YEARS 75 IEEE COMPUTER SOCIETY

Insights Into the Origins of the IEEE Computer Society and the Invention of Electronic Digital Computing

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Using some nearly forgotten facts, this article reviews the origins of the IEEE Computer Society and the first Technical Committee on Electronic Computers, established about 10 years after the revolutionary invention of electronic digital computing.

For decades, the IEEE Computer Society (CS) has been, by far, the largest professional unit within IEEE. As early as 1968, its predecessor, the Computer Group, surpassed the 10,000-member milestone.[11] Since then, the IEEE CS has grown substantially, servicing more than 225,000 community members in 2021. This has been in line with the rapid global developments of computer science and engineering—the main driving force of the unprecedented digital revolution, which has transformed modern life.

The professional community activities in computer science and engineering began in the first year after the World War II. The CS origins can be traced back to 1946 when there were two independent and sometimes rival organizations: the American Institute of Electrical Engineers (AIEE) and the Institute of Radio Engineers (IRE). These two institutions eventually merged in 1963, creating IEEE. A lot has been written on this matter over the last 75 years, but there are still many questions that require answers and clarifications, particularly because the IRE and AIEE had initially created separate committees dedicated to the new field of computing.

Within the AIEE, the Subcommittee on Large-Scale Computing Devices was initially formed as part of the Basic Sciences Committee during May/June 1946 with Charles Concordia as the first chair.[20] In 1947, with the backing of AIEE leadership, the group started preparing for elevation to full committee status while dropping "Large-Scale" from its title. Eventually, the AIEE Committee on Computing Devices was formally approved by the Board of Directors on 29 January 1948 and achieved full official standing on 1 August 1948.

The uniqueness of the IRE lies in the fact that, during the first half of the 20th century, it was the most scientific of all of the American engineering societies. This spirit found its expression in the institute's high membership standards, a stress upon creativity, its democratic elections, and its dedication to international scientific collaboration. There was a strong convergence between the values implicit in the development of a highly scientific field and the professional atmosphere created by the founders of the IRE. In line with these principles, the IRE Technical Committee (TC) on Electronic Computers was initially formed in 1946 as a subcommittee, just like the AIEE Subcommittee on Large-Scale Computing Devices. However, it is still unclear why, in 1951, the IRE decided to establish the Professional Group on Electronic Computers (PGEC)[21] with no evidence showing continuity between the new group and the existing TC. The PGEC creation was a move in the right direction as PGEC turned out to be very successful in the 1950s and the early 1960s, before the merger of the IRE and the AIEE in 1963.

THE INCEPTION OF THE IRE TC ON ELECTRONIC COMPUTERS

The first IRE TC on Electronic Computers played an important historic role, and, therefore, we shall review some nearly forgotten facts. The earliest evidence of professional activities in this new area within the IRE dates back to 1946. The technical program of the highly successful 1947 IRE National Convention (3–6 March 1947) was published in January[6,7] and February 1947.[8,9] It included 122 papers, five of which were presented in the session, "Electronic Digital Computers," on Tuesday, 4 March 1947 in the West Ballroom, The Commodore Hotel, New York City.[10] These papers had to have been prepared and submitted in 1946 for inclusion on the technical program. The authors—J.W. Forrester [Massachusetts Institute of Technology (MIT)], S.N. Alexander [National Bureau of Standards (NBS)], H.H. Goldstine [Institute for Advanced Study (IAS)], J.A. Rajchman (RCA), and P. Crawford [U.S. Office of Naval Research (ONR)]—were officially listed as inaugural members of the IRE TC on Electronic Computers in 1948. Several interesting exhibits were presented in special demonstration rooms, including component units of the Electronic Discrete Variable Computer (EDVAC), which was declassified only one week before the show.

A total of 73 IRE TC and subcommittee meetings were held in 1947.[2] These included the Technical Subcommittee on Electronic Digital Computers, which must have been established in 1946. Later in 1947, Arthur Burks published in *Proceedings of the IRE* his highly cited ENIAC paper,[17] submitted in 1946. The 1947 annual report of the secretary, Haraden Pratt, as received by the IRE Board of Directors, includes the following statement:[2]

*Three new important Technical Committees, ... and **the Electronic Computers Committee**, were created, which indicates an increased trend in Technical Committee activities for the future.*

An extensive online search established that, after the successful start of the Subcommittee and the creation of the IRE TC on Electronic Computers in 1947, the IRE Executive Committee approved a bylaw amendment to include the TC on Electronic Computers in Section 80 and appointed James R. Weiner as the first chairman of the same TC at its meeting on 6 January 1948:[3]

***Bylaw Section 80.** Dr. Goldsmith moved that the Constitution and Laws Committee be instructed to prepare a Bylaw amending Bylaw Section 80 to include the new Technical Committee on "Electronic Computers." (Unanimously approved.)*

***Chairman, Technical Committee on Electronic Computers.** Dr. Goldsmith moved that the Executive Committee approve the appointment of J.R. Weiner as Chairman of the Technical*

Committee on Electronic Computers. (Unanimously approved.)

These decisions not only confirmed the elevation to full committee status but also the drop of "Digital" from the title, which would leave room for the inclusion of analog (continuous) computers in the definition of scope, as approved by the IRE Executive Committee on 2 March 1948:[4]

Definition of Scope of the Electronic Computers Committee. Mr. S. L. Bailey moved that the Executive Committee approve the following definition of scope of the Electronic Computers Committee, submitted by the Committee Chairman, James R. Weiner, with the suggestion that the Technical Secretary investigate the use of the term "continuous" in this application:

The Technical Committee on Electronic Computers is responsible for all work relating to digital and continuous computers. Included are applications to scientific computing, fire control, and industrial control problems. A primary duty of the Committee will include the compilation of a glossary of definitions designed to correct the many current ambiguities. Additional duties of the Committee include standardization of test methods, coordination with the Papers Procurement Committee, and computer session planning. (Unanimously approved.)

This TC continued to be very active in 1948 with a committee meeting and nine papers presented in two regular sessions, "Computers I – Systems" and "Computers II – Components," at the 1948 IRE National Convention 22–25 March 1948.[5] Many of the authors of these papers were founding members of the IRE TC on Electronic Computers. Another fascinating fact is that among the invited speakers for the special session

"Advances Significant to Electronics" were Norbert Wiener (MIT), "Cybernetics"; Claude Shannon (Bell Labs) , "Information Theory"; and John von Neumann (IAS), "Computer Theory." [5]

In his article from 1991,[1] Merlin Smith gives a list of the 21 founding members of the first IRE TC on Electronic Computers (1 May 1948). Regretfully, this article does not provide a reference to the original publication, which was eventually found in *Proceedings of the IRE*:[2]

Technical Committee on Electronic Computers
Chairman: J.R. Weiner (Raytheon Manufacturing Co.); Vice-Chairman: G.R. Stibitz (Bell Labs); Members: S.N. Alexander (NBS), J.V. Atanasoff (NOL), J.H. Bigelow (Princeton Univ.), Perry Crawford (ONR), C.S. Draper (MIT), J.P. Eckert Jr. (Eckert-Mauchly Computer Corp.), J.W. Forrester (MIT), H. Goldstine (IAS), E.L. Harder (Westinghouse Electric Co.), B.L. Havens (Columbia University), E. Lakatos, G.D. McCann (California State Polytechnic Inst.), C.H. Page, J.A. Rajchman (RCA), Nathaniel Rochester (Sylvania Electric Products Inc.), Robert Serrell (RCA), T.K. Sharpless (Univ. of Pennsylvania), R. Snyder (Univ. of Pennsylvania), and C.F. West (Raytheon Manufacturing Co.).

The IRE TC on Electronic Computers inaugural roster (as listed above) is an impressive collection of early computer pioneers that includes the inventor of electronic digital computing: John Vincent Atanasoff.

THE INVENTION OF ELECTRONIC DIGITAL COMPUTING
The 1930s saw an unprecedented ebullience of scientific ideas and proposals looking for different solutions to the automatic calculations challenge. The variety of interests from

academic institutions, commercial endeavors, and government administration further added to the richness of possible approaches. It was in these circumstances that Atanasoff's exceptional invention and development of electronic digital computing marked the beginning of the information revolution.[18] In 1937, after significant research and practical investigations, Atanasoff came up with the basic design principles of electronic digital computing.[13] These included the use of

› electronics technology for computational speed as opposed to mechanical or electromechanical technology
› binary arithmetic for simplicity of implementation as opposed to decimal arithmetic
› digital calculations for accuracy as opposed to analog calculations
› dynamically refreshed memory for low cost and reliability.

Based on these revolutionary concepts and after further practical investigation, a proof-of-concept prototype became operational and was demonstrated in October 1939. This was followed by the development of a full-scale computing machine [called the Atanasoff-Berry Computer (ABC) since the late 1960s] for solving systems of equations using digital electronics. It was demonstrated between 1939 and 1942 by Atanasoff and his graduate assistant, Clifford E. Berry.

A few years after Atanasoff's project, the British "Colossus" electronic digital computer was independently designed and built at the Post Office Research Labs at Dollis Hill in North London between March and December 1943.[22] The first prototype, developed for the top-secret code-breaking facility (known as "Station X") at Bletchley Park, was first operational on Christmas Day, 1943. After receiving highly favorable feedback from its initial operation, the project team, led by

Thomas H. (Tommy) Flowers, built another 10 improved Colossus versions, which were extensively used to break the German "fish" codes in the last two years of World War II.

Around the same time, another groundbreaking project, classified as confidential and led by J. Presper Eckert Jr. and John W. Mauchly, started in June 1943 at the University of Pennsylvania. This was the Electronic Numerical Integrator and Computer (ENIAC), which became operational in December 1945 and was announced to the media in February 1946, followed by a well-run publicity campaign. ENIAC's popularity remains widely acknowledged within the professional community to this day.

There are, however, some important facts which need to be emphasized again. In June 1941, Mauchly visited Atanasoff in Iowa State to learn in detail about his project. It is well documented that Atanasoff had submitted a patent application to Iowa State, but the university neglected to file it. Atanasoff also informed Mauchly about this matter and stated in his letter to him (dated 7 October 1941): "I have no qualms about having informed you about our device, but it does require that we refrain from making public any details for the time being."

Soon after that, ENIAC's design and construction were derived with no acknowledgment of Atanasoff's invention. As stated in Judge Earl R. Larson's Federal Court's historic decision (19 October 1973):

> Between 1937 and 1942, Atanasoff, then a professor of physics and mathematics at Iowa State College, Ames, Iowa, developed and built an automatic electronic digital computer. The work of Atanasoff was known to Mauchly before any effort pertinent to the ENIAC machine or patent began. Eckert and Mauchly did not themselves first invent the automatic electronic digital computer, but instead derived that subject matter from Dr. John Vincent Atanasoff.

Despite the long list of publications, discussions, interviews, and announcements, some of the details are still not well elucidated. For example, it is often believed that the computer's name, "ABC," was given during the development of the project. In fact, Atanasoff started using the acronym in the late 1960s to recognize Berry's contribution in his testimony for the court case on 15 June 1971.[13] Before that, he referred to it as the "computing machine"[14] while the only other book providing a two-page description of the "Atanasoff-Berry computer" was published in 1966.[12]

This again confirms Atanasoff as the sole inventor of electronic digital computing concepts and his innovative contributions to the creation of modern computers. While Berry had proven himself as a gifted young engineer at the time of his graduation in the summer of 1939, we have not seen published evidence about any contributions by him to the invention of electronic digital computing. In one of his letters (12 July 1963) to R.K. Richards,[23] Berry mentions September 1939 as the first month when he was fully occupied as a graduate assistant, building the frame without any real idea about what was going to go in the machine. At the same time, in October 1939, Atanasoff demonstrated the operation of his first partial prototype. Even the topic area of Berry's master's thesis, titled "Design of an Electrical Data Recording and Reading Mechanism" (1941), had been provided solely by his supervisor.[13] Atanasoff and Berry worked very closely together on the implementation, and existing publications are very clear about their productive partnership.

Berry quickly developed as one of the most forward-looking computer designers at that time. Applying his skills from the computing machine project with Atanasoff in his future work, he was initially the project manager of the electronic analog machine
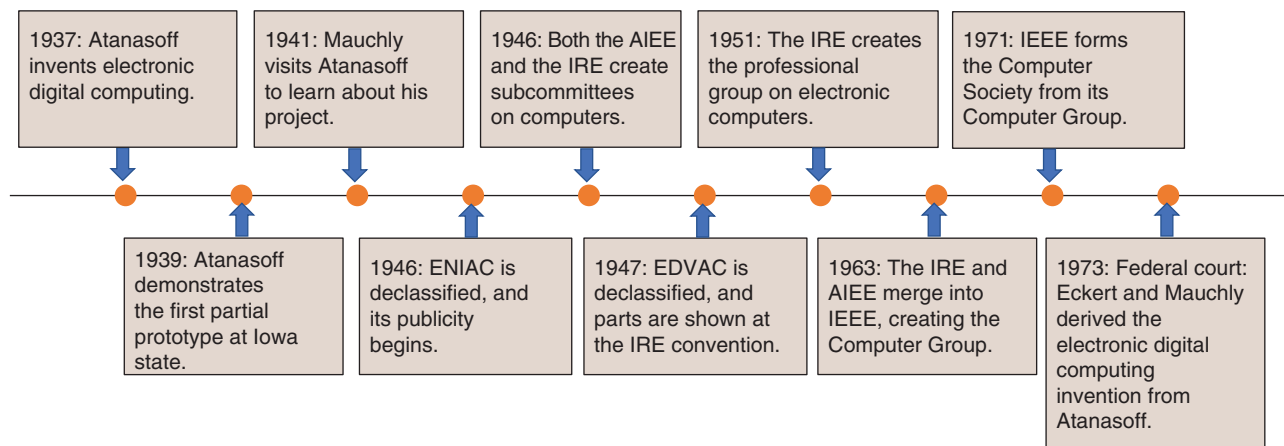

FIGURE 1. The main milestones in the first 35 years of electronic digital computing.

CEC 30-103[15] at the ElectroData part of the Consolidated Engineering Corporation (CEC). After ElectroData's acquisition by Burroughs Corporation in 1956, Berry led Burroughs into electronic digital computing.

The list of early commercially available electronic computers includes (in chronological order): CEC 30–103 (1949), Universal Automatic Computer (UNIVAC) I (1951), and IBM 701 (1952). Both CEC 30-103 and the later completed CEC-30-201 (1954) were electronic analog computers and, therefore, relatively small systems while UNIVAC I and IBM 701 were electronic digital computers.

Of all of the brilliant scientists who have shaped the early years of electronic computing, Atanasoff was the first one to use digital electronics to implement arithmetic operations.[24] About 10 years after his revolutionary invention, organized technical activities in the field began (see Figure 1). The IRE TC on Electronic Computers built critical mass from the very beginning of its existence, initially as a subcommittee. It played a particularly influential role with its very strong membership, which included Atanasoff, Eckert, Stibitz, Weiner, Rochester, Goldstine, Alexander, and others. Atanasoff's design principles propagated via ENIAC and EDVAC (both declassified in 1946–1947) to most of the commercially available modern computers and remain at the core of electronic digital computing technologies to the present day.

A fully identical reconstruction of Atanasoff's original computing machine was completed[16] and demonstrated[25] in the 1990s. Since 2011, when it was moved to the Computer History Museum in Mountain View, this reconstruction has been attracting the wider public's attention.[19] ▣

REFERENCES
1. M. G. Smith, "IEEE Computer Society: Four decades of service," *Computer*, vol. 24, no. 9, pp. 6–12, Sept. 1991. doi: 10.1109/2.84894.
2. "Institute news and radio notes," *Proc. IRE*, vol. 36, no. 6, p. 761, June 1948. doi: 10.1109/JRPROC.1948.230545.
3. "Institute news and radio notes," *Proc. IRE*, vol. 36, no. 4, p. 505, Apr. 1948. doi: 10.1109/JRPROC.1948.229654.
4. "Institute news and radio notes," *Proc. IRE*, vol. 36, no. 5, p. 633, May 1948. doi: 10.1109/JRPROC.1948.226203.
5. "Institute news and radio notes," *Proc. IRE*, vol. 36, no. 3, pp. 365–380, Mar. 1948. doi: 10.1109/JRPROC.1948.233924.
6. "1947 IRE National Convention and Radio Engineering Show," *Proc. IRE: J. Commun. Electron. Eng.*, vol. 35, no. 1, p. 3, Jan. 1947. [Online]. Available: https://worldradiohistory.com/hd2/IDX-Site-Technical/Engineering-General/Archive-IRE-IDX/IDX/40s/IRE-1947-01-OCR-Page-0003.pdf
7. "Institute news and radio notes," *Proc. IRE*, vol. 35, no. 1, p. 49, Jan. 1947. doi: 10.1109/JRPROC.1947.231221.
8. "Program for the 1947 IRE National Convention," *Communications*, vol. 27, no. 2, pp. 18–40, Feb. 1947. [Online]. Available: https://www.rsp-italy.it/Electronics/Magazines/Communications/Communications1947 02.pdf
9. "Extensive plans set for 1947 IRE National Convention March 3, 4, 5, and 6 in New York," *Proc. IRE*, vol. 35, no. 2, pp. 172–184, Feb. 1947. doi: 10.1109/JRPROC.1947.231597.
10. 1947 IRE National Convention, "Institute news and radio notes," *Proc. IRE*, vol. 35, no. 5, pp. 499–503, May 1947. 10.1109/JRPROC.1947.226253.
11. J. D. Ryder and D. G. Fink, *Engineers & Electrons: A Century of Electrical Progress*. Piscataway, NJ: IEEE Press, 1984. [Online]. Available: https://ethw.org/w/images/c/cc/Engineers_&_Electrons.pdf
12. R. K. Richards, *Electronic Digital Systems*. Hoboken, NJ: Wiley, 1966.
13. J. V. Atanasoff, "Advent of electronic digital computing," *IEEE Ann. Hist. Comput.*, vol. 6, no. 3, pp. 229–282, July–Sept. 1984. doi: 10.1109/MAHC.1984.10028.
14. J. V. Atanasoff, *Computing Machine for the Solution of Large Systems of Linear Algebraic Equations*. Ames, IA: Iowa State College, Aug. 1940. Republished in B. Randell (Ed.), *The Origins of Digital Computers*, pp. 305–325. Springer-Verlag, 1973.
15. J. Strickland, "Stories," *Volunteer Inform. Exchange*, vol. 1, no. 7, p. 2, Computer History Museum, 2011. [Online]. Available: http://s3data.computerhistory.org/chmedu/VIE-007.pdf
16. J. Gustafson, "Reconstruction of the Atanasoff–Berry computer," in *The First Computers—History and Architectures*, R. Rojas and U. Hashagen, Eds. Cambridge, MA: MIT Press, 2000, pp. 91–106. [Online]. Available: https://www.researchgate.net/publication/262402944_Reconstruction_of_the_Atanasoff-Berry_computer
17. A. W. Burks, "Electronic computing circuits of the ENIAC," *Proc. IRE*, vol. 35, no. 8, pp. 756–767, Aug. 1947. doi: 10.1109/JRPROC.1947.234265.
18. A. R. Burks and A. W. Burks, *The First Electronic Computer: The Atanasoff Story*. Ann Arbor, MI: Univ. of Michigan Press, 1988.

19. C. Severance. *Interview with John C. Hollar–History of Computing, Computing Conversations, IEEE Computer Society* (Aug. 24, 2013). Accessed June 20, 2021. [Online Video]. Available: http://youtu.be/poh9ROv_LR8

20. C. Concordia, "In the beginning there was the AIEE Committee on computing devices (the first 25 years)," *Computer*, vol. 9, no. 12, pp. 42–44, Dec. 1976. doi: 10.1109/C-M.1976.218469.

21. M. M. Astrahan, "In the beginning there was the IRE professional group on electronic computers (the first 25 years)," *Computer*, vol. 9, no. 12, pp. 43–44, Dec. 1976. doi: 10.1109/C-M.1976.218469.

22. T. H. Flowers, "The design of Colossus," *IEEE Ann. Hist. Comput.*, vol. 5, no. 3, pp. 239–252, July 1983. doi: 10.1109/MAHC.1983.10079.

23. J. R. Berry, "Clifford Edward Berry, 1918–1963: His role in early computers," *IEEE Ann. Hist. Comput.*, vol. 8, no. 4, pp. 361–369, Oct. 1986. doi: 10.1109/MAHC.1986.10066.

24. J.V. Atanasoff. *The First Electronic Digital Computer, Computer History Museum* (Nov. 11, 1980). [Online Video]. Accessed June 20, 2021. Available: https://youtu.be/Yxrcp1QSPvw

25. J. Gustafson and C. Shorb. *The Atanasoff–Berry Computer in Operation*. Iowa State University (1999). [Online Video]. Accessed June 20, 2021. Available: https://youtu.be/YyxGIbtMS9E

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