



# The Personal Computer Revolution: Crash Course Computer Science #25

Crash Course: Computer Science

<https://youtube.com/watch?v=M5BZou6C01w>

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## ====Intro (0:00)====

Hi, I'm Carrie Anne and welcome to CrashCourse Computer Science! As we discussed last week, the idea of having a computer all to yourself - a personal computer - was elusive for the first three decades of electronic computing. It was just way too expensive for a computer to be owned and used by one single person.

But by the early 1970s, all the required components had fallen into place to build a low-cost but still usefully powerful computer. Not a toy, but a tool. Most influential in this transition was the advent of the single-chip CPU's, which were surprisingly powerful yet small and inexpensive.

Advances in integrated circuits also offered low-cost solid-state memory, both for computer RAM and ROM. Suddenly it was possible to have an entire computer on one circuit board, dramatically reducing manufacturing costs. Additionally, there was cheap and reliable computer storage, like magnetic tapes cassettes and floppy disks. And finally the last ingredient was low-cost displays, often just repurposed televisions.

If you blended these four ingredients together in the 1970s, you got, what was called a microcomputer, because these things were so tiny compared to "normal" computers of that era - the types you'd see in businesses or universities.

But more important than their size was their cost. These were, for the first time, sufficiently cheap. It was practical to buy one and only have one person ever use it. No time sharing, no multi-user logins, just a single owner, and user. The personal computer era had arrived.

## [THEME SONG]

Computer cost and performance eventually reached the point where personal computing became viable. But, it's hard to define exactly when that happened. There's no one point in time. And as such, there are many contenders for the title, "First Personal Computer," like the Kenback-1 and MCM/70.

Less disputed, however, is the first commercially successful personal computer: The Altair 8800. This machine debuted on the cover of Popular Electronics in 1975, and was sold as a \$439 kit that you built yourself. Inflation-adjusted, that's about \$2,000 today, which isn't chump change, but extremely cheap for a computer in 1975.

Tens of thousands of kits were sold to computer hobbyists, and because of its popularity, there were soon all sorts of nifty add-ons available . . . things like extra memory, a paper tape reader, and even a teletype interface. This allowed you, for example, to load a longer, more complicated program from punch tape, and then interact with it using a teletype terminal.

However, these programs still had to be written in machine code, which was really low level and nasty, even for hardcore computer enthusiasts. This problem didn't escape a young Bill Gates and Paul Allen, who were 19 and 22 respectively. They contacted MITS, the company making the Altair 8800, suggesting the computer would be more attractive to hobbyists if it could run programs written in BASIC, a popular and simple programming language.

To do this, they needed to write a program that converted BASIC instructions into native machine code, what's called an interpreter. This is very similar to a compiler, but happens as the program runs, instead of beforehand. Let's go to the thought bubble!

MITS was interested and agreed to meet Bill and Paul for a demonstration. Problem is, they hadn't written the interpreter yet. So they hacked it together in just a few weeks without even an Altair 8800 to develop on, finishing the final piece of code on the plane.

The first time they knew their code worked was at MITS headquarters in Albuquerque, New Mexico, for the demo. Fortunately, it went well and MITS agreed to distribute their software. Altair BASIC became the newly formed Microsoft's first product. Although computer hobbyists existed prior to 1975, the Altair 8800 really jump-started the movement. Enthusiast groups formed, sharing knowledge and software and passion about computing.

Most legendary among these is the Homebrew Computer Club, which met for the first time in March 1975 to see a review unit of the Altair 8800, one of the first to ship to California. At that first meeting was 24-year-old Steve Wozniak, who was so inspired by the Altair 8800 that he set out to design his own computer.

In May 1976, he demonstrated his prototype to the Club and shared the schematics with interested members. Unusual for the time, it was designed to connect to a TV and offered a text interface - a first for a low-cost computer. Interest was high, and shortly after fellow club member and college friend Steve Jobs, suggested that instead of just sharing the designs for free, that they should just sell an assembled motherboard.

However, you still had to add your own keyboard, power supply, and enclosure. It went on sale in July 1976 with a price tag of \$666.66. It was called the Apple 1, and it was Apple Computer's first product. Thanks thought bubble!

Like the Altair 8800, the Apple 1 was sold as a kit. It appealed to hobbyists, who didn't mind tinkering and soldering, but consumers and businesses weren't interested. This changed in 1977, with the release of three game-changing computers, that could be used right out of the box. First was the Apple II, Apple's earliest product that sold as a complete system that was professionally designed and manufactured. It also offered rudimentary color graphics and sound output, amazing features for a low machine.

The Apple II series of computers sold by the millions and quickly propelled Apple to the forefront of the personal computing industry. The second computer was the TRS-80 Model I, made by the Tandy Corporation and sold by RadioShack - hence the "TRS".

Although less advanced than the Apple II, it was half the cost and sold like hot cakes. Finally, there was the Commodore PET 2001, with a unique all-in-one design that combined computer, monitor, keyboard, and tape drive into one device, aimed to appeal to consumers. It started to blur the line between computer and appliance.

These three computers became known as the 1977 Trinity. They all came bundled with BASIC interpreters, allowing non-computer-wizards to create programs. The consumer software industry also took off, offering games and productivity tools for personal computers, like calculators and word processors.

The killer app of the era was 1979's VisiCalc, the first spreadsheet program - which was infinitely better than paper - and the forerunner of programs like Microsoft Excel and Google Sheets. But perhaps the biggest legacy of these computers was their marketing - they were the first to be targeted at households, and not just businesses and hobbyists.

And for the first time in a substantial way, computers started to



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appear in homes, and also small businesses and schools. This caught the attention of the biggest computer company on the planet, IBM, who had seen its share of the overall computer market shrink from 60% in 1970 to around 30% by 1980. This was mainly because IBM had ignored the microcomputer market, which was growing at about 40% annually.

As microcomputers evolved into personal computers, IBM knew it needed to get in on the action. But to do this, it would have to radically rethink its computer strategy and design. In 1980, IBM's least-expensive computer, the 5120, cost roughly \$10,000, which was never going to compete with the likes of the Apple II. This meant starting from scratch.

A crack team of twelve engineers, later nicknamed the dirty dozen, were sent off to offices in Boca Raton, Florida, to be left alone and put their talents to work. Shielded from IBM internal politics, they were able to design a machine as they desired. Instead of using IBM propriety CPUs, they chose Intel chips.

Instead of using IBM's preferred operating system, CP/M, they licensed Microsoft's Disk Operating System: DOS and so on, from the screen to the printer. For the first time, IBM divisions had to compete with outside firms to build hardware and software for the new computer. This radical break from the company tradition of in-house development kept costs low and brought partner firms into the fold.

After just a year of development, the IBM Personal Computer, or IBM PC was released. It was an immediate success, especially with businesses that had long trusted the IBM brand. But most influential to its ultimate success was that the computer featured an open architecture, with good documentation and expansion slots, allowing third parties to create new hardware and peripherals for the platform.

That included things like graphics cards, sound cards, external hard drives, joysticks, and countless other add-ons. This spurred innovation, and also competition, resulting in a huge ecosystem of products. This open architecture became known as "IBM Compatible." If you bought an "IBM Compatible" computer, it meant you could use that huge ecosystem of software and hardware.

Being an open architecture also meant that competitor companies could follow the standard and create their own IBM Compatible computers. Soon, Compaq and Dell were selling their own PC clones. And Microsoft was happy to license MS-DOS to them, quickly making it the most popular PC operating system. IBM alone sold two million PCs in the first three years, overtaking Apple.

With a large user base, software and hardware developers concentrated their efforts on IBM Compatible platforms - there were just more users to sell to. Then, people wishing to buy a computer bought the one with the most software and hardware available, and this effect snowballed; whereas companies producing non-IBM-compatible computers, often with superior specs, failed.

Only Apple kept significant market share without IBM compatibility. Apple ultimately chose to take the opposite approach - a "closed architecture" - proprietary designs that typically prevent people from adding new hardware to their computers. This meant that Apple made its own computers, with its own operating system, and often its own peripherals, like displays, keyboards, and printers.

By controlling the full stack, from hardware to software, Apple was able to control the user experience and improve reliability. These competing business strategies were the genesis of the "Mac" versus "PC" division that still exists today . . . which is a misnomer, because they're both personal computers! But whatever!

To survive the onslaught of low-cost PCs, Apple needed to up its game, and offer a user experience that PCs and DOS couldn't. Their answer was the Macintosh, released in 1984. This groundbreaking, reasonably-low-cost, all-in-one computer booted not a command-line text interface, but rather a graphical user interface, our topic for next week. See you then.

Crash Course Computer Science is produced in association with PBS Digital Studios. At their channel, you can check out a playlist of shows like PBS Idea Channel, Physics Girl, and It's Okay To Be Smart. This episode was filmed at the Chad and Stacy Emigholz Studio in Indianapolis, Indiana and it was made with the help of all of these nice people and our wonderful graphics team Thought Cafe. Thanks for watching, I'll CPU later.