Review

Chapter 1: Introduction

Definition of OS

- **Users View :** Easy to use, Resource Utilization
- **System View :** Resource Allocator

Interrupt

- **Trap :** Hardware can trigger it anytime by bus.
- **System call or monitor call :** Software can trigger it by executing special operation.

Modes

- **User mode :** mode bit = 1
- **Kernel mode :** mode bit = 0
  Tips : some instructions can only executed in kernel mode while the OS ask system call to use API functions to access kernel space.

Chapter 2 : Operation System Structures

Operation System Service

- UI
- Program Execution
- I/O operations
- File System Manipulation
- Communication
- Error Detection
- Resource Allocation
- Accounting
- Protection and Security

Interface -- Command Line + Command Interpreter

Two types of command interpreter

- The command interpreter itself contains the code to execute the command
- The command interpreter only load the file into the memory and execute it

System Calls

A software want to access the kernel space, the OS give an API to it and the API access the kernel space. As a result, system call can be also viewed as an connection between software and kernel.

Operating System Structure

- Layered Structure : ① Easy to construct and debug ②A layer can only use lower layers ③Less efficient
- Micro Kernels : ①Easy to extend ②More reliable and secure ③Frequently use of message function (Increase communication between user space and kernel space)
- Modules : Flexible (can call any other modules) and Efficient (don't invoke message passing)

Chapter 3 : Processes

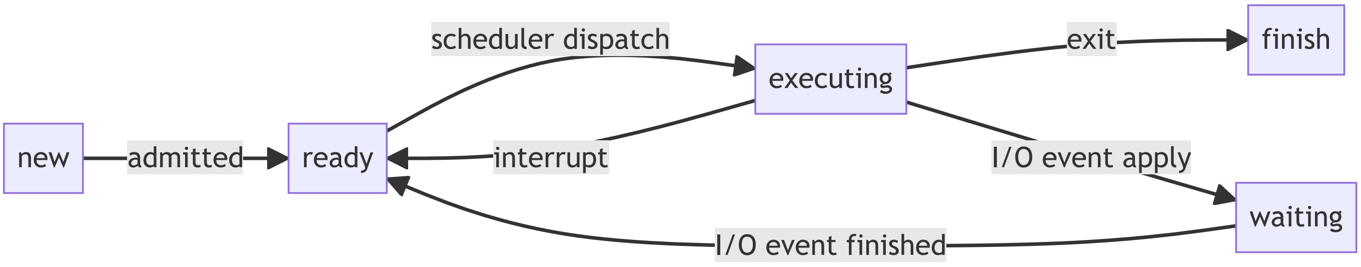
Process In Memory

stack
heap
data
text

- Stack is used to store temporary data
- Heap is used to store memory allocated to this process
- data is used to store global variables
- text is used to store code

Process State

IMPORTANT



PCB

Process control unit is a component used to record the information of a specific process.

Scheduler

- Long Term Scheduler (Job Scheduler) : From disk to memory
- Middle Term Scheduler (Swapping) : push back to memory and then push in, in order to reduce multiprogramming
- Short Term Scheduler (CPU Scheduler) : From memory to CPU

Context Switch

Context switch means the OS record the old process PCB and load a new process through its PCB, context switch time is pure overhead.

Fork()&Exec()

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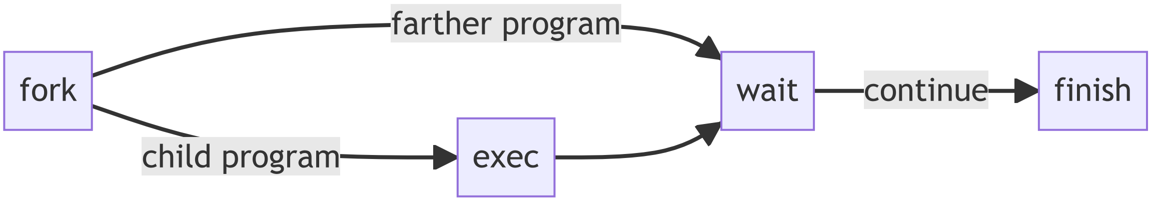


fork can set two process

- the return value is 0 in child process
- the return value is child process id in farther process

Inter Process Communication

- Messaging Passing
  1. Direct or Indirect
  2. Synchronize or Asynchronize
  3. Zero Capacity or Bounded Capacity or Unbounded Capacity
- Shared memory
  Bounded Buffer or Unbounded Buffer
  when in == out the buffer is empty
  when in == (out-1)%size the buffer is full

Chapter 4 : Threads

Overview

A thread comprise a **thread ID**, a **program counter**, a **register set** and a **stack**.
Code, **data** and **files** are shared among various threads which belong to the same process. Each threads has its own **stack** and **register**.

Benefits of Using Threads

- Responsiveness
- Resource Sharing
- Economy
- Increase Concurrency

Multithreads Models

Users threads are managed without kernel support while kernel threads are supported and managed directly by the operation system.

There are roughly four types of threads models

- **Many to one**
- **One to one**
- **Many to many**
- **Two level model**

Thread Library

Provide the programmer an API to create and manage threads.

Chapter 5 : CPU Scheduling

evaluation criteria

- **CPU Utilization**
- **Throughput :** The number of processes which can be completed per time unit
- **Turnaround Time :** The time of submission the process to the time of completion
- **Waiting Time :** Total wait time between the time of submission the process to the time of completion
- **Response Time :** The time of submission the process to the time of first response

Scheduling Algorithm

1. First Come First Serve : Nonpreemptive
2. Shortest Job First : Nonpreemptive or Preemptive
3. Priority : Might cause indefinite blocking or starvation and aging can avoid it.
4. Round Robin
5. Multilevel Feedback Queue

Gantt chart Starvation time slice

Chapter 6 : Process Synchronization

The Critical Section Problem

Three requirement

1. Mutual Exclusive
2. Progress
3. Bounded waiting

Peterson's Algorithm

1. Raise your hand first and give up your position to others.
2. When others hand down and its your turn, execute.
3. Hand down.

Synchronization Hardware

1. Start waiting and hold a key
2. Sry to open through the key until the door opened or waiting stop
3. Execute
4. Find next waiting process and stop its waiting

Semaphore

The disadvantage of primary semaphore (spinlock) is **busy waiting**.

Monitor

Only one process at a time can be activate within the monitor.

```
        condition x, y;
        x.wait();
        x.signal();
```

Chapter 7 : Deadlock

Necessary Conditions

1. **Mutual Exclusive**
2. **Hold and wait**
3. **No preemption**
4. **Circular wait**

Deadlock Prevention

Ensure one of the necessary conditions cannot happen.

Deadlock Avoidance

1. **Banker's Algorithm**

- **Safety Algorithm :** Initialize work = available and finish = false
- **Resource Request Algorithm :** if request is less than need and available, try to allocate the request, if it turns into a safe state, the request can be accepted.

2. **Resource Allocation Graph Algorithm**

- **Request edge**
- **Every resource has only one example**

Deadlock Detection

1. **Wait for Graph**
2. **Detection Algorithm (Similar to safety algorithm)**

Methods to Recover from Deadlock

- Abort all deadlock process
- Abort one process at a time until the deadlock cycle is eliminated.

Chapter 8 : Memory

Logical and Physical Address

Logical address is always generated by CPU, **logical address** add the value in **relocation register** is equal to **physical address**

Memory Allocation

- Methods : first-fit, best-fit, worst-fit

Paging

No outer fragmentation while have inner fragmentation.

This method use **TLB** to accelerate and try to improve the **hit rate**.

Segmentation

Chapter 9 : Virtual Memory

Algorithm to Deal with Page Fault

- First in first out
- Optimal
- Least recently used

Methods to Deal with Trashing

- Working Set Model
- Page Fault Model

Chapter 10 : File System Interface

File Access

- Sequential Access
- Direct Access
- Index Access

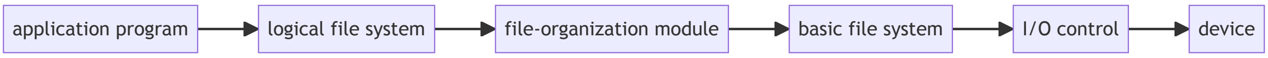
Directory Structure

- Single Level Directory

- Two Level Directory
- Tree Structure Directory

Chapter 11 : File System Implementation

File System Organized Layers



Allocation Methods

- Contiguous allocation
- Linked allocation
- Index alloation

Free Space Management

- Bit Vector
- Linked List
- Grouping

Chapter 12 : Mass-Storage Systems

Basic Terms

spindle, track, sector, platter, disk arm, read-write head

Disk Scheduling

- FCFS : First Come First Served
- SSTF : Shortest Seek Time First
- SCAN
- C-SCAN
- LOOK
- C-LOOK

RAID Structure

Chapter 13 : I/O Systems

Polling
Interrupt
DMA

address binding
swapping
memory mapping and protection
memory allocation
fragmentation

effective access time