

# Memory Management: Segmentation and Paging

Concepts, Address Translation, and  
Visual Explanation

# Why Memory Management?

- Efficient use of main memory
- Process isolation and protection
- Support for multitasking
- Simplified program execution

# What is Segmentation?

Segmentation is a memory management technique that divides a program into logical segments. Each segment represents a logical unit such as:

- Code
- Data
- Stack

Each segment can have different sizes and permissions.

# Segmentation Key Characteristics

- Logical division of memory
- Variable-sized segments
- Each segment has base and limit
- Supports protection and sharing

# Segmentation Address Translation

Logical Address = <Segment Number, Offset>

Address Translation Steps:

1. Segment number indexes the segment table
2. Base address is obtained from segment table
3. Offset is added to base address
4. Physical address is generated

If offset > segment limit → segmentation fault

# Segmentation Example

Segment Table:

Segment 0 (Code): Base = 1000, Limit = 400

Segment 1 (Data): Base = 2000, Limit = 300

Logical Address: <1, 120>

Physical Address =  $2000 + 120 = 2120$

# Segmentation Diagram

Logical Address

<Segment, Offset>

→ Segment Table

→ Physical Memory



# What is Paging?

Paging is a memory management technique that divides memory into fixed-size blocks.

- Logical memory is divided into pages
- Physical memory is divided into frames

Pages are mapped to frames using a page table.



# Paging Key Characteristics

- Fixed-size pages and frames
- Eliminates external fragmentation
- Uses page table for mapping
- Supports virtual memory

# Paging Address Translation

Logical Address = <Page Number, Offset>

Address Translation Steps:

1. Page number indexes page table
2. Frame number is retrieved
3. Frame number + offset → Physical address

If page not present → page fault

# Paging Example

Page Size = 1 KB

Logical Address = 2500

Page Number =  $2500 / 1024 = 2$

Offset =  $2500 \% 1024 = 452$

If Page Table[2] = Frame 5

Physical Address =  $5 * 1024 + 452 = 5572$

# Paging Diagram

Logical Address

<Page, Offset>

→ Page Table

→ Physical Memory Frame



# Segmentation vs Paging

- Segmentation is logical, Paging is physical
- Segmentation uses variable size, Paging uses fixed size
- Paging avoids external fragmentation
- Segmentation supports logical protection

# Summary

Segmentation and paging are fundamental memory management techniques.

Segmentation focuses on logical program structure, while paging focuses on efficient physical memory use.

Modern systems often combine both techniques for optimal performance and protection.