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 multiprocessoring (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

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

Figure 2.14 General UNIX Architecture
UNIX Kernel

Fig. 2.15
Modern UNIX Kernel
Fig 2.16

Common Facilities

- exec switch
- vnode/vfs interface
- STREAMS
- scheduler framework
- block device switch
- virtual memory framework
- file mappings
- device mappings
- anonymous mappings

Connections:
- a.out
- elf
- coff
- NFS
- FFS
- s5fs
- RFS
- time-sharing processes
- system processes
- network driver
- tty driver
- disk driver
- tape driver
Some UNIX Systems

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