Some Great Myths of the History of Computing

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Abstract: While Computing is a relatively new field, the true history of information technology is being confounded by the promulgation of myths that hide and confuse the truth. The current students of computing and information technology grew up not knowing that there was a world before the personal computer, or monitors, or the mouse. or Windows, and have little concept of where we came from or the steps that led to the present-day state-of-the-art. Bringing an understanding of computing into the classroom has the effect of bringing humanity to an otherwise androidal society, to recognize those who have made important contributions to the world of information technology, and to identify ideas and concepts that have been lost in the plethora of innovation.

Key words: history of computing

1. INTRODUCTION

A myth is a false belief or a traditional account that differs from fact that is frequently perpetuated by otherwise respectable sources. In information technology there are two primary sources of myths – the textbooks used by students, and the assumptions made by their teachers or mentors. The majority of beginning textbooks recognize the necessity of including at least a modicum of history to justify the source of the concepts to be introduced in the rest of the book, but regrettably the authors do little research on this topic or rely on unsubstantiated resources.

Typical of a perpetuated myth was the belief that Charles Babbage could not complete his machines because the engineering technology of the 1800s was insufficient to implement his concepts. Even though the Science Museum (London) possessed the complete set of working drawings for the

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Difference Engine, and Babbage had built several small prototypes that he deposited in archives around the world, the myth was immortalized. Under the direction of Doron Swade, (Assistant Director and Head of Collections) the Science Museum built a copy of the Difference Engine in time for the bicentenary of the birth of Charles Babbage in 1991. Using only mechanical engineering techniques available in the era of Babbage, Doron and his assistants completed the construction of the Difference Engine, essentially to Babbage's specifications. [23]

However debunking such a myth by such means is beyond the resources of most historians. On the other hand the location of original documents or reports of the relevant age can reveal the truth.

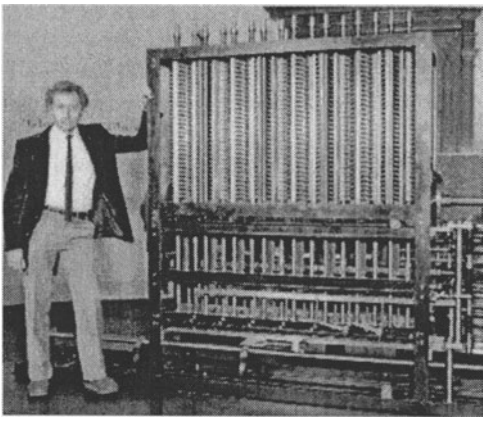

Figure 1: **Doron Swade and the Difference Engine**

(by permission of the Science Museum)

Some of the most frequently misstated facts relate to the identification of firsts in the field. This is partially the result of our propensity to choose to add enough adjectives to a description of an event or commodity to give it uniqueness. Thus in describing origin of the computer we can ask the question in terms of the first computer, the first modern computer, the first analog computer, the first digital computer, the first electronic computer, the first useful computer, etc. Even looking at so-called historical plaques that proclaim the importance of historical sites use enough adjectives to prove their point. For example, the web site annotating the history of the University of Pennsylvania describes the ENIAC as the world's first electronic large-scale, general-purpose digital computer and there is a sign outside the Moore School with the same annotation.

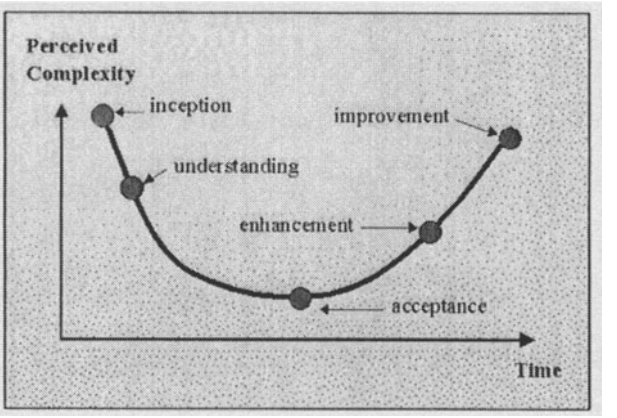

Figure 2: Perceived Complexity

Sometimes first "memorable" version of a concept or product is the one which is best known in the market. In fact, it would appear to be obvious that the "perceived complexity" of an product is a prime factor in a potential customer's decision to purchase that product. Similarly we can argue that the product that is first acceptable to the public is that which is best remembered. For example, in terms of personal computers (previously called microcomputers) the first recognizable operating system is most likely DOS, even though there were prior systems including CP/M. Likewise, the first programming language is likely to be considered to be FORTRAN even though there were several languages previously. FORTRAN was the first to be readily available and, possibly, understandable.

The history web site at Virginia Tech (http://ei.cs.vt.edu/~history) is the most frequently visited site at the institution, and the source of many questions from school children about the history of computing. Many of these questions reveal that they do not have a good knowledge of this history, and often have been given answers that they do not trust or accept.

2. COMMON MYTHS

Most computer users know that the basic number representation system of a computer is the binary system, but yet few have any notion of its origin. Even historians have difficulty answering this question, though they have some feeling for the origin of other number systems. A little research reveals John Napier (c1550-1617) used the binary number system in his chessboard calculator, though he used the symbols *a* and *b* instead of 0 and

1. [21] However, there are examples of two-character number systems in documents from India prior to the year 1000 AD that have been identified by B. van Nooten. [26] Readers of the draft of this paper have suggested that there exist binary representations in the trigrams of I Ching (China, 1042 BC) and in the Yin Yang of Korea. While it is not totally clear that these systems were used in numeration, or beyond mathematical curiosities, the concept was there. This then raises another question about firsts: which is a better first, the idea or the usage?

And while the point of interest is in the Far East, attempting to identify the first calculator is also an interesting exercise. The challenge is not only to define "first" but also "calculator". Obviously the definition of a calculator does not include the requirement "to operate without human intervention" as we would expect to find in the definition of a computer, but what characteristics are necessary? Should it automatically provide all four common arithmetic operations; or can the first perform only addition? Should it have automatic carry from one position to the next during arithmetic operations? Starting with a mechanical machine that had all these characteristics, and working chronologically and technogically backwards the partial list of significant calculators is [30]:

- The Millionaire (1890)
- Leibniz' Machine (1674)
- The Pascalene (1642)
- The Slide Rule (1622)
- Napier's Bones (1617)
- Abacus

There do not seem to be any surprises or myths in this listing, until we begin to ask questions about the abacus; what is the origin? Chinese? Japanese? Russian? Michael Williams reports that there are no records of the abacus in any of these three areas prior 1200AD (the time of Marco Polo) [29] whereas there are ample records of abacus-like tables in use in Greece back to 250BC. Then why do the myths about these "machines" link them with the Far East? Probably because the use of the abacus in the Western hemisphere stopped about 250 years ago, while in many parts of the Far East they are still in use.

Figure 3: Ada Augusta, Countess of Lovelace

Ada Augusta is frequently cited as being the world's first programmer, in recognition of her translation of the description of the Analytical Engine by Menabrea, and her added notes that included some algorithmic descriptions that can be interpreted as "programs". But then if the machine was designed by Babbage, would he have not known how to direct the operations of his own machine? In that case should not Babbage be the first programmer? But did he not get the ideas for the program cards from Jacquard?

In the modern era, Grace Murray Hopper always claimed to have been the third programmer on the Harvard Mark I calculator giving the credit to Robert Campbell and Richard Bloch to having been there when she arrived in 1943. Howard Aiken obviously knew how to program his own machine, but left the details of "making numbers" to his staff.

IN THE BYRON VAULT BELOW
LIE THE REMAINS OF
ADA AUGUSTA
ONLY DAUGHTER OF
GEORGE GORDON NOEL
6TH LORD BYRON
AND WIFE OF
WILLIAM, EARL OF LOVELACE

BORN 10TH DECR 1812
DIED 27TH NOVR 1852

R.I.P.

Figure 4: Ada Monumental Plaque, Hucknall Church

Returning to Ada, there has always been a controversy in the US regarding her true name. Betty Toole (as many others) refers to her as Ada Lovelace [24], lacking the understanding of the difference between a family name and a title. A visit to the Byron burial vault in Hucknall, Nottinghamshire will not help, since the plaque above the vault provides the details shown in figure 4. However Burke's Peerage [1] shows that the family name of the Earl of Lovelace in Ada's time was King, though the family changed their name to Noel shortly after her death.

Regarding the question of firsts, let us examine the question of identifying the very first computer.[i] Perhaps we should first resolve the problem of the definition of a computer, and we choose a legal definition from the 1984 Virginia Computer Crimes Act:

> "'COMPUTER' means an electronic, magnetic, optical, hydraulic or organic device or group of devices which, pursuant to a COMPUTER program, to human instruction, ..., can automatically perform COMPUTER operations with or on COMPUTER data and can communicate the results to another COMPUTER or to a person."

Alternatively the "von Neumann Architecture" to be found described in most classic textbooks might be the standard against which to compare candidate machines. Nonetheless, this architecture is not that to be found in John von Neumann's EDVAC description [27] but instead is the description of a different machine described by Arthur Burks, Herman Goldstine, and J. von Neumann in 1946 [6] which stated:

> "...inasmuch as the completed device will be a general-purpose computing machine it should contain main organs relating to arithmetic, memory-storage, control and connection with the human operator. It is intended that the machine be fully automatic in character, i.e. independent of the human operator after the computation starts."

So why do not we call it the "Burks or Goldstine architecture"?

Charles Babbage's Analytical Engine (c1840) clearly meets these requirements, whereas the claim for the first US machine by Herman Hollerith (1890) is erroneous. However, Babbage never completed the construction of this machine, whereas the machines built by Hollerith led to an industry that lasted for 70 years. Like the Difference Engine Babbage left behind detailed drawings for the Analytical Engine that have been reviewed in detail by Alan Bromley [5]. His opinion is that this design would truly implement a working computer.

Who developed the first modern digital computer is a common question on the history web site. [17] Our standard (FAQ) answer is that there are at least five people that can be identified as having the basic ideas of a computer in the second half of the 1930s, it being a time when all the components were ready, and it was the task of the pioneers to put them together in the right infrastructure to create the computer (alphabetically):

- Howard Aiken — Harvard Mark I (ASCC)
- John Vincent Atanasoff — the ABC
- George Stibitz — Bell Labs Model 1[ii]
- Alan Turing — the Universal machine
- Konrad Zuse — Z1 (and later Z2, Z3, Z4)

But which of these resulted in a real practical computer? Probably only the work of Konrad Zuse, but unfortunately his work went unknown until much later. In the 1940s we can now identify two major efforts:

- Tom Flowers et al — Colossus (1944)
- John Mauchly and J. Presper Eckert — ENIAC (1946)

So why do people "remember" the ENIAC? They had god public relations, were declassified at a convenient time, and it found immediate applications beyond the government and the military, while the knowledge of the Colossus was restricted for many years.

The "Stored Program Concept" is another concept that is often attributed to John von Neumann. While Metropolis and Worlton [20] stated "Von Neumann contributed significantly to the *development* of this concept, but to credit him with its invention is an error", they choose not to identify the originator. In 1982 AFIPS organized a meeting of the "principals" including J. Presper Eckert, Maurice Wilkes, and others who each expressed their opinions of the source of the concept. Eckert pointed out that Harry Huskey had reported that when he joined the ENIAC project in April 1944 the concept was under discussion; von Neumann did not join the project until August of that year. Von Neumann's advocate, Herman Goldstine, challenged this chronology and produced his own reports that did not include a reference to the concept until September 1944. [2] The 1936 patent claims of Konrad Zuse were never mentioned in this discussion, but his son points to the statement (translated):

> "The program itself can be stored too, where the instructions are delivered to the control unit by the clock frequency of the machine." [31] as proving that the idea existed almost ten years before the age of the ENIAC.

"The First Draft of a Report on the EDVAC" is also the subject of controversy, primarily in identifying the full set of authors. The AFIPS panel in 1982 suggested that this first draft written by John von Neumann would eventually have the names of J. Presper Eckert, John Mauchly, Arthur Burks, and Herman Goldstine added before final publication, which of course never happened. [27]

The first stored program computer was clearly the 1947 Manchester "baby", beating out the University of Pennsylvania's plans for the EDVAC expressed in the draft report. However, this machine was a feasibility project, and the computing capabilities of this machine had been sacrificed in order to concentrate on the stored program concept. [15] Consequently the first useful stored program machine was Maurice Wilkes' EDSAC which went into operation in May 1949, three years ahead of EDVAC. [28, p. 142] Within the USA the first stored program machine was the BINAC, built by Remington Rand for the Air Force in 1949. Unfortunately the BINAC never became fully operational but the experience helped to foster the construction of the UNIVAC. Touted to be the first business or commercial computer, the first UNIVAC was delivered to the US Bureau of the Census in 1951. In February of that same year the LEO (Lyons Electronic Office) machine was demonstrated to Princess Elizabeth (now Queen Elizabeth II) and the first regularly scheduled jobs were run for the Lyons company starting in November 1951. [4] The LEO was used by several other organizations over the next two years in extremely innovative projects, including weather forecasting by the UK meteorological Office. However, the LEO did not go into full-time operation until December 1953, and it was not until September 1958 that the first machine was delivered to a company other than Lyons. The UNIVAC can also be put into the list of firsts when it is noted that this was the first machine for which there was a true "assembly line" with the goal of delivering up to fifty systems; forty six were eventually installed.

A business machine that is often overlooked is ERMA – Electronic Recording Method of Accounting – built by General Electric for the Bank of America in 1957. This machine opened up a new market for computers in the banking industry, but more significantly initiated the automatic processing of bank checks through the use of MICR (Magnetic Ink Character Recognition), the basic concepts of which have not changed in 45 years, and which are accepted world-wide. The idea of MICR came not from GE, but from SRI (then Stanford Research Institute, now SRI International). [18][iii] Like the mouse, of which few know the originator, MICR, used by most of us on a daily basis has a source hidden in history.

In 1978 at the (first) History of Programming Languages Conference, Grace Murray Hopper announced the existence of the first computer bug having been found in a relay of the Harvard Mark I calculator in 1945,

though in the published version the machine was identified as the Mark II. [11] Since that time there has been some discussion as to the accuracy of this account, and whether this truly was the origin of the term "computer bug". Tropp reported that the term had been used by Thomas Edison in 1878! [25] The *New York Times,* and others, printed stories about the bug at various times and with various twists, including referring to the machine as the "Mach 1"! After the logbook eventually arrived at the Smithsonian Museum in the early 1990s, Peggy Kidwell was able to confirm that the actual machine was the Mark II and the date was 9 September 1947. [14] But who actually found the bug? Grace Hopper used the phrase "we took the moth out of the relay". At a reunion of the Harvard Mark III pioneers in 1988, the computer operator, Bill Burke of Pulaski VA, claimed that he was the person who actually took the bug out of the relay from the Mark II; Dr. Hopper was the one who pasted it into the logbook.

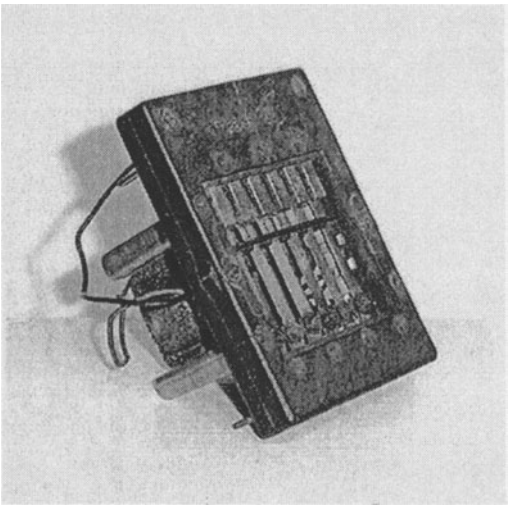

Figure 5: Harvard Mark III relay in the possession of the author

There are many myths that are related to Grace Murray Hopper, not the least of which was the fable repeated in most 1991 obituaries that she had been the developer of the programming language COBOL. This rumor was vaunted frequently during her lifetime, but she never went into print to correct the assertion. In fact, her programming languages A-1, B-0 and FLOWMATIC were significant contributions to the design of COBOL, and she was an active supporter of the language development activity. The language was the result of the work of the CODASYL "short range" committee led by Joe Wegstein of the US National Bureau of Standards. Intended to be a quick solution to the problem of producing a business counterpart to FORTRAN, the prototype became the long lasting product.

Dr. Hopper did write the first compilers for COBOL, and demonstrated that it was a portable system across different machines.

In 1996, in the year that the University of Pennsylvania celebrated the 50th anniversary of the unveiling of ENIAC, the question of which was the first professional computer organization. The IEEE Computer Society laid claim to the "brass ring" on the grounds that its ancestors, the American Institute for Electrical Engineering (AIEE) and the Institute for Radio Engineers (IRE) had formed a "Large Scale Computing Committee" in 1946. This committee survived in several configurations until 1953 when AIEE and IRE joined to create the IEEE, and until 1957 when the Computer Society was founded. The Association for Computing Machinery laid claim to the year 1947 based on the founding of the Eastern Association for Computing Machinery, and a similar organization on the west coast of the US. While the west coast society went its own way, the Eastern Association changed its named a year later by dropping the "Eastern" word. Thus the ACM has existed longer as a single entity, while the IEEE Computer Society can claim ancestors of a slightly earlier year.

The first rotating disk, designed under the leadership of Reynold Johnson, was announced in 1956 in the form of the IBM 305 RAMAC for the IBM 650 system. While this led, over 25 years to the hard disk, the floppy disk and the diskette as we know them today, a disk is simply a flattened version of a drum. The IBM 650 itself was a drum machine, and other drum machines had been built in the 1950s by Engineering Research Associates (ERA) for the US National Security Agency. However, Andrew Booth, University of London, had been building tiny drum memories since 1946 for his series of machines, the first of which was the ARC (Automatic Relay Computer).

The concept of the compiler was introduced by Grace Murray Hopper in 1952, and she built several translators for her languages thereafter. [10] Nonetheless, these languages were not (syntactically) highly structured and the process of translation was not much beyond that of an assembler. It was John Backus and his team that built the compiler for the programming language FORTRAN (1954-1957) that is generally considered to be the first fully fledged compiler. Prior to their work there had been a number of interpreters of slightly simpler programming languages, and which contained some elements of compilers. Backus credited Laning and Zierler, working on an interpreter for an algebraic language on the TX-0 at MIT, for giving him the ideas for the language FORTRAN [2], and Alec Glennie had developed Autocode at the University of Manchester for the Mark I as early as 1952. Glennie's language was fairly simple, being alphanumeric rather than numeric and contained the capabilities of looping and conditional expressions. But then, Konrad Zuse had proposed a language named

Plankalkül and described its translator in 1945 though never implemented it. [32]

On a personal note, I have felt snubbed since ACM SIGCSE presented an award to David Gries in recognition of having written the first book on compilers in 1971. [8] The first edition of my own book The Anatomy of a Compiler was published in 1967 [16], while Brian Randall and L.J. Russell had published their book in 1964 [22], and colleagues have identified two other books that were published circa 1970.

Not counting machines that were disassembled and then reassembled elsewhere, most thinking people usually ascribe the first portable computer to the space program, and the Smithsonian Air and Space Museum displays computers that were aboard the Mercury spacecraft of the 1960s. The expectation of a portable computer, such as the laptop of today, is that they should be small. The first computer intended to be mobile was the Mobidic (MOBIle Digital Computer), built by Sylvania for the US Army in 1957. [12] Housed in a large truck, MOBIDIC was intended for use by the US Army Signals Corps for communications systems. The first computer that could be carried by a single, but strong, person was the IBM 5100. Priced at over $10,000, weighing about 50 lbs, and supporting only one programming language, the IBM 5100 was a curiosity but not a successful product line in 1975. This was the era of the microcomputer, a term first used in connection with the French MICRAL in 1973. It was also the era of the "build-it-yourself" kits, the first of which was offered by the Scelbi Computer Consulting Company also in 1973. In July 1974: Jonathon Titus and Peter Rony of Virginia Tech offered the Mark 8, based on the Intel 8008, in the *Radio Electronics* magazine, and were moderately successful until overtaken by the Altair 8800 advertised in *Popular Electronics* magazine in December 1974.

A recently re-energized myth is that of the first e-mail. The *New York Times* and the *Washington Post* both reprinted an Associated Press report that 1 October 2001 was the 30th anniversary of the first e-mail. [7]

"Sometime in late 1971, a computer engineer named Ray Tomlinson sent the first e-mail message. 'I sent a number of test messages to myself from one machine to the other,' he recalls now. 'The test messages were entirely forgettable. ... Most likely the first message was QWERTYIOP or something similar.'"

Not so. In 1965 Dartmouth College had installed terminals in several other colleges for them to use their time sharing system and the BASIC language. One of those colleges was Smith College in Northampton Massachusetts, a women's college at a time when Dartmouth was still a men's college. DTSS had the capability of transferring files between users, and before long the men of Dartmouth and the women of Smith discovered

that they could send messages back and forth by this means. This capability was formalized into a mail system for all to use. I remember vividly sitting in a meeting in 1967 trying to decide what one-character command would be used for this capability. "m" had already been used for move, as "f" meant file and "l" was login. "e" had not been assigned a meaning and someone observed that if we called it "electronic-mail" then "e" would be appropriate. Thus it became "e-mail".

At the time of writing, a new controversy of that same era surfaced. It is question of who invented "packet switching", a technology that was highly influential in the success of the early networks and eventually the Internet. The combatants are identified as Leonard Kleinrock (UCLA), Donald Davies (NPL), and Paul Baran (formerly of the RAND Corporation). While all have been given international awards for their contributions to the field, there is the question, typical of those we have seen before, of who had the idea and who created the first implementation. Kleinrock described his system (though not named packet switching) in a MIT dissertation in 1961, Baran outlined a packet-switched network that would make communications less vulnerable to attack or disruption in the early 1960's, while Davies, first applied the word "packet" to data communication in the mid-1960's, and later built a small packet-switched network. [9]

3. SUMMARY

In the second volume of the *Annals of the History of Computing*, Metropolis and Worlton [20] sought to correct three errors (myths) and gave the following advice:

1. *Allow no published error to go uncorrected.* Only through a vigorous weeding process can we hope to stop the propagation of the seeds of error.
2. *Do not publish conjectures as though they were facts.* Lack of caution is one of the obvious marks of the "bad amateur."
3. *Do not depend upon secondary sources.* The error function for Nth-level repetition is monotonically increasing.
4. *Remember that the basis of scientific history is bibliography.* Start with a good bibliography and end with a better one.

But PRIMARY sources are difficult to find, primarily because we did not practice good documentation in the early days, and there were no archival journals dedicated to the field. Even where pioneers have written about their experiences, it is not uncommon for observers of the same event or period to have different recollections.

In the Foreword to the first issue of the *Annals of the History of Computing,* Aaron Finerman stated:

> "...critical examination, accompanied by even more critical debate and commentary, can help reveal the brilliant from the blunder, the creative from the mundane, and the true breakthrough from the shallow triumph of the day. In this manner we gain the insight to better distinguish between the wheat and the chaff of today-to learn from past accomplishments and from past mistakes how to better shape the future direction of this field." [13]

This paper hopes to keep that tradition alive with the sincere hope that we have created no new myths in this presentation. A current NSF sponsored project – CITIDEL – is working on the resource portion of this problem, developing, among other subjects, a digital library on the history of computing for the support of faculty and students as part of the National SMET Digital Library. (See http://www.citidel.org).

I am sure that on reading this paper others will identify other myths that need correction; I plan to keep the collection growing over the years so that we can tell our new students of the true history of our field, not tainted by nationalism or ignorance.

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End Notes

[i] I am reminded that people (commonly women) who used calculators to perform computations prior to the availability of the computer were named "computers:, and that in the UK the machines were initially named "computors".

[ii] Stibitz complained to this author that the designations of his machines are often written in Roman numerals (as in the case of the Aiken-Harvard machines) whereas he always used Arabic numerals.

[iii] Today the same character set is still in use, though the recognition is now optical rather than magnetic.

[iv] The reprint of this paper states that it was presented in Pittsburgh PA, however other references to the 1952 ACM conference also list Toronto as the venue.