

**CHARLES BABBAGE'S ANALYTICAL ENGINE**  
OBSTACLES FACED: INCOMPLETE DESIGN, INADEQUATE TECHNOLOGY  
OUTCOME: FATHER OF COMPUTERS  
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“The difference between a tool and a machine is not capable of very precise distinction; nor is it necessary, in a popular explanation of those terms, to limit very strictly their acceptance.”

-Charles Babbage

Machines should not just be limited to their name. This was a prevalent idea during the Industrial Revolution, which was a time when hand labor was rapidly being replaced by machines as the main way of producing goods. It began in England with the Agricultural Revolution where large land farmers were experimenting with different machines and techniques to make farming more efficient. In order to produce these machines, they needed iron and coal, of which England had an abundance. Because of the new production of machines, population and food increased. Industrialization spread all over the world and changed every aspect of the way society functioned. During this time a very wise mathematician, named Charles Babbage revolutionized the way we think about our world by designing the first programmable computer, The Analytical Engine. Although Babbage faced many obstacles in his lifetime and when creating the analytical engine, his principal designs have been mimicked in today's digital computers.

Babbage is generally referred to as the father of computers for inventing the Analytical Engine, but he did much more than that in his lifetime. He was born into a middle class family on December 26, 1791 in Walworth, Surrey. He was one of four children born to Benjamin Babbage and Elizabeth Teape. Growing up he always had a keen interest in math. Although he went to local public schools, he was tutored by an Oxford scholar, to test into Cambridge. He entered Trinity College, Cambridge, in 1810. He felt out of place at first and did not enjoy what he was learning in classes (“Babbage”). He enjoyed the analytical side of math more. In spring of 1812 he finally found colleagues. They formed an organization called the Analytical Society, an association dedicated to changing the way of notating differential calculus. The leader of this group was John Herschel. Together Herschel and Babbage wrote a volume called *Memoirs of the Analytical Society* (“Babbage, Charles”). Later in his life “he was a prolific inventor, a mathematician, scientist, politician, critic of the scientific establishment and political economist. Babbage pioneered lighthouse signaling, proposed ‘black box’ recorders for monitoring the conditions preceding railway catastrophes, advocated decimal currency and the use of tidal power once coal reserves were exhausted” (“Babbage”). Due to Babbage’s education and childhood he helped society progress.

Before the great Analytical Engine there was a machine Babbage invented in 1821 called the Difference Engine. The idea of the Difference Engine came about when Babbage wanted a way to make sure there was not any mistakes in his data when preparing tables for the Royal Nautical Almanac, a volume showing tables representing the night sky (“Babbage, Charles”). In fact, the “machine would calculate polynomial interpolations; it would draw curves through points on a graph. Babbage called this machine the Difference Engine, because it used the method of finite differences to compute the interpolations” (“Babbage, Charles”). His many designs and blueprints of the difference engine won him a grant from the Britain and a gold medal from the astronomical society. After his successes he started trying to build the difference engine and soon realized how complicated it was. He edited his original designs for about seven years. In 1827 he abandoned the difference engine with the death of his wife, son, and father. After the deaths of his loved ones he traveled around Europe and was introduced to many leading scientist, which stirred his ideas. He came back to England full of inspiration. In 1834, with his Difference Machine still unfinished, he thought of a new machine that would change the way our society functions, the analytical engine (“Babbage, Charles”). He would never thought of this first step towards a computer with out his initial idea of the difference machine.

According to Charles Babbage “The Analytical Engine is a machine to calculate the numerical value or values of any formula or function of which the mathematician can indicate the method of solution. It is to be absolutely automatic, the slave of the mathematician, carrying out his orders and relieving him from the drudgery of computing. It must print the results, or any intermediate result arrived at” (qtd. in Dalakov). Babbage made it programmable with punch cards. It had a Central processing unit or CPU, which he called the ‘mill’ where numbers were calculated and processed. It had a Memory, which he called the ‘store’ where numbers could be held to wait for further orders. He even designed a printer to output his results. Another component he designed was the capability of ‘if-then’ statements, which makes it so if one result appears then the machine will do one thing but if another result appears then the machine will do another thing. Lastly he designed the ‘loop’, which is when the machine would do a command repeatedly a fixed amount of times (Harris). His analytical machine was very

impressive although he never built it in time of his death. People generally believe this is because the mechanism at the time was not sufficient enough to precisely engineer every piece, which was crucial in his design (“Babbage”). Georgi Dalakov explains, “There exist over two hundred drawings, in full detail, to scale, of the engine and its parts. There are also over four hundred notations of different parts” (Dalakov). Because of these notations Babbage is vastly commemorated.

Although Babbage faced many struggles in life and with both his machines, he is honored today for designing the first components of a computer. He is an inspiration to future generations of scientists and mathematicians for thinking so creatively during a time when supplies were limited. His designs are mimicked in today's modern digital computers. If it was not for Babbage it would be hard to instantly research about him in a blink of a second. So thanks Babbage for revolutionizing the world one idea at a time.

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