Ada Lovelace

<https://en.wikipedia.org/wiki/Ada_Lovelace>

Augusta Ada King-Noel, Countess of Lovelace (née Byron; 10 December 1815 – 27 November 1852) was an English mathematician and writer, chiefly known for her work on Charles Babbage's proposed mechanical general-purpose computer, the Analytical Engine. She was the first to recognise that the machine had applications beyond pure calculation, and created the first algorithm intended to be carried out by such a machine. As a result, she is often regarded as the first to recognise the full potential of a "computing machine" and the first computer programmer.[1][2][3]

Biography

Ada Lovelace was the only legitimate child of the poet Lord Byron, and his wife Anne Isabella Milbanke ("Annabella"), Lady Wentworth.[4] All of Byron's other children were born out of wedlock to other women.[5] Byron separated from his wife a month after Ada was born and left England forever four months later, eventually dying of disease in the Greek War of Independence when Ada was eight years old. Her mother remained bitter towards Lord Byron and promoted Ada's interest in mathematics and logic in an effort to prevent her from developing what she saw as the insanity seen in her father, but Ada remained interested in him despite this (and was, upon her eventual death, buried next to him at her request). Often ill, she spent most of her childhood sick. Ada married William King in 1835. King was made Earl of Lovelace in 1838, and she became Countess of Lovelace.

Her educational and social exploits brought her into contact with scientists such as Andrew Crosse, Sir David Brewster, Charles Wheatstone, Michael Faraday and the author Charles Dickens, which she used to further her education. Ada described her approach as "poetical science"[6] and herself as an "Analyst (& Metaphysician)".[7]

When she was a teenager, her mathematical talents led her to a long working relationship and friendship with fellow British mathematician Charles Babbage, also known as "the father of computers", and in particular, Babbage's work on the Analytical Engine. Lovelace first met him in June 1833, through their mutual friend, and her private tutor, Mary Somerville. Between 1842 and 1843, Ada translated an article by Italian military engineer Luigi Menabrea on the engine, which she supplemented with an elaborate set of notes, simply called Notes. These notes contain what many consider to be the first computer program—that is, an algorithm designed to be carried out by a machine. Lovelace's notes are important in the early history of computers. She also developed a vision of the capability of computers to go beyond mere calculating or number-crunching, while many others, including Babbage himself, focused only on those capabilities.[8] Her mindset of "poetical science" led her to ask questions about the Analytical Engine (as shown in her notes) examining how individuals and society relate to technology as a collaborative tool.[5]

She died of uterine cancer in 1852 at the age of 36.

Education

Throughout her illnesses, she continued her education.[39] Her mother's obsession with rooting out any of the insanity of which she accused Byron was one of the reasons that Ada was taught mathematics from an early age. She was privately schooled in mathematics and science by William Frend, William King,[a] and Mary Somerville, the noted researcher and scientific author of the 19th century. One of her later tutors was the mathematician and logician Augustus De Morgan. From 1832, when she was seventeen, her mathematical abilities began to emerge,[23] and her interest in mathematics dominated the majority of her adult life. In a letter to Lady Byron, De Morgan suggested that her daughter's skill in mathematics could lead her to become "an original mathematical investigator, perhaps of first-rate eminence".[40]

Lovelace often questioned basic assumptions by integrating poetry and science. While studying differential calculus, she wrote to De Morgan:

I may remark that the curious transformations many formulae can undergo, the unsuspected and to a beginner apparently impossible identity of forms exceedingly dissimilar at first sight, is I think one of the chief difficulties in the early part of mathematical studies. I am often reminded of certain sprites and fairies one reads of, who are at one's elbows in one shape now, and the next minute in a form most dissimilar[41]

Lovelace believed that intuition and imagination were critical to effectively applying mathematical and scientific concepts. She valued metaphysics as much as mathematics, viewing both as tools for exploring "the unseen worlds around us".[42]

Work

During a nine-month period in 1842–43, Lovelace translated the Italian mathematician Luigi Menabrea's article on Babbage's newest proposed machine, the Analytical Engine. With the article, she appended a set of notes.[55] Explaining the Analytical Engine's function was a difficult task, as even many other scientists did not really grasp the concept and the British establishment was uninterested in it.[56] Lovelace's notes even had to explain how the Analytical Engine differed from the original Difference Engine.[57] Her work was well received at the time; the scientist Michael Faraday described himself as a supporter of her writing.[58]

The notes are around three times longer than the article itself and include (in Section G[59]), in complete detail, a method for calculating a sequence of Bernoulli numbers with the Engine, which could have run correctly had the Analytical Engine been built[60] (only his Difference Engine has been built, completed in London in 2002[61]). Based on this work Lovelace is now widely considered the first computer programmer[1] and her method is recognised as the world's first computer program.[62]

Section G also contains Lovelace's dismissal of artificial intelligence. She wrote that "The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform. It can follow analysis; but it has no power of anticipating any analytical relations or truths." This objection has been the subject of much debate and rebuttal, for example by Alan Turing in his paper "Computing Machinery and Intelligence".[63]

First computer program

In 1840, Babbage was invited to give a seminar at the University of Turin about his Analytical Engine. Luigi Menabrea, a young Italian engineer, and the future Prime Minister of Italy wrote up Babbage's lecture in French, and this transcript was subsequently published in the Bibliothèque universelle de Genève in October 1842. Babbage's friend Charles Wheatstone commissioned Ada Lovelace to translate Menabrea's paper into English. She then augmented the paper with notes, which were added to the translation. Ada Lovelace spent the better part of a year doing this, assisted with input from Babbage. These notes, which are more extensive than Menabrea's paper, were then published in Taylor's Scientific Memoirs under the initialism AAL.

Ada Lovelace's notes were labelled alphabetically from A to G. In note G, she describes an algorithm for the Analytical Engine to compute Bernoulli numbers. It is considered the first published algorithm ever specifically tailored for implementation on a computer, and Ada Lovelace has often been cited as the first computer programmer for this reason.[65][66] The engine was never completed so her program was never tested.[67]

In 1953, more than a century after her death, Ada Lovelace's notes on Babbage's Analytical Engine were republished. The engine has now been recognised as an early model for a computer and her notes as a description of a computer and software

Beyond numbers

In her notes, Lovelace emphasised the difference between the Analytical Engine and previous calculating machines, particularly its ability to be programmed to solve problems of any complexity.[68] She realised the potential of the device extended far beyond mere number crunching. In her notes, she wrote:

[The Analytical Engine] might act upon other things besides number, were objects found whose mutual fundamental relations could be expressed by those of the abstract science of operations, and which should be also susceptible of adaptations to the action of the operating notation and mechanism of the engine...Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent.[69][70]

This analysis was an important development from previous ideas about the capabilities of computing devices and anticipated the implications of modern computing one hundred years before they were realised. Walter Isaacson ascribes Lovelace's insight regarding the application of computing to any process based on logical symbols to an observation about textiles: "When she saw some mechanical looms that used punchcards to direct the weaving of beautiful patterns, it reminded her of how Babbage's engine used punched cards to make calculations."[71] This insight is seen as significant by writers such as Betty Toole and Benjamin Woolley, as well as the programmer John Graham-Cumming, whose project Plan 28 has the aim of constructing the first complete Analytical Engine.[72][73][74]

According to the historian of computing and Babbage specialist Doron Swade:

Ada saw something that Babbage in some sense failed to see. In Babbage's world his engines were bound by number...What Lovelace saw – what Ada Byron saw—was that number could represent entities other than quantity. So once you had a machine for manipulating numbers, if those numbers represented other things, letters, musical notes, then the machine could manipulate symbols of which number was one instance, according to rules. It is this fundamental transition from a machine which is a number cruncher to a machine for manipulating symbols according to rules that is the fundamental transition from calculation to computation–to general-purpose computation – and looking back from the present high ground of modern computing, if we are looking and sifting history for that transition, then that transition was made explicitly by Ada in that 1843 paper.[1]

Commemoration

The computer language Ada, created on behalf of the United States Department of Defense, was named after Lovelace. The reference manual for the language was approved on 10 December 1980 and the Department of Defense Military Standard for the language, MIL-STD-1815, was given the number of the year of her birth.

Since 1998 the British Computer Society (BCS) has awarded the Lovelace Medal,[92] and in 2008 initiated an annual competition for women students.[93] BCSWomen sponsors the Lovelace Colloquium, an annual conference for women undergraduates.[93] Ada College is a further-education college in Tottenham Hale, London focused on digital skills.[94]

Ada Lovelace Day is an annual event celebrated in mid-October[95] whose goal is to "... raise the profile of women in science, technology, engineering, and maths," (see Women in STEM fields) and to "create new role models for girls and women" in these fields. The Ada Initiative was a non-profit organisation dedicated to increasing the involvement of women in the free culture and open source movements.[96]

The Engineering in Computer Science and Telecommunications College building in Zaragoza University is called the Ada Byron Building.[97] The computer centre in the village of Porlock, near where Lovelace lived, is named after her. Ada Lovelace House is a council-owned building in Kirkby-in-Ashfield, Nottinghamshire, near where Lovelace spent her infancy; the building was once an internet centre[98]

One of the tunnel boring machines excavating London's Crossrail project is named Ada.[99]

Ada: A Journal of Gender, New Media, and Technology is an "open-access, multi-modal, [open-]peer-reviewed feminist journal concerned with the intersections of gender, new media, and technology" that began in 2012 and is run by the Fembot Collective.[100]

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