Threads and Concurrency

Pertemuan 7 dan 8

Kompetensi Khusus

- Mahasiswa mampu menentukan proses dan thread untuk diterapkan ke dalam manajemen thread yang akan dijalankan (C3, A2)(C1)

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1. Overview
2. Multicore Programming
3. Multithreading Models
4. Thread Libraries
5. Implicit Threading
6. Threading Issues

1. Overview

Single and Multithreaded Processes

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.

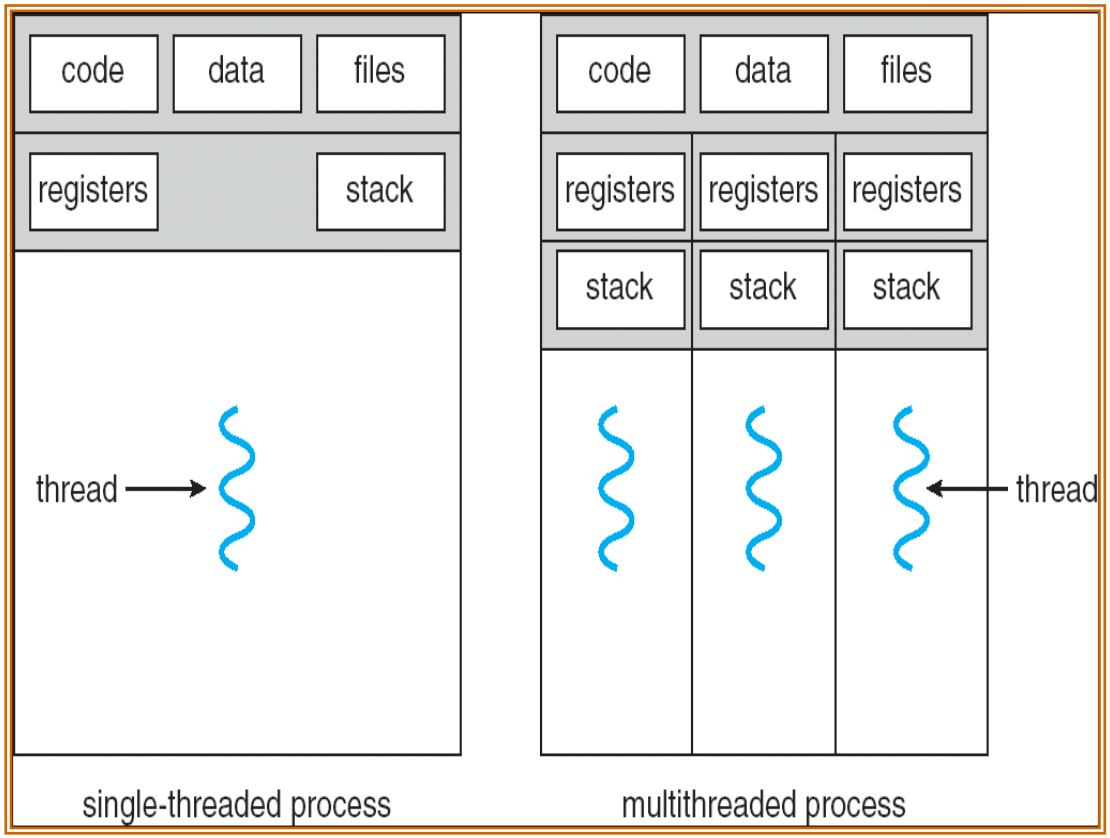

Fig. Single-threaded and multithreaded processes.

Benefits

- Responsiveness
- Resource Sharing
- Economy
- Utilization of MP Architectures

2. Multicore Programming

User Threads

- Thread management done by user-level threads library

- Three primary thread libraries:
  - POSIX Pthreads
  - Win32 threads
  - Java threads

Kernel Threads

- Supported by the Kernel

- Examples
  - Windows XP/2000
  - Solaris
  - Linux
  - Tru64 UNIX
  - Mac OS X

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3. Multithreading Models

3.1 Multithreading Models

- Many-to-One
- One-to-One
- Many-to-Many

3.1.1 Many-to-One

- Many user-level threads mapped to single kernel thread
- Examples:
  - Solaris Green Threads
  - GNU Portable Threads

3.1.1 Many-to-One

The many-to-one model maps many user-level threads to one kernel thread. Thread management is done by the thread library in user space, so it is efficient; but the entire process will block if a thread makes a blocking system call.

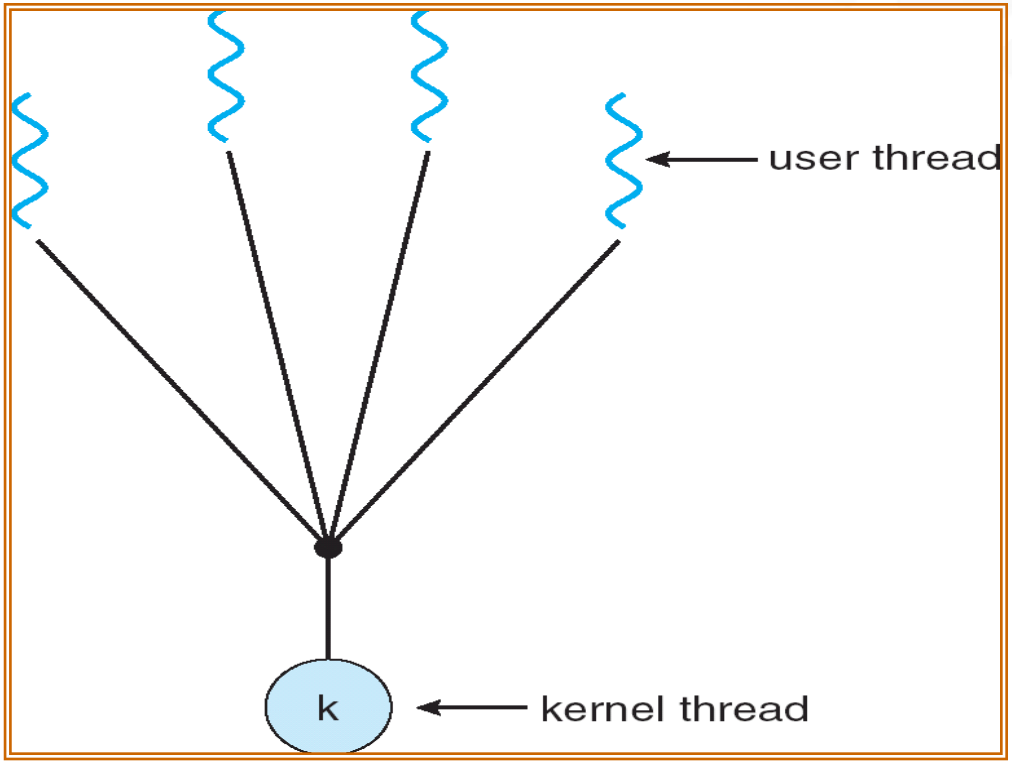

Fig. Many-to-one model

3.1.2 One-to-One

- Each user-level thread maps to kernel thread
- Examples
  - Windows NT/XP/2000
  - Linux
  - Solaris 9 and later

3.1.3 Many-to-Many Model

The many-to-many model multiplexes many user-level threads to a smaller or equal number of kernel threads.

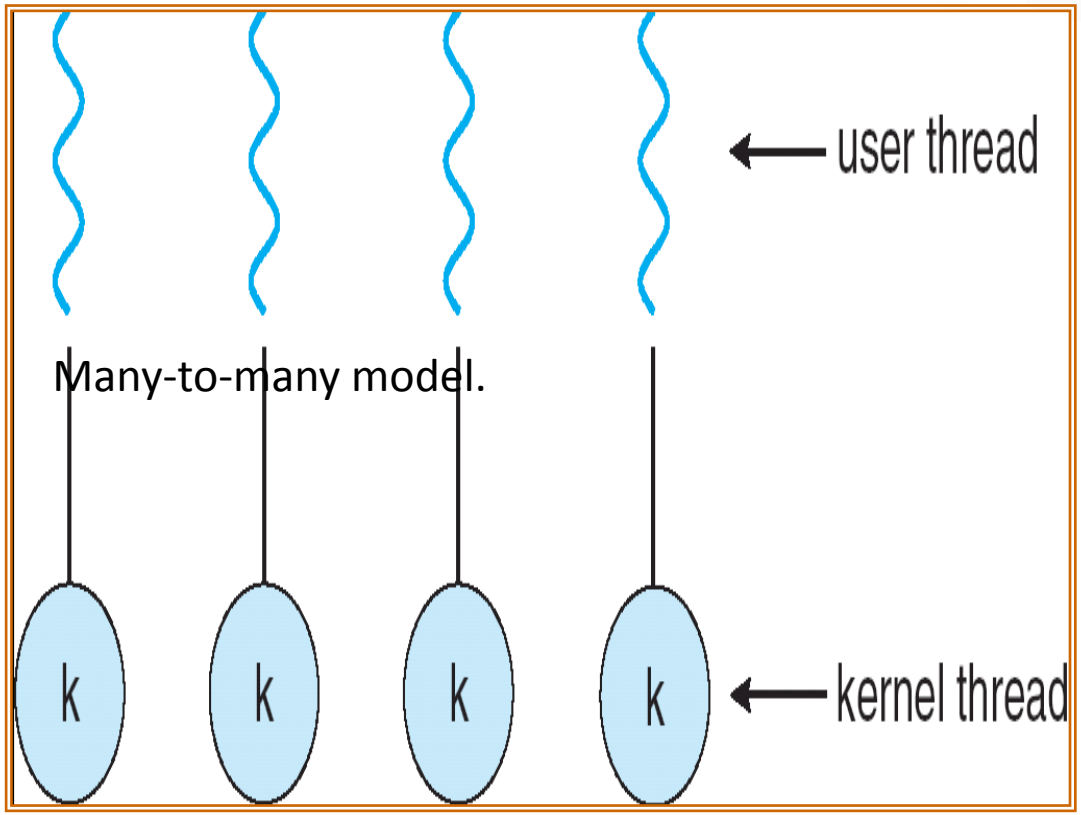

Fig. Many-to-manymodel

3.4 Two-level Model

- Similar to M:M, except that it allows a user thread to be bound to kernel thread
- Examples
  - IRIX
  - HP-UX
  - Tru64 UNIX
  - Solaris 8 and earlier

3.4 Two-level Model

One popular variation on the many-to-many model still multiplexes many user-level threads to a smaller or equal number of kernel threads but also allows a user-level thread to be bound to a kernel thread. This variation, sometimes referred to as the two-level model

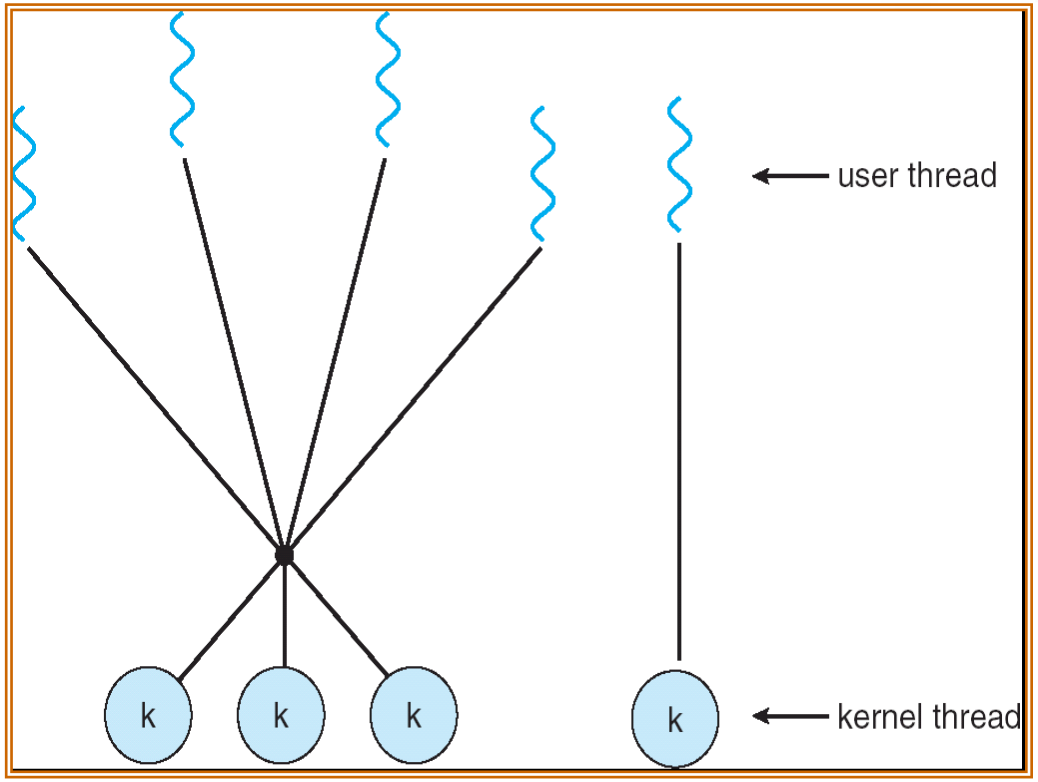

Fig. Two-level model

4. Thread Libraries

4.1 Threading Issues

- Semantics of fork() and exec() system calls
- Thread cancellation
- Signal handling
- Thread pools
- Thread specific data
- Scheduler activations

4.2 Semantics of fork() and exec()

- Does fork() duplicate only the calling thread or all threads?

4.3 Thread Cancellation

- Terminating a thread before it has finished
- Two general approaches:
  - Asynchronous cancellation terminates the target thread immediately
  - Deferred cancellation allows the target thread to periodically check if it should be cancelled

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5. Implicit Threading

5.1 Signal Handling

- Signals are used in UNIX systems to notify a process that a particular event has occurred
- A signal handler is used to process signals
  - Signal is generated by particular event
  - Signal is delivered to a process
  - Signal is handled
- Options:
  - Deliver the signal to the thread to which the signal applies
  - Deliver the signal to every thread in the process
  - Deliver the signal to certain threads in the process
  - Assign a specific threa to receive all signals for the process

5.2 Thread Pools

- Create a number of threads in a pool where they await work
- Advantages:
  - Usually slightly faster to service a request with an existing thread than create a new thread
  - Allows the number of threads in the application(s) to be bound to the size of the pool

5.3 Thread Specific Data

- Allows each thread to have its own copy of data
- Useful when you do not have control over the thread creation process (i.e., when using a thread pool)

5.4 Scheduler Activations

- Both M:M and Two-level models require communication to maintain the appropriate number of kernel threads allocated to the application
- Scheduler activations provide upcalls - a communication mechanism from the kernel to the thread library
- This communication allows an application to maintain the correct number kernel threads

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6. Threading Issues

6.1 Pthreads

- A POSIX standard (IEEE 1003.1c) API for thread creation and synchronization
- API specifies behavior of the thread library, implementation is up to development of the library
- Common in UNIX operating systems (Solaris, Linux, Mac OS X)

6.2 Windows XP Threads

- Implements the one-to-one mapping
- Each thread contains
  - A thread id
  - Register set
  - Separate user and kernel stacks
  - Private data storage area
- The register set, stacks, and private storage area are known as the context of the threads
- The primary data structures of a thread include:
  - ETHREAD (executive thread block)
  - KTHREAD (kernel thread block)
  - TEB (thread environment block)

6.3 Linux Threads

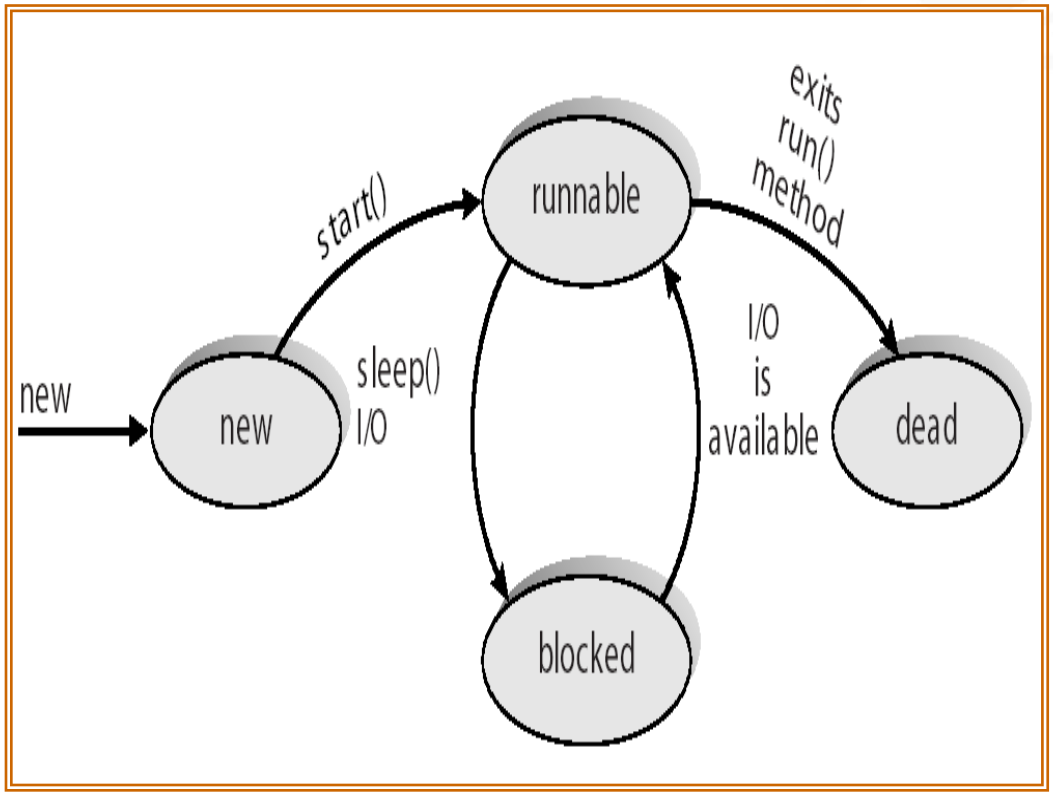
- Linux refers to them as tasks rather than threads
- Thread creation is done through **clone**() system call
- **clone**() allows a child task to share the address space of the parent task (process)

6.4 Java Threads

- Java threads are managed by the JVM
- Java threads may be created by:
  - Extending Thread class
  - Implementing the Runnable interface

6.4.1 Java Thread States

There are two techniques for creating threads in a Java program. One approach is to create a new class that is derived from the Thread class and to override its run 0 method. An alternative- and more commonly used_x0002_technique is to define a class that implements the Runnable interface.



Summary

- Benfit Threads are responsiveness, resource sharing, economy, utilization of MP architectures
- Multithreading Models consist of Many-to-One, One-to-One, Many-to-Many
- Advantages of Thread Pools are usually slightly faster to service a request with an existing thread than create a new thread and allows the number of threads in the application(s) to be bound to the size of the pool

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Thank You