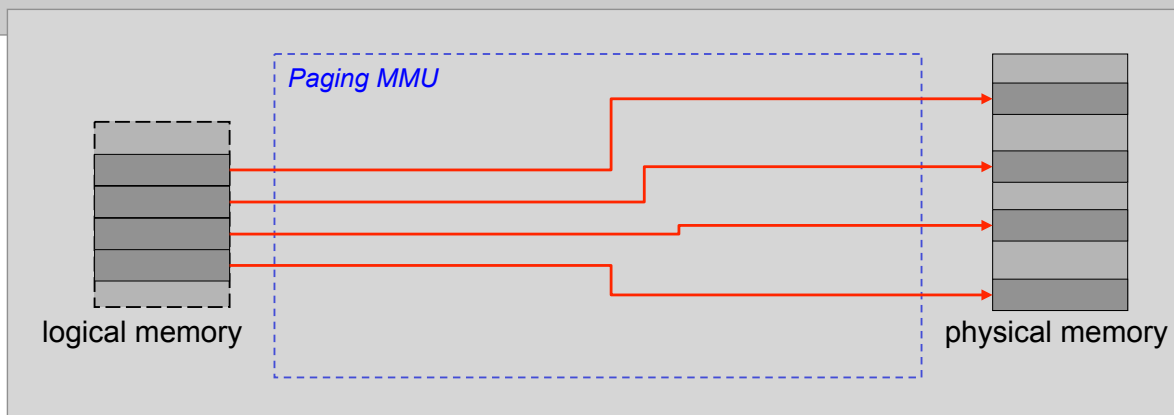# Segmentation

- Observation: Programmers don't think in pages!

- Segmentation

- Pro-and-Cons of segmentation; external fragmentation

- Solution: Segmented Paging

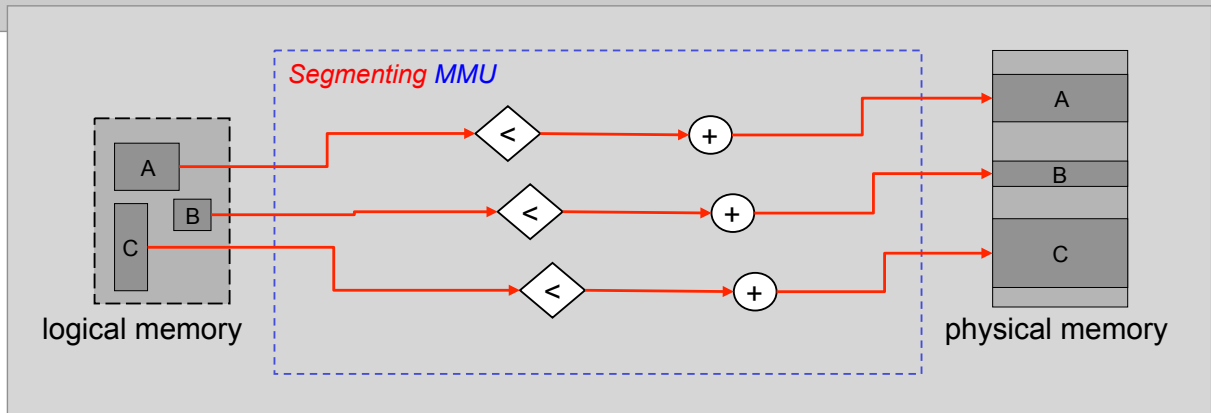# Segmentation: Problem with Paging

Observation:

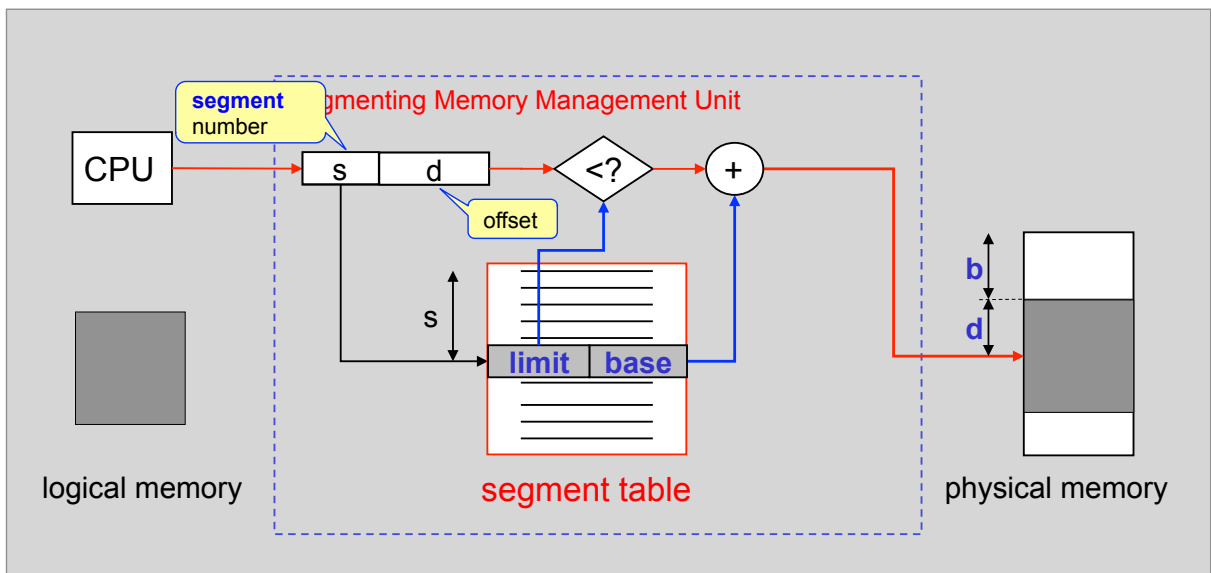Users think of memory in terms of segments (data, code, stack, objects, ...)

Paging MMU

logical memory

physical memory

Segmentation: Problem with Paging

Observation:

Users think of memory in terms of segments (data, code, stack, objects, ...)

Segmenting MMU
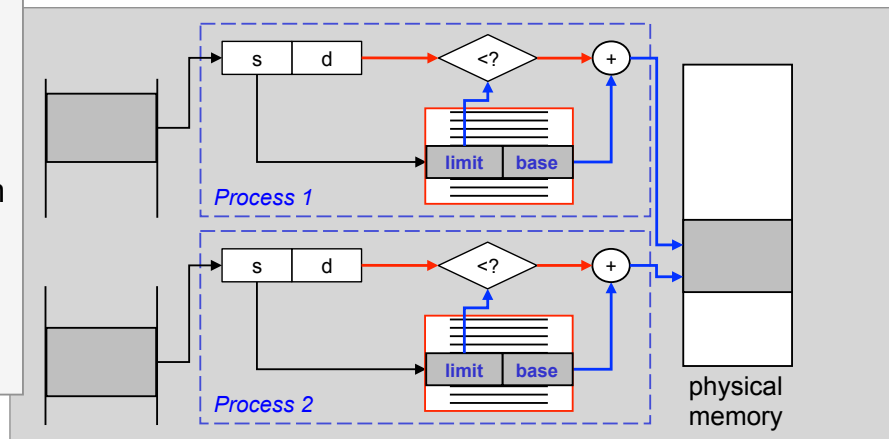
logical memory

physical memory

Segmentation in Hardware

Segmenting Memory Management Unit

CPU

segment number

s   d

offset

<?

+

s

limit   base

segment table

b

d

logical memory

physical memory

Segmentation: Pros and Cons

Pros:
- Data in a segment typically semantically related
- Protection can be associated with segments
  - read/write protection
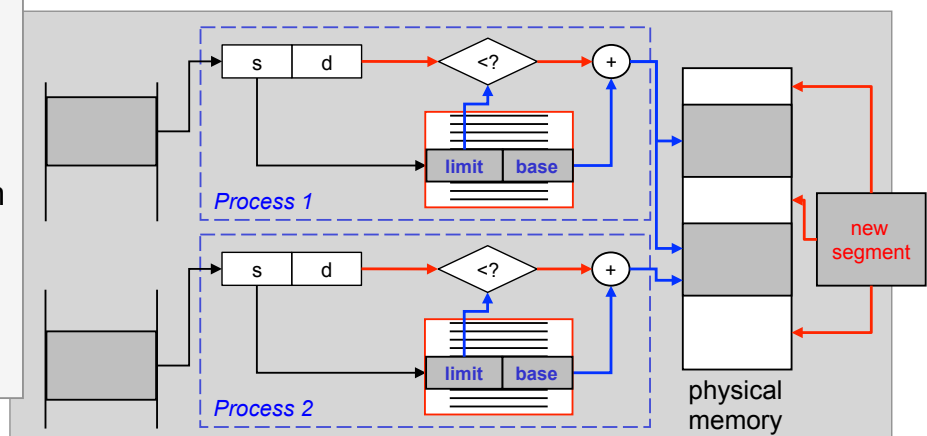 - range checks for arrays
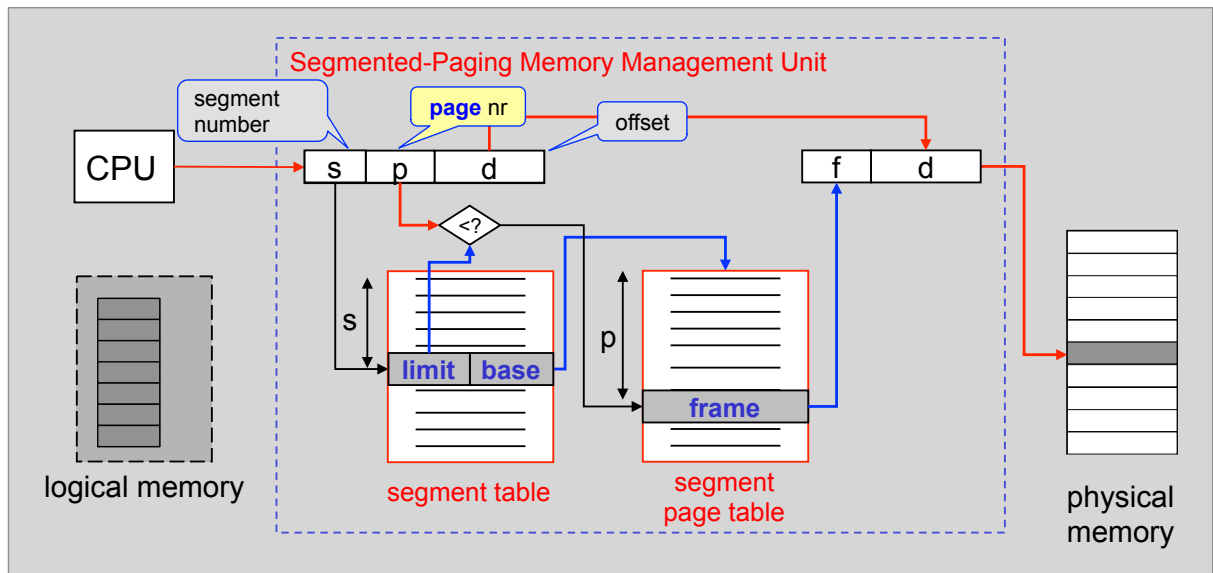- Data and code sharing

Segmentation: Pros and Cons

Pros:
- Data in a segment typically semantically related
- Protection can be associated with segments
  - read/write protection
  - range checks for arrays
- Data and code sharing

Cons:
- External Fragmentation!

Segmented Paging

Segmented-Paging Memory Management Unit

- logical memory
- segment table
- segment page table
- physical memory

CPU → s | p | d → <? ... f | d

segment number — page nr — offset

s — limit | base

p — frame

Segmentation: Summary

- Programmers like to think in terms of memory segments

- Segmentation allows for efficient allocation and management of semantically-related data segments

- Segmentation re-introduces external Fragmentation

- Segmented Paging eliminates fragmentation