Computing Architecture Concepts

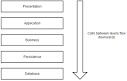
A computer is a machine designed to process, store, and retrieve data. Data may be numbers in a spreadsheet, characters of text in a document, dots of colour in an image, waveforms of sound, or the state of some system, such as a CPU fan or a CD player. All data is stored in the computer as binary.

The computer manipulates the data by performing operations on the binary. Displaying an image on a screen is accomplished by moving an array of numbers to the video memory, each number representing a pixel of colour. To play an MP3 audio file, the computer reads an array of numbers from disk and into memory, manipulates those numbers to convert the compressed audio data into raw audio data, and then outputs the new set of numbers (the raw audio data) to the audio chip.

Everything that a computer does, from web browsing to printing, involves moving and processing binary. The electronics of a computer is nothing more than a system designed to hold, move, and change the binary.

A computer system is composed of many parts, both hardware and software. At the heart of the computer is the processor, the hardware that executes the computer programs. The computer also has memory, often several different types in one system. The memory is used to store programs while the processor is running them, as well as store the data that the programs are manipulating. The computer also has devices for storing data, or exchanging data with the outside world. These may allow the input of text via a keyboard, the display of information on a screen, or the movement of programs and data to or from a disk drive.

The software controls the operation and functionality of the computer.

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At the lowest level, there are programs that are run by the processor when the computer first powers up. These programs initialize the other hardware subsystems to a known state and configure the computer for correct operation. This software is known as firmware.

The bootloader is located in the firmware. The bootloader is a special program run by the processor that reads the operating system from disk and places it in memory so that the processor may then run it. The bootloader is present in desktop computers and may be present in some embedded computers.

Above the firmware, the operating system controls the operation of the computer. It organizes the use of memory and controls devices such as the keyboard, mouse, screen, disk drives, and so on. It is also the software that often provides an interface to the user, enabling her to run application programs and access her files on disk. The operating system typically provides a set of software tools for application programs, providing a mechanism by which they too can access the screen, disk drives, and so on. Not all embedded systems use or even need an operating system. Often, an embedded system will simply run code dedicated to its task, and the presence of an operating system is overkill. In other instances, such as network routers, an operating system provides necessary software integration and greatly simplifies the development process.

At the highest level, the application software constitutes the programs that provide the functionality of the computer. Everything below the application is considered system software. For embedded systems, the software layers can be blurred, reflecting an embedded systems needs to be straightforward and simplistic.