

CH1

CH2

CH3

CH4

CH5

CH6

CH7 Main Memory

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

- 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

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