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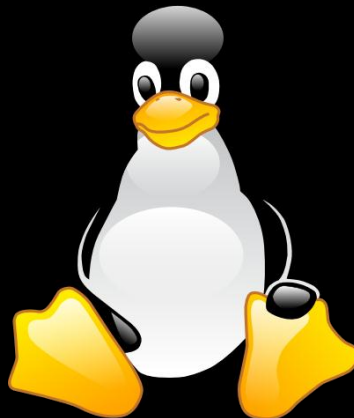
University of Pune

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Subject code: 314441

OPERATING SYSTEM

Part 11: Threading Issues



Threads

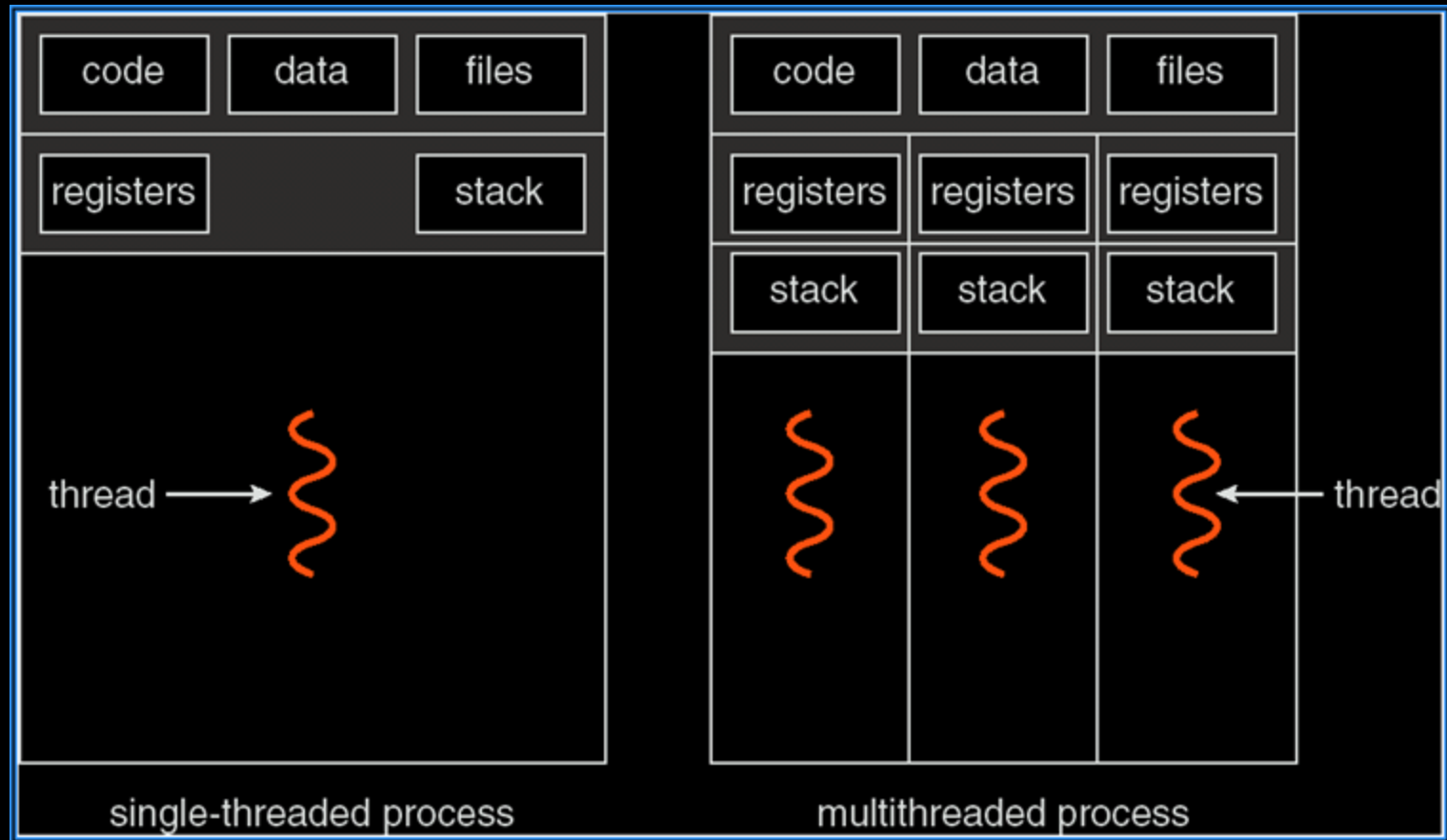


- ▣ Lightweight process.
- ▣ Asynchronous code path within a process.





Single and Multithreaded Processes



Benefits



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





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



Multithreading models



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



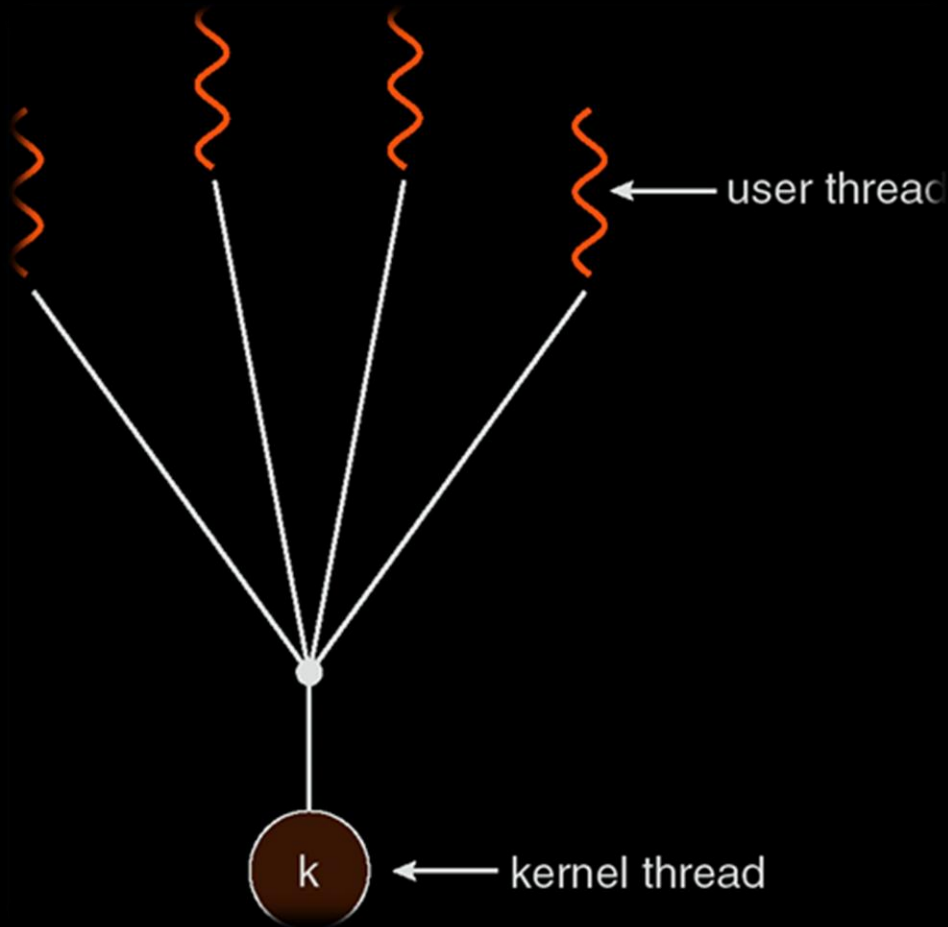
Many to One



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



Many to One



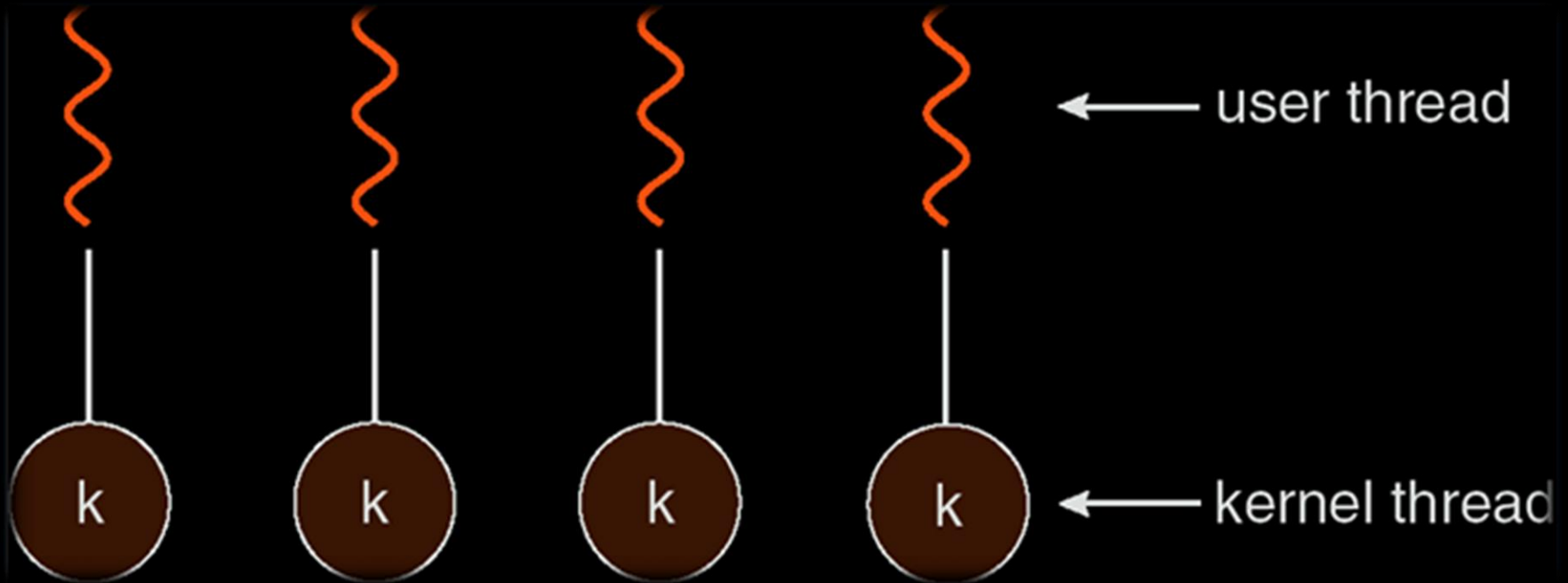
One to One



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



One to One

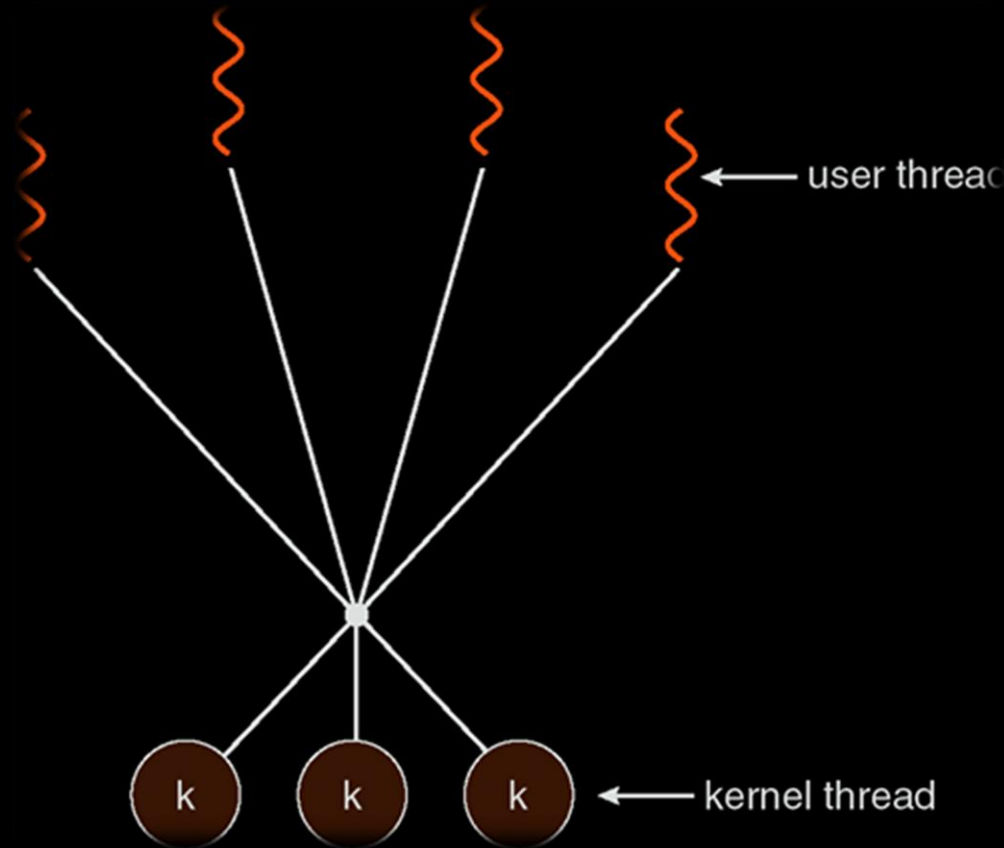


Many to Many



- ▣ Allows many user level threads to be mapped to many kernel threads
- ▣ Allows the operating system to create a sufficient number of kernel threads
- ▣ Solaris prior to version 9
- ▣ Windows NT/2000 with the ThreadFiber package

Many to Many



Two-level model

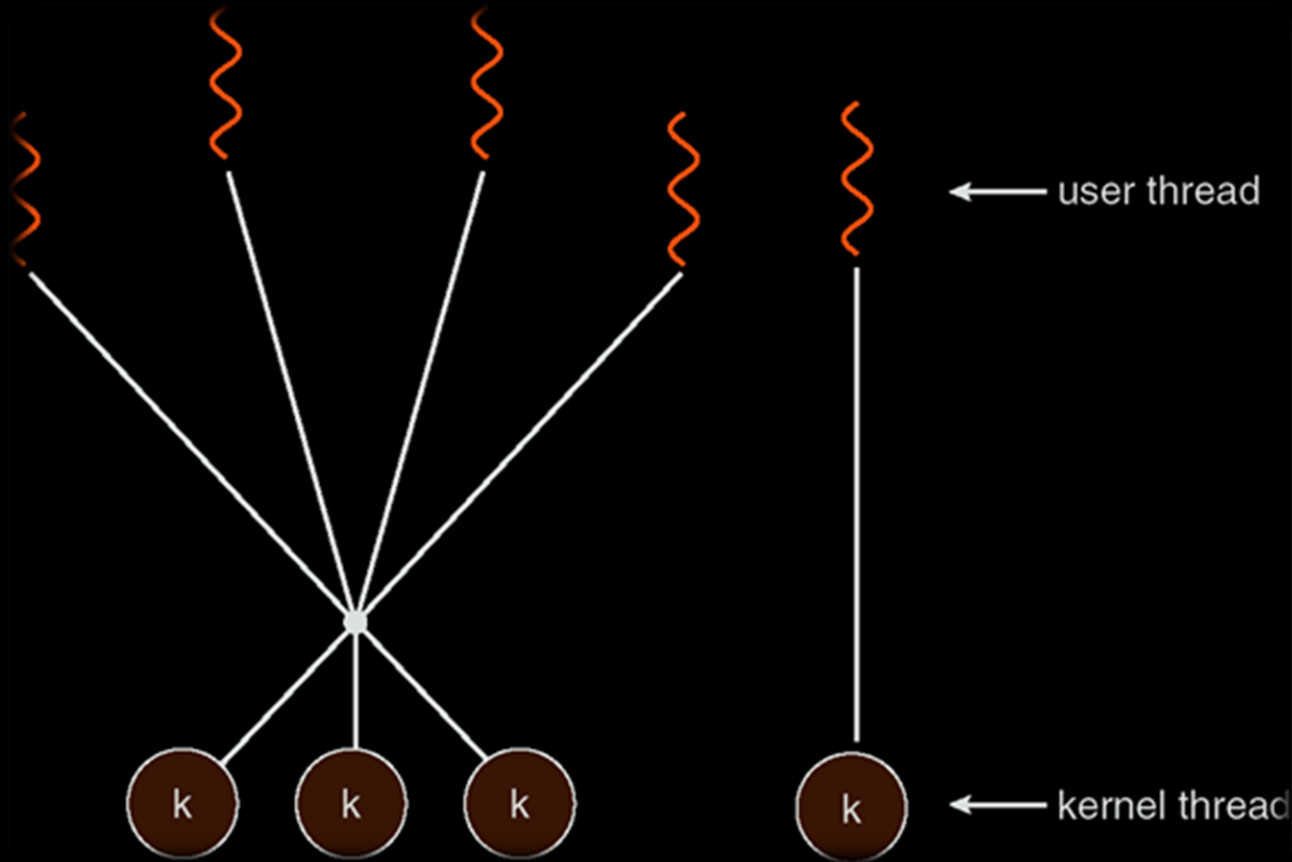


- ▣ Similar to M:M, except that it allows a user thread to be bound to kernel thread
- ▣ Examples
 - IRIX
 - HP-UX
 - Tru64 UNIX
 - Solaris 8 and earlier





Two-level model



Threading issues



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



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



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



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)



Scheduler activities



- ▣ 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



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)



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)



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)



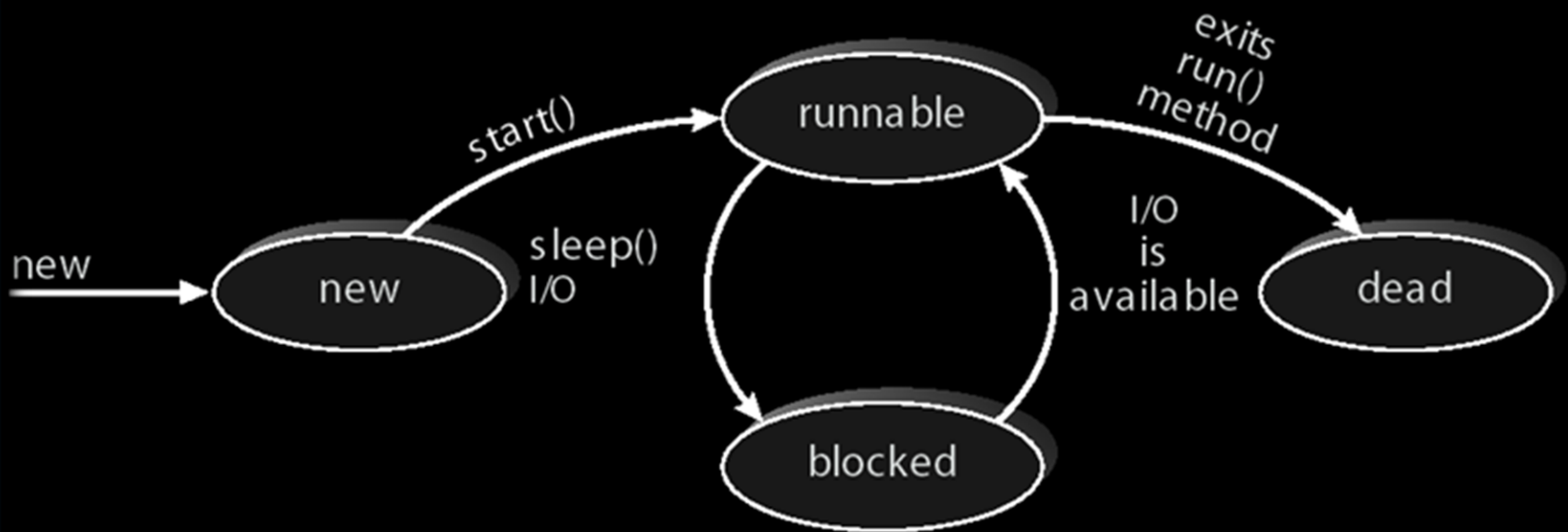
Java Threads



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



Java thread states





Reference Books

- ▣ “Operating System Concepts” by *Silberchartz, Galvin, Gagne*, Wiley India Publications.

- ▣ Rating:

