Pentium

Pentium is the name of the popular **microprocessor** produced by **Intel**, the largest **semiconductor** company in the world. The name Pentium was adopted when the 586 architecture was delivered (as a follow-up to the 286, 386, and 486 chips) because a name can be patented but a number could not. This prohibits the sale of chips named Pentium by other companies building functional copies of the microprocessor, as is the case for the Athlon chip, manufactured by **Advanced Micro Devices** (AMD).

Intel introduced the 8086 microprocessor in 1978. It was one of the first to provide 16-bit registers and a 16-bit memory **bus**. Although other options were available, the 8086 was adopted by **IBM** in 1981 as the core of its **personal computer** (PC) architecture. From then on, IBM PCs and compatibles remained tied to the Intel architecture, which has been evolving continually during the last 22 years.

The 80286 microprocessor was introduced by Intel in 1982; it was the basis of the PC/AT architecture. The new chip allowed addressing more than 1 megabyte (MB) of memory, one of the main design flaws in the original PCs. At the time, software applications were already being written that surpassed the available memory capacity of 1 MB in the first PCs.

The next chip generation was introduced in 1985. The 80386 microprocessor provided a 32-bit internal architecture with a 32-bit bus. The chip was much faster than the 8088 and the 80286 but was downwardly compatible with both of them. This was a very important component of Intel's strategy: Although every new processor introduced novel features, they were always compatible with older chips. **Software** written and compiled for the 8088 continued running on the 80386 in *native mode*. Of course, software developers could compile their programs for the new chip, but most of them opted for the lowest common denominator (the 8088), thus guaranteeing that the programs could run on any PC.

At this point a pattern can be identified: A new microprocessor generation is introduced roughly every three to four years (1978, 1982, 1985). Following this trend, the 80486 microprocessor was released in 1989. It included an internal **cache** to make execution faster and integrated the **floating-point** coprocessor with the integer unit in a single package. Until then, the **central processing unit** (CPU) and the floating-point coprocessor were two different chips that had to be placed side by side on the **motherboard**. Integrating the numeric coprocessor with the CPU meant that almost all of Intel's competitors in the floating-point field went out of business.

The next chip generation, the 80586, was released in 1993 and was renamed Pentium for the aforementioned patent reasons. Intel had fought a long series of battles with other semiconductor manufacturers, claiming that they had stolen parts of Intel's circuit design. It is not illegal to build a functional copy of a chip, but it is illegal to copy the chip layout of the original producer. Companies that design copies of a chip usually capture the entire design process on videotapes taken in a clean room, where the designers are isolated from the rest of the company. This separation is needed because the same company building the clone can also be a second source for Intel processors. In the semiconductor field, due to its cyclic nature, manufacturers usually produce chips for other companies in their own **silicon** foundries. This was the case with AMD, which was the manufacturer of Intel chips for Intel under a licensing agreement but was at the same time designing its own line of microprocessor clones. "Intel inside" stickers now make potential customers aware if an Intel chip or a clone from the competitors is used in a PC.

The Pentium has gone through two other major releases: the Pentium II was delivered in 1997 and the Pentium III in 1999. All Pentium chips have a 32-bit internal register architecture but a 64-bit external bus. This means that two 32-bit words can be loaded at the same time. This is important for the Pentium chips, because they use pipelining and have a *superscalar* design. Superscalar means that although the instruction stream is read sequentially from the memory, the instructions are executed in parallel. The Pentium also uses instruction reordering—that is, the internal execution order of the instructions is optimized for internal parallelism. This could mean, for

example, that 10 instructions are executed in exactly the reverse order in which they are read, but this is not visible from the outside since the final results are provided as if the instructions had been executed in the original order. To keep its pipeline and functional units busy, the Pentium needs to access memory at the fastest possible rate. Therefore, several levels of caching are used to hold the data and the program. Whereas the 8088 chip had a clock rate of only 5 megahertz, the Pentium III can be clocked with up to 1 gigahertz, that is, 200 times faster.

The Pentium III includes many state-of-the-art features such as multiple branch prediction (to predict in advance if a program will branch), new instructions for data streaming (video and audio), and the MMX extensions. The MMX instructions work with the floating-point registers (which are 64 bits wide), handling them as a vector of eight 8-bit numbers. Each 8-bit number can represent, for example, the color of a pixel on the screen. The same operation can be applied at once to the eight components of the vector. This makes it possible to speed up many common multimedia operations. The MMX extensions are in fact a type of integrated small array processor of SIMD (single instruction multiple data) type.

Although Intel released the Itanium processor in 1999, a new 64-bit architecture developed together with **Hewlett-Packard**, the popularity of the Pentium line, and the sheer number of computers using this chip, mean that it will continue to be available well into the first decade of the twenty-first century.

FURTHER READING

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—Raúl Rojas

Perl

Perl is a computing language, popularly referred to as a *scripting language* and most often compared to Python, Tcl, and Rexx. However, its inventor, Larry Wall, emphasizes that Perl is a general-purpose computing language suited to about the same range of tasks as such languages as **C**, **C++**, and **Java**.

Wall originally invented Perl in 1986 to generate reports common in system administration of **Unix** hosts. Early Perl did many of the same jobs as the common Unix utilities "sed" and "awk," but faster and with wider generality. Perl thus became popular among Unix administrators.

When the **World Wide Web** exploded during 1994 and 1995, Perl was widely adopted as the language of choice for scripting the common gateway interface (CGI) dynamic content. Perl's strong string manipulation capabilities and expressiveness are a good match for CGI tasks. Perl has been so successful in this role that many people mistakenly identify CGI and Perl, or believe that Perl is the only language that can be used to script Web content.

Perl has continued to mature in several dimensions that do not relate directly to either system administration or Web work. The most important advances of the second half of the 1990s included direct support of **object-oriented programming** styles; enhanced portability, especially to such operating systems as **Windows** and MacOS; **graphical user interface** (GUI) bindings; and mechanisms for support and maintenance of Perl that have made its adoption by commercial organizations more comfortable.

Perl's appeal, like that of any computing language, arises from the interplay of several dimensions. It is important to distinguish these aspects: the abstract language, particular implementations, the support library to the language, and the "social" practices and habits that surround the language.

The abstract Perl language superficially resembles other common languages, including awk, /bin/sh, and C. It is quite different from many other languages in that it does *not* aspire to such qualities as orthogonality and simplicity. Wall has a background in (human) linguistics and a strong sense that Perl should be an