Intel Wins in Four Decades, but AMD Catches Up

The Editor's Poll on Favorite Microprocessors

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Microprocessors have evolved substantially since the introduction of the Intel 4004 half a century ago. Over the years, several processors have stood out for their innovative designs, commercial successes, forays into new application domains, and significant performance and efficiency enhancements compared to their competitors. We polled the computer architecture community, and received votes from 254 processor designers and engineers, researchers from academia and industry, faculty, and graduate students, identifying their favorite processors from every decade since the 1970s, as well as their favorite processor of all time. The results of the poll are presented in this article.

1970s: THE EARLY DECADE

While the Intel 4004 was undoubtedly the pioneer, the Intel 8086, launched in 1978, was clearly the most popular choice for the 1970s, with almost 30% of the vote (see Figure 1). Even today, processors based on x86 architectures continue to dominate in the desktop, server, and cloud computing segments. The DEC PDP-11, the most popular minicomputer of the 1970s also found favor with over 21% of the vote.

Here are a few comments from the supporters of DEC PDP-11:

> *"The PDP-11 was an elegant clean, clear design, rich without being overdone."*

> *"I like the PDP-11 for its clean and beautiful ISA."*

0272-1732 © 2021 IEEE
Digital Object Identifier 10.1109/MM.2021.3119825
Date of current version 19 November 2021.

Admirers of Intel 8086 wrote:

> *"This laptop in front of me and that ~40-year-old chip share the same fundamental architecture."*

> *"The 8086 led to the x86 architecture, which eventually became Intel's most successful line of processors which has impacted the entire computer industry."*

1980s: THE RISE OF RISC

Following the introduction of Intel 8086, the Intel 80x86 series of processors laid the foundation for future generations of Intel processors. From the 16-bit 80186 (launched in 1982) containing around 50,000 transistors to the 32-bit 80486 processor (launched in 1989), comprising of over a million transistors, the x86 family of processors developed rapidly both in complexity of design as well as performance through the 1980s and was favored by nearly 44% of the community (see Figure 2). The MIPS R2000 that ushered in the RISC era was second, with 32% of the vote.

Comments from supporters of MIPS R2000 include:

> *"A very clean RISC architecture. Showed that a processor can work without hardware interlocks."*

> *"The cleanest architecture (save for delayed branches), decent performance, perfect for education."*

Some Intel 80x86 voters wrote:

> *"Clearly, the 80x86 has dominated the PC market for over three decades."*

> *"80386 for launching the attack of the killer micros. First easy to buy processor that condensed a lot of big-iron OS principles. IMHO,*

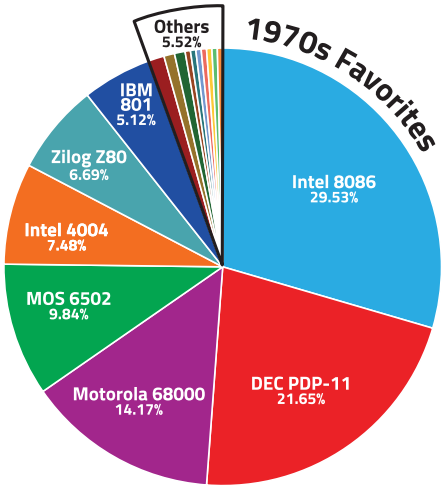

FIGURE 1. Favorite microprocessors from the 1970s.

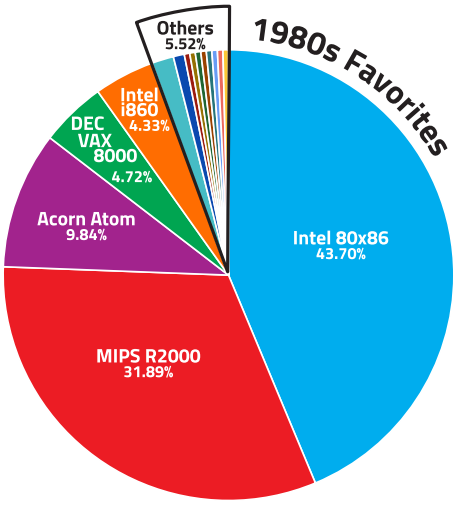

FIGURE 2. Favorite microprocessors from the 1980s.

we owe a lot of the open-source revolution (Linux, etc.) to 80386."

1990s: THE RACE FOR GHz

Intel continued its early dominance of this poll through the 1990s with the Pentium processor series winning over 31% of the vote (see Figure 3). The Out-of-Order (OoO) superscalar P6 microarchitecture branded as Pentium Pro was introduced in the middle of this decade. The DEC Alpha processor ran a close second, with 28% of the vote. One of the final offerings from the Digital Equipment Corporation, the Alpha processor was a RISC-based architecture that was positioned as a counterpoint to the CISC-based VAX series.

The DEC Alpha enthusiasts wrote:

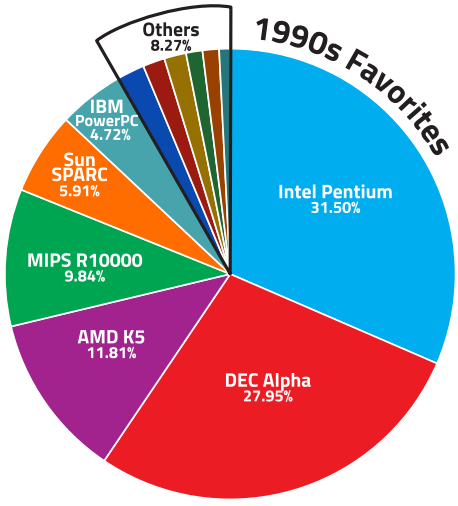

FIGURE 3. Favorite microprocessors from the 1990s

"The Alpha was a tour-de-force. It was the last no compromise RISC architecture and pushed the envelope in almost all fields of computing. We still reap the exploits of that."

"The cleanest architecture (save for delayed branches), decent performance, perfect for education."

The fans of Intel Pentium wrote:

"It is the Pentium pro that led the PCs to replace the RISC processors everywhere and that architecture is still alive, from 150MHz to 5GHz."

"The Pentium Pro (first OoO from Intel) saved the x86 ISA from the onslaught of the RISC cores machines by playing their game!"

2000s: EFFICIENT MULTICORE DESIGN

Intel processors continued to be favored among the voters, despite the turn of the century. The Intel Core line, derived from the Pentium M processor series, was launched in 2006 and was favored by 23% of the voters (see Figure 4). The Core architecture continues to be the basis for several current-day processors targeting desktop and mobile markets. Meanwhile, the AMD Opteron was in second place, garnering 17% of the votes; however, it may be noted that Intel processors grabbed three out of the top four spots.

Some admirers of AMD Opteron wrote:

"AMD64 changed the game and saved the world (of x86)."

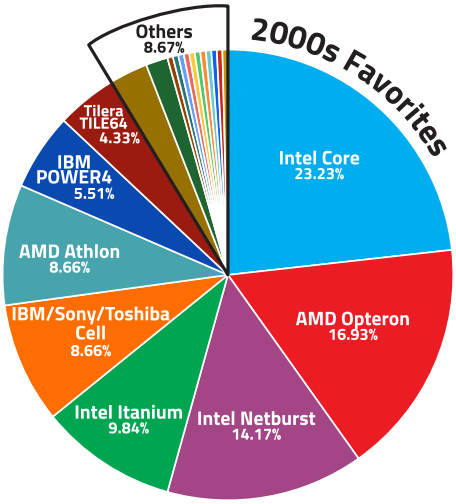

FIGURE 4. Favorite microprocessors from the 2000s.

"Opteron in a way was responsible for pushing the entire industry toward 64-bit."

Comments on Intel Core series include:

"A prime example of power vs performance trade-offs."

"Performance and power efficiency that turned Intel around and dominated the industry for a decade."

2010s: HETEROGENEOUS ARCHITECTURE

Intel's streak finally ended in the 2010s, with the AMD Zen (26%) and the Apple M1 (24%) leading the pack (see Figure 5). The AMD Zen architecture was introduced in 2017 with the Ryzen series and its highly flexible chiplet-based design has enabled it to be deployed in low-end laptops to high-end server-class machines. The Apple M1, an ARM-based chip, was the first in-house design deployed by Apple in Macintosh computers, and it replaced Intel-based chips in late 2020.

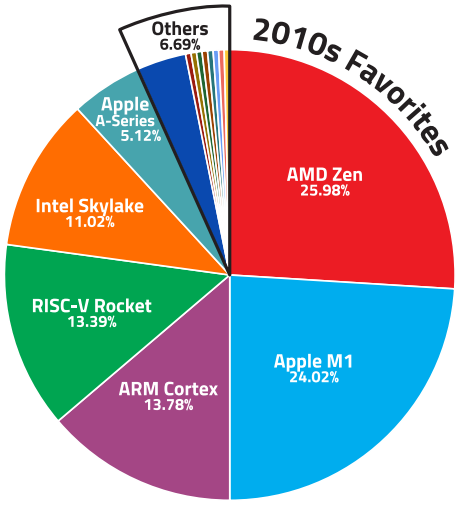

FIGURE 5. Favorite microprocessors from the 2010s.

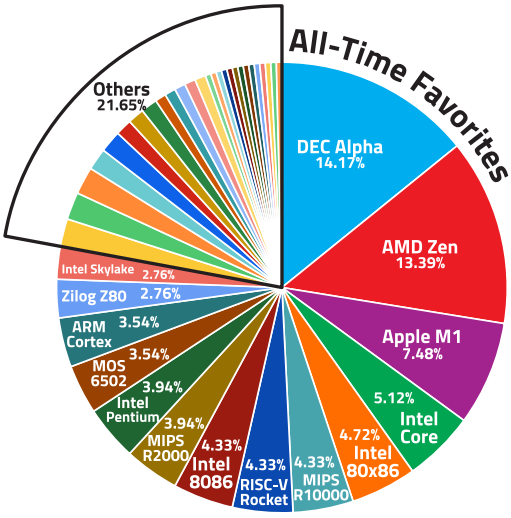

FIGURE 6. Favorite microprocessors of all time.

Comments from Apple M1 fans include:

"For being the most high-performance and low power core at the same time! And debunking once and for all that the ISA is irrelevant for high performance processors."

"μarch is dead, oh no, wait, there's [sic] people showing it's not. But you have to dominate the whole ecosystem."

Some AMD Zen admirers wrote:

"Chiplets and compartmentalization."

"The ultimate comeback kid."

SUMMARY

The all-time favorites list sprang a surprise, with DEC Alpha being voted number one, just edging ahead of AMD Zen (see Figure 6). Although it was not voted the favorite in its own decade, the DEC Alpha processor's lasting impact on modern-day processors is evident from its popularity even today. AMD Zen ran a close second, possibly stemming from its popularity in the 2010s through the present decade. Several processors from Intel that were voted favorites in individual decades, also found themselves near the top of the list.

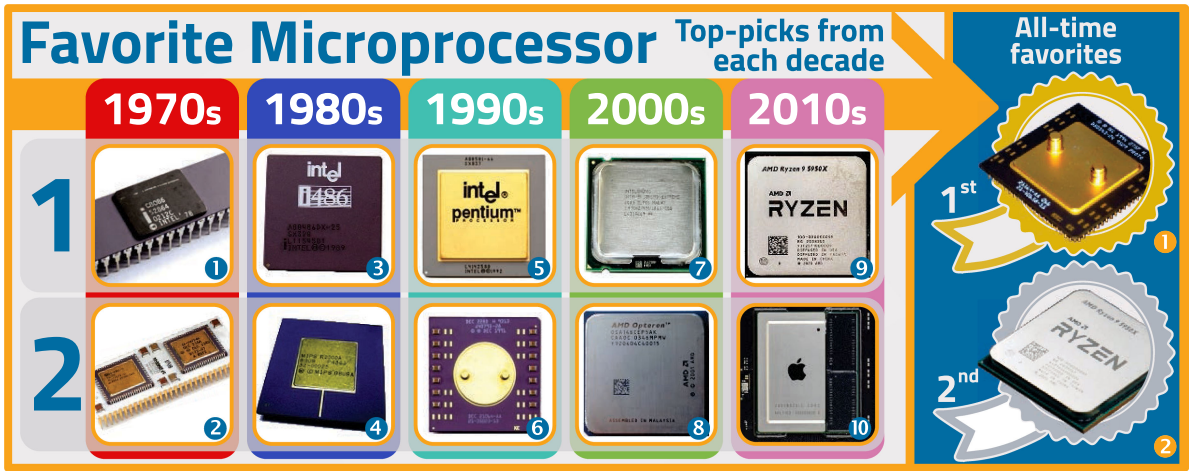

FIGURE 7. Top picks for each decade and the all-time favorites. Photo courtesy of ●●●6©wikipedia.org, ❸©wikichip.org, ❹©silirium.ru, ●❽©cpu-world.com, ❾©techpowerup.com, ❿©ifixit.com, ❶©worthpoint.com, and ❷©hwcooling.net.

One of the comments on AMD Zen was:

> *"Great comeback story, used in so many SOCs from laptops to servers to Threadripper!"*

Here are a few comments on DEC Alpha:

> *"Alpha was the heart of engineers—however in real life, Goliath beat David."*
>
> *"The reference superscalar out-of-order architecture. The excellent descriptions of the microarchitecture as well as quantitative performance analyses published in the literature have had an extremely high tutorial value for many researchers and practitioners."*

Figure 7 depicts the top picks for each decade and the all-time winners. At 50 years, the microprocessor arena is still hot, and competition is vigorous. Many more interesting architectures and chips are certain to appear in the coming decades, but at Platinum Jubilee or the Centenary, we are sure these teenagers and middle-aged processors that won the poll now will still bring some excitement!

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