



Nervous System #24: Ada Byron Lovelace, The First Computer Programmer

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With the aggressive pace of technological change and the onslaught of news regarding data breaches, cyber-attacks, and technological threats to privacy and security, it is easy to assume these are fundamentally new threats. The pace of technological change is slower than it feels, and many seemingly new categories of threats have been with us longer than we remember.

Nervous System is a bimonthly blog that approaches issues of data privacy and cyber security from the context of history—to look to the past for clues about how to interpret the present and prepare for the future.

Augusta Ada Byron King was the only legitimate child of legendary Romantic poet Lord Byron. She married the Earl of Lovelace, thereby becoming the Countess of Lovelace. For many women of her social station in her era, these facts alone would have made her reputation—but Ada is known today for her pioneering work in what came to be computer science.

In the early 1800s, there were no digital computers—at least not as physical objects that people could use—but Ada's friend Charles Babbage was developing the idea of them in the form of his plans for the so-called "Analytical Engine." A gifted mathematician, Ada found the project compelling, and she wrote an algorithm to be executed by such a machine, were it ever to be built. As such, she wrote the first-ever computer program.

When Ada was still just a babe in arms, Lord Byron separated from her mother, Annabella Milbanke, and left England, never to return. Milbanke determined to keep Byron's influence on the child to a minimum. The fabled poet never saw his daughter again. Ada did not learn her father's identity until after Byron had died. Annabella immersed Ada in the study of mathematics and science, thinking these to be the antithesis of Byron's poetic imagination. As it happened, Ada proved to be an unusually gifted student.

In those days, women were not permitted to attend university or join scientific societies, but Ada's natural abilities easily eclipsed those of university-trained men. She had rarefied insight into math, coupled with an imaginative intuition, but no socially acceptable outlet by which to explore those skills.

Meanwhile, the venerable scientist Charles Babbage had completed work on his "Difference Engine," a mechanical calculator designed to handle complex polynomial functions that typically vexed human "calculators." Ada met Babbage to view his invention, and he was struck that of all his visitors, here at last was someone who genuinely *understood* the machine. She was seventeen years old.

Babbage was keen to move on from the Difference Engine to something altogether more challenging. He called it the Analytical Engine, but struggled to find the right words with which to describe something the world had never seen, or contemplated, before.

Ada, now the Countess of Lovelace, began corresponding and collaborating with Babbage. She was a vigorous proselytizer for his ideas. When the Italian engineer Luigi Menabrea wrote a paper about Babbage’s work for a Swiss academic journal, Ada was commissioned to translate it into English. Not content with mere translation, she opted to embellish the paper with her own extensive annotations. Ada’s “Translator’s Notes” ran three times as long as Menabrea’s paper and were significantly more compelling. The Notes anticipated and described a general-purpose machine that used pre-programmed algorithms to execute an essentially unbounded set of operations, not limited to the manipulation of numbers.

In order to conceal her femininity, the September 1843 edition of *Scientific Memoirs* published her Notes under the initials “A.A.L.” The Notes are today hailed as a seminal cornerstone of computer science and the first full-throated articulation of the foundational concepts of modern computing.

Babbage’s Analytical Engine would allow complex concepts to be abstracted into symbols that would be kept in a *store* until being passed into the *mill* of the machine to be operated upon (Babbage chose his terminology from the familiar world of nineteenth-century industry). He dreamed of abstracting a series of instructions into something that could be stored, and later recalled for use, enabling the machine to act like a sort of mechanical brain...

Ada had her own ideas of how to represent logical operations as symbols, the crucial building block to encode instructions for Babbage’s Engine. She saw that the use of symbolic logic would allow the Engine to do more than merely crunch numbers—it could perform its operations on almost any type of problem. For example, she reasoned, the Engine could compose music.

By way of illustrating the use of symbolic logic to encode a series of instructions, she set her attention to the Bernoulli process—an infinite sequence of rational numbers that are not derived from any one direct formula. Ada encoded the steps to calculate these numbers as a series of logical operations that formed a recursive loop, with the output of one cycle feeding into the next cycle. It was an *algorithm*—a computer program for a computer that did not exist.

Lovelace died of uterine cancer in 1852, and at her request she was laid to rest in a grave next to Lord Byron, the father she never knew, one genius alongside another.

Babbage never completed his Analytical Engine. Outside of Ada’s passionate fascination, few in England recognized its potential. Babbage pursued other projects and fancies, and died in 1871, still tinkering with plans for the unbuilt Engine. Instead, a new generation of mathematicians and inventors brought it into existence in the twentieth century in the form of modern digital computers.

Mindful of Lovelace’s extraordinary contributions to the field, Ada’s “A.A.L.” notes were republished in 1953 as an appendix to the volume *Faster than Thought: A Symposium on Digital Computing Machines*.

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