

Ada Lovelace's Legacy for Computation History

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Abstract: This scientific and academic paper aims to make a historical review of the female contribution to the history of computing, through a bibliographic research by qualitative methodology of data analysis. So this story begins with Augusta Ada King, Countess Ada Lovelace, a precursor to the field of development and programming in the field of computer technology by developing the first machine-executable algorithm, in this case the Charles Babbage Analytical Engine. Thus, there is the redemption of female names that have made a major contribution to the development of computer history and which are of utmost importance to connoisseurs of computer science today. It then presents aspects of Ada Lovelace's life, which shows her story from the variations that have reached family relationships and moments of dedication in mathematics studies, as well as her writing talent manifested through poetic science that has resulted in a futuristic vision and that led to imagine the potential of machines long before being used or displayed, thus showing them a human being far ahead of her time and with fantastic ideas for her time, considering that at that time as women they had no rights and no spaces they have today. Thus, she demonstrated that her imagination about artifacts went beyond her usefulness to humans. Finally, we analyze or analyze Ada's thinking left to science and technology, as well as some curiosities about who is a memorable person for humanity to the present day in the field of use, including being celebrated and acclaimed using a date that how to recover. Its memory and have a great worldwide repercussion, as well as a programming language that bears her name and other expressions of rescue of her memory, characterizing a social recognition for a person.

Keywords: Ada Lovelace, Technology, Development and Programming, Computation History

1. Introduction

Technology is constantly evolving along with human interaction techniques. It is the result of a meeting between science and engineering that remains innovative, providing numerous solutions to society's problems, as well as creating other needs, whether through hardware or software, which keeps the flow of continuity of its improvement.

Although the word "Technology" is classified grammatically in the female gender, its field of activity is predominantly male, although when searching for female

performances in technology, it is possible to know and understand various female performances in this field of knowledge. Some women stand out for their pioneering spirit among which we highlight:

- I. Grace Murray Hopper [6, 13, 23], for her contribution to the development of COBOL Language;
- II. Kathleen (Kay) McNulty Mauchly [6, 13], Antonelli [13], Jean Jennings Bartik [6, 13], Frances Synder Holberton [13], Marlyn Wescoff Melzer [6, 13], Frances Bilas Spence [6, 13] and Ruth Lichterman Teitelbaum [13], who developed ENIAC, the first electronic computer;

- III. Adele Goldberg [6, 13]: worked on the creation of the first "window", an icon-based interface;
- IV. Madge Greswold [13]: assisted in the development of the ICON programming language;
- V. Lois Haibt [13]: developed an arithmetic expression parser, an essential component for the FORTRAN compiler;
- VI. SAW. Sister Mary Kenneth Keller [6, 13]: participated in the development of the BASIC language. She was also the first woman to receive a doctoral degree in computer science in the United States;
- VII. Emmy Noether [13]: Researched abstract algebra that provided the foundation for the creation of the PROLOG language;
- VIII. Jean E. Sammet [13]: oversaw the initial specifications and design of the COBOL compiler on MOBIDIC. She was also president of ACM (Association for Computing Machinery) in the 1970s;
- IX. HedyLamarr [23]: Together with composer George Antheil, she invented, during World War II, a communications system for the United States Armed Forces that served as the basis for the WI-FI system, GPS, and current mobile telephony.

These are some names that exemplify the presence of women in this area of knowledge. The first computer science class to graduate from IME-USP was predominantly female [3], but these days they are minorities among students in all universities offering computer training. So it is important to ask us why this reality has changed? One hypothesis may be that before the creation of the personal computer (PC), computers were great calculators, but with their popularization there was the playful purpose of games, which stigmatized the idea that "gambling is a boy thing". "[3].



Figure 1. First class of the Computing Course by IME-USP in 1974 [3].

In this article we intend to present a portion of the legacy left by the pioneer in Computer Science in the field of Development and Programming [4, 7, 10, 11], Augusta Ada King, Countess Lovelace [14, 15], or as she is best known and most admired, Ada Lovelace, to society, as she was the developer of the first code processed by a machine, thus building a major milestone in the present technological development through the interaction between technology and

the machine.

With this, this article aims to arouse, in the reader, the sensitivity to know and reflect on the historical construction of Computer Technology and Science, recognizing the contribution of women and the legacy of this memorable character that makes up a part important in the trajectory of this area of knowledge.

2. Ada Lovelace's Life

Born on December 10, 1815 [9, 10, 11, 16, 18] in the village of Patricbourne (Canterbury, England), Augusta Ada King, only legitimate daughter of George Gordon Byron (Lord Byron) [14, 16, 18], an influential poet in British romanticism [4, 10, 11, 16, 18], was raised by her Mother, Anne Isabela Noel Byron (Lady Byron or Annabella), English mathematics [10, 11, 16].



Figure 2. Ada Lovelace and her parents: Lord Byron and Annabella.

The drama of her parents' separation, coupled with family controversies [14] revealed to English society, did not hinder their intellectual development. [10] The marriage between Lord Byron and Annabelle was brief and ended five (5) months after Ada's birth [9, 10, 14]. Her mother learned that Augusta was the name of one of her ex-husband's lovers, so she decided to call Augusta only Ada [10, 14, 15]. During her childhood she was educated not only in the art of music, reading and writing, but mainly in the mathematics of arithmetic logic, following a disciplinary routine through tutors such as Mary Somerville Mathematics [4, 10, 11, 14, 15, 16, 17], first woman to join the Royal Society of Astronomy. In some letters Ada wrote to her mother, especially in the correspondence of June 1, 1826 [10], while Annabelle traveled, one can see how much an applied child she was:

"Today I am studying a little Italian and wrote an essay on arrowroot [...] When you come back, I think I'll know something of decimal numbers. I don't understand the compound three rule, but I haven't given up yet. With you I learn more than with books [...] I get up between six and six-thirty in the morning, breakfast at nine, lunch one and dinner at six [...]."

Although she had no contact with her 36-year-old father in Greece when Ada was only 8 years old, she inherited, through genetics, Lord Byron's poet temperament. [14] Although there was no paternal support in her formation, this trait showed through her creativity, which made her a pioneer in "poetic science" as well. At age 12 she wrote and illustrated the book "Flyology" [10, 11, 14] in which, inspired by mechanical

engineering, she planned to build a flying machine. Is today what we know as a plane? Perhaps.

At the age of 17, under Mary Somerville's tutoring [4, 5, 10, 11, 14-17], Ada was introduced to Charles Babbage, Professor at Cambridge University [19], who declined her requests to accepted as a student through the correspondences they exchanged for about ten years [4], due to the fact that she was a woman, but which allowed her to perfect her studies. Ada was a victim of the chauvinism that prevailed in the society of the time, and in some cases endure to the present day, which intended formal education exclusively for men while women stayed at home dealing with household things. [5]

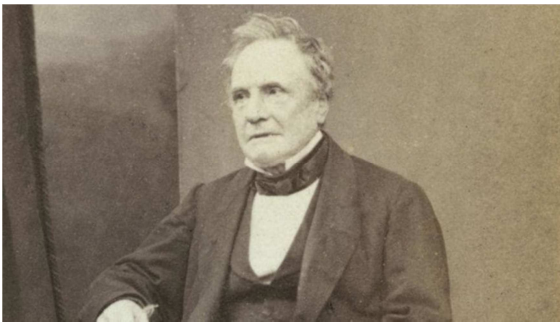


Figure 3. Charles Babbage.

Ada married William King-Noel in 1835 and had three children [4, 10, 16]: Byron (1836); Annabella (1837); and Ralph Gordon (1839). She received the title of Countess in 1838 [4, 8, 10] when her husband became Earl of Lovelace. Shortly after the birth of her 3rd child, now Augusta Ada King, she resumed her studies with the support of her husband, mentored by the 1st Professor of Mathematics at the University of London, Augustus de Morgan [4, 5, 10], where obtained training in algebra, logic and analysis through correspondence education and informally.

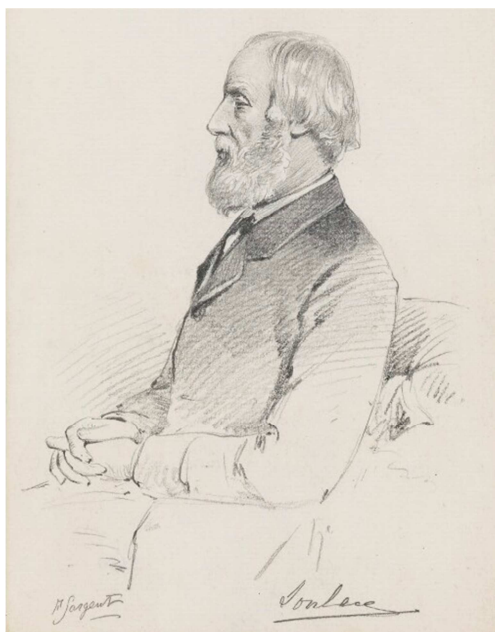


Figure 4. William King-Noel.

Ada died of uterine cancer on November 27, 1852 [10, 14, 17], the same age as her father, 36 years old. Although Ada Lovelace's father had been absent in her life, she admired him and wished to rest by her father's side, and was buried as she wished by his side. [10] Her mother, Annabella, died in 1860 at the age of 68.

3. The Algorithm of Babbage Analytical Engine

Amid the correspondence exchanged with Babbage, Ada can know and study his inventions, in particular the Analytical Engine [1, 2, 4, 5, 16-18] or analytical ingenuity, which at first was a difference, but due to lack of investment by the British government the project shifted focus to analytical machine [2, 16, 18].

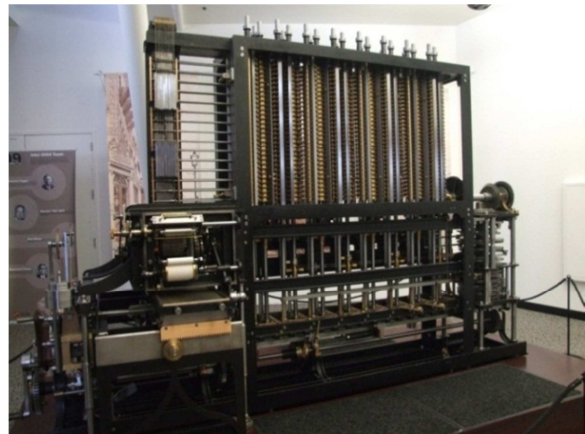


Figure 5. "Analytical Engine" em exposição no Museu da Ciência, em Londres [19].

This invention of Babbage was described, in an article in French, produced in October 1842 [1, 2] by Luigi Federico Menabrea, Italian military engineer [10, 16, 18]. Ada became aware of this writing on the recommendation of one of her friends, the physicist Charles Wheatstone [1, 2], who recommended the development of a translation. So she devoted herself for nine months and added several notes, called "lovelaciennes" [1, 2, 10, 12, 16].

Ada presented this work to Babbage in early 1843 [18], who suggested that she improve this translation using her own notes [2, 10, 12, 16]. She accepted the suggestion and, with the insertion of her various notes, made autonomously, resulted in a work three times larger and much richer compared to the original [12, 16, 18]. The document "High Priestess of the Babbage Machine" [1, 10, 12, 16] was recognized as superior to that of Menabrea, in addition to specifying the input process (punch cards indicating data and instructions), processing (calculation of numbers of Bernoulli [19]) and output (punch cards), included in the 7th note an algorithm [12, 16, 18] for processing on analytical machines, structured by a sequence of recurring complex numbers that was recognized as the first computer program [4, 5, 7, 10, 12, 16] long before this artifact was created.

Diagram for the computation by the Engine of the Numbers of Bernoulli. See Note G. (page 722 *et seq.*)

Number of Operation.	Nature of Operation.	Variables acted upon.	Variables receiving results.	Indication of change in the value on any Variable.	Statement of Results.	Data.												Working Variables.												Result Variables.			
						$1V_1$	$1V_2$	$1V_3$	$1V_4$	$1V_5$	$1V_6$	$1V_7$	$1V_8$	$1V_9$	$1V_{10}$	$1V_{11}$	$1V_{12}$	$1V_{13}$	$1V_{14}$	$1V_{15}$	$1V_{16}$	$1V_{17}$	$1V_{18}$	$1V_{19}$	$1V_{20}$	$1V_{21}$	$1V_{22}$	$1V_{23}$	$1V_{24}$	$1V_{25}$	$1V_{26}$		
						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	\times	$1V_2 \times 1V_3$	$1V_6, 1V_8, 1V_4$	$1V_2 = 1V_2$ $1V_6 = 1V_6$ $1V_8 = 1V_8$ $1V_4 = 1V_4$	$= 2n$	1	2	n																									
2	$-$	$1V_4 - 1V_1$	$1V_6$	$1V_6 = 1V_6$	$= 2n - 1$	1																											
3	$+$	$1V_6 + 1V_1$	$1V_8$	$1V_8 = 1V_8$	$= 2n + 1$	1																											
4	$+$	$1V_8 + 1V_4$	$1V_{11}$	$1V_{11} = 1V_{11}$	$= 2n + 1$	1																											
5	$+$	$1V_{11} + 1V_6$	$1V_{13}$	$1V_{13} = 1V_{13}$	$= 2n + 1$	1																											
6	$-$	$1V_{13} - 1V_{11}$	$1V_{15}$	$1V_{15} = 1V_{15}$	$= 2n - 1$	1																											
7	$-$	$1V_{15} - 1V_{13}$	$1V_{17}$	$1V_{17} = 1V_{17}$	$= 2n - 1$	1																											
8	$+$	$1V_2 + 1V_7$	$1V_2$	$1V_2 = 1V_2$	$= 2 + 0 = 2$	2																											
9	$+$	$1V_6 + 1V_7$	$1V_{11}$	$1V_{11} = 1V_{11}$	$= 2n - 1$	1																											
10	\times	$1V_{11} \times 1V_{11}$	$1V_{12}$	$1V_{12} = 1V_{12}$	$= B_1 \cdot \frac{2n-1}{2} = B_1 A_1$																												
11	$+$	$1V_{12} + 1V_{11}$	$1V_{13}$	$1V_{13} = 1V_{13}$	$= \frac{1}{2} \cdot \frac{2n-1}{2} + B_1 \cdot \frac{2n}{2}$																												
12	$-$	$1V_{13} - 1V_1$	$1V_{15}$	$1V_{15} = 1V_{15}$	$= n - 2 (= 2)$	1																											
13	$-$	$1V_6 - 1V_1$	$1V_6$	$1V_6 = 1V_6$	$= 2n - 1$	1																											
14	$+$	$1V_1 + 1V_7$	$1V_7$	$1V_7 = 1V_7$	$= 2 + 1 = 3$	1																											
15	$+$	$1V_7 + 1V_6$	$1V_8$	$1V_8 = 1V_8$	$= 2n - 1$	1																											
16	\times	$1V_8 \times 1V_{11}$	$1V_{11}$	$1V_{11} = 1V_{11}$	$= \frac{2n-1}{2} \cdot \frac{2n-1}{2}$																												
17	$-$	$1V_6 - 1V_1$	$1V_6$	$1V_6 = 1V_6$	$= 2n - 2$	1																											
18	$+$	$1V_1 + 1V_7$	$1V_7$	$1V_7 = 1V_7$	$= 3 + 1 = 4$	1																											
19	$+$	$1V_7 + 1V_6$	$1V_8$	$1V_8 = 1V_8$	$= 2n - 2$	1																											
20	\times	$1V_8 \times 1V_{11}$	$1V_{11}$	$1V_{11} = 1V_{11}$	$= \frac{2n-2}{2} \cdot \frac{2n-1}{2} = A_3$																												
21	\times	$1V_{11} \times 1V_{11}$	$1V_{12}$	$1V_{12} = 1V_{12}$	$= B_1 \cdot \frac{2n-1}{2} \cdot \frac{2n-1}{2} = B_1 A_1$																												
22	$+$	$1V_{12} + 1V_{11}$	$1V_{13}$	$1V_{13} = 1V_{13}$	$= A_0 + B_1 A_1 + B_1 A_2$																												
23	$-$	$1V_{13} - 1V_1$	$1V_{15}$	$1V_{15} = 1V_{15}$	$= n - 3 (= 1)$	1																											
Here follows a repetition of Operations thirteen to twenty-three.																																	
24	$+$	$1V_{13} + 1V_{24}$	$1V_{24}$	$1V_{24} = 1V_{24}$	$= B_7$																												
25	$+$	$1V_1 + 1V_2$	$1V_3$	$1V_3 = 1V_3$	$= n + 1 = 4 + 1 = 5$	1																											

Figure 6. Ada Lovelace's Algorithm for Charles Babbage's Analytical Engineer [16, 19].

Among her notes, Ada stressed that when the machine existed, it would be the guide to the evolution of science [1, 12]. She was undoubtedly an advanced scientist of her time. It could foresee the impacts of an artifact that no one even imagined to develop. So in order to fund the project, she devoted herself to applying her intellectual skills to gambling such as traditional horse racing, but lost several times, piling up a debt of £ 3,200. [18] Unfortunately neither Ada nor Babbage lived to see how the analytic function worked, as it was a costly machine for the time and it took a little over a century to get out of paper.

4. Recognition of Society

Despite not having a formal academic background in mathematics, since at that time the universities did not accept women for higher education, Ada Lovelace had her notes and the translation of the article, published by BV Bowden in "Faster than though," a Symposium on Machines. of Digital Computing held in 1953, in addition to the recognition of several mathematicians who admired and still admire their works, such as Cambridge University Professor Alan Turing [18], known as the "Father of Modern Computing" for having developed a machine with a system that translated texts encrypted by the Germans during World War II.

In 1878, the University of London allowed women to

graduate, 26 years after Ada's death. Also, on the path of Ada Lovelace, some initiatives of recognition and in memory of her legacy were created, such as:

- I. ADA Programming Language [14, 16] - Created in honor of the pioneer of algorithms, originated from Pascal, Simula, among others, served as the basis of the Ruby language, in 1974 this language was hired by the United States Department of Defense (DoD), as it is structured, object oriented, imperative, static and high level, replacing about 450 other languages that were used, standardized by ISO in 1982, having its latest version in 2012;
- II. Ada Lovelace Day [14, 16, 17] - Created in 2009 at London's Southbank Cultural Center, is celebrated on 15 October as a way of giving visibility to women's participation in science, technology, engineering and mathematics. Events related to this day happen in several universities around the world, among them we highlight the Federal Technological University of Paraná (UTFPR) that has been holding the event since 2014;
- III. Doodle Tribute - by Google, made available on its search platform on December 10, 2012, Ada's 197th birthday;
- IV. Calculating Ada Documentary - The Countless of Computing - In 2015 BBC UK released a documentary,

presented by Dr. Hannah Fry, traversing various British places where you can find tangible records of the history of Ada Lovelace;

- V. Launching, in Brazil, of two books aimed at children and youth, written by Silvia Amélia Bim. The first entitled "The Life of Ada Lovelace" [21] launched in 2018 with the support of the Brazilian Computer Society (SBC) and the digital girls project and edited by SBC publisher. The second under the title "Ada Lovelace, the Curious Countess" [20], released in 2019 by the same author, but by the publisher Inverse. The books are two beautiful tributes to this brilliant scientist

5. Conclusion

For academics and professionals in the Technological and Scientific area, knowing the history of the emergence of computing is an act of improving knowledge, recognizing the trajectory of great personalities that contributed to its construction. Although for many, the deterministic view of technology is very present, but it is in the process of deconstruction.

Knowing and recognizing women's contribution to scientific development is urgent. Knowing that they have always been present in these areas of knowledge, knowing the trajectory of pioneer women in the sciences that, despite suffering all sorts of prejudice and discrimination, contributed to the scientific development of humanity, allows more girls / girls / women to be interested in enter these careers. Believing this is what we share with readers the story of Ada Lovelace.

Ada Lovelace's connection to the future of technology came about through her interdisciplinary vision, for she linked the exact sciences of mathematics to the humanities of letters through the "poetic science" reflected in her algorithm where, indeed, there was an interaction between machine and the technique. Just as recognition of her legacy opened the door for women to enter London's academic life, her knowledge translated into words and numbers also provided the opportunity for the emergence of an area of technology, the area of Development and Programming.

Steve Jobs, in a 2005 Stanford graduation speech, said a very important phrase: "You cannot connect the dots by looking ahead; You can only connect the dots by looking back. So you have to believe that the dots will somehow connect in the future." Faced with increasingly accessible technologies, it is possible to imagine what the flight machine, the aircraft, which Ada so idealized, perhaps trying to see with her eyes, would be able to understand the value of her great contribution to the world. current.

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