

IA-32

IA-32 (short for "**Intel Architecture, 32-bit**", sometimes also called **i386**^{[1][2][3]}) is the 32-bit version of the x86 instruction set architecture, designed by Intel and first implemented in the 80386 microprocessor in 1985. IA-32 is the first incarnation of x86 that supports 32-bit computing;^[4] as a result, the "IA-32" term may be used as a metonym to refer to all x86 versions that support 32-bit computing.^{[5][6]}

Within various programming language directives, IA-32 is still sometimes referred to as the "i386" architecture. In some other contexts, certain iterations of the IA-32 ISA are sometimes labelled **i486**, **i586** and **i686**, referring to the instruction supersets offered by the 80486, the P5 and the P6 microarchitectures respectively. These updates offered numerous additions alongside the base IA-32 set including floating-point capabilities and the MMX extensions.

Intel was historically the largest manufacturer of IA-32 processors, with the second biggest supplier having been AMD. During the 1990s, VIA, Transmeta and other chip manufacturers also produced IA-32 compatible processors (e.g. WinChip). In the modern era, Intel still produced IA-32 processors under the Intel Quark microcontroller platform until 2019; however, since the 2000s, the majority of manufacturers (Intel included) moved almost exclusively to implementing CPUs based on the 64-bit variant of x86, x86-64. x86-64, by specification, offers legacy operating modes that operate on the IA-32 ISA for backwards compatibility. Even given the contemporary prevalence of x86-64, as of 2018, IA-32 protected mode versions of many modern operating systems are still maintained, e.g. Microsoft Windows (until Windows 10; Windows 11 requires x86-64-compatible processor for x86 versions)^[7] and the Debian Linux distribution.^[8] In spite of IA-32's name (and causing some potential confusion), the 64-bit evolution of x86 that originated out of AMD would not be known as "IA-64", that name instead belonging to Intel's Itanium architecture.

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Architectural features

The primary defining characteristic of IA-32 is the availability of 32-bit general-purpose processor registers (for example, EAX and EBX), 32-bit integer arithmetic and logical operations, 32-bit offsets within a segment in protected mode, and the translation of segmented addresses to 32-bit linear addresses. The designers took the opportunity to make other improvements as well. Some of the most significant changes (relative to the 16-bit 286 instruction set) are described below.

32-bit integer capability

All general-purpose registers (GPRs) are expanded from 16 bits to 32 bits, and all arithmetic and logical operations, memory-to-register and register-to-memory operations,

etc., can operate directly on 32-bit integers. Pushes and pops on the stack default to 4-byte strides, and non-segmented pointers are 4 bytes wide.

More general addressing modes

Any GPR can be used as a base register, and any GPR other than ESP can be used as an index register, in a memory reference. The index register value can be multiplied by 1, 2, 4, or 8 before being added to the base register value and displacement.

Additional segment registers

Two additional segment registers, FS and GS, are provided.

Larger virtual address space

The IA-32 architecture defines a 48-bit segmented address format, with a 16-bit segment number and a 32-bit offset within the segment. Segmented addresses are mapped to 32-bit linear addresses.

Demand paging

32-bit linear addresses are virtual addresses rather than physical addresses; they are translated to physical addresses through a page table. In the 80386, 80486, and the original Pentium processors, the physical address was 32 bits; in the Pentium Pro and later processors, the Physical Address Extension allowed 36-bit physical addresses, although the linear address size was still 32 bits.

Operating modes

Operating mode	Operating system required	Type of code being run	Default address size	Default operand size	Typical GPR width
<u>Protected mode</u>	32-bit operating system or boot loader	32-bit protected-mode code	32 bits	32 bits	32 bits
	16-bit protected-mode operating system or boot loader, or 32-bit boot loader	16-bit protected-mode code	16 bits	16 bits	16 or 32 bits
<u>Virtual 8086 mode</u>	16- or 32-bit protected-mode operating system	16-bit real-mode code	16 bits	16 bits	16 or 32 bits
<u>Real mode</u>	16-bit real-mode operating system or boot loader, or 32-bit boot loader	16-bit real-mode code	16 bits	16 bits	16 or 32 bits
<u>Unreal mode</u>	16-bit real-mode operating system or boot loader, or 32-bit boot loader	16-bit real-mode code	32 bits	16 bits	16 or 32 bits

See also

- x86-64
- IA-64
- List of former IA-32 compatible processor manufacturers
- Transient execution CPU vulnerability

References

1. "DITTO" (<https://web.archive.org/web/20120602013413/https://developer.apple.com/library/mac/#documentation/Darwin/Reference/ManPages/man1/ditto.1.html>). *BSD General Commands Manual*. Apple. December 19, 2008. Archived from the original (<https://developer.apple.com/library/mac/#documentation/Darwin/Reference/ManPages/man1/ditto.1.html>) on

June 2, 2012. Retrieved August 3, 2013. "Thin Universal binaries to the specified architecture [...] should be specified as "i386", "x86_64", etc."

2. "Additional Predefined Macros" (<https://software.intel.com/content/www/us/en/develop/documentation/cpp-compiler-developer-guide-and-reference/top/compiler-reference/macros/additional-predefined-macros.html>). *software.intel.com*. Intel. Archived (<https://web.archive.org/web/20210215084323/https://software.intel.com/content/www/us/en/develop/documentation/cpp-compiler-developer-guide-and-reference/top/compiler-reference/macros/additional-predefined-macros.html>) from the original on February 15, 2021. Retrieved November 25, 2020.
3. Kemp, Steve. "Running 32-bit Applications on 64-bit Debian GNU/Linux" (<http://www.debian-administration.org/articles/534>). *Debian Administration*. Archived (<https://web.archive.org/web/20130916160905/http://www.debian-administration.org/articles/534>) from the original on September 16, 2013. Retrieved August 31, 2013.
4. "Intel 64 and IA-32 Architectures Software Developer's Manual" (<http://www.intel.com/content/www/us/en/processors/architectures-software-developer-manuals.html>). Intel Corporation. September 2014. p. 31. Archived (<https://web.archive.org/web/20120126002939/http://www.intel.com/content/www/us/en/processors/architectures-software-developer-manuals.html>) from the original on January 26, 2012. Retrieved December 19, 2014. "The Intel386 processor was the first 32-bit processor in the IA-32 architecture family. It introduced 32-bit registers for use both to hold operands and for addressing."
5. Green, Ronald W. (May 5, 2009). "What do IA-32, Intel 64 and IA-64 Architecture mean?" (<https://software.intel.com/en-us/articles/ia-32-intelr-64-ia-64-architecture-mean/>). *software.intel.com*. Intel. Archived (<https://web.archive.org/web/20141219144304/https://software.intel.com/en-us/articles/ia-32-intelr-64-ia-64-architecture-mean/>) from the original on December 19, 2014. Retrieved December 19, 2014.
6. "Supported Hardware" (<https://archive.today/20141219153039/https://help.ubuntu.com/12.04/installation-guide/en.i386/ch02s01.html>). *Ubuntu Help*. Canonical. Archived from the original (<https://help.ubuntu.com/12.04/installation-guide/en.i386/ch02s01.html>) on December 19, 2014. Retrieved August 31, 2013.
7. "Windows 10 System Requirements & Specifications | Microsoft" (<https://www.microsoft.com/en-us/windows/windows-10-specifications#primaryR2>). *www.microsoft.com*. Archived (<https://web.archive.org/web/20180501190351/https://www.microsoft.com/en-us/windows/windows-10-specifications#primaryR2>) from the original on May 1, 2018. Retrieved August 20, 2018.
8. "Debian GNU/Linux on x86 Machines" (<https://www.debian.org/ports/i386/>). Archived (<https://web.archive.org/web/20190428051247/https://www.debian.org/ports/i386/>) from the original on April 28, 2019. Retrieved August 20, 2020.

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