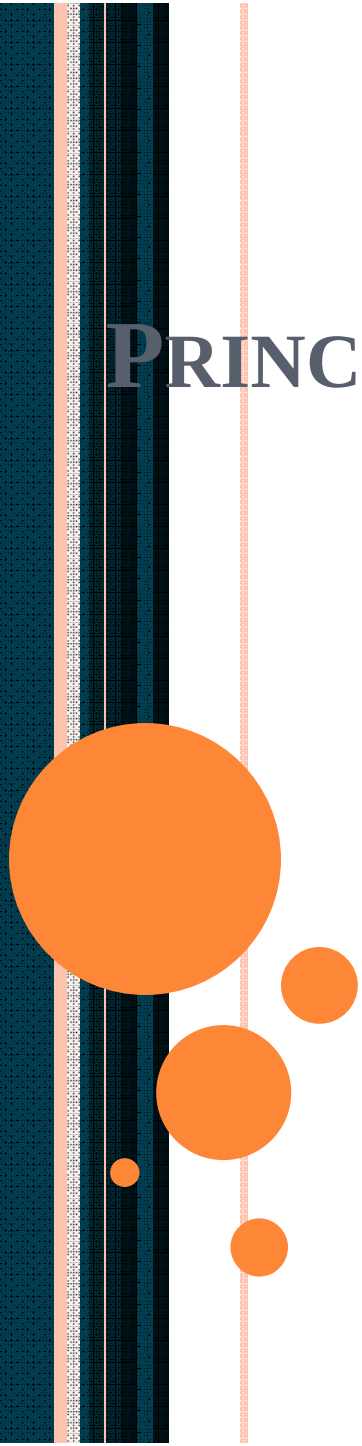
PRINCIPLES OF OPERATING SYSTEMS

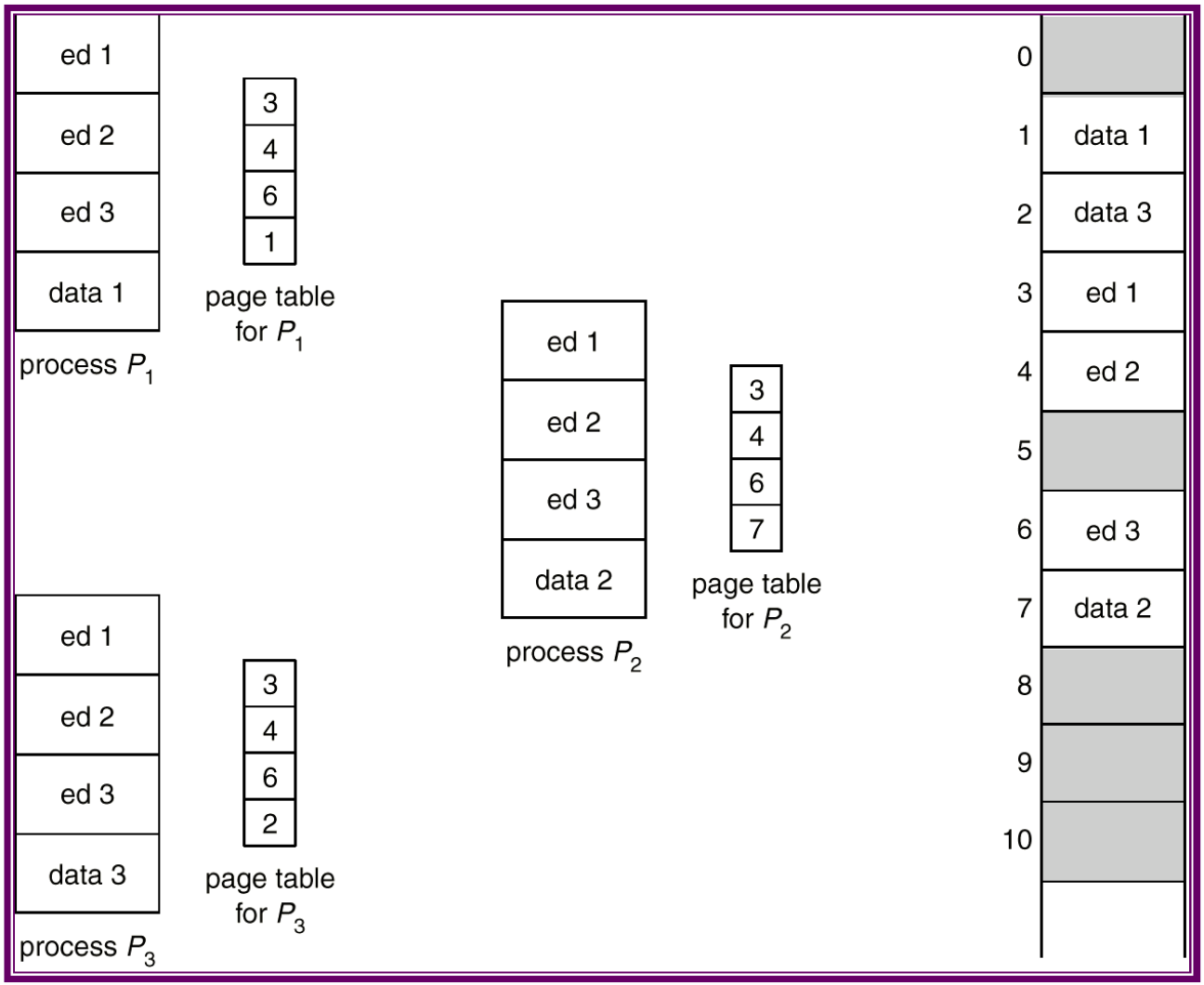


LECTURE 15 : SHARED PAGES AND SEGMENTATION

Shared Pages

- Shared code
  - One copy of read-only (reentrant) code shared among processes (i.e., text editors, compilers, window systems).
  - Shared code must appear in same location in the logical address space of all processes.
- Private code and data
  - Each process keeps a separate copy of the code and data.
  - The pages for the private code and data can appear anywhere in the logical address space.

Shared Pages Example

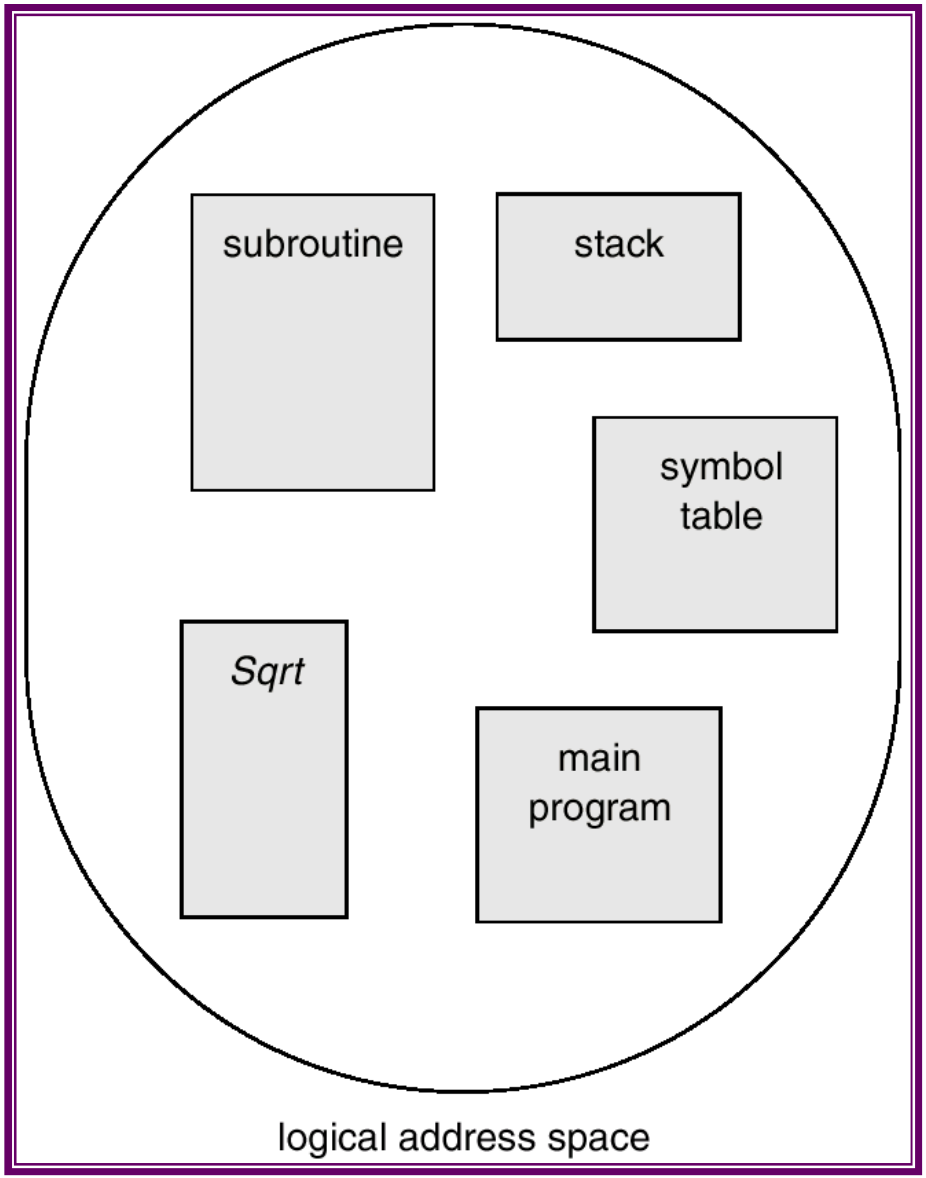


Segmentation

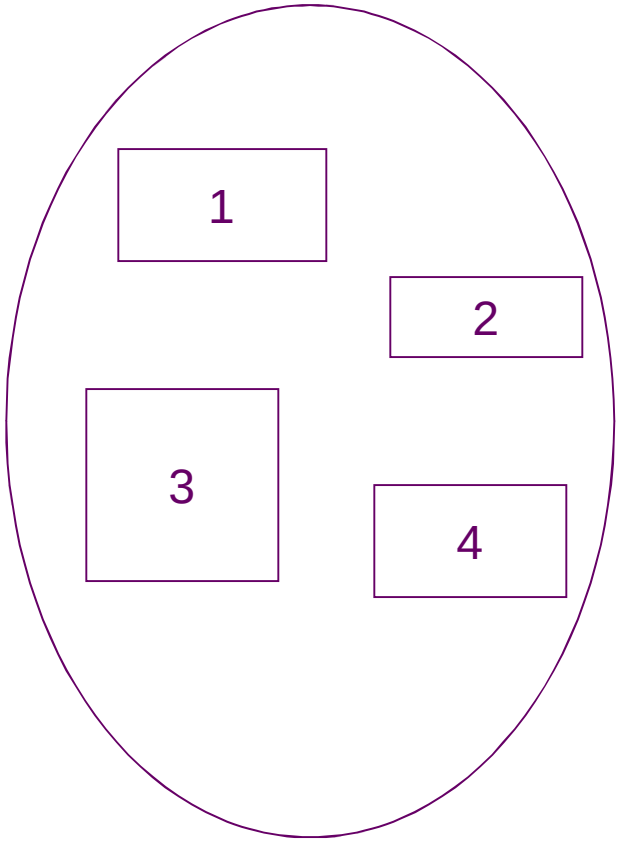
- Memory-management scheme that supports user view of memory.
- A program is a collection of segments. A segment is a logical unit such as:

  main program,
  procedure,
  function,
  method,
  object,
  local variables, global variables,
  common block,
  stack,
  symbol table, arrays

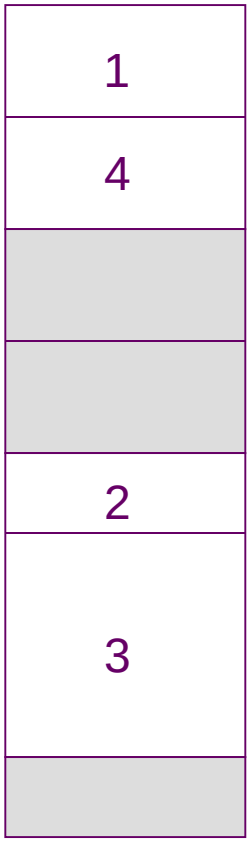
User's View of a Program



Logical View of Segmentation



user space



physical memory space

Segmentation Architecture

- Logical address consists of a two tuple:

  <segment-number, offset>,

- *Segment table* – maps two-dimensional physical addresses; each table entry has:
  - base – contains the starting physical address where the segments reside in memory.
  - *limit* – specifies the length of the segment.
- *Segment-table base register (STBR)* points to the segment table's location in memory.
- *Segment-table length register (STLR)* indicates number of segments used by a program;

  segment number *s* is legal if *s* < STLR.

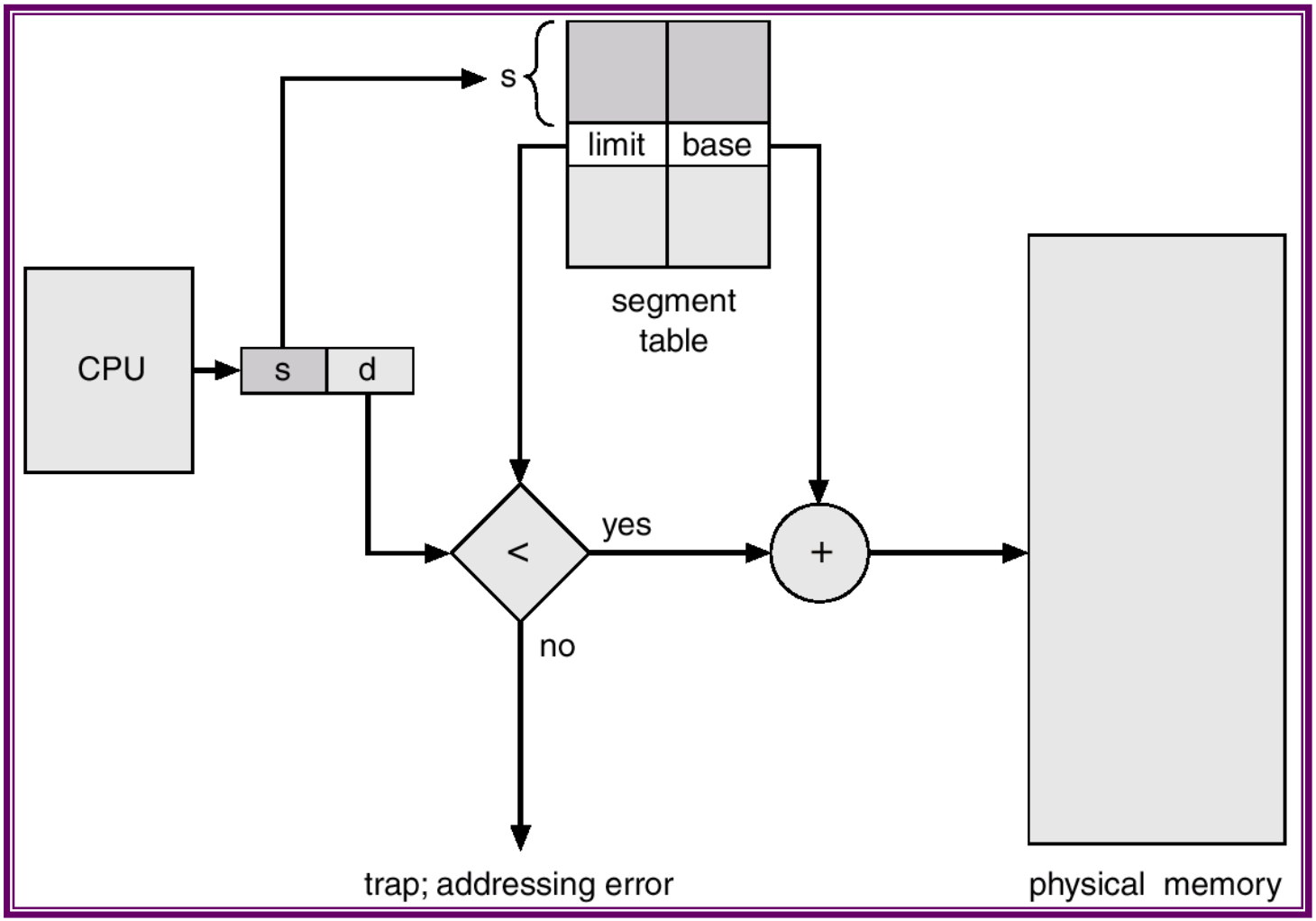
Segmentation Architecture (Cont.)

- Relocation.
  - dynamic
  - by segment table
- Sharing.
  - shared segments
  - same segment number
- Allocation.
  - first fit/best fit
  - external fragmentation

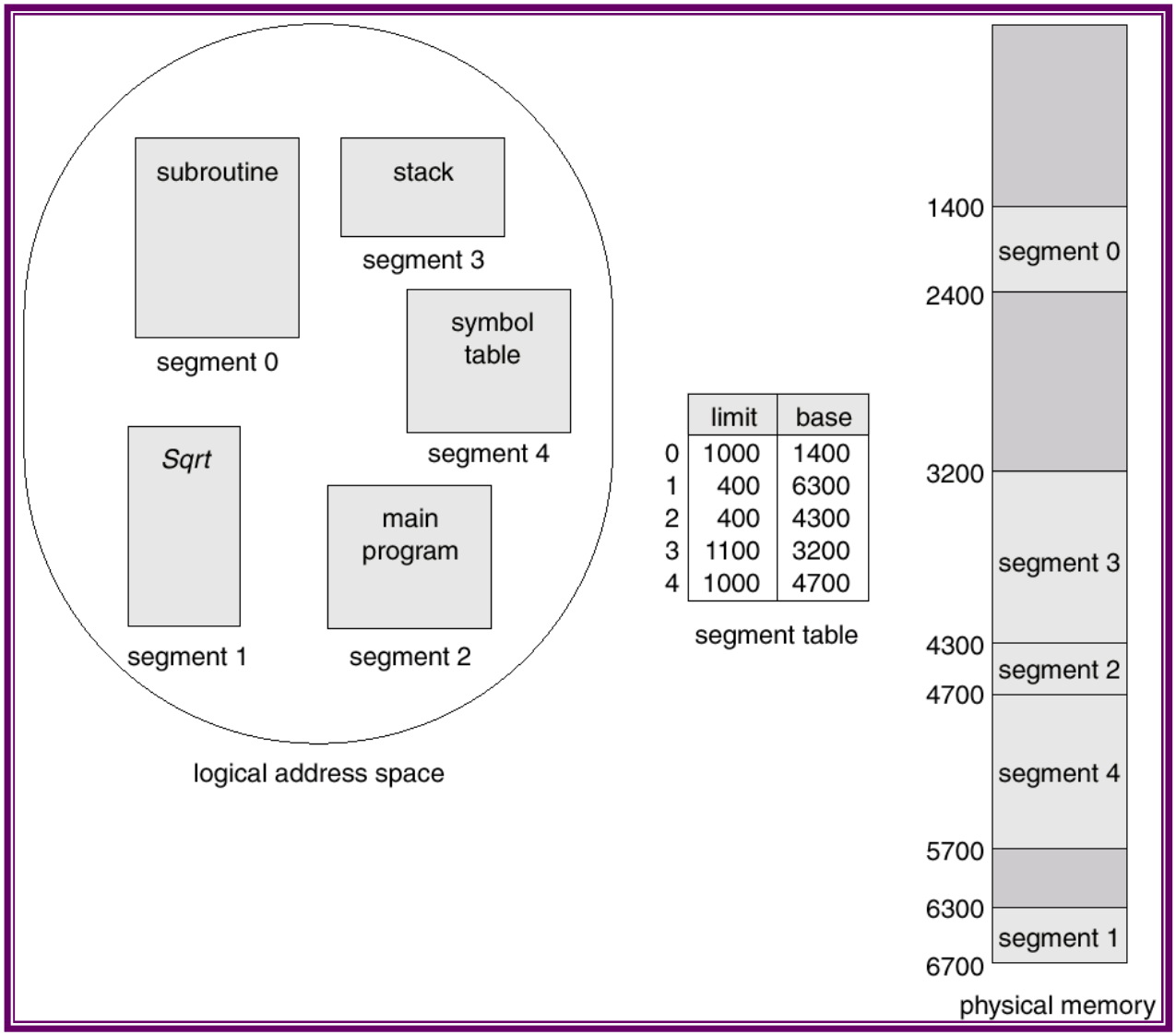
Segmentation Architecture (Cont.)

- Protection. With each entry in segment table associate:
  - validation bit = 0 $\Rightarrow$ illegal segment
  - read/write/execute privileges
- Protection bits associated with segments; code sharing occurs at segment level.
- Since segments vary in length, memory allocation is a dynamic storage-allocation problem.
- A segmentation example is shown in the following diagram

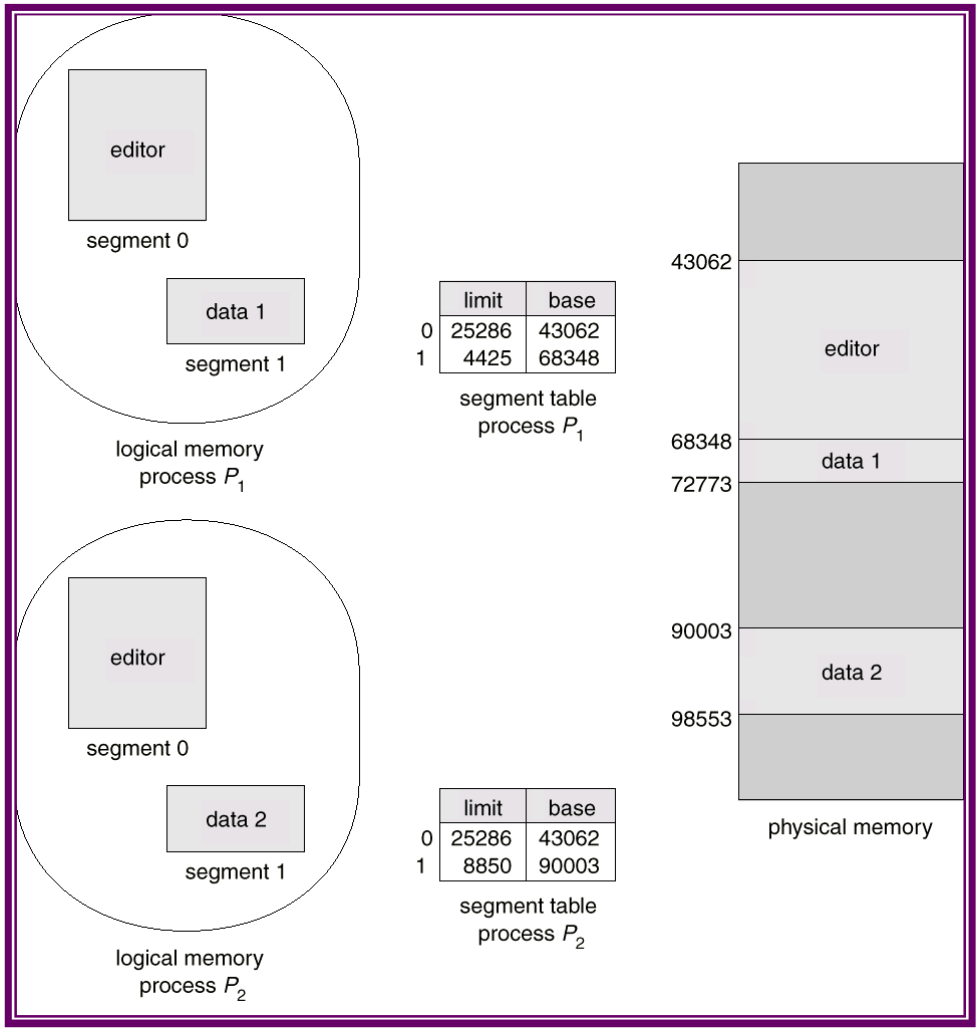
Segmentation Hardware



Example of Segmentation



Sharing of Segments

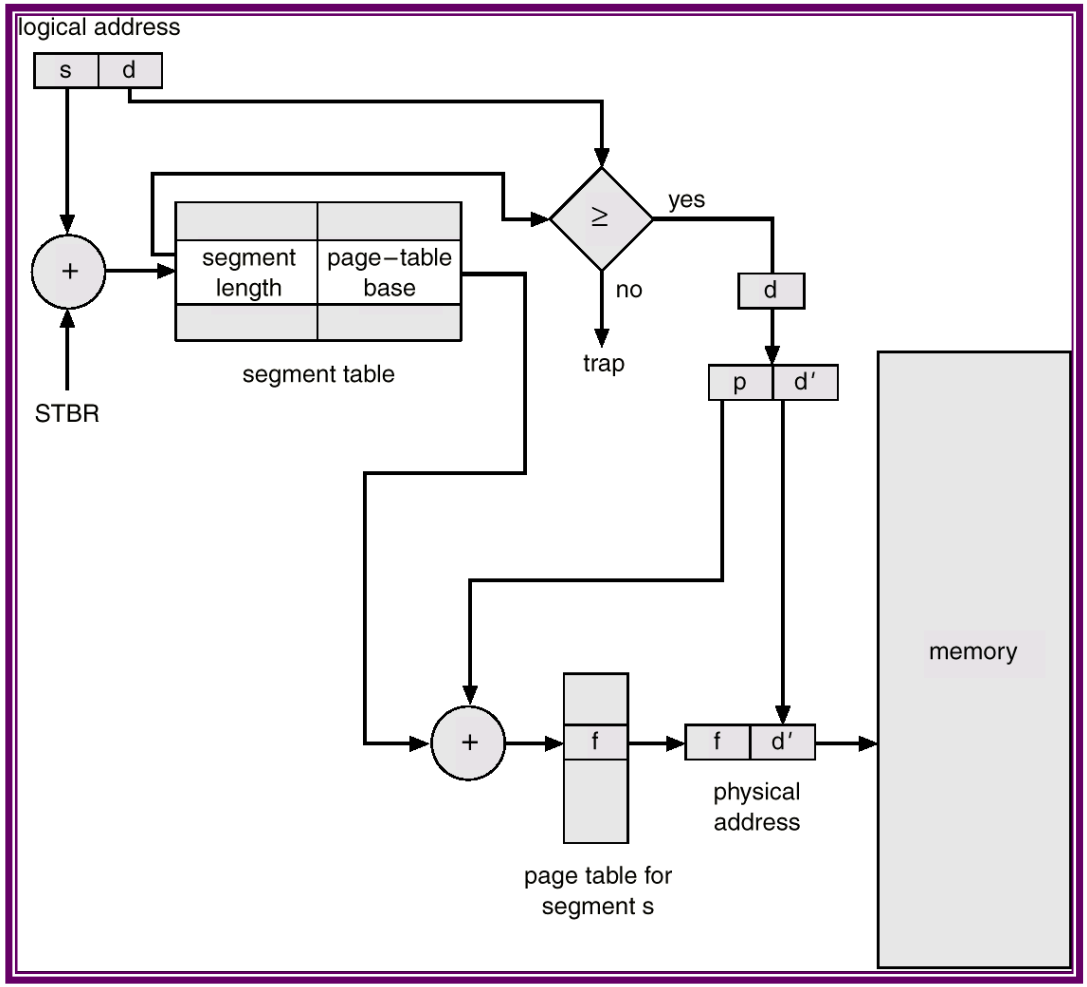


Segmentation with Paging – MULTICS

- The MULTICS system solved problems of external fragmentation and lengthy search times by paging the segments.

- Solution differs from pure segmentation in that the segment-table entry contains not the base address of the segment, but rather the base address of a *page table* for this segment.

MULTICS Address Translation Scheme



Segmentation with Paging – Intel 386

- As shown in the following diagram, the Intel 386 uses segmentation with paging for memory management with a two-level paging scheme.

Intel 30386 Address Translation