

# Computers through the Generations

## Be a Power Reader

**Reading for a Purpose** Reading with a purpose in mind helps you focus on the important information. One way to figure out what is important is to *read the Review Questions first*. That way, you will know what the author thinks are the key facts and ideas.

## What Is a Generation?

When you (and any brothers and sisters you might have) were born, your parents started a new generation. Each generation learns from the last one, but each generation also has new ideas. This is because the world is constantly changing.

Likewise, the history of computers is divided into generations. Each new generation is built on what we have learned from the last generation.

## The First Generation

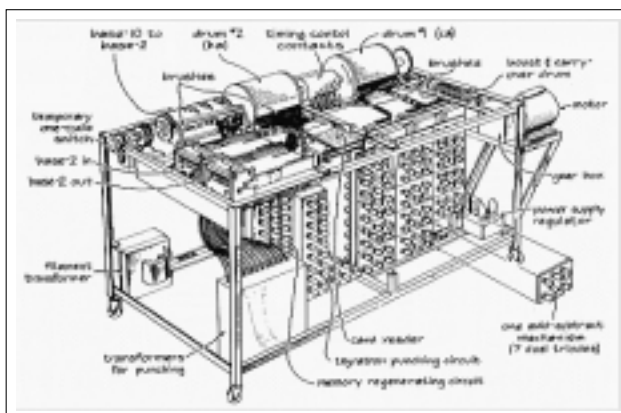
### The ABC

Can you think of any major events that happened between 1937 and 1942? Maybe your grandparents were born during this time. World War II was raging. The U.S. entered the war near the end of 1942. In Ames, Iowa, home of Iowa State University, the first electronic computer was being

built. The term **electronic** is used to describe this computer because its parts were connected by electrical wires. It was named after its developers, John Vincent Atanasoff and Clifford Berry. It was called the **Atanasoff-Berry Computer** (or **ABC**).

At that time, there were calculators that could perform arithmetic. Several features made the ABC different from a calculator. For one thing, it could store processing results and then use them again at a later time. These processing results were stored in **computer memory**. Being able to store and reuse data is an important reason why computers are useful to us today. Computers wouldn't be of much use to banks, for example, if they couldn't keep track of our savings accounts from one month to the next.

The ABC used **binary code**. Binary code is sometimes referred to as **base-2**. It only uses two digits: 0 and 1. Binary code is important because it allows us to use switches to store data. The computer recognizes an "off" switch as a "0" and an "on" switch as a "1." Inside the ABC were about **300 vacuum tubes**. These tubes acted as on/off switches. They were used to give the computer instructions in binary code. Unfortunately, vacuum tubes had their drawbacks. If just one tube burned out, the computer would not work. The tubes were slow and could become very hot. It was essential to keep the rooms that held the tubes very cool.



Atanasoff-Berry Computer

## The Mark I

About this same time, a Harvard University math professor named Howard Aiken was thinking it would be great to have a machine to solve math problems. His team of scientists developed a machine called the ASCC (Automatic Sequence Controlled Calculator). However, today it is better known as the **Mark I**. When they finished the machine in 1944, it weighed 5 tons! It could do three arithmetic problems each second. For that time, this speed was amazing.

Navy Captain Grace Murray Hopper was part of the team that built the Mark I. Hopper developed a special type of **computer program** called a **compiler**. A compiler lets people use English-like words to give instructions to computers. For example, instead of entering a binary code such as “1011 0010” to tell the computer to read a number, the word “READ” might be used. The computer’s compiler would know that the word “READ” stood for the code “1011 0010.” Compilers made it much easier to give instructions to computers.

## The ENIAC and UNIVAC

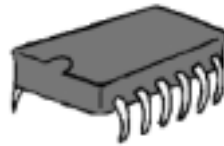
You may already know that the U.S. military is one of the world’s biggest users of computers. So it isn’t surprising that the military played a role in the early development of computers. During World War II, the U.S. army had many problems. It needed to design planes and schedule the movement of supplies, soldiers, and ships. Two men, J. Presper Eckert and John Mauchly, believed they could invent a high-speed calculator to help the military. They finished the **ENIAC (Electronic Numerical Integrator and Calculator)** in 1946. It filled an entire room.

Mauchly and Eckert then started one of the first commercial computer companies. In 1951, they introduced the **UNIVAC (Universal Automatic Computer)**. This was the first computer to be sold to businesses.

This started the period of huge business machines called **mainframes**. Each

mainframe had hundreds of vacuum tubes and miles of electrical wires. Only places such as universities and large businesses had mainframes.

If you were to visit an early mainframe, you might feel like you were visiting in a hospital. The computer was often kept in a large room with glass windows. It generated so much heat that the room had to be air conditioned. Only highly-trained technicians were allowed to enter data into the computer. These computers were constantly going “down,” and they were expensive, costing up to a million dollars.



## The Second Generation

In 1947, a new invention was to lead to major changes. The **transistor** was born. Transistors are tiny electronic devices that control the flow of electricity. They are much smaller than vacuum tubes. One transistor could replace more than 50 vacuum tubes, and transistors weren’t constantly burning out or breaking. By 1960, newer and smaller computers that used transistors were for sale. IBM (International Business Machines) had a whole family of computers that used transistors. IBM’s System/360 series were popular because they were smaller and less expensive than earlier mainframes.

## The Third Generation

In 1965, Digital Equipment Corporation (DEC) introduced a new computer that caught everybody’s attention. It was called the PDP-8. Unlike earlier machines, it was only about the size of a small refrigerator. Even better, it was much cheaper than older machines. It cost only \$18,000.

What made the PDP-8 different from early computers was that it used **integrated circuits (ICs)** rather than transistors. ICs (often called *chips*) are tiny pieces of silicon.

Electronic circuits are etched into the chips. One IC could do the work of thousands of transistors. Before long, ICs were used in all computers.

Computers using ICs were much smaller and cheaper than earlier computers. They were also much faster and more powerful.

## The Fourth Generation

Can you imagine starting a computer company in your family's garage? That's exactly what Steve Jobs and Steve Wozniak did. They officially started Apple Computer in 1976. Jobs was 21 years old and Wozniak was 26 years old. In 1977, they introduced the Apple II computer. The Apple II was popular in homes, schools, and even businesses for many years.

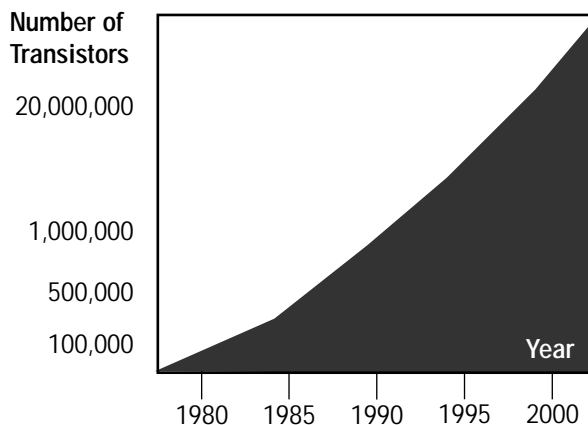
The large machines used up until this time were designed to be used by many people at once. Apple computers were a type of computer—the **personal computer**. Personal computers are designed to be used by only one person at a time.

Personal computers became popular because of the introduction of the microprocessor. At the heart of every computer is a **central processing unit (CPU)**. It is the part that actually does work such as performing arithmetic. Before, a computer's CPU had been spread over several chips. Then, in the early 1970s, the **microprocessor** came along. A microprocessor is a CPU that is on a single chip. This allowed computers to become even smaller and less expensive.

Many companies developed personal computers. IBM introduced its first personal computer in 1981. Other companies, such as Hewlett-Packard, Dell, and Gateway, later

developed computers that were compatible with the IBM PC. A computer is compatible with another computer if it can run the same computer programs (or *software*). In 1984, Apple Computer introduced an easy-to-use computer called the Macintosh. This led to computers that were more "user-friendly."

Today's microprocessors are unbelievably powerful. Imagine shrinking both the Mark I and ENIAC to a size smaller than a dime. Today's dime-size microprocessor would be more powerful than both of these machines together. Intel® Corporation's Pentium® 4 microprocessor is a good example. This single electronic chip contains more than 40 million transistors.



Number of Transistors in a Microprocessor

The speeds of today's microprocessors are typically measured in **gigahertz (GHz)**, or billions of cycles per second. The Pentium 4 microprocessor can have a speed of 3 GHz. This means that it can do 3 billion simple arithmetic problems every second. Do you remember when we mentioned that the Mark I could do 3 problems per second? It was considered fast for its time!



## Review Questions

1. How was the second generation of computers different from the first generation?
2. Why was the use of binary code an important step in the history of computers?
3. Compare integrated circuits to vacuum tubes and transistors.
4. What is a microprocessor?



## What Do You Think?

1. Do you think the generations in your family can be compared to computer generations? Have there been changes from one generation to another? What have some of these changes been?
2. We've talked about a number of inventions, such as binary code, transistors, and integrated circuits, that were important in the development of computers. Which of these inventions do you think was most important? Why?

## Glossary

**ABC (Atanasoff-Berry Computer)** The first electronic digital computer; it was developed by John Atanasoff and Clifford Berry. It used vacuum tubes and binary code.

**binary code** A sequence of 1s and 0s used to give instructions to computers. Also called *base-2*.

**central processing unit (CPU)** The “brain” of the computer; it is where processing is done.

**compiler** A computer program that allows people to use simple words to give instructions to a computer.

**computer memory** The part of a computer system that stores data so that the computer can use it again when it is needed.

**computer program** A list of instructions that a computer can follow to carry out a task. Also called *software*.

**electronic** A term used to describe a device whose parts are connected by electrical wires.

**ENIAC (Electronic Numerical Integrator and Calculator)** An early digital computer developed by J. Presper Eckert and John Mauchly.

**gigahertz (GHz)** Billions of cycles per second. One way of measuring the processing speed of a microprocessor.

**integrated circuit (IC)** A tiny piece of silicon with electronic circuits etched into it. Also called a *chip*.

**mainframe** A large computer designed to be used by many people at the same time. Mainframes are most commonly used by large businesses and universities.

**Mark I** An early digital computer developed by a team of scientists including Howard Aiken at Harvard University.

**microprocessor** A central processing unit that is on a single computer chip.

**personal computer (PC)** A small computer designed to be used by a single person at a time.

**transistor** A small electronic device that can control the flow of electricity.

**UNIVAC (Universal Automatic Computer)** The first computer to be sold to businesses.

**vacuum tube** An electrical device that worked by turning on a switch to allow current to flow through it and turning off the switch to stop the current. Early computers were operated by vacuum tubes, which were large and often burned out.