8086 Microprocessor (µP)

Introduction

The 8086 gave rise to the x86 architecture, which eventually became Intel's most successful line of processors.

Name	8086 µP = x86 = x86-32 = x32, x86-64 = x64
Designer	Intel, AMD (Advanced Micro Devices)
Bits	16-bit, 32-bit, and then 64-bit
Introduce	1978 (16-bit), 1985 (32-bit), 2003 (64-bit)

Have you ever come across x86-32 (also known as x32) and x86-64 (also known as x64) but do not know what they mean? We will cover everything you need to know about x86 and its architecture together with x64 and their differences between each other.

A CPU core, is the "brain" of a CPU. It receives instructions, and performs calculations, to satisfy those instructions. A CPU can have multiple cores. A processor with two cores is called a dual-core processor; with four cores, a quad-core; six cores, hexa-core; eight cores, octa-core. As of 2019, the majority of consumer CPUs feature between two and twelve cores. While, Workstation and Server CPUs may feature as many as 48 cores.

What is x86 Architecture?

The x86 is developed based on the Intel 8086 microprocessor and its 8088 variant where it started out as a 16-bit instruction set for 16-bit processors, and then it grew to 32-bit instruction sets. The bit (in both 32-bit and 16-bit) is shorthand for a number only. For example: For a 32-bit number, it will look like something like this 10101010101010101010101010101010.

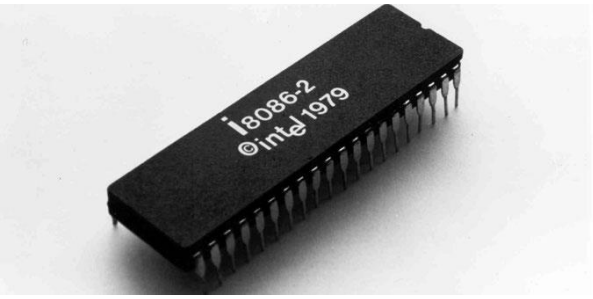

Fig. 1: The x86-32 architectures were based on the Intel 8086 **µP** chip

What is x64 Architecture?

x64 is shorthand for 64-bit processor architecture. It is often contrasted with x86 architecture, which refers to 32-bit Intel processors. However, x64 refers to all 64-bit processors, regardless of the manufacturer. The "x86-64" label specifies a 64-bit x86 processor.

The primary difference between a 32-bit and 64-bit processor is how the CPU addresses memory. A 32-bit processor can only access about 4 GB of RAM)addressable values). While a 64-bit processor can access over 4 billion times more memory than a 32-bit processor, removing any practical memory limitations. In short, any amount of memory greater than 4 GB can be easily handled by it. x64 processors can run 64-bit applications, which are built and compiled for 64-bit hardware.

Between 2000 and 2010, x64 processors grew in popularity. Both Microsoft and Apple released 64-bit versions of their operating systems. Since 2010, nearly all desktop and mobile devices have been built with x64 processors. Most applications are now 64-bit as well.

NOTE 1: In 2019, Apple released macOS 10.15 Catalina, which dropped support for 32-bit applications. As of 2020, Microsoft Windows still supports both 32 bit and 64-bit applications.

NOTE 2: It is important to make sure your processor meets the system requirements of a new application before installing it. Generally, you should install the 64-bit version if given a choice.

NOTE 3: Today, the term "x86" is used generally to refer to any 32-bit processor.

Fig. 2: The first CPU to introduce the x86-64 extensions in 2003 (AMD)

Operating System

Introduction

An Operating System (OS) is a software that acts as an interface between computer hardware components and the user. Every computer system must have at least one operating system to run other programs. Applications like Browsers, MS Office, Notepad Games, etc., need some environment to run and perform its tasks. OS is the first program run on a computer when the computer boots up.

The OS helps you to communicate with the computer without knowing how to speak the computer's language. It is not possible for the user to use any computer or mobile device without having an operating system.

Operating System - Definition: OS is a set of programs that controls the execution of application programs and acts as an interface between the user of a computer and the computer hardware. It represents the basic program on your computer that is automatically loaded when the computer is started up.

The operating system acts as a manager of the below resources and allocates them to specific programs and users, whenever necessary to perform a particular task. Therefore, an operating system is the Resource Manager i.e. it can manage the resource of a computer system internally. Here are some of the resources managed by the OS:

(1) Software (Data, Information) (2) Processors (3) Main memory
(4) Hardware (Peripheral devices) (5) networks (6) Secondary Memory

Operating systems play a critical role in many different areas of a computer's functioning.

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Responsibilities of OS:

1. Process isolation-prevent independent processes from interfering with each other.
2. Automatic allocation and management -transparent to the programmer.
3. Support of modular programming.
4. Protection and access control.
5. Long-Term Storage.

Operating system functions:

In an operating system, software performs each of the function:

1. **Process management:** Process management helps OS to create and delete processes. It also provides mechanisms for synchronization and communication among processes.
2. **Memory management:** Memory management module performs the task of allocation and de-allocation of memory space to programs in need of this resources.
3. **File management:** The files have to be stored in various storage devices. They have to be transferred from one storage device to another. This is taken care of by the OS. It manages all the file-related activities such as organization storage, retrieval, naming, sharing, and protection of files.
4. **Device Management:** Device management keeps tracks of all devices. This module also responsible for this task is known as the I/O controller. It also performs the task of allocation and de-allocation of the devices.
5. **I/O System Management:** One of the main objects of any OS is to hide the peculiarities of that hardware devices from the user.
6. **Secondary-Storage Management:** Systems have several levels of storage which includes primary storage, secondary storage, and cache storage. Instructions and data must be stored in primary storage or cache so that a running program can reference it.
7. **Security:** Security module protects the data and information of a computer system against malware threat and authorized access.

8. **Interpret Command & Error detection:** A command interpreter is the part of a computer operating system that understands and interpreting commands that are entered interactively by a human being or from a program. **Error detection - OS** needs to be constantly aware of possible errors. May occur in the CPU and memory hardware, in I/O devices, in a user program. For each type of error, OS should take the appropriate action to ensure correct and consistent computing.
9. **Networking:** A distributed system is a group of processors which do not share memory, hardware devices, or a clock. The processors communicate with one another through the network.
10. **Job accounting:** Operating system Keeps track of time and resources used by various tasks and users, this information can be used to track resource usage for a particular user or group of user.
11. **Assigning priority to job:** The OS is the one which has to decide and allot priority to the jobs which are to be executed.
12. **Communication management:** Coordination and assignment of compilers, interpreters, and another software resource of the various users of the computer systems.

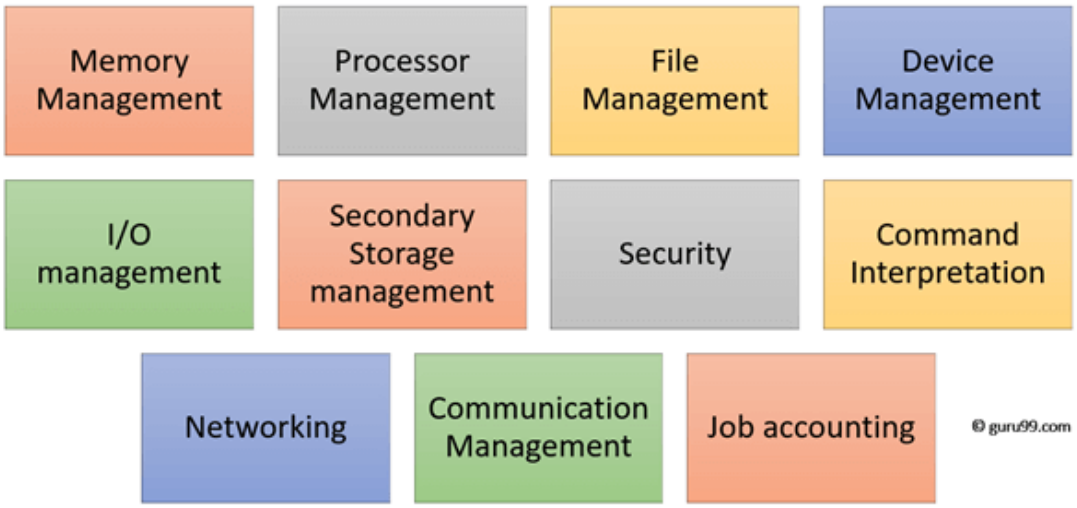

Fig. 3 Shows the Basic Functions of an Operating System

The OS provides a number of services (control & support) to assist the users of the computer system:

- **For the programmers:** Provides program development tools such as: debuggers, editors, file management, etc.
- **For the end-users:** Provides the interface to the application programs, e.g. Internet explorer.
- **For programs:** Loads instructions and data into memory, prepares I/O devises for usage, use CPU time, handles interrupts and error conditions.

The hierarchical view of the computer system illustrates how the OS interacts with the users of the computer system:

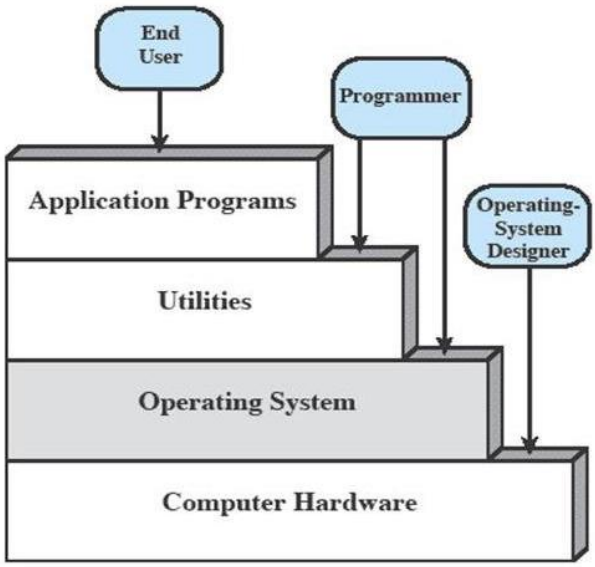

Fig. 4 shows the layers and views of a Computer System

Main Objectives in OS design:

- To make the computer system convenient and easy to use for user.
- To use the computer hardware in an efficient way.
- Execute user programs and make solving user problems easier
  - **Convenience:** makes computer user friendly.
  - **Efficiency:** allows computer to use resources efficiently.
  - **Ability to evolve:** constructed in a way to permit effective development, testing and introduction of new functions without interfering with service.