W4118 Operating Systems

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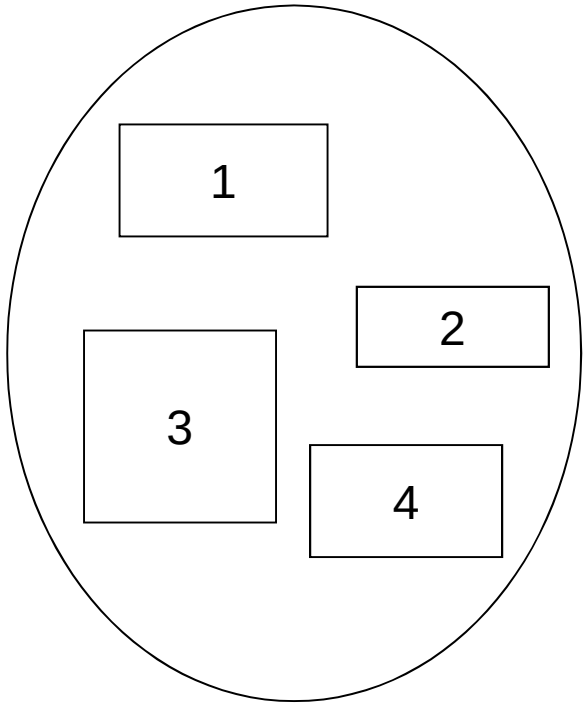
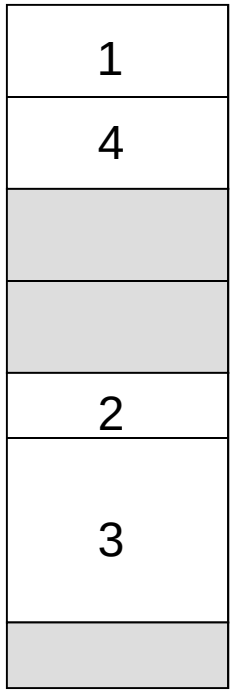
Segmentation

- Divide virtual address space into logical segments
- Each segment can be part of physical memory
- Separate base and limit for each segment
- Separate protection bits as well

Logical view of segmentation



user space

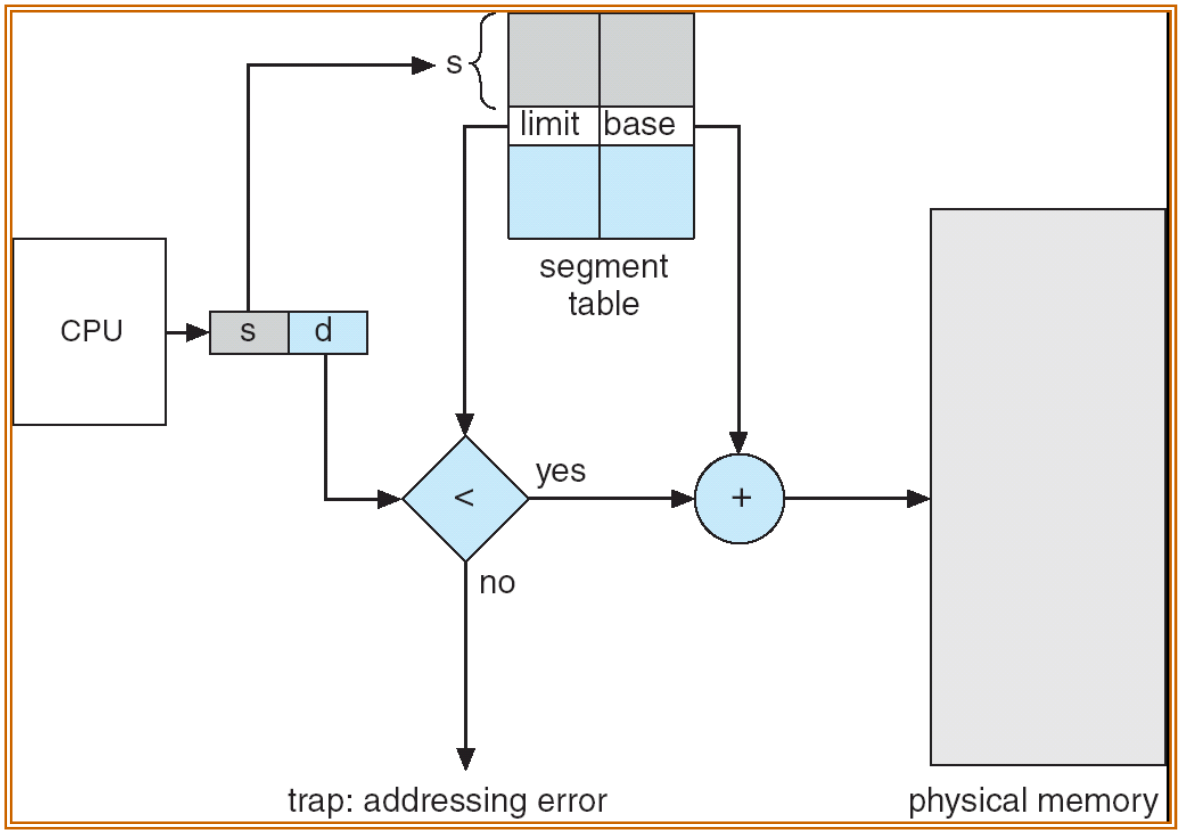


physical memory space

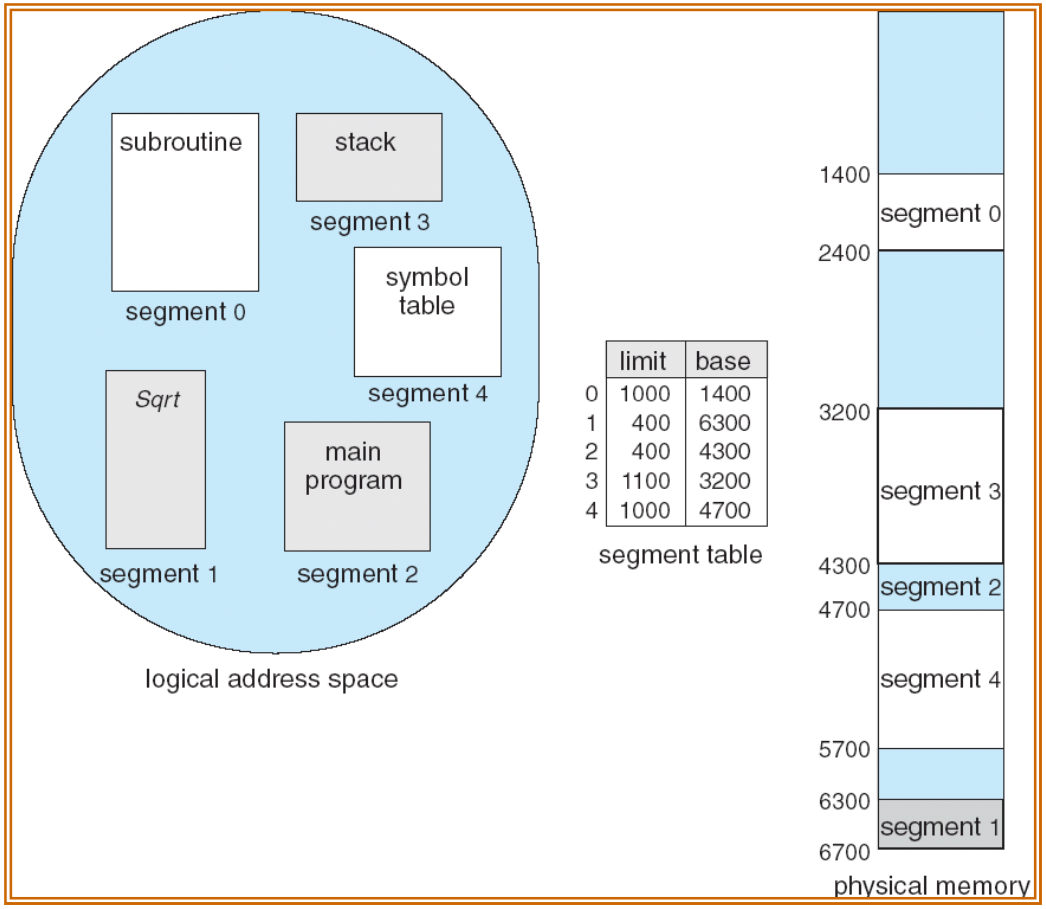
Segmentation translation

- Virtual address: <segment-number, offset>
- Segment table maps segment number to segment information
  - Base: starting address of the segment in physical memory
  - Limit: length of the segment
  - Addition metadata includes protection bits

Segmentation hardware



Example of segmentation



Pros and cons of segmentation

- Advantages
  - Segment sharing
  - Easier to relocate segment than entire program
  - Avoids allocating unused memory
  - Flexible protection
  - Efficient translation
    - Segment table small ➔ fit in MMU
- Disadvantages
  - Segments have variable lengths ➔ dynamic allocation (best fit? first fit?)
  - External fragmentation: wasted memory