Lecture 6
Process Management: Threads

Overview

- All modern operating systems provide features enabling a process to contain multiple threads of control.

- A thread comprises a thread ID, a program counter, a register set, and a stack. It shares with other threads belonging to the same process its code section, data section, and other operating-system resources, such as open files and signals.
- A traditional (or ***heavyweight) process*** has a single thread of control. If a process has multiple threads of control, it can perform more than one task at a time. Figure 4.1 illustrates the difference between a traditional **single-threaded process and a multithreaded process.**

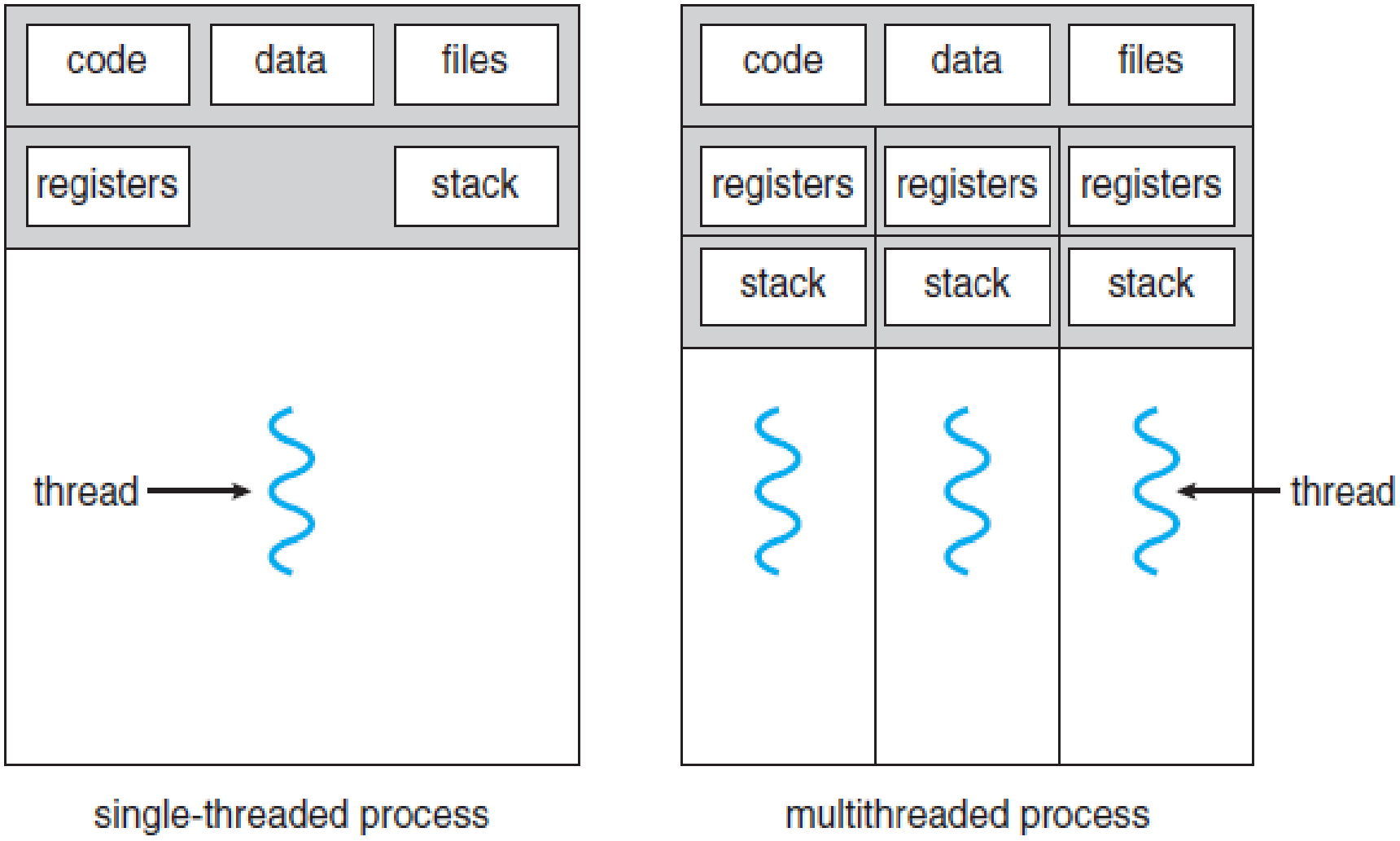


Figure 4.1 Single-threaded and multithreaded processes.

Example

A word processor may have a thread for displaying graphics, another thread for responding to keystrokes from the user, and a third thread for performing spelling and grammar checking in the background.

Benefits

- **Responsiveness.** Multithreading an interactive application may allow a program to continue running even if part of it is blocked or is performing a lengthy operation, thereby increasing responsiveness to the user.
- **Resource sharing. T**hreads share the memory and the resources of the process to which they belong by default. The benefit of sharing code and data is that it allows an application to have several different threads of activity within the same address space.

- **Scalability.** The benefits of multithreading can be even greater in a multiprocessor architecture, where threads may be running in parallel on different processing cores. A single-threaded process can run on only one processor, regardless how many are available.

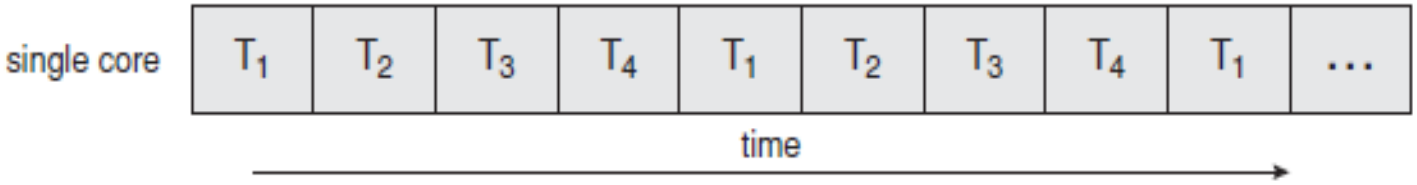
Multicore systems

A recent trend in CPU design is to include multiple computing **cores** on a single chip. Such multiprocessor systems are termed **multicore.**

They can be more efficient than multiple chips with single cores because on-chip communication is faster than between-chip communication. In addition, one chip with multiple cores uses significantly less power than multiple single-core chips.

Multithreaded programming provides a mechanism for more efficient use of these multiple computing cores and improved concurrency.

Consider an application with four threads. On a system with a single computing core, concurrency merely means that the execution of the threads will be interleaved over time because the processing core is capable of executing only one thread at a time.



On a system with multiple cores, however, concurrency means that the threads can run in parallel, because the system can assign a separate thread to each core.