Concurrent Programming with UNIX Processes

UNIX Tools for Concurrent Programming

1. The *process* (old)
2. The *thread* (relatively new)

The Process, I

Abstractly, a program in execution

Multiple simultaneous processes allow multiple activities; e.g., compile one source file while editing another

CPU is shared by **preemptive multitasking**—the OS **scheduler** interrupts one process to schedule another

Switching (at computer time scale) yields "apparent parallelism" (at human time scale)—*true* concurrency is possible only with multiple CPUs

The Process, II

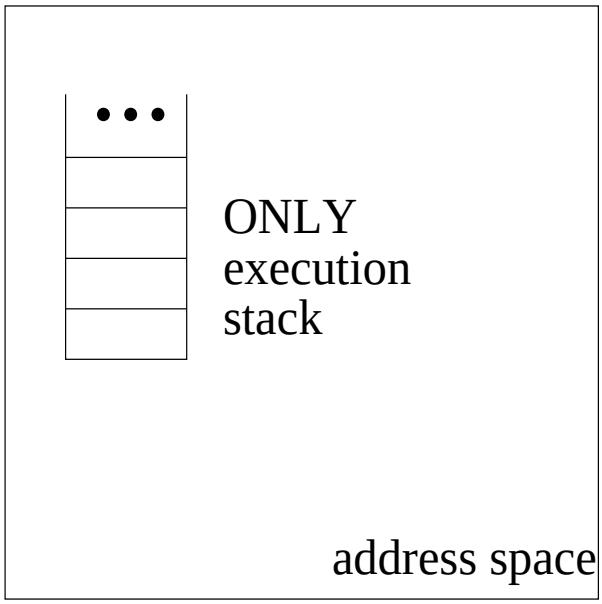
Each process kept separate from others by OS's intervention in addressing (enabled by specialized hardware)

Many-to-many relationship between process & program:

- 1 process can execute many programs during its lifetime
- And, of course, many processes can run the same program at the same time

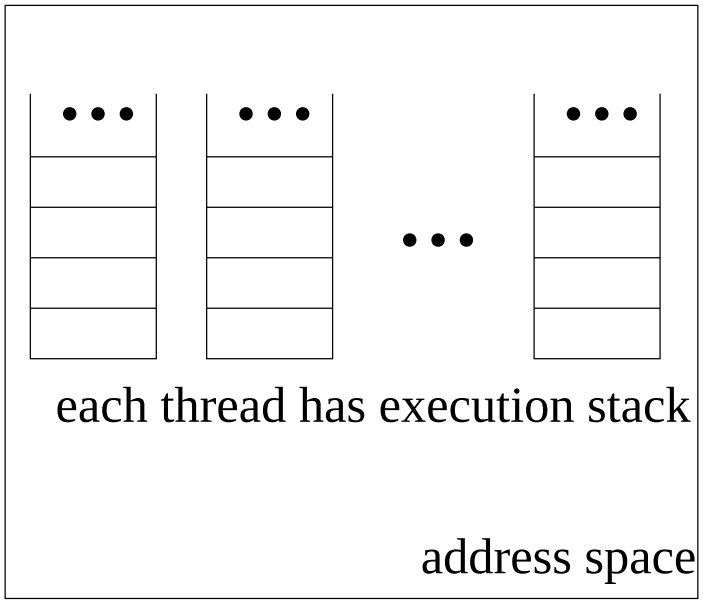
OSes now support concept of multiple **threads** within a process

Single-threaded Process



Process is the schedulable unit

Multiple Threads Within a Process



OS knows about threads

Thread is the schedulable unit