**Memory Management – Part 2**

Readings: Chapter 7

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**Paging**

- Partition memory into equal fixed-size chunks that are relatively small
- Process is also divided into small fixed-size chunks of the same size

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**Addresses**

- **Logical**
  - Reference to a memory location independent of the current assignment of data to memory

- **Relative**
  - A particular example of logical address, in which the address is expressed as a location relative to some known point

- **Physical or Absolute**
  - Actual location in main memory

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**Figure 7.9 Assignment of Process Pages to Free Frames**

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Page Table

- Maintained by operating system for each process
- Contains the frame location for each page in the process
- Processor must know how to access for the current process
- Used by processor to produce a physical address

Figure 7.10 Data Structures for the Example of Figure 7.9 at Time Epoch (f)

(a) Partitioning

(b) Paging

(c) Segmentation

Relative address = 1502
Logical address = Page# = 1, Offset = 478
Logical address = Segment# = 1, Offset = 752

Figure 7.11 Logical Addresses

(a) Paging

6-bit page # 10-bit offset

16-bit physical address

Figure 7.12 Examples of Logical-to-Physical Address Translation
Segmentation

- A program can be subdivided into segments
  - May vary in length
  - There is a maximum length

- Addressing consists of two parts:
  - Segment number
  - An offset

- Similar to dynamic partitioning

- Eliminates internal fragmentation

Address Translation

- Another consequence of unequal size segments is that there is no simple relationship between logical addresses and physical addresses
- The following steps are needed for address translation:
  - Extract the segment number as the leftmost \( n \) bits of the logical address
  - Use the segment number as an index into the process segment table to find the starting physical address of the segment
  - Compare the offset, expressed in the rightmost \( m \) bits, to the length of the segment. If the offset is greater than or equal to the length, the address is invalid
  - The desired physical address is the sum of the starting physical address of the segment plus the offset

![Figure 7.12 Examples of Logical-to-Physical Address Translation](image)

- Usually visible
  - Provided as a convenience for organizing programs and data

- Typically the programmer will assign programs and data to different segments

- For purposes of modular programming the program or data may be further broken down into multiple segments
  - The principal inconvenience of this service is that the programmer must be aware of the maximum segment size limitation

![Figure 7.12 Examples of Logical-to-Physical Address Translation](image)