Virtual Memory

DON'T PANIC!

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Scheduling Administrivia

- Design Reviews on Monday!
  - Signup is live?
  - Show up prepared
- Project due the following Sunday.

What's going to happen in this Project

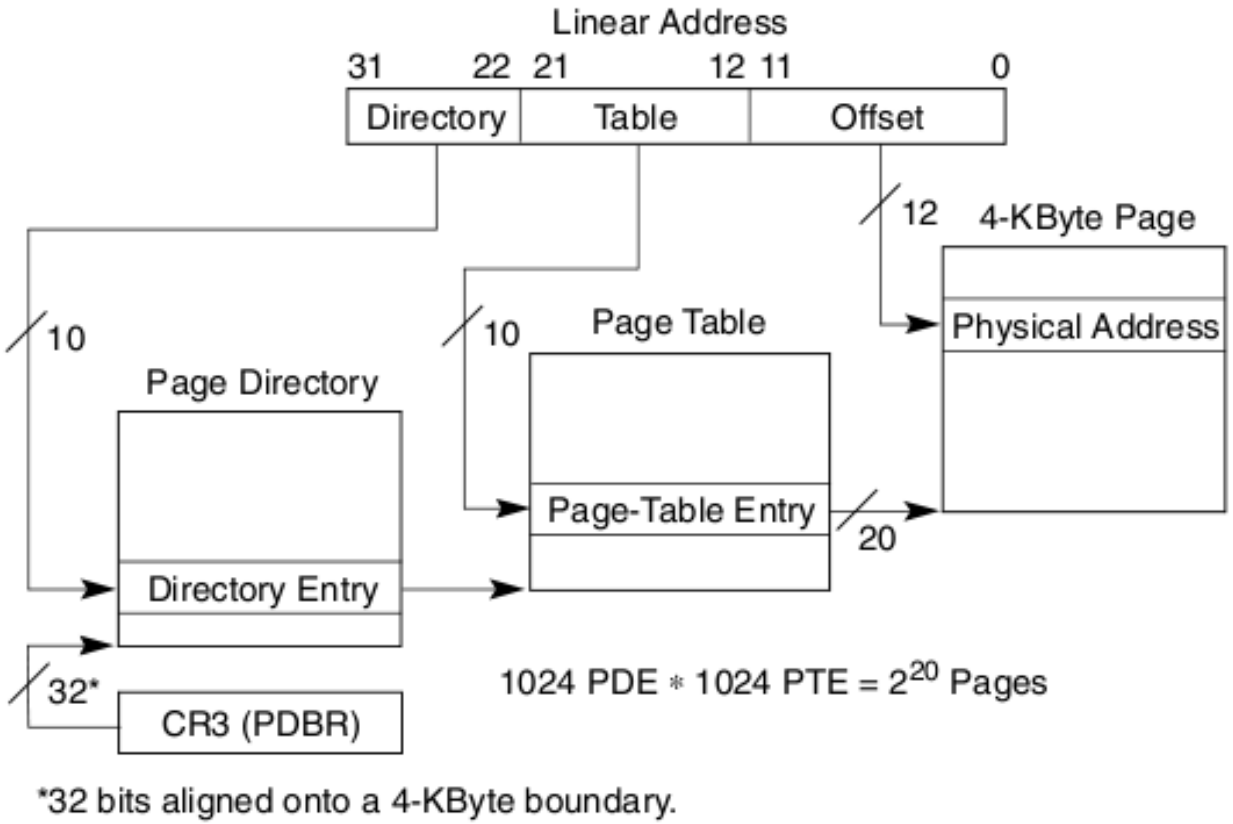
- Different memory layouts for different tasks
- Restriction of user processes to the user mode
- You will use usb for swap storage
  - Process uses whatever location it was originally loaded from (swap_loc)
  - Multiple process instances will be broken this means

What You'll Implement

- Initializing Memory (kernel page stuff)
- Setting up each process' memory
- Handling Page Faults
- Swap in and Swap out
- Extra Credit: better eviction policy

2-Level Page Table (i386)

- Link on the Project Description to Intel Manual



Directory Entries

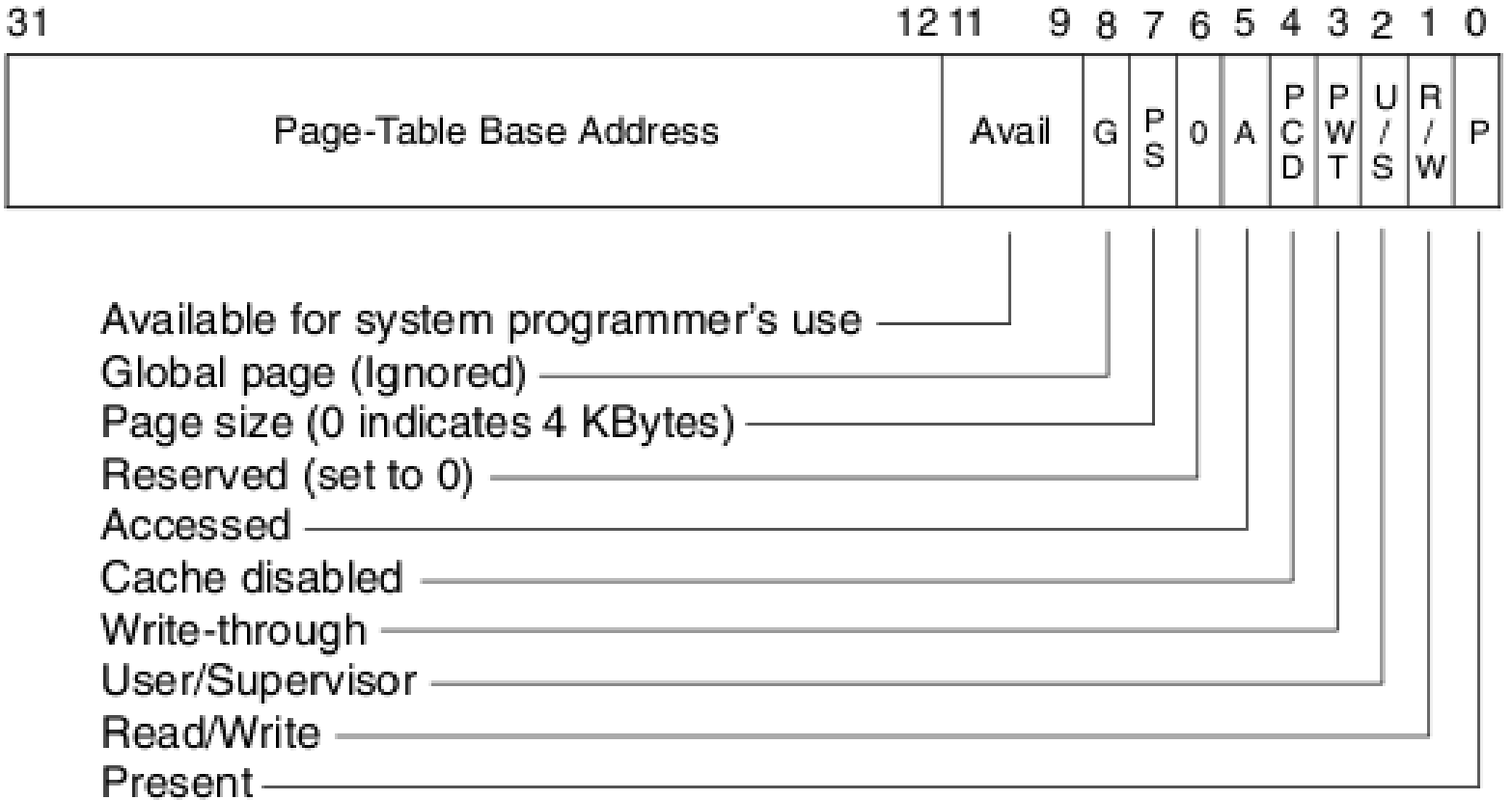
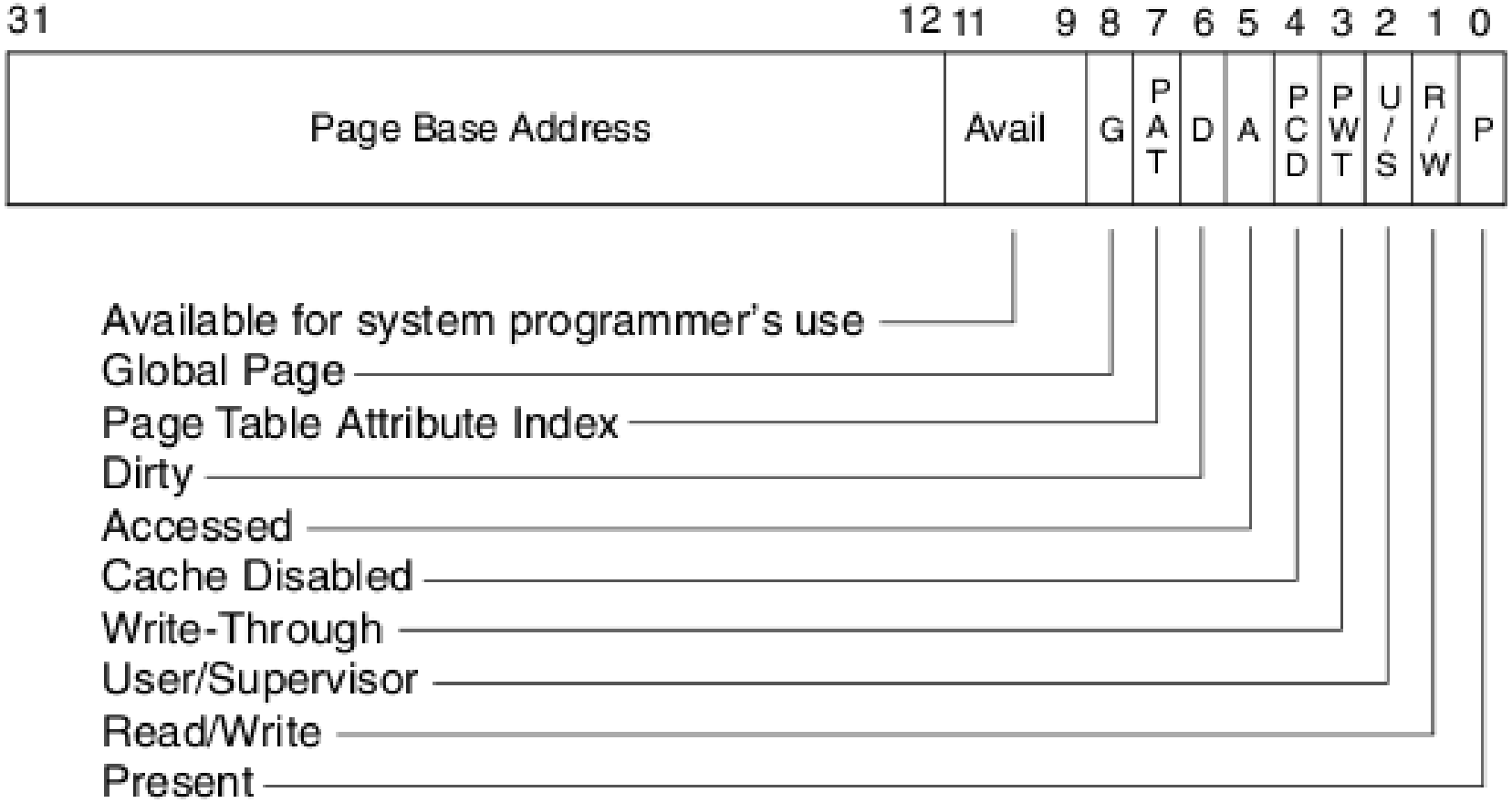


Table Entries



Entry Flags

- P: Whether the page or page table being pointed is loaded.
- U/S: 0-> no user access
- R/W: 0-> user read-only
- A : Accessed (set on swap-in)
- D : Dirty
  - (Only for page-table entry; you'll use this at swap-out)

Setting Up Kernel Memory

- Allocate N_KERNEL_PTS (page tables)
- Fill them out until you've reach MAX_PHYSICAL_MEMORY
- PHYSICAL = VIRTUAL
- Need to be marked correctly
  - (especially SCREEN_ADDR)

Setting Up Process Memory

- Map kernel page tables starting at 0
- PROCESS_START (vaddr of code + data)
  - Use one page table and fill it out
  - It needs pcb->swap_size memory
- PROCESS_STACK (vaddr of stack top)
  - Use N_PROCESS_STACK_PAGES for the stack

Page Fault Handling

- Get a free page (from the page allocator)
- Swap into the page
- Set the page table entry to the page's address and set present flag
- When do you need to flush the TLB?

Page Allocator

- If free page, return it
- Otherwise, you'll need to swap a page out
- Some pages are **pinned** and you never evict them!
- In this project, implement any simple way (e.g., FIFO)
- Extra credit opportunity!

Things you'll write

- **memory.[ch]**
- init_memory()
- setup_page_table(pcb_t *p)
- page_fault_handler()
- page_alloc(int pinned)
- page_replacement_policy()
- page_swap_in(int pagenumber)
- page_swap_out(int pagenumber)
- You will probably need to define structures to handle

What Can Make Your Life Easier

- One page table is enough for a process' code and data memory space (starts at PROCESS_START)
- Some pages don't need to be swapped out
  - *Need in this case means with respect to grading.*
  - kernel pages, process page directory, page table, stack table and stack pages.

Good Luck!

- Prepare for Design Reviews
- Enjoy your break?

Questions!