Operating Systems

Without an operating system, a computer would not be useful. Minimally, you need an operating system to locate files and to start programs. The programs that you run need services from the operating system to access devices and to interact with other programs. Operating systems on large computers need to provide more services than those on personal computers do.

Here are some typical services:

- *Program loading.* Every operating system provides some way of launching application programs. The user indicates what program should be run, usually by typing the name of the program or by clicking on an icon. The operating system locates the program code, loads it into memory, and starts it.

- *Managing files.* A storage device, such as a hard disk is, electronically, simply a device capable of storing a huge sequence of zeroes and ones. It is up to the operating system to bring some structure to the storage layout and organize it into files, folders, and so on. The operating system also needs to impose some amount of security and redundancy into the file system so that a power outage does not jeopardize the contents of an entire hard disk. Some operating systems do a better job in this regard than others.
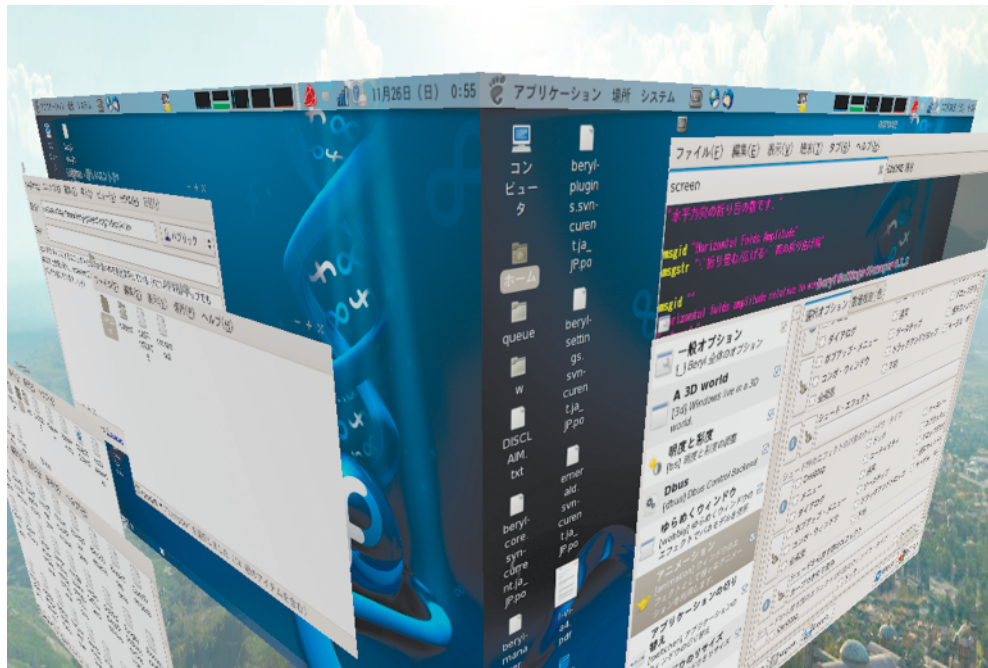
A Graphical Software Environment for the Linux Operating System

- *Virtual memory.* RAM is expensive, and few computers have enough RAM to hold all programs and their data that a user would like to run simultaneously. Most operating systems extend the available memory by storing some data on the hard disk. The application programs do not realize whether a particular data item is in memory or in the virtual memory disk storage. When a program accesses a data item that is currently not in RAM, the processor senses this and notifies the operating system. The operating system swaps the needed data from the hard disk into RAM, simultaneously swapping out a memory block of equal size that had not been accessed for some time.

- *Handling multiple users.* The operating systems of large and powerful computers allow simultaneous access by multiple users. Each user is connected through a separate terminal. The operating system authenticates users by checking that each one has a valid account and password. It gives each user a small slice of processor time, then serves the next user.

- *Multitasking.* Even if you are the sole user of a computer, you may want to run multiple applications—for example, to read your e-mail in one window and run the Java compiler in another. The operating system is responsible for dividing processor time between the applications you are running, so that each can make progress.

- *Printing.* The operating system queues up the print requests that are sent by multiple applications. This is necessary to make sure that the printed pages do not contain a mixture of words sent simultaneously from separate programs.

- *Windows.* Many operating systems present their users with a desktop made up of multiple windows. The operating system manages the location and appearance of the window frames; the applications are responsible for the interiors.

- *Fonts.* To render text on the screen and the printer, the shapes of characters must be defined. This is especially important for programs that can display multiple type styles and sizes. Modern operating systems contain a central font repository.

- *Communicating between programs.* The operating system can facilitate the transfer of information between programs. That transfer can happen through *cut and paste* or *interprocess communication.* Cut and paste is a user-initiated data transfer in which the user copies data from one application into a transfer buffer (often called a "clipboard") managed by the operating system and inserts the buffer's contents into another application. Interprocess communication is initiated by applications that transfer data without direct user involvement.

- *Networking.* The operating system provides protocols and services for enabling applications to reach information on other computers attached to the network.

Today, the most popular operating systems for personal computers are Linux (see the figure), the Macintosh OS, and Microsoft Windows.