



Processes

- Recall that a process includes many things
 - An address space (defining all the code and data pages)
 - OS resources (e.g., open files) and accounting information
 - Execution state (PC, SP, regs, etc.)
- Creating a new process is costly because of all of the data structures that must be allocated and initialized
 - Recall struct proc in Solaris
 - ...which does not even include page tables, perhaps TLB flushing, etc.
- Communicating between processes is costly because most communication goes through the OS

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• Overhead of system calls and copying data

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Rethinking Processes

- What is similar in these cooperating processes?
 - They all share the same code and data (address space)
 - They all share the same privileges
 - They all share the same resources (files, sockets, etc.)
- What don't they share?
 - Each has its own execution state: PC, SP, and registers
- Key idea: Why don't we separate the concept of a process from its execution state?

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- Process: address space, privileges, resources, etc.
- Execution state: PC, SP, registers

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• Exec state also called thread of control, or thread





























- Kernel-level threads
 - Integrated with OS (informed scheduling)
 - Slow to create, manipulate, synchronize
- User-level threads
 - Fast to create, manipulate, synchronize
 - Not integrated with OS (uninformed scheduling)
- Understanding the differences between kernel- and user-level threads is important

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- For programming (correctness, performance)
- For test-taking

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Implementing Threads

- Implementing threads has a number of issues
 - Interface
 - Context switch
 - Preemptive vs. Non-preemptive
 - What do they mean?
 - Scheduling

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- Synchronization (next lecture)
- Focus on user-level threads
 - Kernel-level threads are similar to original process management and implementation in the OS

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