

The Operating System

- An Operating System (OS) is a computer program
 - It controls the use of system resources by application programs
 - It provides services (and interfaces to those services) that many application programs use

Controlling System Resources: The Four Useful Illusions

- Many separate computers, one for each process
- Large memory
- Disks and other secondary storage are organized as collections of files
- Windows and menus (an interaction metaphor)

Separate Computer Illusion: Memory and Processor allocation

- OS allocates memory to processes/applications
 - Terminology: process is an execution of program
 - Don't allow processes to read/write outside own area
- OS allocates processor cycles
 - After a short time-slice, process is interrupted (stops executing)
 - OS lets another process execute some instructions
 - When first process resumes, it doesn't know it was ever interrupted (the "own processor illusion")
 - Programs can be written as if executions will not be interrupted

Large Memory Illusion: OS Memory Handling

- OS allocates memory to applications
- Each memory access is mediated by OS
 - Branch to OS, OS fetches, then returns control to application
 - Indirection
 - Application refers to memory location relative to the allocation and OS decodes request, figuring out where data really is

Benefits of OS Memory Handling

- Protection
 - OS ensures that no process accesses another's area
- Larger “virtual memory”
 - OS may fetch some locations from disk rather than main memory
 - Application program unaware of location of data on disk or RAM

File Illusion: I/O Handling and File Systems

- Devices actually have physical storage (e.g., sectors and tracks on a hard disk)
- But it's easier for users and programmers to think about directories and files
- OS Provides file system operations
 - Create, delete, open, close a file
 - Set access privileges on file
 - Seek to particular position in file
 - Read or write at current position
- OS Maps all of these into operations on the physical devices
 - OS has device driver program for each component
- Different OSs provide slightly different abstractions
 - DOS/Windows (FAT16, FAT32, NTFS); Mac (HFS+, UFS)
 - Different filename conventions, different allocation schemes, different ways of storing maps of data, etc.

Windows Illusions: An Interaction Metaphor

- Reality: Screen is an array of pixels
- Illusion 1: Menus
 - Depending on where you click, different action happens
 - Technique: OS looks up location where mouse was clicked, executes appropriate action
- Illusion 2: Overlapping windows
 - A window may cover part or all of another
 - When a window is uncovered, its contents appear
 - Technique: OS saves bitmap of covered windows
 - Application does not need to know how to redraw the contents of its window; just how to draw it initially

User Input And Event Handling

- OS gathers input (keyboard, mouse) into a buffer
 - OS passes mouse input to process responsible for graphical interface
 - OS passes keyboard input to "current process"
- Processing keyboard or mouse input can change current process, what windows are displayed, etc.
 - Alt-F4, command-Q, minimize window button, etc.

OS Architecture

- Often have a small kernel
 - Performs most basic functions
- Other functions added as separate programs
 - File system
 - Networking
 - User interface shell
 - Functions which are useful to include in the OS but are outside the kernel are middleware
 - In a layer between the operating system and applications
 - Middleware is often OS independent
 - Higher level functions are also sometimes called middleware
 - E.g., transaction processing, mobile code (e.g., Java interpreter)