Modern Operating Systems

- Microkernel architecture
  - Assigns only a few essential functions to the kernel
    - Address spaces
    - Interprocess communication (IPC)
    - Basic scheduling
Modern Operating Systems

- Multithreading
  - Process is divided into threads that can run concurrently
    - Thread
      - Dispatchable unit of work
      - executes sequentially and is interruptable
    - Process is a collection of one or more threads
Modern Operating Systems

- Symmetric multiprocessing (SMP)
  - There are multiple processors
  - These processors share same main memory and I/O facilities
  - All processors can perform the same functions
Multiprogramming and Multiprocessing

1 processor multiprogramming

(a) Interleaving (multiprogramming, one processor)

2 processors multiprocessing

(b) Interleaving and overlapping (multiprocessing; two processors)

Sequence 4

Figure 2.12 Multiprogramming and Multiprocessing
Modern Operating Systems

- Distributed operating systems
  - Provides the illusion of a single main memory space and single secondary memory space
Modern Operating Systems

• Object-oriented design
  – Used for adding modular extensions to a small kernel
  – Enables programmers to customize an operating system without disrupting system integrity
Windows Architecture

- Modular structure for flexibility
- Executes on a variety of hardware platforms
- Supports application written for other operating system
Windows 2000 Architecture

Sequence 4

Lsass = local security authentication server
POSIX = portable operating system interface
GDI = graphics device interface
DLL = dynamic link libraries

Colored area indicates Executive
Operating System Organization

• Modified microkernel architecture
  – Not a pure microkernel
  – Many system functions outside of the microkernel run in kernel mode
• Any module can be removed, upgraded, or replaced without rewriting the entire system
Kernel-Mode Components

• Executive
  – Contains base operating system services
    • Memory management
    • Process and thread management
    • Security
    • I/O
    • Interprocess communication

• Kernel
  – Consists of the most used components
Kernel-Mode Components

- Hardware abstraction layer (HAL)
  - Isolates the operating system from platform-specific hardware differences
- Device drivers
  - Translate user I/O function calls into specific hardware device I/O requests
- Windowing and graphics systems
  - Implements the graphical user interface (GUI)
Windows Executive

- I/O manager
- Cache manager
- Object manager
- Plug and play manager
- Power manager
- Security reference monitor
- Virtual memory manager
- Process/thread manager
- Configuration manager
- Local procedure call (LPC) facility
User-Mode Processes

- Special system support processes
  - E.g.: logon process and the session manager
- Service processes
- Environment subsystems
- User applications
Client/Server Model

- Simplifies the Executive
  - Possible to construct a variety of APIs
- Improves reliability
  - Each service runs on a separate process with its own partition of memory
  - Clients cannot directly access hardware
- Provides a uniform means for applications to communicate via LPC
- Provides base for distributed computing
Threads and SMP

- Operating system routines can run on any available processor
- Different routines can execute simultaneously on different processors
- Multiple threads of execution within a single process may execute on different processors simultaneously
- Server processes may use multiple threads
- Share data and resources between process
Windows Objects

• Windows relies heavily on object oriented design
  – Encapsulation
    • Object consists of one or more data items and one or more procedures
  – Object class or instance
    • Create specified instances of an object
  – Inheritance
    • Support to some extent in the Executive
  – Polymorphism
UNIX

• Hardware is surrounded by the operating system software
• Operating system is called the system kernel
• Comes with a number of user services and interfaces
  – Shell
  – Components of the C compiler
UNIX

Figure 2.14 General UNIX Architecture
UNIX Kernel

Fig. 2.15
Modern UNIX Kernel
Fig 2.16

Diagram of Modern UNIX Kernel.
Some UNIX Systems

- System V Release 4 (SVR4)
- Solaris 10
- 4.4BSD
- Linux
- OS X