操作系统 Operating Systems

L24 内存换入-请求调页

Swap in

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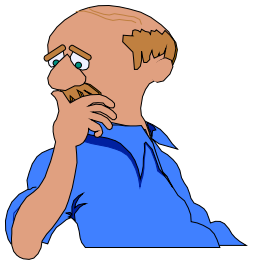
段、页同时存在



cs:ip

逻辑地址

4G

用户栈段

用户代码段

用户数据段

操作系统段

0

虚拟内存

0x00345008

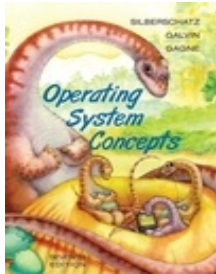
虚拟地址

物理地址

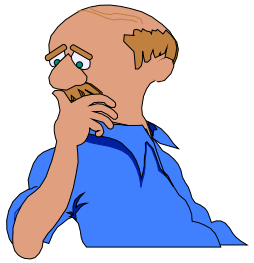
0x7008

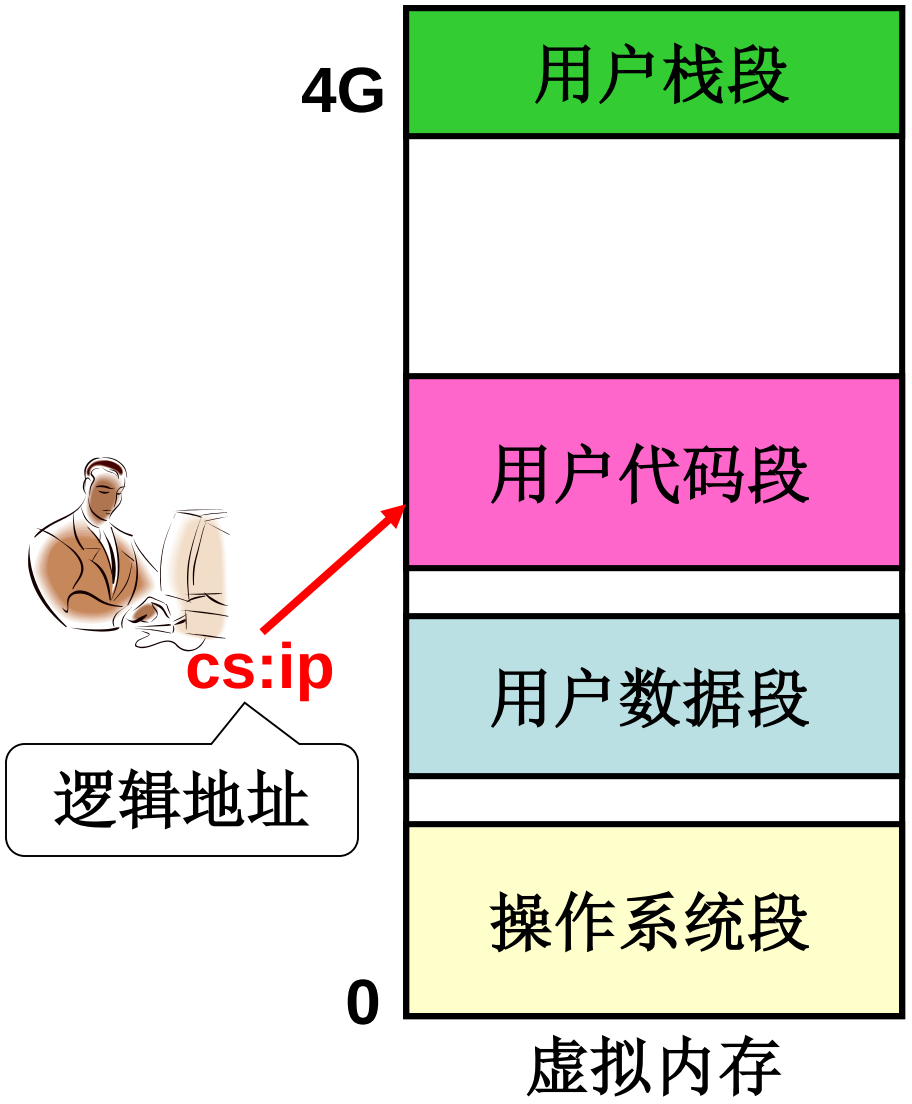
对用户是透明的

内存



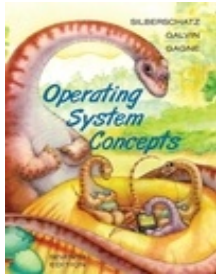
用户眼里的内存!





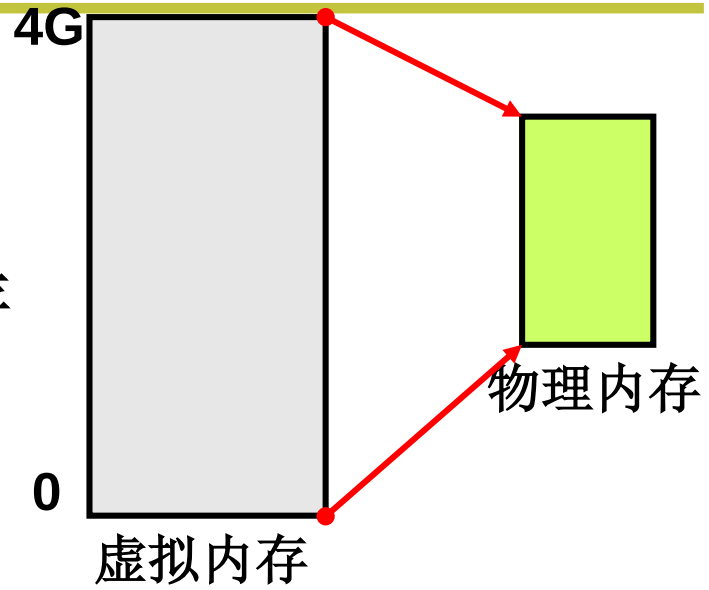
- 4GB(大且规整)的“内存”，可供用户使用，如char *p, p=3G，实际上就是用地址
- 用户可随意使用该“内存”，就象单独拥有4G内存
- 这个“内存”怎么映射到物理内存，用户全然不知

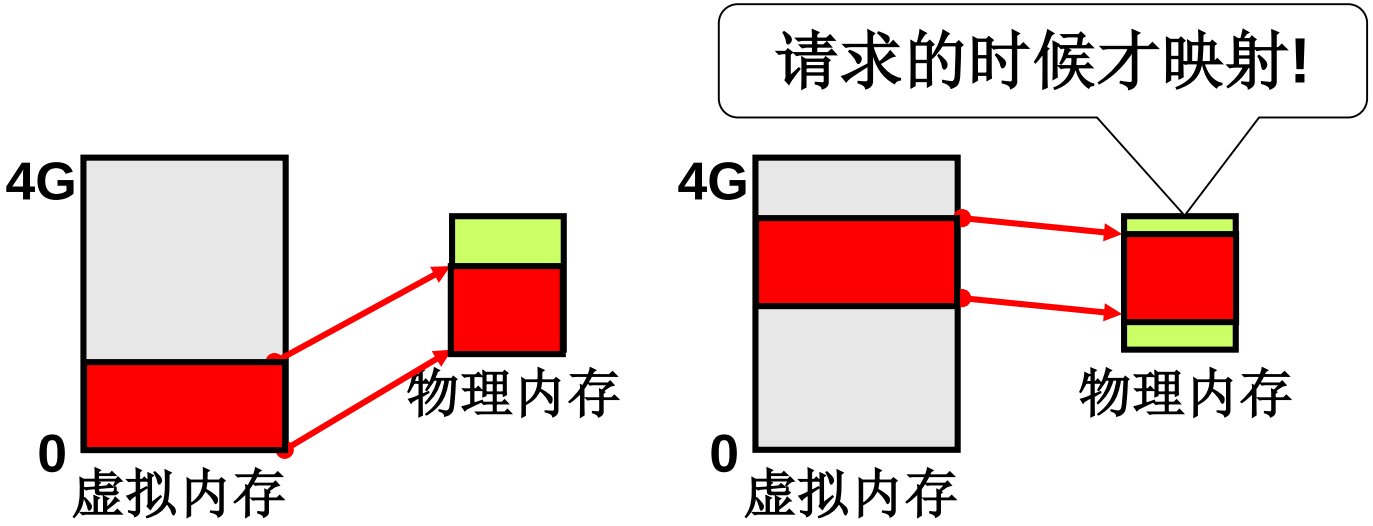
必须映射，否则不能用!

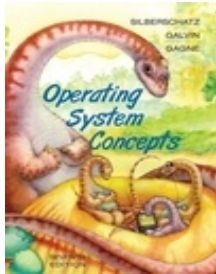


用换入、换出实现“大内存”

- 左边4G，右边1G怎么办?
  - 访问p(=0G - 1G)时，将这部分映射到物理内存
  - 再访问p(=3G-4G）时，再映射这一部分







请求调页

段号+偏移(cs:ip)

逻辑地址

段号	基址	长度	保护
0	0x4000	0x0800	R

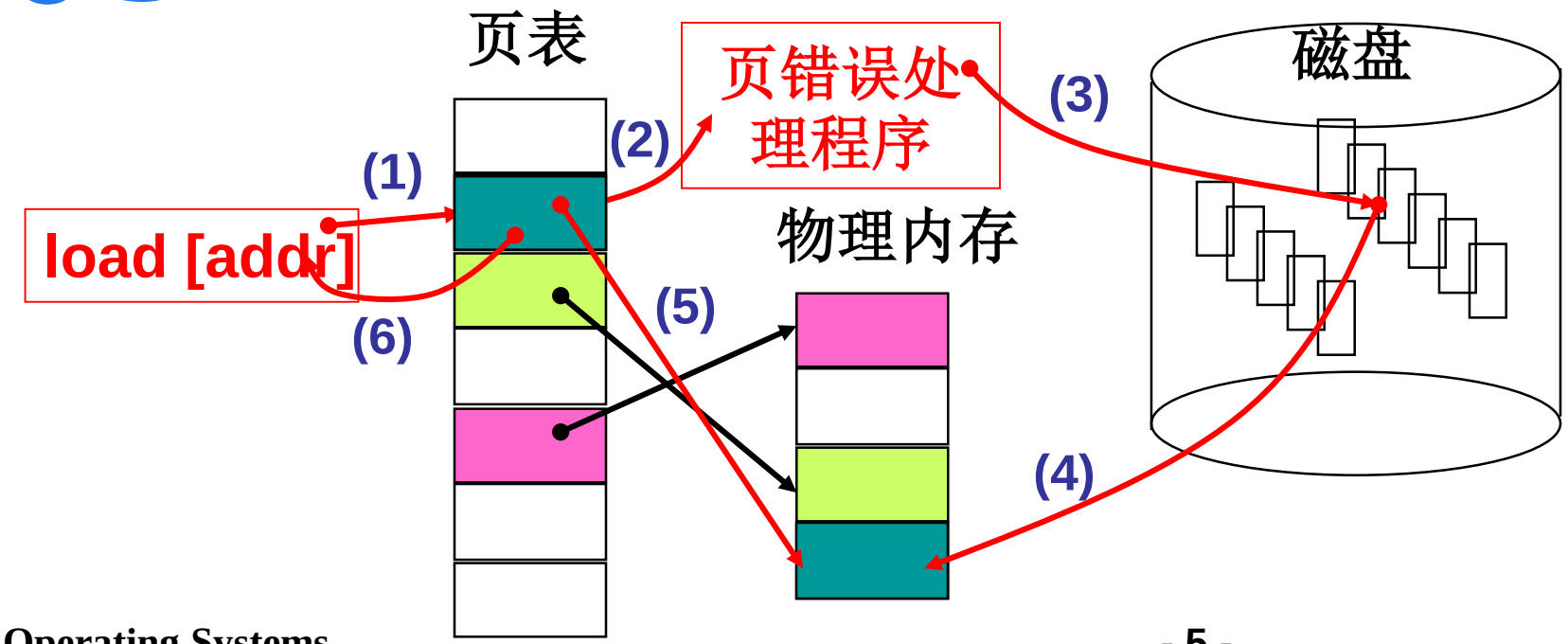
虚拟地址

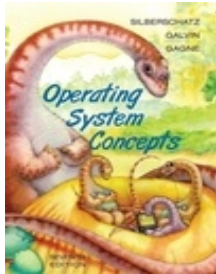
页号	偏移

物理地址

物理页号	偏移

页框号	保护
5	R
没有映射	R/W





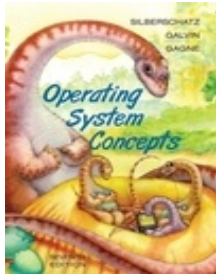
问题：采用请求调页而不是请求调段，是因为?( )

A. 请求调页对用户更透明

B. 用户程序需要因为请求调段而重写

C. 请求调页的粒度更细，更能提高内存效率

D. 请求调段不工作在内核态



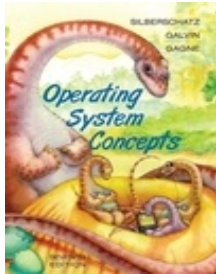
一个实际系统的请求调页

- 这个故事从哪里开始?
  - 请求调页，当然从缺页中断开始

中断号	名称	说明
12	Segment not Present	描述符所指的段不存在
14	Page fault	页不在内存

```
void trap_init(void)
{ set_trap_gate(14, &page_fault); }
```

```
#define set_trap_gate(n, addr) \
    _set_gate(&idt[n], 15, 0, addr);
```



处理中断page fault

```
//在linux/mm/page.s中
.globl _page_fault
    xchgl %eax,(%esp)
    pushl %ecx
    pushl %edx
    push %ds
    push %es
    push %fs
    movl $0x10, %edx
    mov %dx, %ds
    mov %dx, %es
    mov %dx, %fs
    movl %cr2, %edx
```

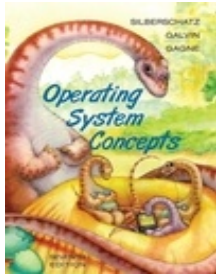
错误码被压到了栈中

页错误线性地址

```
    pushl %edx
    pushl %eax
    testl $1, %eax
    jne 1f
    call _do_no_page
    jmp 2f
1:  call _do_wp_page //保护
2:  add $8, %esp
    pop %fs
    pop %es
    pop %ds
    pop %edx
    pop %ecx
    pop %eax
    iret
```

压入参数

测试标志P



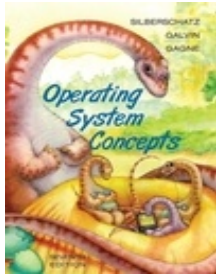
do_no_page

```
//在linux/mm/memory.c中
void do_no_page(unsigned long error_code,
          unsigned long address)
{  address&=0xfffff000;   //页面地址
   tmp=address-current->start_code; //页面对应的偏移
   if(!current->executable||tmp>=current->end_data){
         get_empty_page(address); return; }
   page=get_free_page();
   bread_page(page, current->executable->i_dev, nr);
   put_page(page, address);
```

不是代码和数据!

读文件系统...

```
void get_empty_page(unsigned long address)
{  unsigned long tmp = get_free_page();
   put_page(tmp, address);}
```



put_page

```
//在linux/mm/memory.c中
unsigned long put_page(unsigned long page, //物理地址
          unsigned long address)
{ unsigned long tmp,  *page_table;
  page_table=(unsigned long *)((address>>20)&ffc);
  if((*page_table)&1)
    page_table=(unsigned long*)(0xfffff000&*page_table);
  else{
     tmp=get_free_page();
     *page_table=tmp|7;
     page_table=(unsigned long*)tmp;}
  page_table[(address>>12)&0x3ff] = page|7;
  return page;
}
```

页目录项