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Module 2

Single-threaded to Multiprocessors

▼ What is a process?

something that runs on a computer e.g. a program being executed

▼ What does process management include?

- allocating system resources
- avoiding conflicts with other processes

▼ What is a process control block or process descriptor?

it stores detailed information about a process

▼ Each process is assigned a state to indicate it’s stage. What are the popular state process models?

- Two Stage:
    - Running
    - Not running
- Five Stage:
    - New: the process has not yet been loaded into main memory
    - Ready: the process is prepared to execute
    - Running: the process is currently being executed
    - Blocked: the process is waiting on an event to happen.

    - Exit: the process is released from main memory because it has halted or aborted

▼ What is a thread?

a segment of a process

▼ A thread can execute what?

any part of the process code including parts currently being executed by another thread

▼ What is an example of a multithreaded application?

a web browser which can hold multiple tabs that are loading and processing data

▼ In a multiprocessor system, how can threads execute?

multiple threads from the same process may execute in parallel

▼ What is Flynn’s taxonomy?

a specific classification of parallel computer architectures that are based on the number of concurrent instructions and data streams available in the architecture

▼ What are the categories in Flynn’s taxonomy?

- SISD: single instruction, single data
- MISD: multiple instruction, single data
- SIMD: single instruction, multiple data
- MIMD: multiple instruction, multiple data

▼ What is user mode?

- a mode in which the process has no direct way to access computer hardware or memory and needs to use system APIs designed for that
- this gives system protection if a process crashes

▼ What is kernel mode?

- a mode that gives processes complete control of the processor and all its instructions, registers, and memory

▼ User-level threads

- smaller and faster than kernel-level threads
- the kernel handles user-level threads as if they were single-threaded processes because user-level threads are implemented by users and the kernel is not aware of their existence
- multithreaded applications in user-level threads can not use multiprocessing
- managed by the runtime system
- do not require the kernel to create them or switch between them
- a user-level threads package can be implemented on an operating system that does not support threads, and it does not require any modification to the OS. however, this also means that they are not well integrated with the OS, so the thread management is poor, resulting in idle, blocked, or locked threads.

▼ Kernel-level threads

- require a mode switch to transfer control from one thread to another in a process
- aka OS-managed threads
- since the kernel has complete knowledge of these threads, the scheduler may give more time to a process with a larger number of threads which can lead to better efficiency
- each thread needs a full thread control block with information about it. this can add overhead and complexity to management

▼ Why do some OS have a combined user level thread and kernel level thread facility?

so multiple threads within the same application can run in parallel on multiple processors

▼ What is one to one multithreading?

  - it requires a kernel thread to create each user thread
  - overhead for managing it, slowing the system
  - Linux and Windows from 95 to XP implement this model

▼ What is many to one multithreading?

  - it maps user level threads to one kernel-level thread
  - efficient model
  - but it can lead to unnecessary blocked processes, and does not allow individual processes to be split across multiple CPUs
  - this model was used by systems such as Green threads for Solaris and GNU Portable Threads, but few systems still use it

▼ What is many to many multithreading?

  - incorporates any number of user threads into an equal or smaller number of kernel threads, combining the best features of the other two models
  - it's used by some versions of the UNIX and Solaris systems