Exercises 1.26, 1.30, 2.6, 2.21, 2.25

1.26 Consider an SMP system similar to what is shown in Figure 1.6. Illustrate with an example how data residing in memory could in fact have two different values in each of the local caches.

Let memory location $A000F000 contain the decimal number 100. Now let both CPU 0 and CPU 1 pull the data at $A000F000 into their local caches. At this point both CPUs have the value of 100. Next let CPU 0 change that value to 50, while CPU 1 changes it to 200. Since both processors are operating on their own local copy of the data, then there are two different values between each processor, and still a third different (original) value remaining at memory location $A000F000.

1.30 Define the essential properties of the following types of operating systems:

a. Batch: “[L]ong-running jobs are submitted to the computer and run without human interaction until completed. These systems may have no time constraints at all” (Silberschatz, 33). Jobs are processed “in bulk, with predetermined input (from files or other sources of data)” (Silberschatz, 35).
b. Interactive: “[Hands-on] computer system [that] provides direct communication between the user and the system. The user gives instructions to the operating system or to a program directly, using a (sic) input device such as a keyboard or a mouse, and waits for immediate results on an output device” (Silberschatz, 19). “Interactive systems [wait] for input from users” (Silberschatz, 35).
c. Time sharing: Also called multitasking and “is a logical extension of multiprogramming. In time-sharing systems, the CPU executes multiple jobs by switching among them, but the switches occur so frequently that the users can interact with each program while it is running. Time sharing requires an interactive (or hands-on) computer system” (Silberschatz, 19), and it requires “that several jobs be kept simultaneously in memory” (Silberschatz, 20).
d. Real time: Type of operating system that is host to almost all embedded systems. It is “used when rigid time requirements have been placed on the operation of a processor or the flow of data. … A real-time system has well-defined, fixed time constraints. Processing must be done within the defined constraints, or the system will fail” (Silberschatz, 32).
e. Network: “[P]rovides features such as file sharing across the network and that includes a communication scheme that allows different processes on different computers to exchange messages. A computer running a network operating system acts autonomously from all other

computers on the network, although it is aware of the network and is able to communicate with other networked computers" (Silberschatz, 31).

f. Parallel: A type of system in which multiple components of a program are divided and run concurrently.
g. Distributed: "[A] collection of physically separate, possibly heterogeneous computer systems that are networked to provide the users with access to the various resources that the system maintains. Access to a shared resource increases computation speed, functionality, data availability, and reliability" (Silberschatz, 30).
h. Clustered: A "type of multiple-CPU system [that gathers] together multiple CUPs to accomplish computational work. [These] systems differ from multiprocessor systems … in that they are composed of two or more individual systems - or nodes - joined together. The definition of the term clustered is not concrete; many commercial packages wrestle with what a clustered system is and why one form is better than another. The generally accepted definition is that clustered computers share storage and are closely linked via a local-area network (LAN) or a faster interconnect, such as InfiniBand" (Silberschatz, 16).
i. Handheld: Types of systems such as Palm and Pocket-PCs, smartphones, and tablets. "Because of their size, most handheld devices have small amounts of memory, slow processors, and small display screens" (Silberschatz, 34). However, it should be noted that this information is very fast becoming outdated owing to the fact that today's handheld devices are much more powerful than those at the time of this book's printing.

2.6 What system calls have to be executed by a command interpreter or shell in order to start a new process?

The fork() system call (on UNIX-based systems) starts a new, identical process, and then the exec() system call is used to load the selected program into memory to be executed.

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?

In a microkernel approach, the OS is structured “by removing all nonessential components from the kernel and implementing them as system and user-level programs. The result is a smaller kernel” (Silberschatz, 73). This modularization of services affords “ease of extending the operating system. All new services are added to user space and consequently do not require modification of the kernel. When the kernel does have to be modified, the changes tend to be fewer, because the microkernel is a smaller kernel. The resulting operating system is easier to port from one hardware design to another. The microkernel also provides more security and reliability, since most services are running as user—rather than kernel—processes. If a service fails, the rest of the operating system remains untouched” (Silberschatz, 74).

A microkernel provides “a communication faclity between the client program and the various services that are also running in user space. Communication is provided by message passing” (Silberschatz, 74).

The disadvantages of a microkernel approach that message passing incurs expensive overhead which is coupled with the fact that many messages are passed between processes (Silberschatz, 74).

2.25 What is the relationship between a guest operating system and a host operating system in a system like VMware? What factors need to be considered in choosing the host operating system?

A guest operating system is logically separated from its host system in that the guest system is often tricked into believing that it is running on real hardware where in fact the hardware it thinks it is running on is simply a file on the host OS. The services of a guest OS are mapped to those provided by its host. For this to happen, a host operating system must provide a system call interface that is capable of accurately translating the system calls of the guest operating system.

How has Ken Thompson influenced the Computer Industry?

“Kenneth Lane Thompson was the principal inventor of UNIX. Even today, more than 35 years later, UNIX and its descendants are still widely regarded as the best computer operating systems to have ever been developed.” (LINFO)

Works Cited

LINFO. "Ken Thompson: A Brief Introduction." Ken Thompson: Developed UNIX at Bell Labs. n.d. Web. <http://www.linfo.org/thompson.html>.

Silberschatz, Abraham, Greg Gagne, Peter B. Galvin, and Abraham Silberschatz. Operating System Concepts with Java. 8th ed. Hoboken, NJ: John Wiley & Sons, 2010. Print.