

Virtual Memory

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Virtual Memory:

1. 作用:

Use main memory as a “cache” for secondary (disk) storage
Programs share main memory

2. 概念: page page fault

由于page Fault Penalty太大, 希望尽可能少miss, 因此采取**Fully associated**

■ Try to minimize page fault rate

- ◆ Fully associative placement
- ◆ Smart replacement algorithms

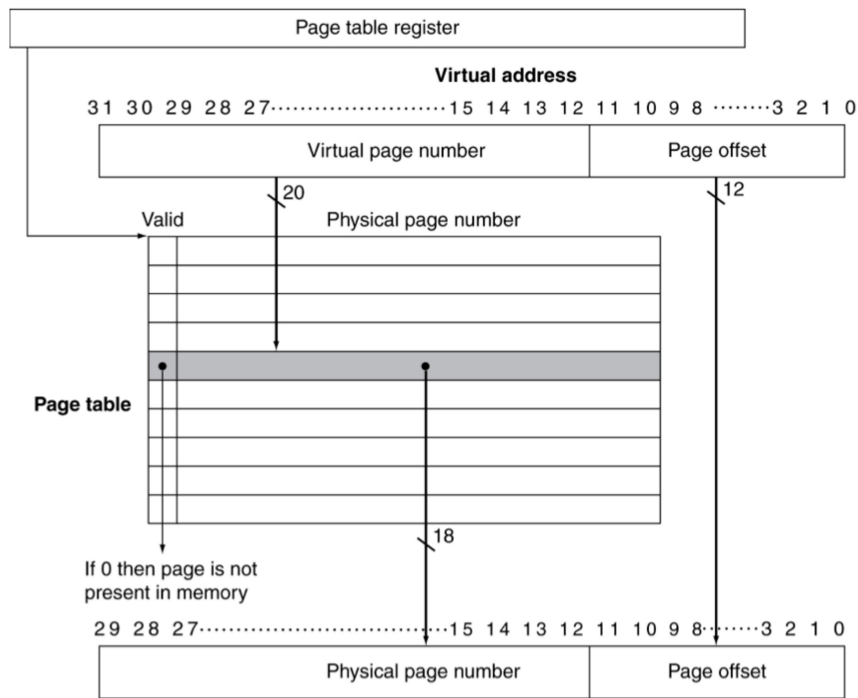
1. virtual address如何与实际地址对应: Page Table

Page Tables

- Where is the placement information? Page Table
 - ◆ Array of page table entries (PTE), indexed by virtual page number
 - ◆ Page table register in CPU points to page table in physical memory
- Each program has its page table. Page table is in memory
- If page is present in memory
 - ◆ PTE stores the physical page number
 - ◆ Plus other status bits (referenced, dirty, ...)
- If page is not present
 - ◆ PTE can refer to location in swap space on disk

Page table储存Vpn到ppn的映射

Page table储存在memory内, 是一块**memory**



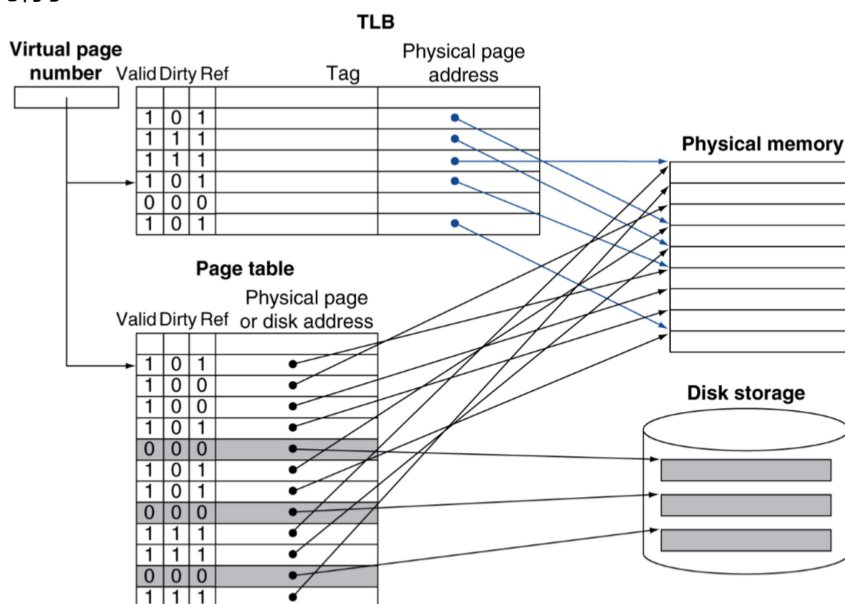
Valid 为0 代表此virtual address对应内容在disk中
 还有dirty reference等其他status bit
 Page table register
 不同程序有不同的page table

2. Replacement and write

Use bit/reference bit——replacement——LRU appromiate
 Dirty bit——write back

3. TLB

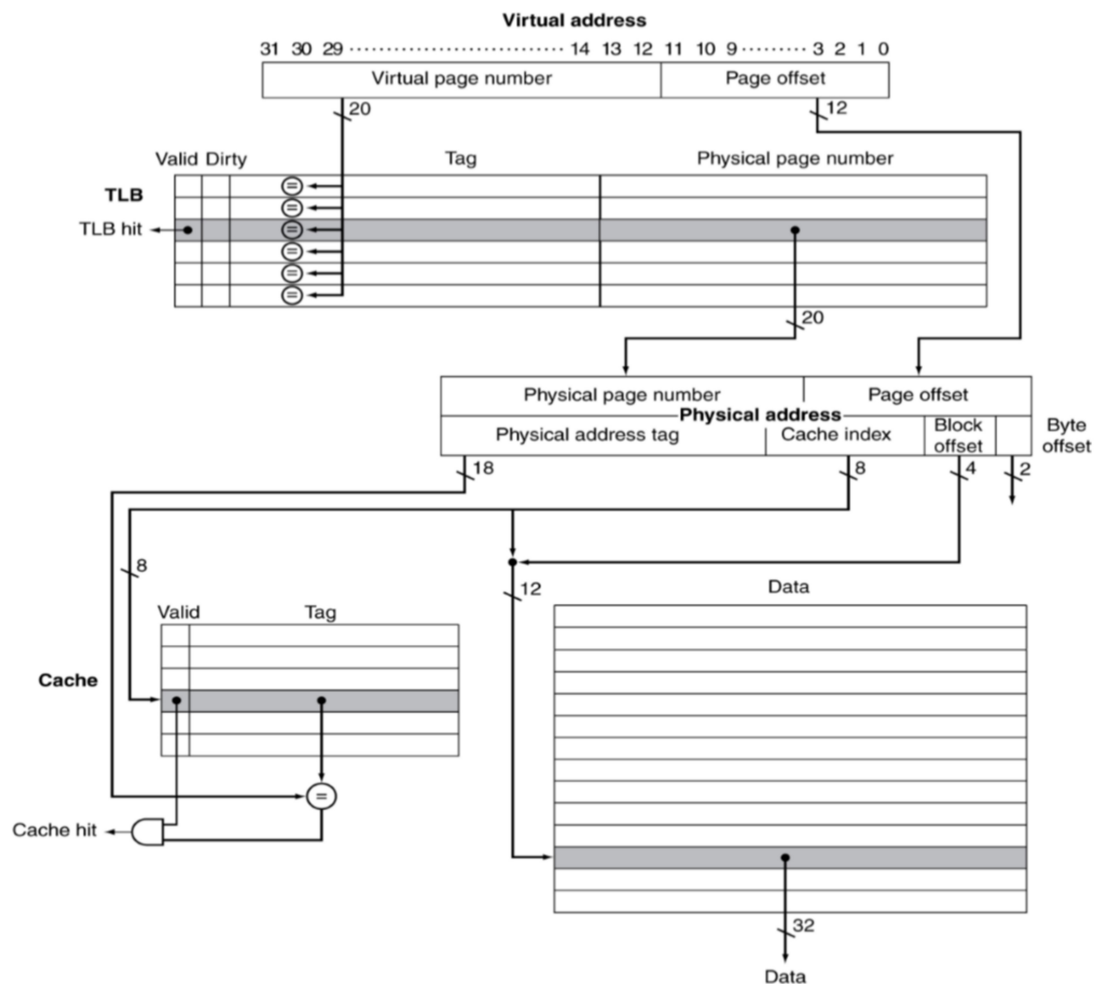
通过virtual address去Access memory需要两次memory access
 因此有了TLB



TLB miss:

- If page is in memory
 - ◆ Load the PTE from memory and retry
 - ◆ Could be handled in hardware
 - Can get complex for more complicated page table structures
 - ◆ Or in software
 - Raise a special exception, with optimized handler
- If page is not in memory (page fault)
 - ◆ OS handles fetching the page and updating the page table
 - ◆ Then restart the faulting instruction

TLB interaction with cache :



4. Memory Protect

不同程序可以share相同的虚拟内存，但需要os协助保证不发生错误访问
os特权模式