

Memory Management using Paging

Introduction

- Today's lab will be based on a simulation of one of the memory management techniques known as paging
- Objective of the lab:
 - Simulation of an address translation scheme for implementing paging

External Fragmentation

- Deallocation causes chunks of memory to be free
- The free chunks of memory might be non-contiguous
- As a result, external fragmentation occurs
- It becomes difficult to allocate contiguous blocks of memory to new processes

Paging

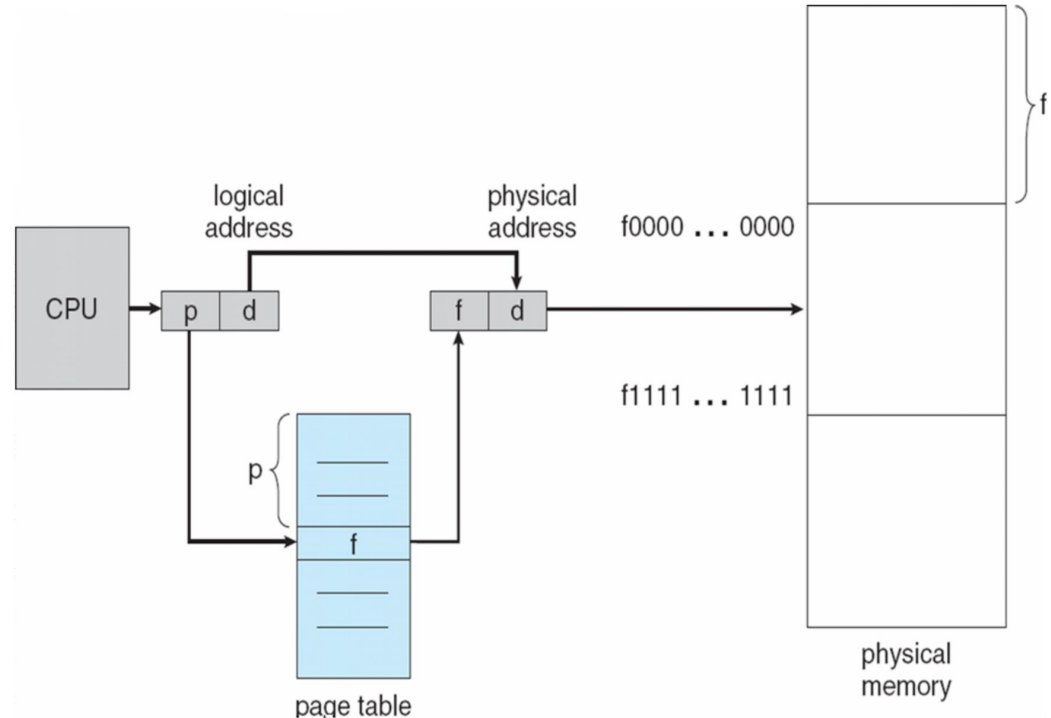
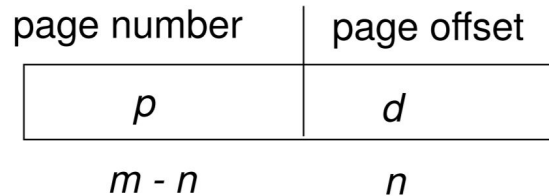
- Mechanism to support non-contiguous allocation of memory
- Logical address space (memory addresses generated by the CPU) distinct from the physical addresses seen by the memory unit
- Address space (logical and physical) divided into fixed-size chunks

Frames and pages

- Chunks in the logical address space are called pages
- Chunks in the physical memory are called frames
- A per-process page table maps the pages of the logical address space to the frames in physical memory

Address Translation

- Page Number
- Frame Number
- Offset
- For logical address space 2^m and page size 2^n



Bitwise Operations

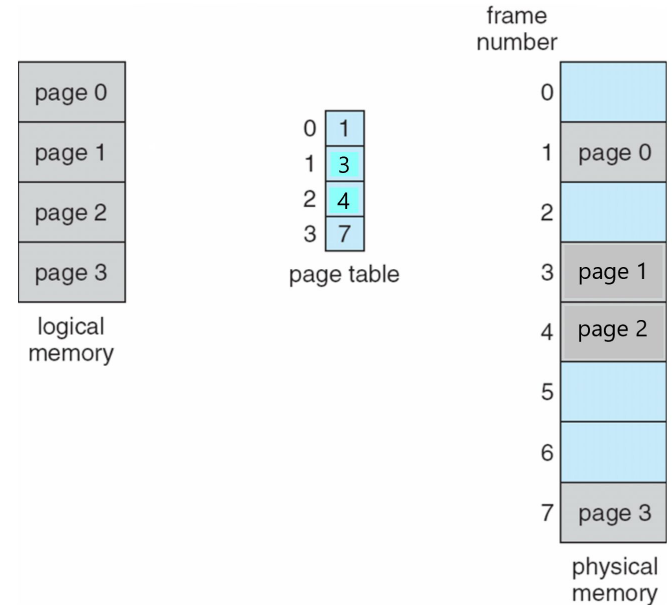
- NOT(~) : not(1010) = 0101
- AND(&) : 1010 and 1101 = 1000
- OR(|) : 1001 and 1101 = 1101
- LSH(<<) : 1011 << 1 = 0110
- RSH(>>) : 1011 >> 1 = 0101

Bit Masking

- You can use bit masking to identify the page number and the offset from a specific logical address
- For example:
 - Logical address
 - Hex: 0xd6334873
 - Binary: 1101 0110 0011 0011 0100 1000 0111 0011
 - Logical Address Space: 2^{32}
 - Page size: 2^{30}
 - 2 bits for page numbers (Most Significant Bit)
 - 30 bits for page offsets (Least Significant Bit)
 - Find appropriate masks to derive the bits for page number and page offset from the logical address

Mapping from Page to Frame

- It will be safe to assume that we have sufficient physical address space (frames) to accommodate the logical address space (pages)
- The page table should contain the mapping from the page number to a specific free frame (in order)
- Page offset and frame offset will be the same
- Bitwise operation on frame number and offset to get the physical location



Conclusion

- Paging is quite useful as a mechanism to allow non-contiguous allocation
- This lab should give you an overview of how logical address can be translated to physical address in the paging memory management