Operating System Concepts

(Memory management: Segmentation and Paging)
Slides Set #16

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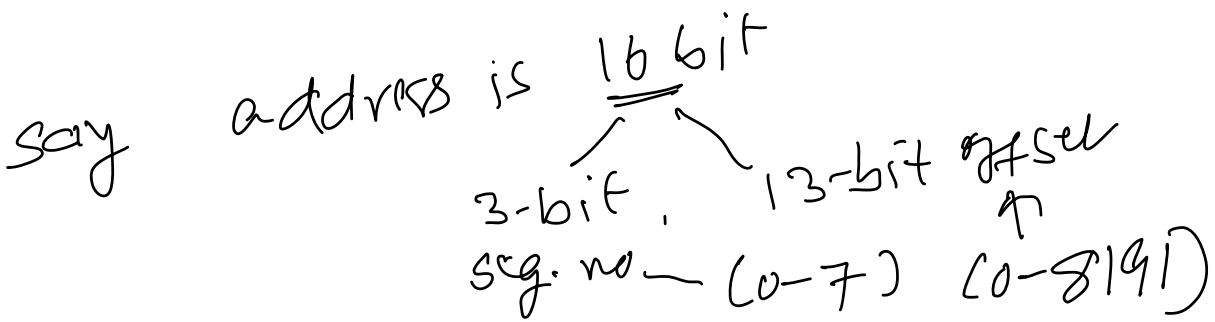
Segmentation....

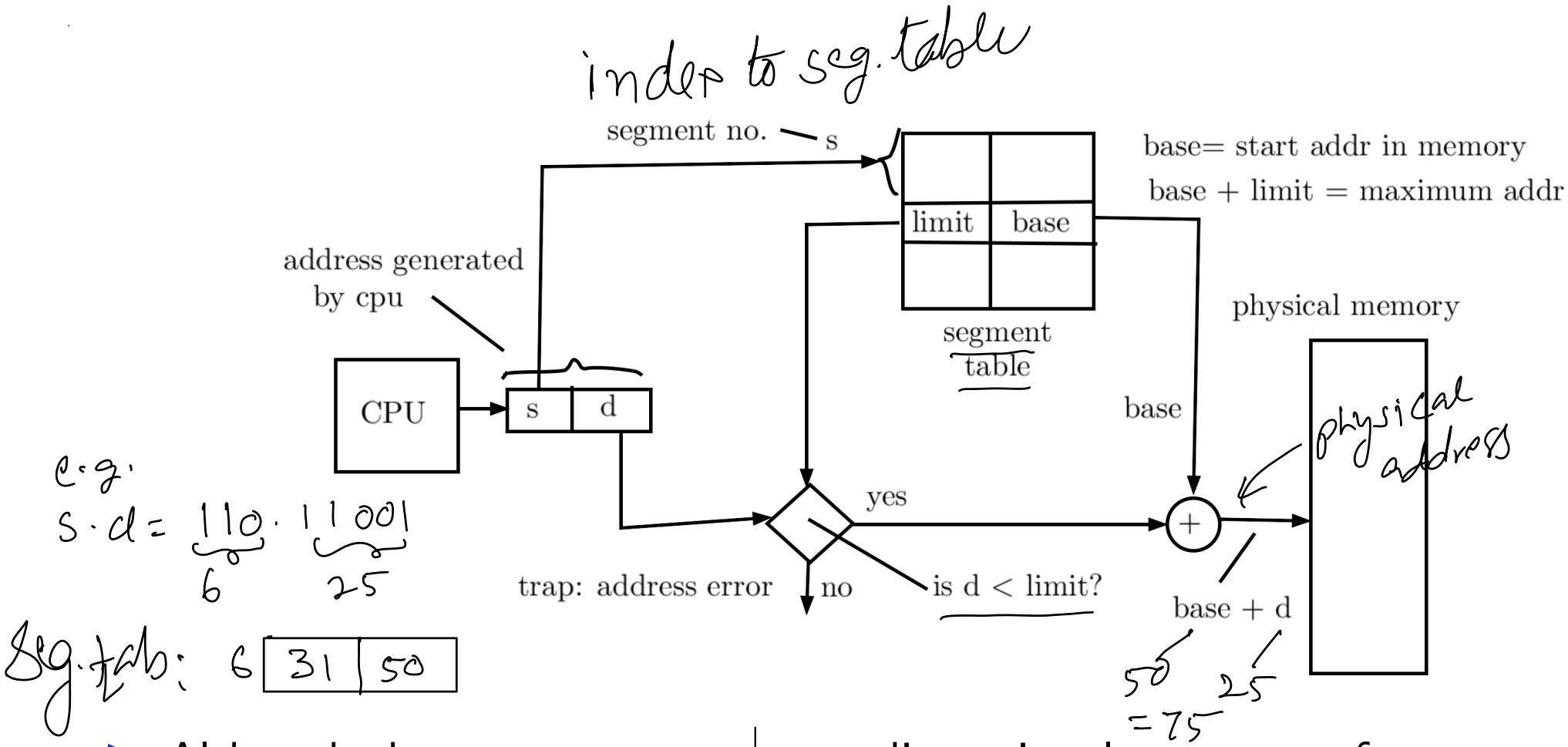


- Each segment has a name and a length. At run time, the CPU generated addresses specify both the segment name and the offset within the segment.

  $<segm\_no., offset>$

  For example, a C compiler will create separate segments for the following:
  - The code (i.e., main() and functions),
  - Global variables,
  - The heap – from which memory is allocated,
  - The stacks used by each thread,
  - The standard C library.

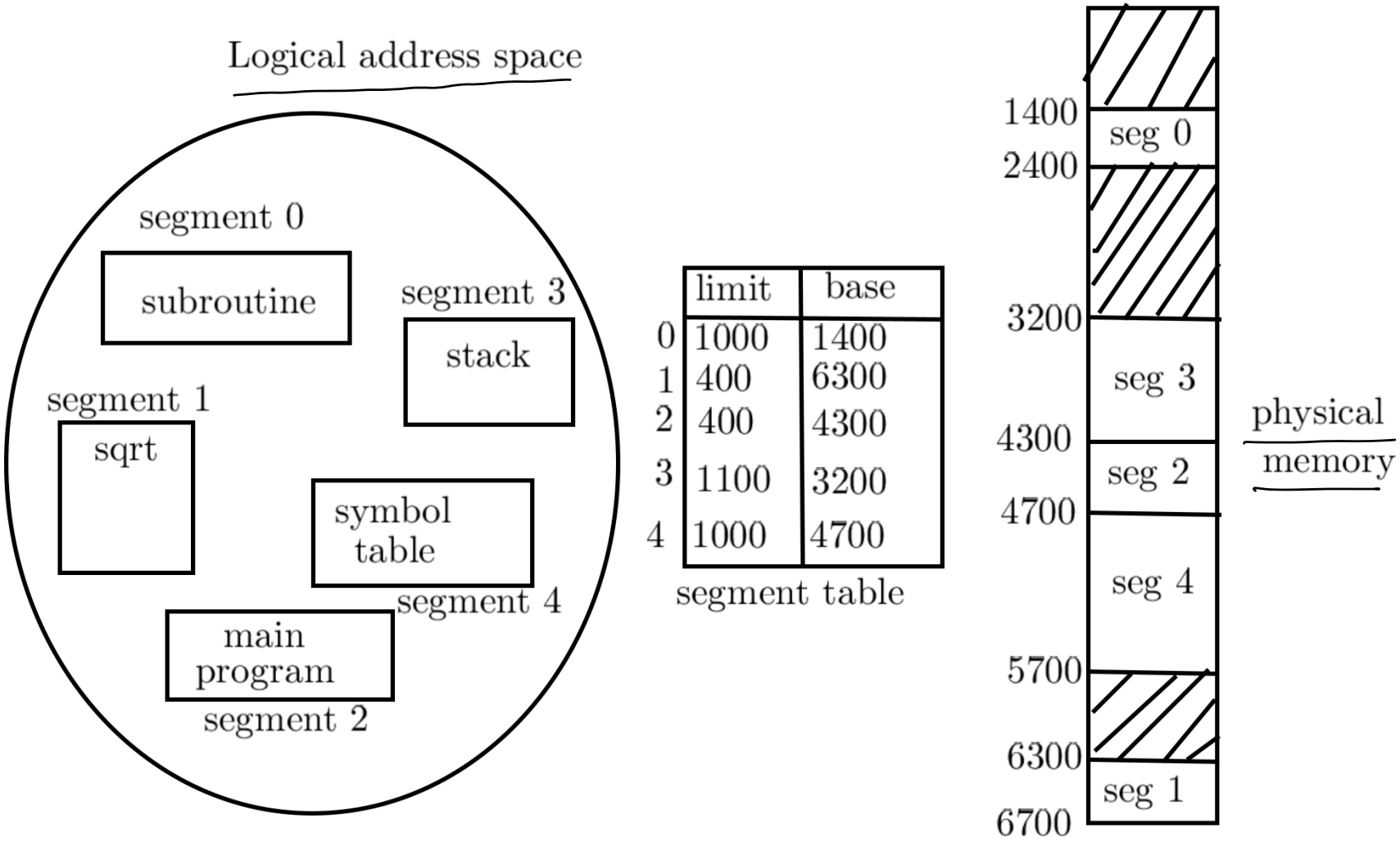
Segmentation Hardware



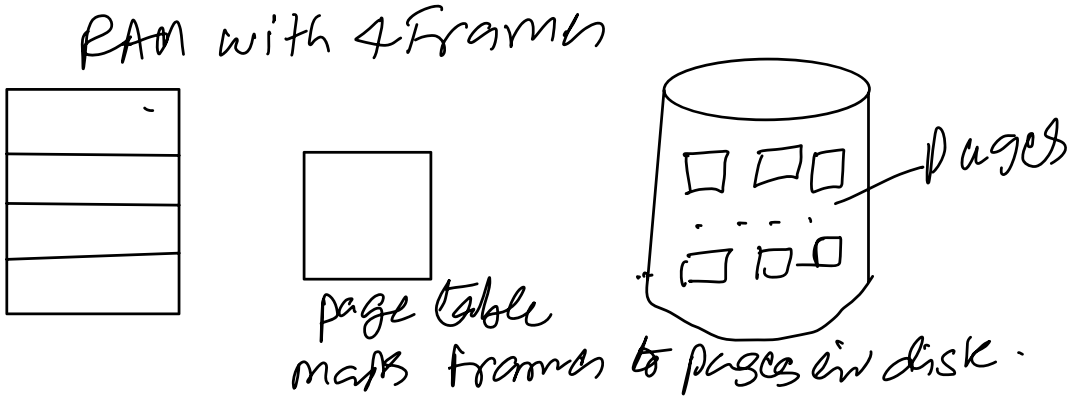
- Although the programmer can refer to objects in the program by a 2-dimensional address, the actual physical memory is still a 1 dimensional sequence of bytes.
- The use of a segment table is illustrated in Figure

Segmentation Hardware...

Consider the situation of five segments numbered from 0 through 4.



Paging



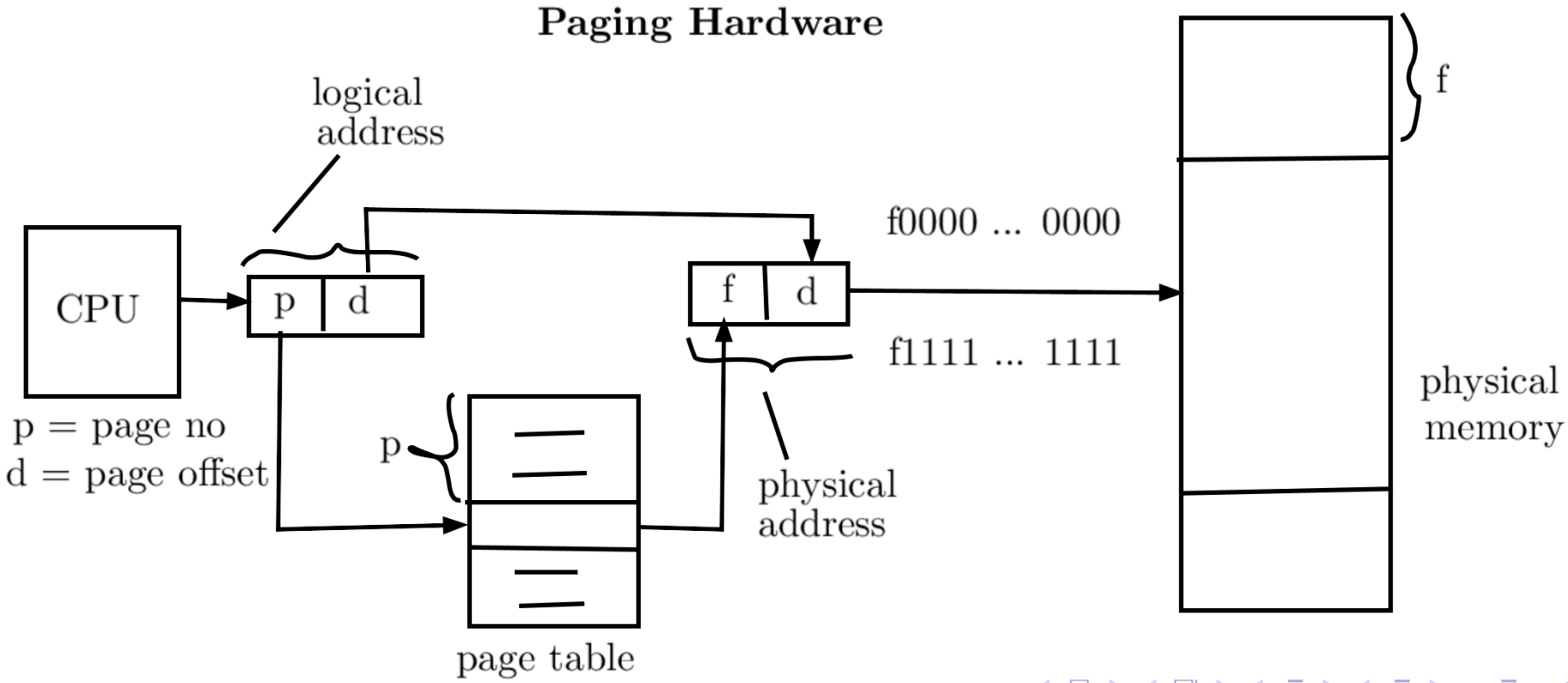
- Segmentation permits the physical address space of a process to be **non-contiguous.**
- Paging also offers this advantage. However, paging avoids external fragmentation and the need for compaction,
- The backing store has the same fragmentation problems discussed in connection with main memory,
- Because of its advantages over earlier methods, paging in its various forms is used in most operating systems,

say: CPU address = 32 bit
pages = 2^{12} = 4096 (0 – 4095)
one page = 2^{20} = 1 MB
Say, RAM = 256 MB ∴ 256 Frames

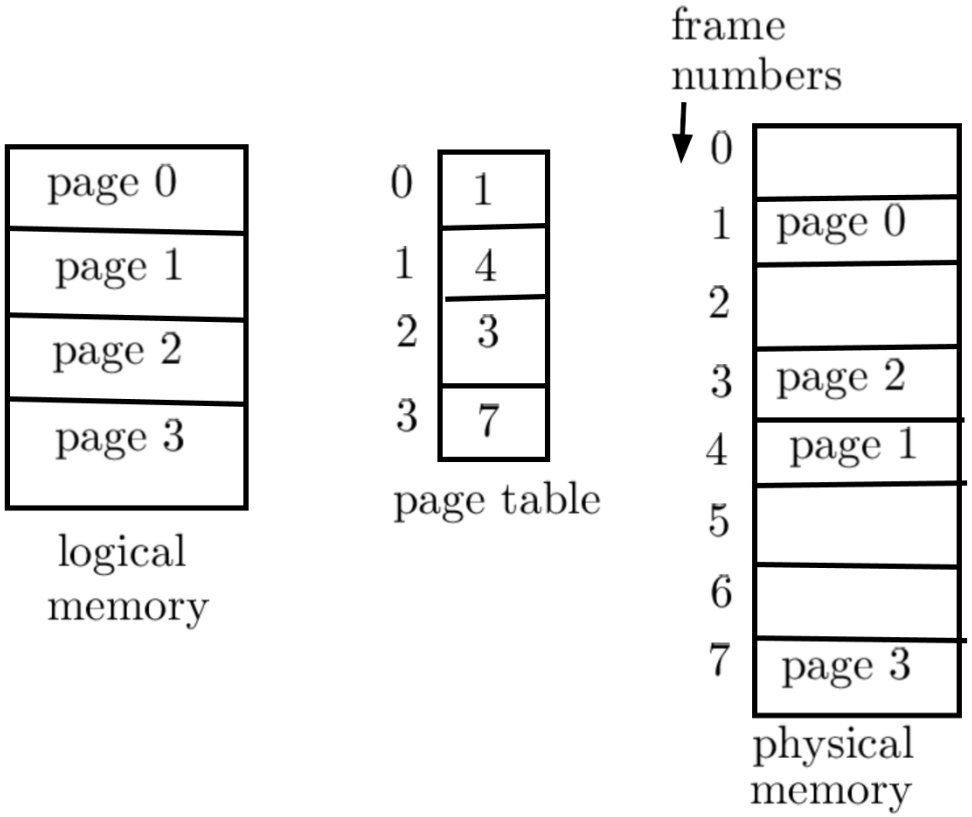
So max. prog. size = 2^{12} pages and max. 256 pages can be in RAM

Paging: Basic method

- **Basic Method**: The basic method for implementing paging involves breaking physical memory into fixed-sized blocks called **frames**
- For example, the logical address space is now totally separate from the physical address space, so a process can have a logical 64-bit address space



Paging model of logical and physical memory



The page size (like the frame size) is defined by the hardware. The size of a page is a power of 2, varying between 512 bytes and 1 GB per page. Thus, the logical address (2^m locations, and length=m bits) is as follows:

p+d= physical addr
⇒ m-n+n = m bit