Homework 1

Tuesday, April 2, 2019 8:47 AM

Due 4/9/2019

Problems from NINTH edition of Operating System Concepts

- 1.19 What is the purpose of interrupts? How does an interrupt differ from a trap? Can traps be generated intentionally by a user program? If so, for what purpose?
  - An interrupt is a flow change that is generated within the system by hardware. A trap is a interrupt generated by software. An interrupt has a use to signal the completion of an input / output (I/O). Traps can be generated intentionally and can be used to catch arithmetic errors or call operating system functions/routines.

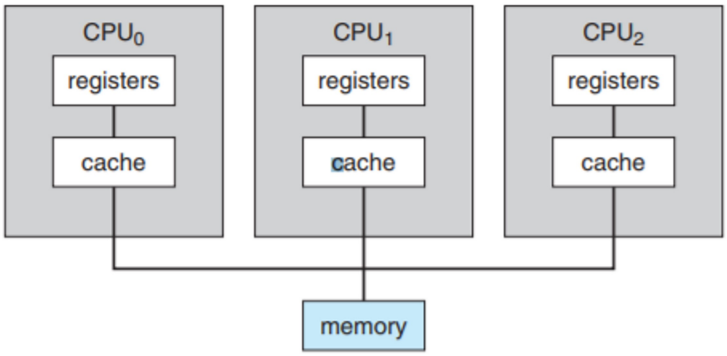

Figure 1.6 Symmetric multiprocessing architecture.

- 1.23 Consider an SMP system similar to the one shown in Figure 1.6. Illustrate with an example how data residing in memory could in fact have a different value in each of the local caches.
  - Imagine two CPUS, CPU1 and CPU2 each with a register and a local cache. When CPU1 reads a data C, with a value say 8, from main memory, it stores it into the local cache. Likewise, CPU2 reads a data value into its own cache as well. However, when CPU1 updates the data value C, from 8 to 15, the update will only occur in CPU1 and will not occur in CPU2. As data C is not stored inside CPU2.
- 2.6 What system calls have to be executed by a command interpreter or shell in order to start a new process?
  - For a Unix system, a fork system call is done initially, then followed by an exec system call which starts a new process. By doing so, the fork clones the immediate exec system call, and the exec call has a new process created on top which is then based on a different executable comparative to the initial calling process.
- 2.21 What is the main advantage of the microkernel approach to system design? How do user programs and system services interact in a microkernel architecture? What are the disadvantages of using the microkernel approach?
  - A microkernel has three main advantages
    a. When adding a new service, the kernel doesn't need to be changed
    b. Security risked is reduced as a higher amount of operations are done in user mode than in kernel mode
    c. A simpler kernel design can be used which results in a more stable and reliable operating system
  - The microkernel primary disadvantage is the overheads needed.
  - User programs and system services interact using interprocess communication mechanisms like messaging. The messaging is then sent by the operating system.
- 2.22 What are the advantages of using loadable kernel modules?
  - Loadable kernel modules allow functionality to be added and removed while the kernel is still

running. No recompilation or rebooting is necessary for the kernel. This also alleviates the design portion of the kernel as one doesn't need to know all potential operating system features there is.

- Choose one System from the slides in Lecture One (Eniac, System 360, Multics, Android, etc..) and describe in detail (one paragraph) its importance to the evolution of Operating Systems
    - Multics was an early time-sharing operating system that primarily focused on the concept on single-level memory. Building many of the important and core features in OS early on which are found in more modern OS now. There were many interesting ideas in Multics, one which was disregarding a distinction between file and process memory, lumping everything together as 'segments' which eventually formed the core idea of virtual memory. Another addition was dynamic linking where applications could use the latest version of any external routine called, which kept consistent versions being run among different users. This was done by allowing other segments being added to the address space. Multics also pioneered the idea of on-line reconfiguration to a new level, where you could swap in and out CPUs, disk drives, memory storage devices without any issue. The final large addition Multics added was the idea of an hierarchical file system, and a command processor in user code, both ideas of which Unix took inspiration from.
- Build and compile both a java and C++ application on a Linux system (do not turn in)
    - Done through WSL and through Linux remote.