

The poetical science of programming

THE DAUGHTER OF A CELEBRITY, THE PRODUCT OF A BROKEN HOME, DRIVEN BY HER HOT-HOUSING MOTHER AND NATURAL CURIOSITY TO SUCCESS IN THE MALE-DOMINATED ARENA OF COMPUTER SCIENCE – only to crash to an early death amid gambling debts and drug addiction. It may sound like an everyday tale of Silicon Valley, but this is the story of Ada Lovelace – and it could have been written by her friend Charles Dickens.



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ADA WAS BORN IN 1815 TO LORD BYRON AND ANNE ISABELLA (ANNABELLA) MILBANKE, A MATHEMATICALLY INCLINED ARISTOCRAT HER HUSBAND DUBBED “THE PRINCESS OF PARALLELOGRAMS”. Byron was equally famous for his sublime poetry and infamous for his unconventional lifestyle – he kept a pet bear in his university room and often went about armed with pistols and daggers. Lady Caroline Lamb, one of the many lovers who had experienced his mercurial temper and callous treatment, famously called him “mad, bad and dangerous to know.”

TAKING FLIGHT

Ada had a difficult, fractured upbringing. Just five weeks after her birth, her parents' marriage dissolved into scandal as Byron continued his affairs – most notoriously, one with his half-sister. Byron fled the country, never to see his wife or daughter again.

Annabella, determined not to let Ada descend into what she perceived as Byron's poetic insanity, focused her childhood on scientific study. At the time, most young girls of her class were restricted to learning how to sew and play the pianoforte, perhaps to speak some French. Ada, however, was tutored by some of the most prominent mathematicians and philosophers of the day, such as William Frend, Augustus De Morgan and Mary Somerville.

A precociously self-proclaimed 'analyst and metaphysician', Ada was hungry for knowledge – particularly about how things worked. At the age of 12, she spent hours studying the anatomy of birds to

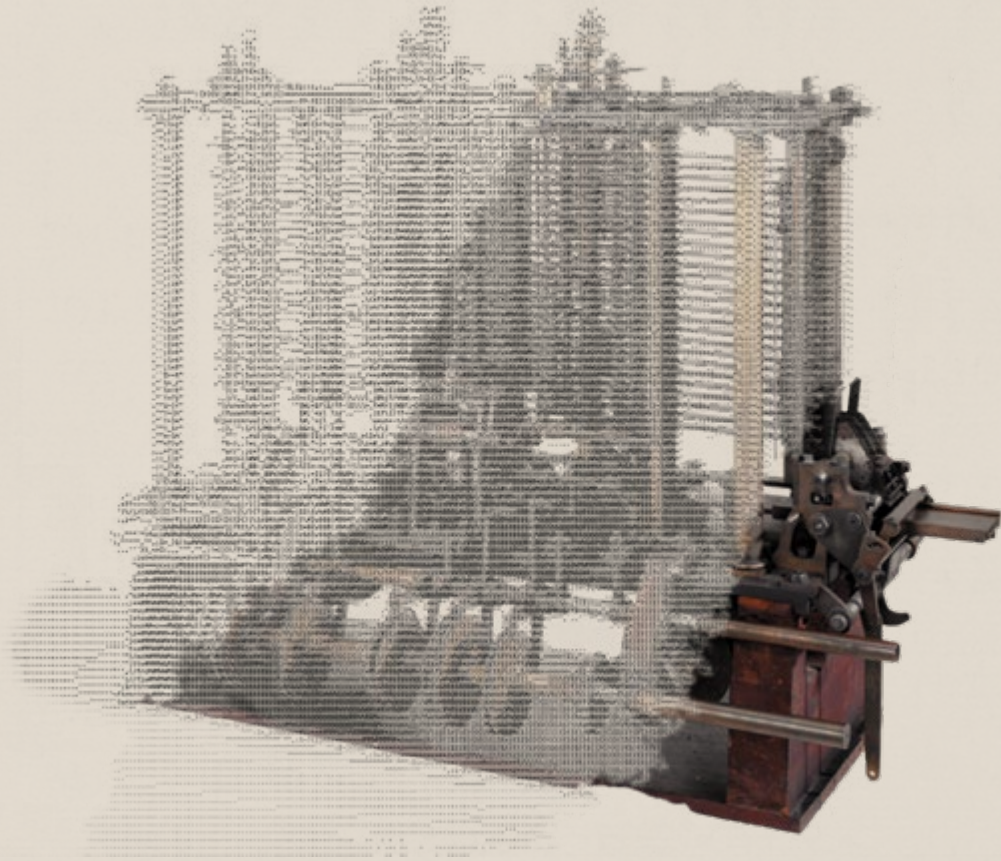
inform her blueprints for a steam powered flying machine. Already, Ada's imagination was taking flight, seeking to transcend the technological limitations of the day.

MAKING A DIFFERENCE

Born 25 years prior, Charles Babbage also had a natural curiosity for engineering. As a child, he often got into hot water for breaking open his toys to examine their inner workings. Little had changed when Ada, aged 17, first met Babbage at a Saturday night soirée. Ada was enthralled by Babbage and was delighted when he demonstrated a small working section of his latest invention – the Difference Engine. This was a mechanical calculator designed to harness the power of gears, levers and rods in order to perform calculations.

A machine of the kind was urgently needed. Back then, operators in many fields – from science to finance – relied on books with vast tables of logarithmic and

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trigonometric figures. But the figures had been calculated by humans, and inaccuracies were rife. To err is human, after all. The British government needed reliable tables – not least to give an edge to its navy, on which the empire and trade depended. The government was interested enough to provide significant funding for the Difference Engine.

PROGRAMMING THE FUTURE

The Difference Engine was never built in its entirety (at least, not until 2002). Babbage discarded it in favour of a new idea: the Analytical Engine, a general purpose computing machine. Whilst it was entirely mechanical, the Analytical Engine embodied many of the features of the electronic computer. It had a memory ('store', in

Babbage's language) and a central processor ('mill') to perform mathematical functions, including multiplication and division.

Ada collaborated with Babbage on one of its key advancements: programmability. For the first time, using technology inspired by the Jacquard loom, a machine was designed to read and execute instructions using holes punched in cards, enabling it to perform a variety of calculations.

It was whilst working alongside Babbage on the Analytical Engine that Ada, who had by now married and become Countess of Lovelace, published the first computer program. She was translating a paper written by Italian mathematician (and later prime minister) Luigi Menabrea about the Analytical Engine. At Babbage's suggestion, she supplemented it with her own exposition

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and detailed notes, labelled A-G. Note G contained a detailed description of the Analytical Engine's ability to calculate Bernoulli numbers (key in number theory and calculus) using what is now considered the first algorithm. The note outlined many features of contemporary computer programs, such as loops, decision-making processes and symbolic manipulation.

THE ART OF SCIENCE

Ada combined the wild romanticism of her father and the rigid rationalism of her mother into what she called 'poetical science'. Whilst Babbage saw his machines primarily as analytical tools, Ada's vision went far beyond Bernoulli numbers.

Doubtless drawing on her studies with De Morgan (a pioneer of symbolic logic), she speculated that the Analytical Engine had the potential to create anything that could be represented symbolically. 'The engine might compose elaborate and scientific pieces of music,' she wrote, foreshadowing today's debates over AI-generated art.

LADY LOVELACE'S OBJECTION

Nevertheless, Ada thought that the Analytical Engine's capabilities would be limited to what could be represented by algorithms. In Note G, she said: 'The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform.'

At first glance, this might seem to contradict her idea that machines could be used to create art or music. However, the key here is autonomy – art forms created by machines, whilst potentially complex and rich, would be directly linked to the creativity of whoever wrote its code. This point is central to the debate over artificial intelligence today – can machines think or create independently as humans do?

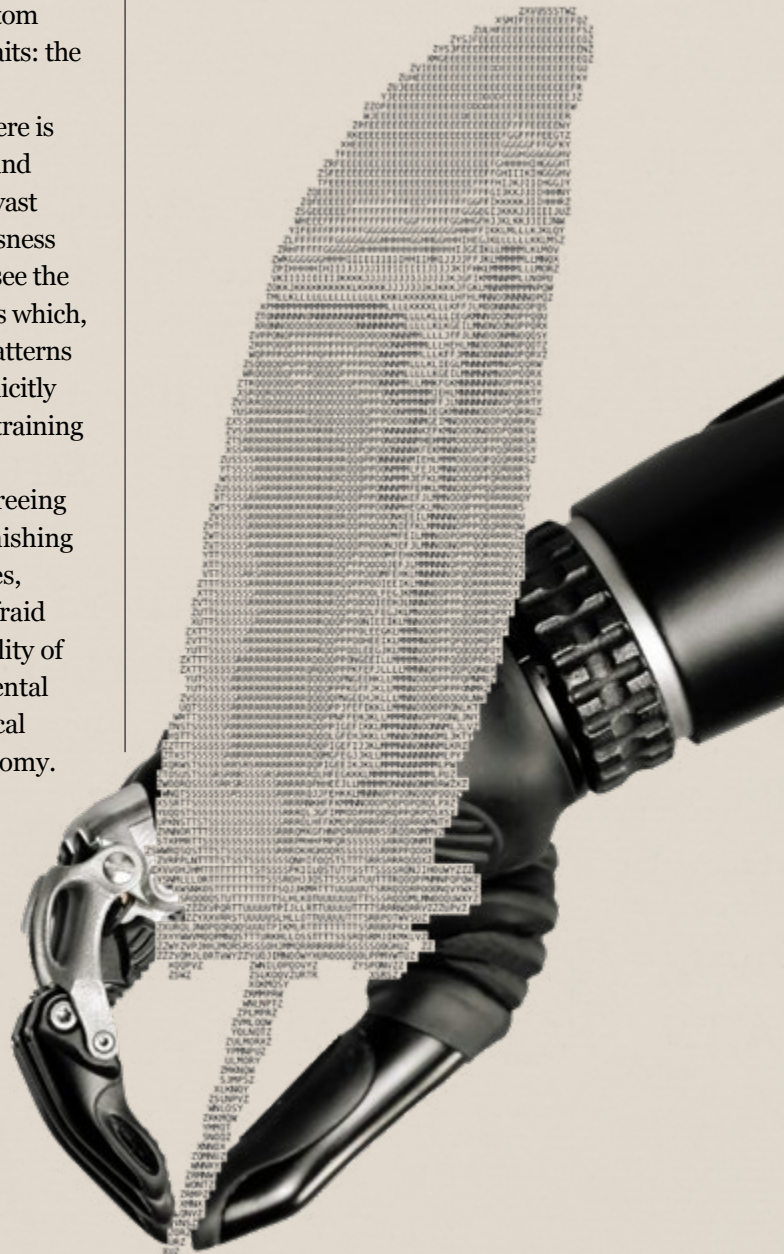
Working a century after Ada, Alan Turing grappled with this idea of mechanical autonomy in his seminal paper 'Computing Machinery and Intelligence'. He dismissed what he called the Lovelace Objection, countering that, whilst machines might appear to do only what they are programmed to, they could theoretically simulate any process including human intelligence, or creativity, if designed to do so.

THE CHARMLESS CHATBOT

Out of this work came the famous Turing test, which is used to assess whether a machine can convincingly imitate human behaviour. ChatGPT version 4, the latest iteration of OpenAI's advanced artificial intelligence chatbot, passed the Turing test. However, a study by Stanford University showed that it ranked among the bottom third of humans in key personality traits: the bot scored well on IQ but not on EQ.

Ada would doubtless argue that there is a distinction between true creativity and imitating human behaviour through vast data input, given the lack of consciousness of large language models. Today, we see the emergence of more generative models which, whilst still fundamentally based on patterns of data, can generate outputs not explicitly programmed or encountered during training – by some definitions ‘creative’.

Turing and Lovelace, whilst disagreeing on parts of their theses, shared astonishing foresight. In the context of their times, both were visionaries who were unafraid to push the boundaries of the capability of machines, arguably playing fundamental roles in the next phase of technological development – and ultimately autonomy.



THE LOVELACE LEGACY

In the 1840s, progress on Babbage's Analytical Engine stalled as the government withdrew its funding in frustration. Ada channelled her mathematical curiosity into other pursuits. Like many mathematicians before and since, she turned to gambling, convinced she could use her abilities to beat the odds. She failed, losing £3,200 on a dud horse in the Derby. Her later years were plagued by chronic health conditions and related opiate abuse. In 1852, Ada, the enchantress of numbers, died aged just 36.

For well over a century, her work went largely unrecognised. In recent years, however, as modern electronics finally caught up with many of the ideas she and Babbage worked on, Ada has come to be seen widely as both a figurehead of women in science and a pioneer of modern computing.

Scientists and historians still hotly debate whether Ada should be credited as the first programmer. Some critics claim Ada was no more than an interpreter of Babbage's work. Others charge that Babbage had envisioned many aspects of his revolutionary invention before he had even met Lovelace. She would have agreed.



In any collaborative exercise, it's hard to say who has contributed exactly what, particularly 180 years after the event. Is it material whether Hillary or Norgay set the first foot on top of Everest? Neither could have succeeded without the other. Certainly, Babbage's memoir and letters reveal the depth of his gratitude to Ada. For example, he writes that Ada did the algebraic working out of all the problems in the Menabrea translation, except for the numbers of Bernoulli. 'This she sent back to me for an amendment, having detected a grave mistake which I had made in the process.'

Almost 100 years before women got the vote, Ada worked at the forefront of a male-dominated field, corresponding with – and lauded by – many of the intellectual luminaries of her day, from Michael Faraday to Charles Dickens. Whilst some of her ideas may have been qualified due to developments in modern technology, Ada Lovelace's legacy is secure as a maverick thinker who bridged the realms of science and art, defied gender stereotypes and catalysed the dawn of a new era in technological potential. ●



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