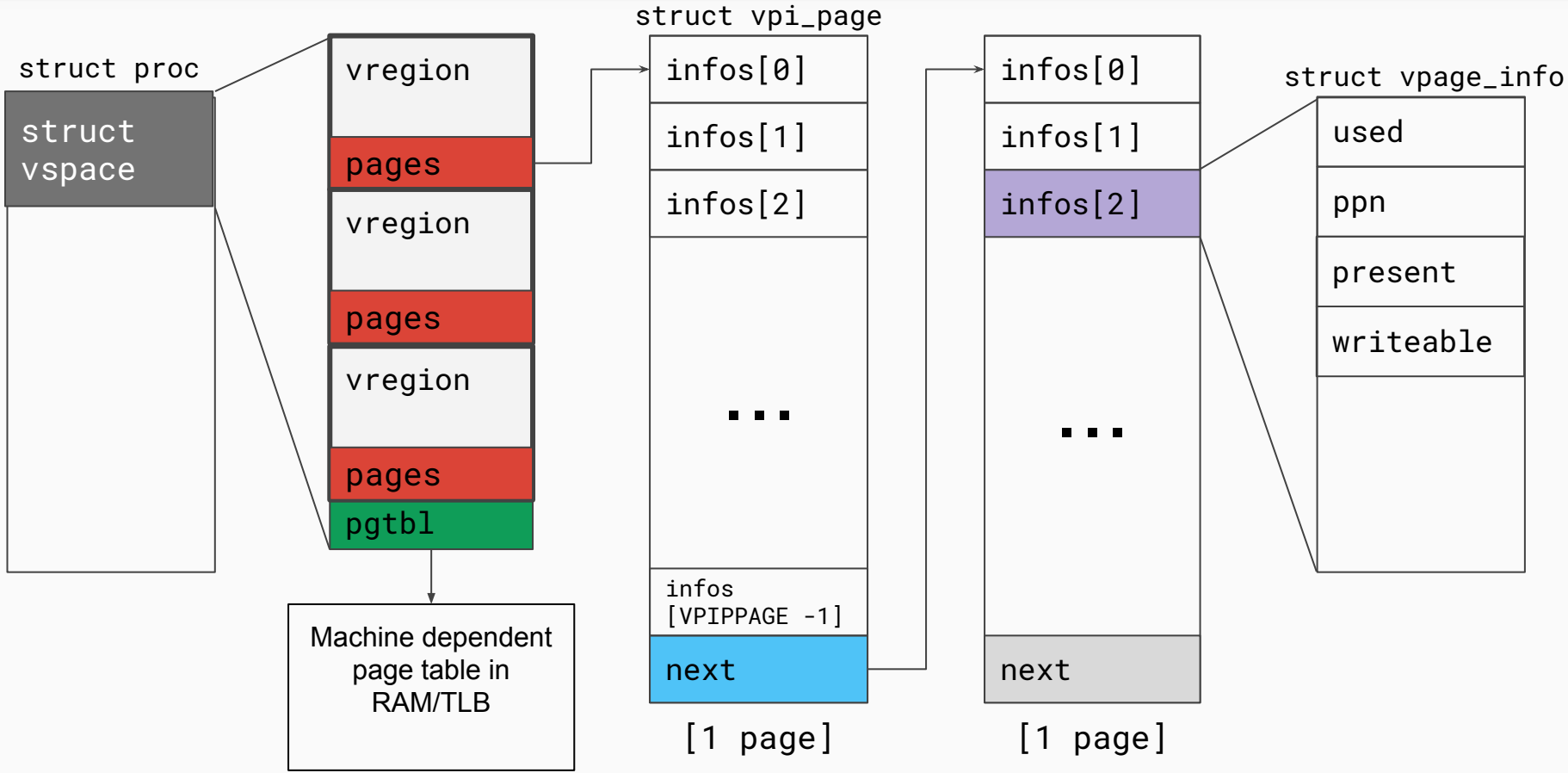
Section 6: Lab 3 Details

CSE 451 19au

vspace Visual Diagram



vregions vs *Page Tables*

- Both have virtual to physical address mappings.
- **`vspace.pgtbl`**
  - Used by hardware to translate virtual addresses to physical addresses
  - **`CR3`** register holds the top level page table (i.e. **`vspace.pgtbl`**)
  - TLB caches virtual -> physical mappings
- **`vspace.regions`**
  - Portable *architecture independent* software representation of the address space
  - Used by kernel to track/update mappings without affecting hardware page table lookups
  - May be incomplete at times (e.g. mappings in exec())
- How do we update the page table to reflect the vspace regions?

vspaceinvalidate(vs)

- “Transforms a vspace into the architecture dependent page table”
  - I.e. virtual mappings in `vs.regions` are reflected in `vs.pgtbl`
  - Git analogy: commit vspace changes to the page table
- Call when you’ve changed a mapping in `vs`.

Pop Quiz: When will you be calling `vspaceinvalidate` in Lab 3?

vspaceinstall(p)

- “Installs the page table into the page table register”
  - I.e. CR3 = `vs.pgtbl`
  - In x86, this flushes the TLB!
  - Git analogy: pushes your committed changes to the TLB/CR3
- If there were changes in the vspace, call after invalidating.

Pop Quiz: When will you be calling `vspaceinstall` in Lab 3? Can you ever get away without calling `vspaceinstall`?

Handling Page Faults in x86_64

- CR2 register holds the faulting linear address (since virtual paging is turned on, this is the virtual address)
  - How do you **r**ead or **l**oad a control register?
- `tf->err` holds the exception error code
  - You can use to determine the type of fault

Great resource: https://wiki.osdev.org/Page_fault

Copy-on-write Fork FAQ

- How do we keep track of physical pages and refcounts?
  - Coremap!
- What vspace functions need to behave differently to support COW fork, and how?
  - vspacecopy()
- Synchronization in modifying the **vspace** in page fault in COW fork?
  - not needed -- current process has exclusive access to its vspace
  - **However, the ref count however could be concurrently modified**