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

2 processors multiprocessing

![Diagram showing multiprogramming and multiprocessor scenarios.](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
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

Fig. 2.14 General UNIX Architecture

UNIX Kernel

Fig. 2.15
Some UNIX Systems

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