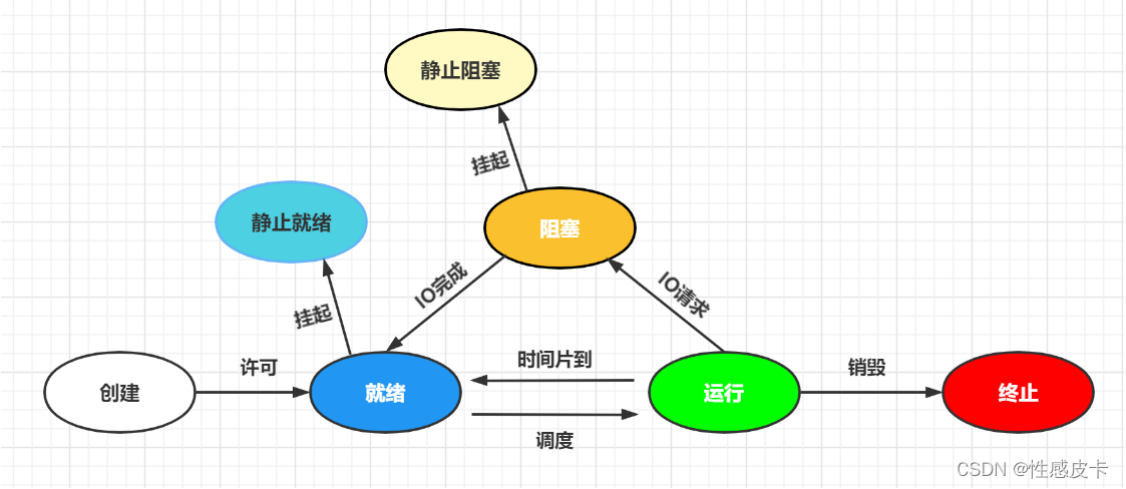
· **running**: Instructions are being executed 就绪态: 指令正在执行中 【基本状态】

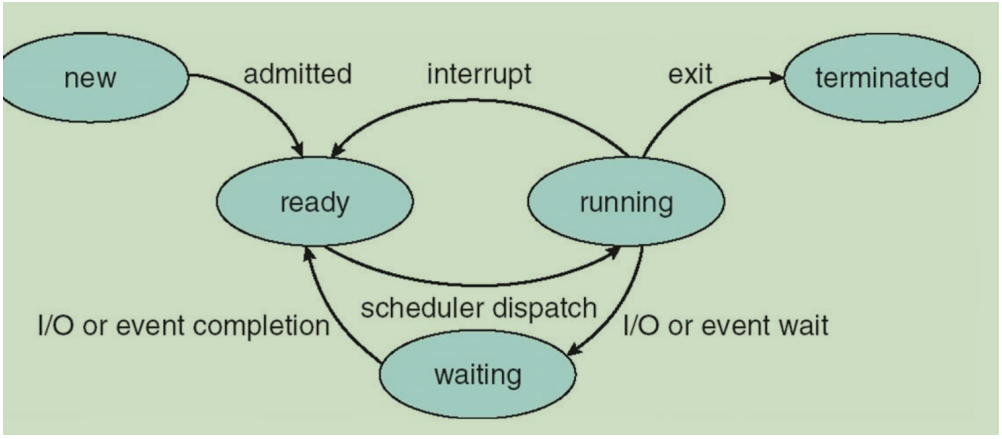
· **waiting**: The process is waiting for some event to occur 阻塞态: 该进程正在等待某些事件发生, 例如等待分配打印机 【基本状态】

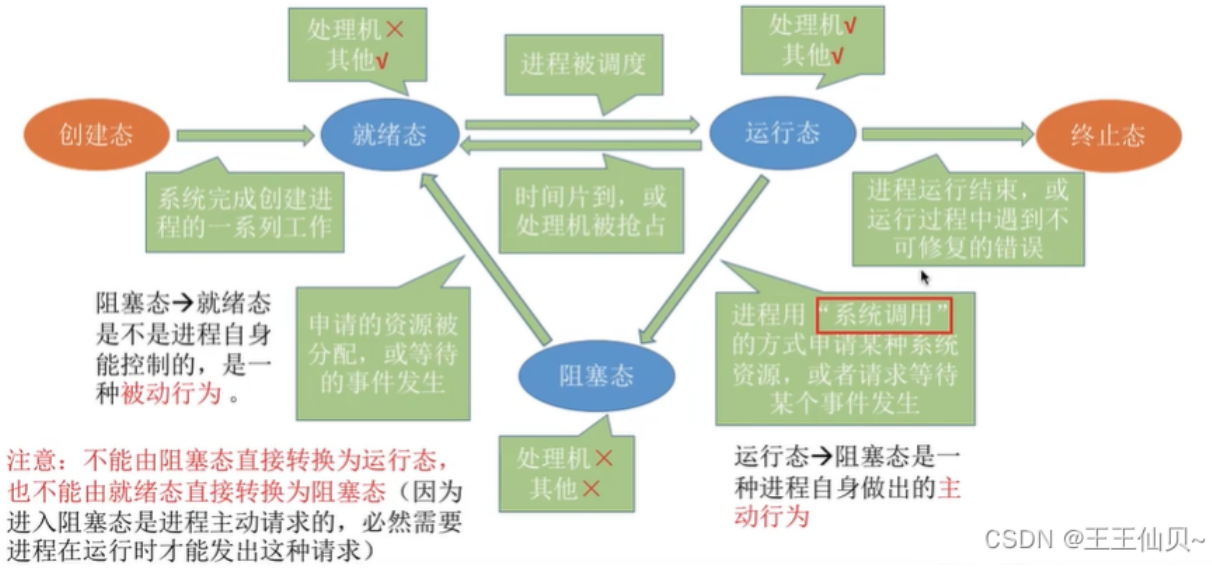
· **ready**: The process is waiting to be assigned to a processor 创建态 (等待态): 该进程正在等待分配给处理器 初始化PCB

· **terminated**: The process has finished execution 终止态: 该过程已完成执行

Diagram of Process State 进程运行状态图像







Process Control Block (PCB) 进程控制块

Process Control block is a **data structure** used for storing the information about a process. Each & every process is identified by its own PCB. (can be also called as Context of Process)

进程控制块是用于存储有关进程的信息的数据结构。 是系统为每个运行的程序配置的一个数据结构。

PCB of each process resides in the main memory. 每个进程的PCB都驻留在主存储器中。

PCB of all the processes are present in a linked list. 所有进程的PCB都存在于链表中。

PCB is important in **multiprogramming** environment as it captures the information pertaining to the number of processes running simultaneously. PCB在**多编程**环境中很重要，因为它捕获与同时运行的进程数量有关的信息。

PCB：存储操作系统对进程进行管理时所需的各种信息。
包含信息：
1）进程描述信息：进程标识符PID（进程创建时操作系统分配的独一无二的标识符，用于区分进程）、用户标识符UID
2）进程控制和管理信息：进程当前状态、进程优先级
3）资源分配清单：程序段指针、数据段指针、键盘、鼠标
4）处理机相关信息：各种寄存器（用于进程状态）

PART II Process Scheduling

Process execution consists of alternating sequence of *CPU execution* and *I/O wait*.

进程执行由 *CPU 执行* 和 *I/O 等待* 的交替串行组成。

Process scheduler: selects from among the processes in memory that are ready to execute, and allocates the CPU to one of them. **进程调度进程**：从内存中准备执行的进程中进行选择，并将 CPU 分配给其中一个进程。

Scheduling queues of processes: **调度进程队列**:

Job queue – set of all processes in the system

作业队列 – 系统中所有进程的集合

Ready queue – set of all processes residing in main memory, ready and waiting to execute

就绪队列 – 驻留在主内存中、已准备就绪并等待执行的所有进程的集合

Device queues – set of processes waiting for an I/O device

设备队列 – 等待 I/O 设备的进程集

Schedulers 调度程序

Long-Term Scheduler is also called Job Scheduler and is responsible for controlling the Degree of Multiprogramming. i.e. the total number of processes that are present in the ready state.

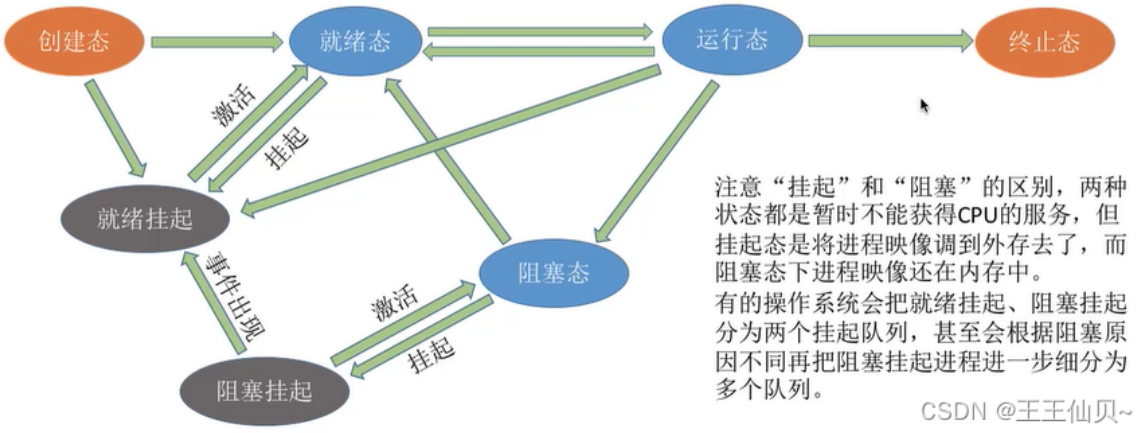
Long-Term Scheduler 也称为 Job Scheduler，负责控制多编程度。即处于就绪状态的进程总数。

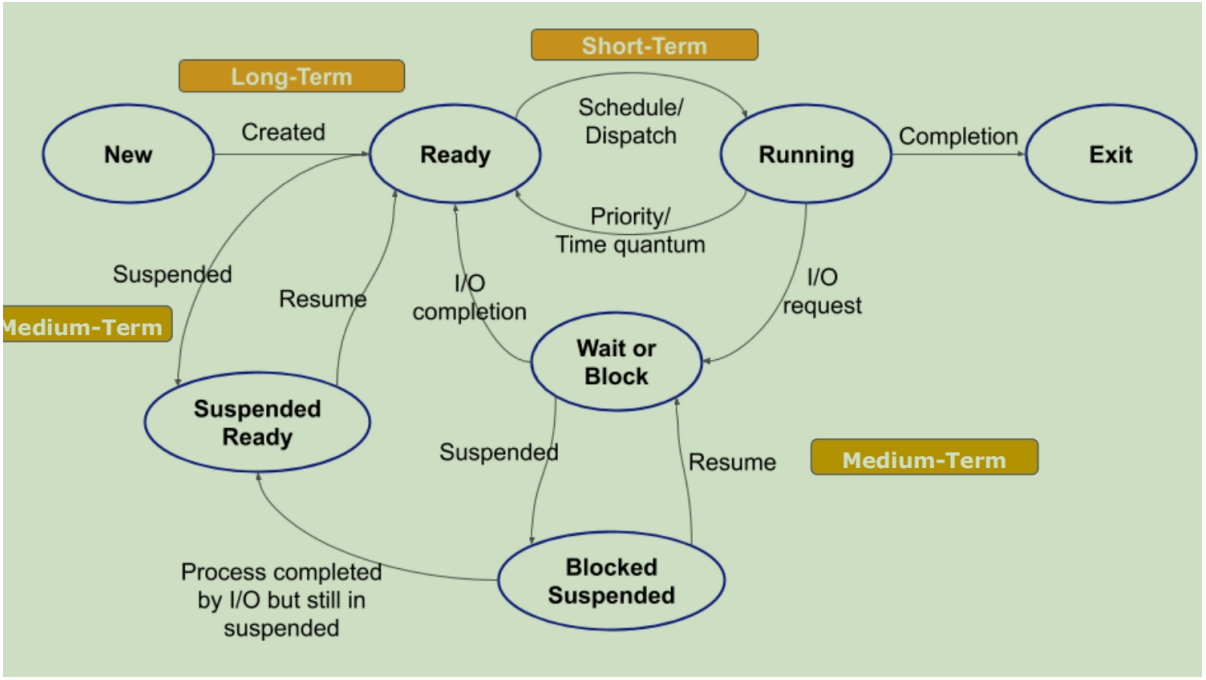
Short-Term Scheduler is also known as **CPU scheduler** and is responsible for selecting one process from the ready state for scheduling it on the running state

Short-Term Scheduler 也称为 **CPU 调度进程**，负责从就绪状态中选择一个进程，以便在运行状态下调度它

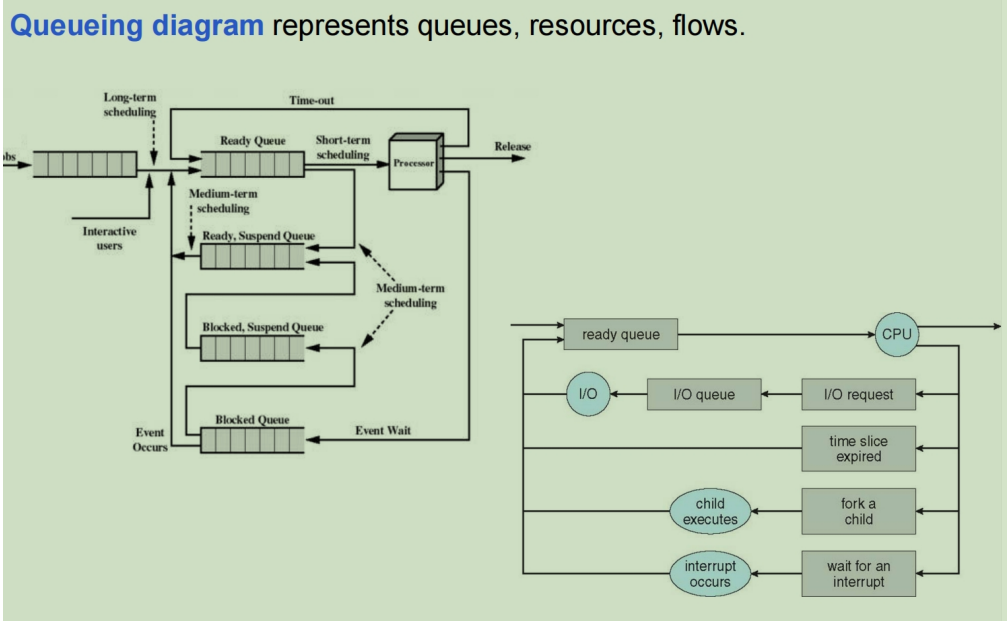
Medium-term scheduler is responsible for **swapping of a process from the Main Memory to Secondary Memory and vice-versa** (mid-term effect on the performance of the system).

中期调度进程负责**将进程从主内存交换到辅助内存**，反之亦然（对系统性能的中期影响）。





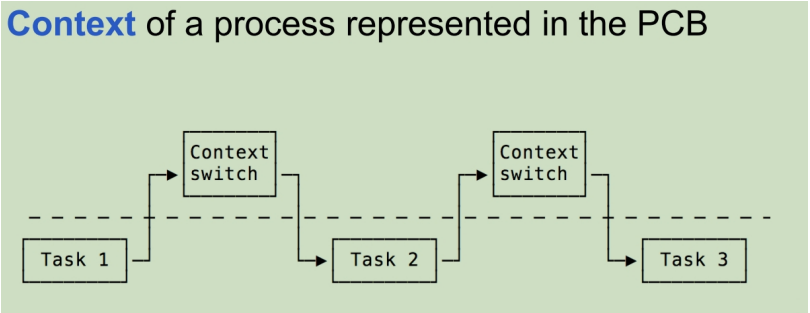
Queueing Diagram for Scheduling 调度排队图



Context Switch 上下文切换

When CPU switches to another process, the system must **save the state** of the old process and load the **saved state** for the new process via a **CONTEXT SWITCH**

当 CPU 切换到另一个进程时，系统必须**保存旧进程的状态**，并通过**上下文开关**加载新进程的**保存状态**



PART III Operation on Processes

System must provide mechanisms for:

- process creation, 进程创建
- process termination, 继承销毁

Process Creation 线程创建

Parent process create **children** processes, which, in turn create other processes, forming a **tree** of processes

父进程创建**子进程**，这些进程又创建其他进程，形成进程的**树**

Resource sharing options

- Parent and children share all resources
- Children share subset of parent' s resources
- Parent and child share no resources
- **资源共享选项**

  家长和子女共享所有资源

  子级共享父级资源的子集

  父项和子项不共享任何资源

Execution options

- Parent and children execute concurrently
- Parent waits until children terminate
- **执行选项**

  父级和子级同时执行

  父级等待子级终止

Process Termination 线程终止

Process executes last statement and then asks the operating system to delete it using the **exit()** system call.

进程执行最后一条语句，然后要求操作系统使用 **exit（）** 系统调用将其删除。

- Returns status data from child to parent
- Process' resources are deallocated by operating system

  将状态数据从子级返回到父级

  进程资源按操作系统解除分配

Parent may wait terminate the execution of children processes.

- Child has exceeded allocated resources

父进程可以等待终止子进程的执行。

子项已超出分配的资源

PART IV Inter-process Communication

INDEPENDENT PROCESSES

neither affect other processes or be affected by other processes.

独立进程 *既不影响其他进程，也不受其他进程的影响。*

COOPERATING PROCESSES - *can affect or be affected by other processes.*

There are several reasons why cooperating processes are allowed:

- **Information Sharing** - processes which need access to the same file for example.
- **Computation speedup** - a problem can be solved faster if the problem can be broken down into sub-tasks to be solved simultaneously
- **Modularity** - break a system down into cooperating modules. (e.g. databases with a client-server architecture.)
- **Convenience** - even a single user may be multi-tasking, such as editing, compiling, printing, and running the same code in different windows

合作进程 可能会影响或受其他进程的影响。

允许合作过程有几个原因：

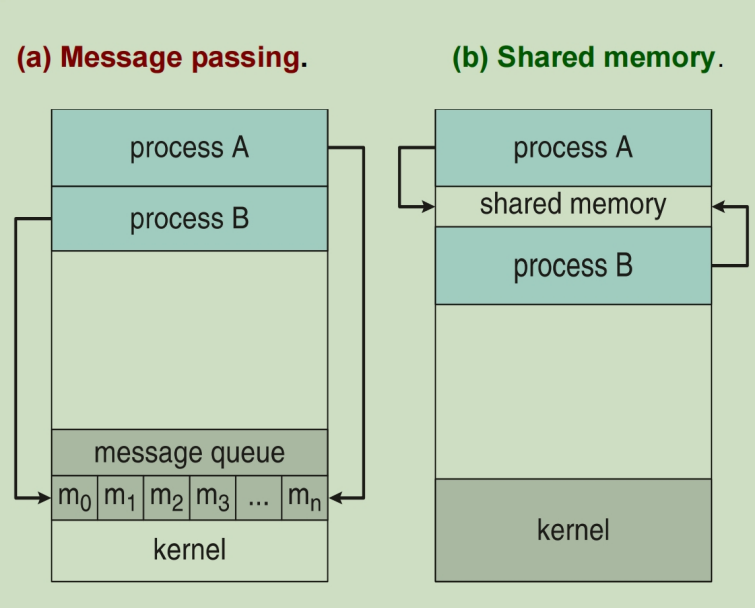
信息共享需要访问同一文档的进程。

计算加速 如果一个问题可以分解为要同时解决的子任务，则可以更快地解决问题

模块化将系统分解为协作模块。（例如，具有客户端-服务器架构的数据库。

方便 即使是单个用户也可能同时处理多项任务，例如编辑、编译、打印和在不同的窗口中运行相同的代码

Communication Model 沟通模型



Message-Passing System 信息传递系统

communication takes place by way of messages exchanged among the *cooperating processes*

通信是通过*合作进程*之间交换消息的方式进行的

A message-passing facility provides at least two operations:

- **send**(*message*)
- **receive**(*message*)

消息传递工具至少提供两个操作：

发送（*留言*）

接收（*消息*）

The *message* size is either fixed or variable *message* 大小可以是固定的，也可以是可变的

If processes *P* and *Q* want to communicate: *a**communication link must exist between them.*

如果进程 *P* 和 *Q* 想要通信：它们之间必须存在 *a通信链接*。

Are several methods for logically implementing a link and the **send()/receive()** operations:

是用于逻辑实现链接和 **send（）/receive（）** 操作的几种方法：

▪ **Direct** or **indirect communication** 直接或间接沟通

▪ **Synchronous** or **asynchronous communication** 同步或异步通信

Shared-Memory System 共享内存系统

a region of memory is shared by cooperating processes. 内存区域由协作进程共享。

processes can *exchange information by reading and writing all the data to the shared region.*

进程可以通过读取和写入共享区域的所有数据来交换信息。

Two types of buffers can be used: 可以使用两种类型的缓冲液:

- **unbounded-buffer** places **no** practical **limit on the size of the buffer**
  unbounded-buffer 放置 **no** practical 限制缓冲区的大小
- **bounded-buffer** assumes that there is a **fixed buffer size**
  bounded-buffer 假定存在一个固定的缓冲区大小

Direct or Indirect Communication 直接或间接交流

exchanged messages by communicating processes reside in a **temporary queue**.

通过通信进程交换的消息驻留在**临时队列**中。

BUFFERING:

Zero capacity. The queue has a maximum length of zero; thus, thelink cannot have any messages waiting in it.

Bounded capacity. The queue has finite length *n*; thus, at most *n*messages can reside in it.

Unbounded capacity. The queue's length is potentially infinite.

缓冲:

零容量。队列的最大长度为零;因此，该链接中不能有任何消息等待。

限制容量。队列的长度有限 *n*;因此，最多 *n*消息可以驻留在其中。

无限容量。队列的长度可能是无限的。

Direct Communication

Processes must name each other explicitly: 进程必须显式命名（必须准确告知对方的信息）:

- **send** (*P*, *message*) – send a message to process P.
  send （*P*， *message*） – 向进程 P 发送消息
- **receive**(*Q*, *message*) – receive a message from process Q.
  receive（*Q*， *message*） – 接收来自进程 Q 的消息

Direct Communication is implemented when *the processes use specific process identifier for the communication*, but it is hard to identify the sender ahead of time.

*直接通信*是在*进程使用特定的进程标识符进行通信*时实现的，但很难提前识别发送者

Indirect Communication

1. **create** a new **mailbox (port)** 创建 新的**邮箱（端口）**
2. send and receive messages through mailbox 通过邮箱发送和接收邮件
    - **send***(A, message)* – send a message to mailbox A

      send*（A， message）* – 向邮箱 A 发送邮件
    - **receive** (A, message)* – receive a message from mailbox A

      receive （A， message）* – 从邮箱 A 接收邮件
3. **destroy** a **mailbox**

Synchronous and Asynchronous Message Passing 同步或异步交流

Message passing may be either *blocking* or *non-blocking* 消息传递可以是*阻止*或*非阻止*

Blocking is considered **synchronous**

阻塞被认为是**同步**

- **Blocking send** -- the sender is blocked until the message is received

  阻止发送 - 在收到消息之前，发件人将被阻止
- **Blocking receive** -- the receiver is blocked until a message is available

  阻止接收 - 接收方被阻止，直到消息可用

Non-blocking is considered **asynchronous**

非阻塞被视为**异步**

- **Non-blocking send** -- the sender sends the message and continue

  非阻塞发送 - 发送者发送消息并继续
- **Non-blocking receive** -- the receiver receives:

  非阻塞接收 -接收者接收：

▪ *A valid message*, or 一个有效的信息

▪ *Null message* 或者空信息