Lecture 4 CS695. 18.1.23

Assignment #1

usage	function listings	function implementation	function dispatch ✓

monolithic (function listings, function implementation, function dispatch)

decoupled components ⇒ service delivery framework.

how to Instantiate / Setup VMs / OS-view abstraction.

① cpu virtualization for VMs.

(i) trap-and-emulate —— ×

(ii) binary translation (full virtualization) || slow

(iii) para virtualization of the CPU (PV) via hypercalls.

(iv) hardware-assisted CPU virtualization

- ~ vmx modes
  - vmx root < PL3 (native appl^n's.), PL0 (hyp. / native OS)
  - vmx non-root < PL3 (App), PL0 (guestos)
- ~ vmx commands — vmexit, vmlaunch, vmresume, vmptrld
- ~ vmcs state. — VM config is save & restored on a per VM basis.

⊛ configurable settings of VMEXIT.

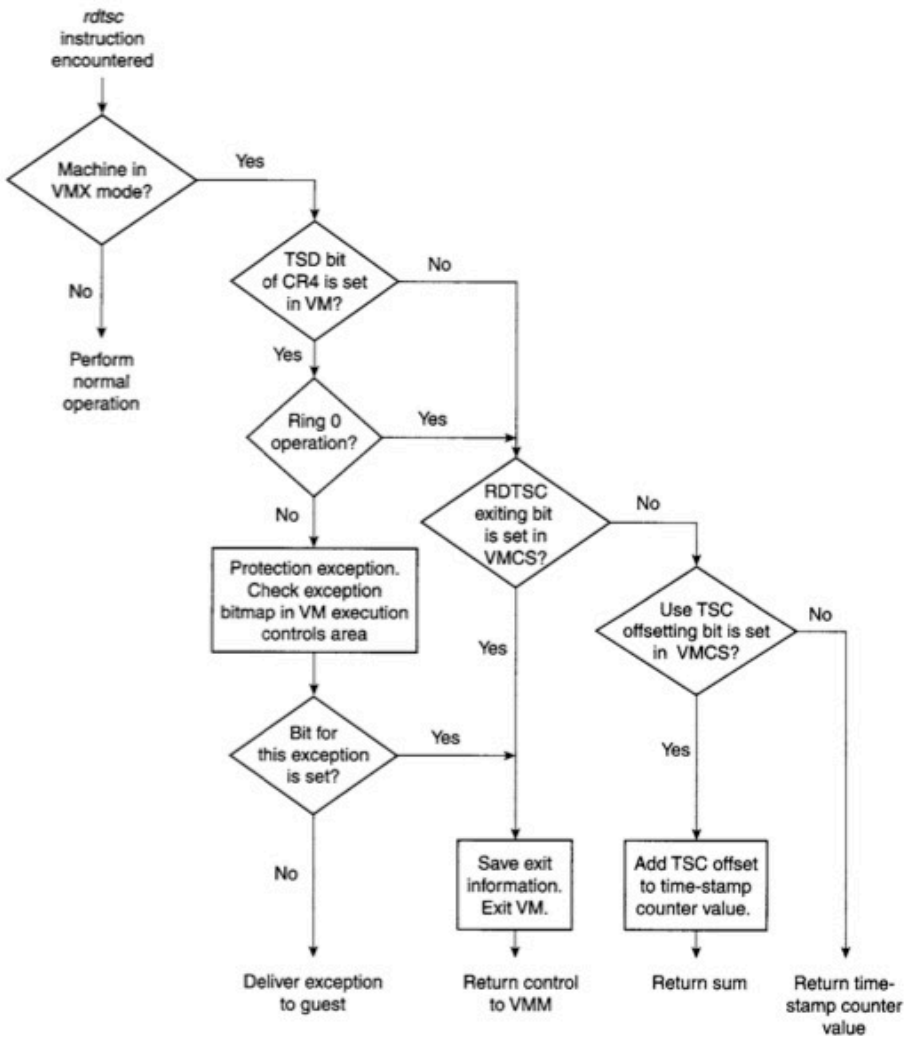
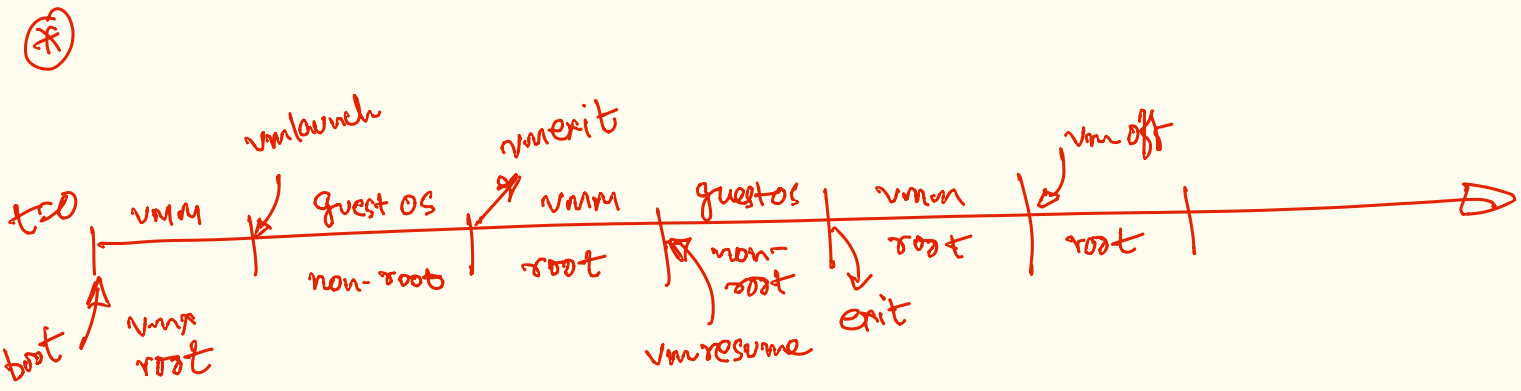


Figure 8.27 Actions Taken by Hardware When a Read Time-Stamp Counter (rdtsc) Instruction Is Encountered.



vmptrld → which points to the VMCS

VMCS ~ virtual machine control structure

- guest area ~ to save guest state on exit
- host area ~ to save host state on entry
- vm exit info ~ area to store state on exit ~ conditions
- vm execution control ~ when to exit
- vm exit control ~ what to store on exit
- vm entry control ~ what to store on entry

* vmcall ~ hardware-assisted hypercall.

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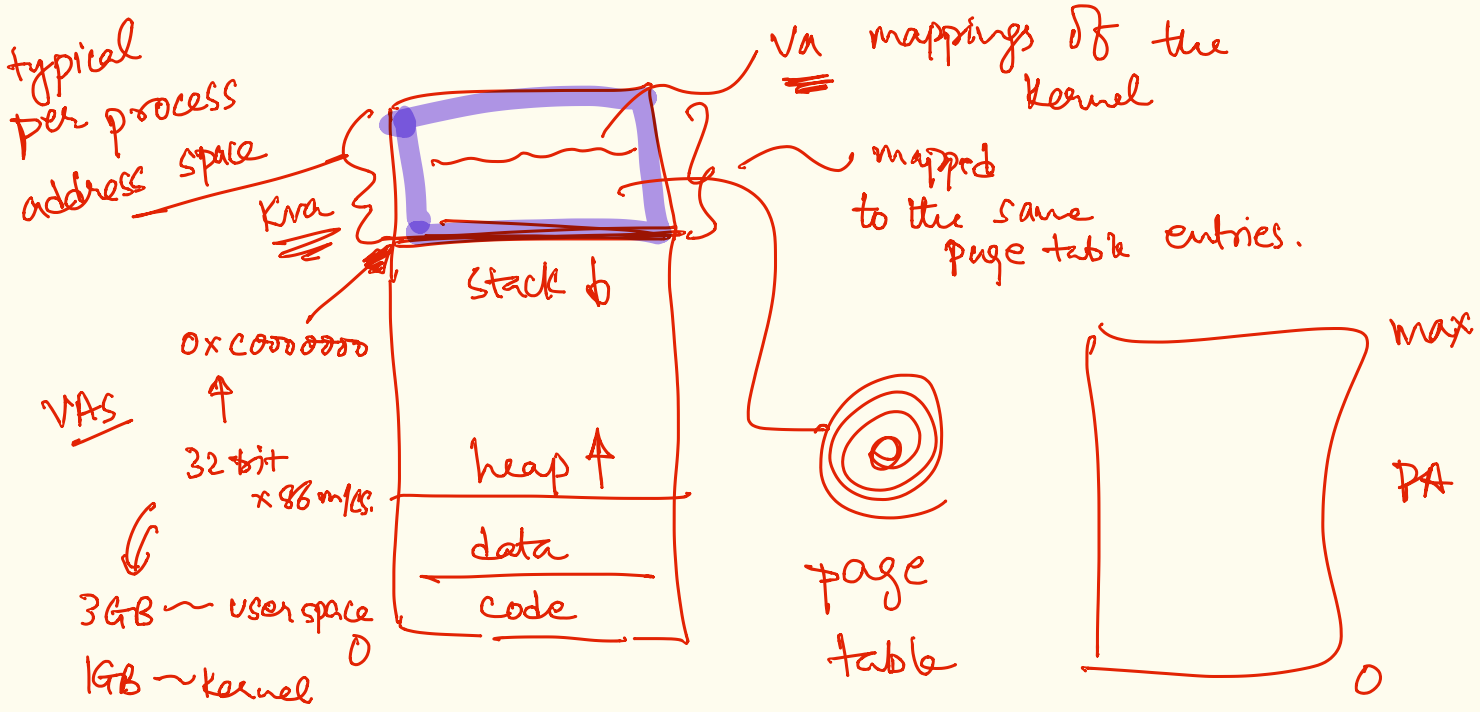
(2) memory virtualization with VMs

* native ~ (virtual) address space
  - 0-starting & linear
  - per process
  - isolated

} segmentation + paging

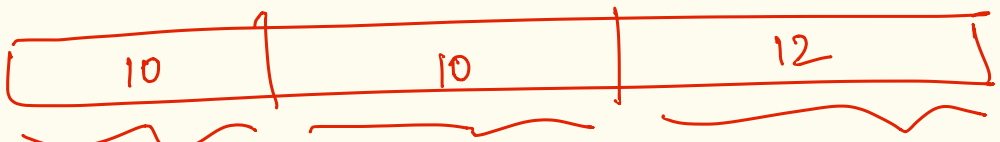


HW assistance for address space abstraction.

CPU modes ~ real mode ~ no virtual memory: all memory accesses are physical addresses.
- access range / size : 1MB
- drastically reduced instruction set.

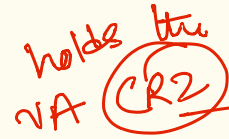
└ protected mode
  └ privilege levels
  └ memory access/protection (segmentation)
  + paging
    └ (virtual) address space ~ v2p via the MMU

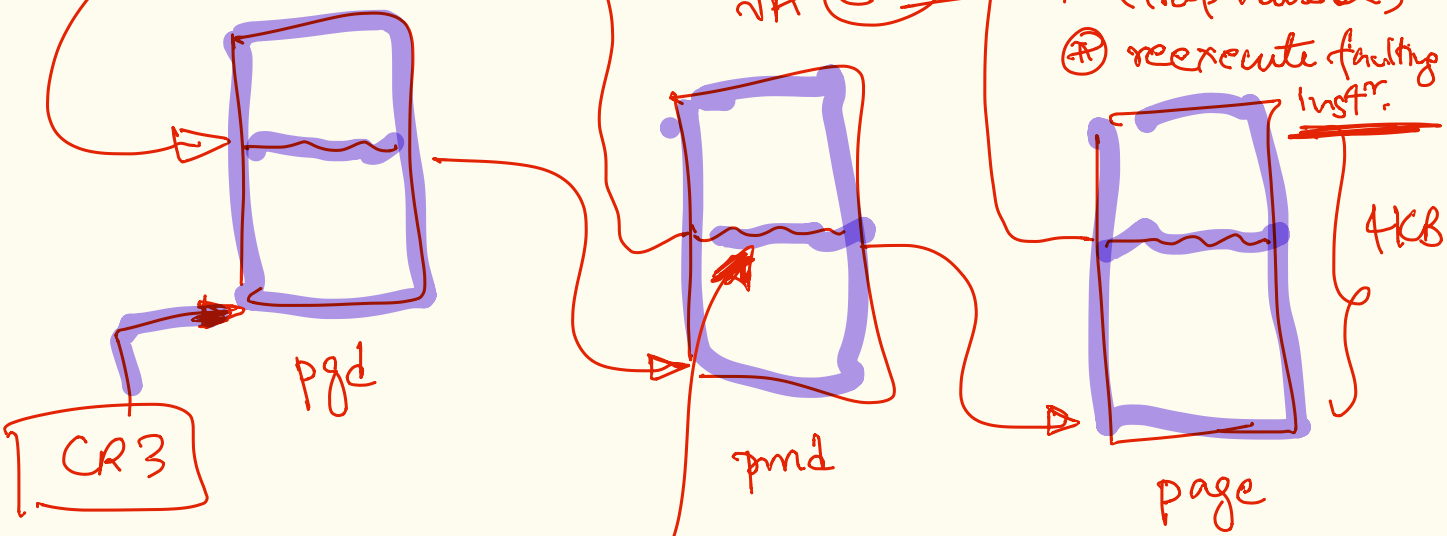
32-bit



page fault
- exception (trap handler)
- reexecute faulting instr.

holds the VA





x86 cpu regs.

used by MMU

pte: page table entry

specifies loc^n info about where to find this page if swapped.

MSB 20 bits ~ specify a page start address

LSB 12 bits ~ pte flags

V	P	R	W	A