

## CH1

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## CH2

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## CH3

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## CH4 Process Management, Thread Management

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Process

process state diagram

- New
- Ready
- Running
- Waiting
- Terminal

PCB

1.Process state 2.Program counter 3.CPU registers 4.CPU-scheduling information 5.Memory-management information 6.Accounting information 7.I/O status information (8.Process ID)

scheduling criteria

- CPU utilization
- Throughput
- Turnaround time
- Waiting time
- Response time

CPU Scheduling Algorithm

- **FCFS**
- SJF
  - Non-preemptive SJF->**SJF**
  - Preemptive SJF->**SRJF**
- **RR**
- **priority**
  - aging
- **multilevel queues**
- **multilevel feedback queues**

Multiple-Processor scheduling

- ASMP(沒什麼好設計的)
- SMP
  - load balancing
    - push migration
    - pull migration
  - processor affinity
    - soft affinity
    - hard affinity

## Real-Time system scheduling

若有Priority Inversion,用Priorify Inheritance解決

- Hard real-time(preemptive kernel)
  - Rate-Monotonic scheduling
  - EDF scheduling
- Soft real-time(preemptive kernel)
  - 不提供aging

## Threads

- private
  - program counter
  - CPU registers set
  - stack
  - local variables
  - thread ID
- shared
  - code section
  - data section(global data)
  - heap
  - static local variables
  - other OS resources(open files, signals, I/O resources,etc.)
- Benefits
  - **responsiveness**
  - **resource sharing**
  - **economy**
  - **scalability**(utilization of multiprocessors architecture)
- Thread management
  - user thread
    - provide a library entirely in user space with no kernel support
    - implement a kernel-level library supported directly by the OS
  - kernel thread

- multithreading models
  - Many-to-One model
  - One-to-One model
  - Many-to-Many model
- 2 strategies of creating multiple threads
  - Asynchronous threading(父,兒之thread concurrently execute)
  - Synchronous threading(父thread要等兒thread做完)
- Pthreads library
  - Pthreads is a specification
  - Run on UNIX
  - Can't run on windows os

## CH5 Deadlock Management

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- necessary conditions
  - **mutual exclusion**
  - **hold and wait**
  - **no preemption**
  - **circular wait**
- resource-allocation graph
  - no cycle, no deadlock
  - 有cycle不一定有deadlock
    - if every resource only has exactly one instance, 有cycle就有deadlock
- methods for handling deadlocks
  - **deadlock prevent**
    - 破除mutual exclusion條件(辦不到)
    - 破除hold and wait條件
    - 破除no preemption條件
    - 破除circular wait條件: resource ordering
  - **deadlock avoidance**
    - banker's algorithm( $O(n^2m)$ ,n: process,m: resource)
    - if system consisting of **m** resources of the same type with **n** processes running in the system
      - $1 \leq MAX_i \leq m$
      - $\sum_{i=1}^n MAX_i < n + m$
  - **deadlock detection and recovery**
    - detect it, and recover(允許系統進入deadlock)
    - detection algorithm( $O(n^2m)$ ,n: process,m: resource)

- **ignore deadlock**
- Recovery from deadlock
  - process and thread termination
    - abort all deadlocked processes
    - abort one process at a time until the deadlock cycle is eliminated(盲目地砍一個)
  - resource preemption

## CH6

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## CH7 Main Memory

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### Binding Time

- compile time
- loading time
- execution time

### Memory Management methods in OS

- **Contiguous Memory Allocation**

- external fragmentation
  - First Fit
  - Best Fit
  - Worst Fit

- **Page**

- internal fragmentation
- page table
  - hierarchical paging
  - hashed page table
  - inverted page table

- **Segment**

- external fragmentation
- Base and Limit

- Paged Segment

## CH8 Virtual Memory

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- 實現Virtual Memory 技術: Demand Paging -pure demand paging -prepaging

### Page Replacement Algorithm(沒有最差，只有最佳)

- **FIFO**(belady's anomaly)
- **OPT**(stack property)

- **LRU**(stack property)
- LRU-approximation(stack property)
  - **Additional reference bits usage**
  - **Second chance**
  - **Enhanced second chance**
- **LFU**(belady's anomaly)
- **MFU**(belady's anomaly)
- **Thrashing**
  - CPU utilization down
  - Paging I/O devices 異常忙碌
  - processes spends more time on paging I/O than normal execution
    - technique to handle Thrashing
      - **decrease multiprogramming degree**(已經thrashing)
      - **page fault frequency control**
      - **working set model**
- Allocation Kernel Memory
  - Buddy system
  - Slab allocation(has no internal, external fragmentation)

## CH9 Massive Storage System

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### Hard Disk

- cylinder
- tracks
- sectors(磁碟控制器控制read,write之基本單位)
- Disk Access Time
  - Seek Time
  - Rotational latency
  - Transfer Time

### Free-Space Management

- Bit vector
- Linked List
  - Grouping
  - Counting

### File Allocation Methods

- Contiguous Allocation
- Linked Allocation

- 變形: FAT
- Indexed Allocation
  - Linked scheme
  - Multilevel index
  - Combined scheme(UNIX i-Node structure)

## HDD scheduling(沒有最好與最差之法則)

- **FCFS**
- **SSTF**
- **SCAN**
  - elevator
- **C-SCAN**
- **LOOK**
  - elevator
- **C-LOOK**

## RAID

- improvement of reliability via redundancy
  - mirror
  - parity check
- improvement in performance via parallelism
  - data striping
    - bits-level
    - block-level
- RAID0(N部)
  - block-level striping
- RAID1(mirror)(N/2部)
- RAID2(ECC-Error-Correcting Code)
  - 沒有實際產品
- RAID3(ECC-Error-Correcting Code)(N+1部)
  - bit-level striping
  - parity check
- RAID4(ECC-Error-Correcting Code)(N+1部)
  - block-level striping
  - parity check
- RAID5(ECC-Error-Correcting Code)(N+1部)

- RAID6(ECC-Error-Correcting Code)(N+2部)
- RAID1+RAID0(更好)
- RAID0+RAID1

## File Directory Structure

- Tree-structured Directory
- Acyclic Graph Directory
- General Graph Directory(允許有cycle)

## File Access Control

- Owner, Group, Other
- RWX(Read, Write, eXecute)
- command: `chmod 755 file`

## Consistency Semantic

- UNIX semantic
  - 訂票系統
- Session semantic
  - 網站上的檔案提供下載讓user填寫
- Immutable-Shared-Files semantic
  - 總經理公告文件第3009號

## NAS(Network-Attached Storage)

- File-based operation
- 會占用網路頻寬

## SAN(Storage-Area Network)

- Block-based operation
- private network
- 不佔用一般網路頻寬