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# **ІНФОРМАЦІЙНА БЕЗПЕКА ТА ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ**

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**Валентина ЯЩУК** – к.т.н., доцент, доцент кафедри управління інформаційною безпекою Львівського державного університету безпеки життєдіяльності

**Андрій ІВАНУСА** – к.т.н., доцент, доцент кафедри управління інформаційною безпекою Львівського державного університету безпеки життєдіяльності

**Валерій ДУДИКЕВИЧ** – д.т.н., професор, завідувач кафедри захисту інформації Національного університету «Львівська політехніка»

**Іван ОПСРЬКІЙ** – д.т.н., доцент, професор кафедри захисту інформації Національного університету «Львівська політехніка»

**Володимир РОМАКА** – д.т.н., професор, професор кафедри захисту інформації Національного університету «Львівська політехніка»

За точність наведених фактів, самостійність наукового аналізу та нормативність стилістики викладу, а також за використання відомостей, що не рекомендовані до відкритої публікації відповідальність несуть автори опублікованих матеріалів.

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## THE HOMEBREW COMPUTER CLUB IN THE HISTORY OF HUMAN INNOVATION

*Litovchenko Valentyn, Pet'ko Lyudmila*

**Mykhailo Dragomanov** Ukrainian State University (city Kyiv, Ukraine)

The aim of this work is to present the Homebrew Computer Club – one of the first groups of computer enthusiasts at Silicon Valley, in which innovations in the field of personal computers, as well as natives of which are now famous figures of the IT-industry. *Described* the founding process of Homebrew Computer Club and its development. Illustrated the legacy of organization and Apple industry.

**Key words:** Homebrew Computer Club, Apple, Company story, Silicon Valley, known members of the Homebrew, IT-technologies, Steve Jobs, Steve Wozniak.

Метою даної роботи є історія заснування Homebrew Computer Club, однієї з перших груп комп'ютерних ентузіастів у Кремнієвій долині, в якій представлені інновації в області персональних комп'ютерів, члени якої стали відомими представниками ІТ-індустрії. *Описано* процес заснування Homebrew Computer Club та його розвиток. Представлено спадщину організації в ІТ-індустрії, зокрема Apple,

**Ключові слова:** Homebrew Computer Club, Apple, історія компанії, Силіконова долина, відомі учасники, ІТ-технології, Стив Джобс, Стив Возняк.

*You've got to find what you love (Steve Jobs, 2005)*

**Homebrew Computer Club** became the greatest pitch in the history of business and one of the most important groups in the history of the technology industry.

Homebrew Computer Club was the group at the heart of the creation of *Silicon Valley* in the USA (Nowdays electronics and big tech is the largest industry in Silicon Valley. But it is also home to some other types of businesses, including big energy and financial services [103]) (Fig. 1, 3). It was a group of electronic enthusiasts who constructed personal computer devices from scratch using gathered electronic parts. The members created technology and founded companies like Apple. The meetings allowed for them to learn from each other's ideas and advancements as well as pair up to venture out on their own. The Homebrew Computer Club was founded by computer engineer and programmer **Gordon French** (Fig. 2) and political activist **Fred Moore** [34] (Fig. 4). The pair had the idea to promote an open forum of discussion that could help to foster their own interests.



Fig. 1. The map of the USA



Fig. 2. Gordon French, 2017



Fig. 3. Silicon Valley, California

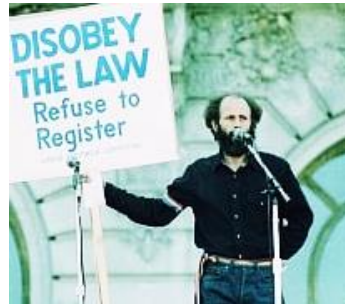


Fig. 4. Fred Moor. 22 March 1980

But what was before founding Homebrew Computer Club in Menlo Park. In 1971 Bill Hewlett of Hewlett Packard fame (Fig. 5), issued a challenge to his engineers: fit all of the features of their desktop scientific calculator into a package which would be small enough for his shirt pocket. The result? The HP-35, the first hand-held calculator (Fig. 6), which was advertised as "a fast, extremely accurate electronic slide rule" [45]. As a result of these developments, (mostly) young men were tinkering in their garages to develop diverse electronic devices. Magazines such as "Radio Electronics" (Fig. 7) featured stories on how to build these kinds of devices by yourself at home [13].



Fig. 5. William Hewlett and David Packard



Fig. 6. The first hand-held calculator HP-35.

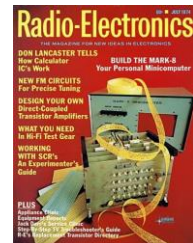


Fig. 7. Radio Electronics (1974)

Hewlett-Packard was and is a testament to the success of the free enterprise system and the American dream. The simple, honorable ideals and intensely productive practices they employed propelled a business started in a garage during the Depression to stardom. William and his lifelong friend and partner, David Packard, owned and ran a unique company dedicated to the premise that profits were based on the well-being of its most important assets: its employees [116, p. 166].

How William Hewlett and David Packard started that era is a fascinating story in the annals of engineering science in a small Palo Alto, California. So it was that Hewlett-Packard came into being in 1939 in their garage with an investment capitol of \$538 where the country witnessed the birth of an era. They had many things in common, apart from the social scene. Both had an avid love of outdoor activities. Hunting, fishing, skiing, and mountain climbing were the early trademarks of the future fathers of the Silicon Valley. And both had a burning desire to discover, develop, and invent [116, p. 167], **see the video [108]**.

In this environment of tinkering and creating mock-ups, Gordon French (along with a few of his acquaintances, notably Lee Felsenstein and Fred Moore) decided to form a club which they named the Homebrew Computer Club. The idea behind the Homebrew Computer Club was to have tinkerers come together to exchange ideas and trade hard-to-get parts [9].

Homebrew Computer Club met at a few locations throughout its existence. The first meeting of the Homebrew Computer Club took place on March 5, 1975, in Gordon French's garage at his home in Menlo Park, California. The meetings were then held in a home in Atherton, California. After some time, they moved to an auditorium at Stanford Linear Accelerator Center. The meeting was moved in 1978 to the Stanford Medical School [35], **see the video [101]**.



Fig. 8. Steve Wozniak, [Unknown], Lee Felsenstein, and Gordon French, circa 1995–2005, at Oasis Beer Garden, in Menlo Park

Lee Felsenstein remembered: *The first Homebrew Computer Club meeting consisted of 30 people standing around an Altair 8800 (the first one to hit Silicon Valley – a review copy set to People's Computer Company, the underground paper of the tiny personal computer set).*

*Fred Moore ran the meeting, and I suggested that we each state for the record what we had done with personal computers, what resources we had, and what we were interested in. This was dutifully transcribed and published in the newsletter by Moore, and sent out to the list in time for the next meeting 2 weeks later (at the Orange Room of the Stanford Linear Accelerator auditorium.*

*By the third meeting Gordon French (a contract mainframe programmer who had collaborated with Moore and offered his garage) was running the meeting – attempting to lecture to the much larger group on basic computer science while half the group milled around outside trying to meet each other [56], see the video [57].*

The complete list of "members" is unavailable as the club welcomed all who join and even sent out newsletters to open membership to those who were further away. However, here is a list of known members of the Homebrew Computer Club: John Draper, Lee Felsenstein, Roger Melen, Thomas "Todd" Fischer, Gordon French, Fred Moore, Steve Wozniak, Harry Garland, Paul Terrell, George Morrow, Adam Osborne, Bob Marsh, Jerry Lawson, Li-Chen Wang, Steven Inness, Dan Werthimer, Steve Dompier, Ted Nelson, Jef Raskin, Michael Holley, Allen Baum, Steve Jobs, Ron Jones, Jim Mehls, Len Shustek [35] (Fig. 9).

A Homebrew Computer Club reunion was held on March 5th, 2001 at SLAC and many of the "Homebrew 3/5/75 Originals" attended (Fig. 9) [54].



Fig. 9. From left to right: *Front Row:* Len Shustek, Gordon French, Marty Spergel, Bob Lash, Ralph Campbell, Mike Carlisle, Walter Bryant, George Oetzel, Harry Garland (1947), Allen Baum, Lee Felsenstein (1945), Dennis Allison (*head turned*), Gene Wallace. *Back Row:* Roger Melen (1946), Bob Marsh, Fred Balin [*who is mostly hidden*]), 2013 [94].

**Bob Lash** wrote in his memories: *"The second meeting of Homebrew was held in an old school house, and Steve Dompier brought in his Altair, and put a transistor radio on top of it. To everyone's utter amazement, it actually played "Fool On The Hill" by picking up buss harmonics and running a clever timing loop. I was astonished! Not long after I used this idea, and hooked a speaker directly to an open-collector driver that was on an incandescent monitoring lamp of the LSB of one of my machine's registers. After toggling the*

*timing loop in, it was playing tunes (although a bit off key). It was cool!" [54; 14], see the video [88].*

**Len Shustek** (Fig. 10) told in interview: *"In January of 1975 the cover issue of Popular Electronics touted the Altair, which was an affordable kit computer that anybody could buy and build, based on the 8080 microprocessor. One of the physicists at SLAC, Dave Gustavson, who's a really good friend of mine, decided for his physics group to order two of these machines, to experiment with using them, instead of the very expensive minicomputers, to do process control for the physics experiments. So we wound up very early on – "we" was really SLAC but I wound up working with Dave on them – with two Altair's that we put together and did all sorts of software and hardware for. The machinist for Dave's group, Group F at SLAC, happened to be a friend of an engineer by the name of Gordon French, who decided that a lot of his friends were interested in his computers, and he would start a club for people interested in computers like the Altair.*



Fig. 10. Len Shustek, 2002

*He held the first meeting in 1975 in his garage, in Gordon French's garage. A group of people, including John Grant, the machinist friend of Dave Gustavson. There were probably a dozen people in the room at the time. And that, as it turns out, was the founding meeting of what became the Homebrew Computer Club. Another SLAC'er and I, Frank Rothacker and I, arranged for the Homebrew Computer Club to meet in one of the meeting rooms at SLAC; originally the Orange Room, but then later the auditorium. For the next four years, the Homebrew Computer Club met at SLAC. Lee Felsenstein was the moderator. I think that history is known; it's been written about. It was one of the important early places where hobbyists shared information about small computers and how to build them yourself. It was one of the places where Bill Gates got angry. He wasn't there, but he got angry at the pirated software that was being distributed freely at the Homebrew Computer Club. People would stand and throw copies of paper tapes out into the audience. Bill Gates' Altair BASIC. Bill wrote an open letter that got published in the Homebrew Computer Club newsletter, decrying the activity of pirates – software pirates – and saying, "how do you ever expect high quality software to be written for microprocessors*

*if the people writing them can't be compensated for their efforts?"*[69, p. 13–14], **see the video [70], see the documentary [77].**

The Club met in the auditorium of the Stanford Linear Accelerator Center (Fig. 11, 12), and hobbyists displayed their latest creations in its lobby entry. Anyone who came even once was considered a "member" and could sign up for the newsletter [96]. The Homebrew Computer Club existed from 1975 to 1986. It is widely credited as a critical force in the development of the microcomputer revolution and the rise of Silicon Valley (**see the documentary [106]**).

The Stanford Linear Accelerator Center (SLAC) is a national basic research laboratory devoted to experimental and theoretical research in elementary particle physics, to the development of new techniques in high-energy accelerators and elementary particle detectors, and to a broad program of research using synchrotron radiation. It is located on 425 acres of Stanford property west of the main campus, on Sand Hill Road. Stanford University operates SLAC under a contract with the US Department of Energy (**see the videos [9; 104]**). Established in 1962, SLAC has become a world-renowned elementary particle physics laboratory, recognized for more than four decades of achievement in the field. Some of the highlights of SLAC's distinguished history are shown in the timeline. SLAC houses the longest linear accelerator (linac) in the world – a machine 3.2 km long that can accelerate electrons to energies of 50 gigaelectron volts (GeV; 50 billion electron volts) [100]. Research at SLAC has produced three Nobel Prizes in Physics and one in Chemistry [68], (**see the video [82]**).

*Below* Aerial view of the Stanford Linear Accelerator Center (SLAC) with the linear accelerator (upper right) and PEP-II collider highlighted (Fig. 11). Electrons from the electron gun (orange) and positrons from the positron source (green) are accelerated in the linear accelerator. In the PEP-II (large ring) the electrons (red ring) and positrons (yellow ring) are circulated in opposite directions. They collide in the BaBar detector (blue), creating B mesons and anti-B mesons. Differences in these particles' rates of decay may explain why there is more matter than antimatter. SLAC is in California, USA (**see the video [46]**).



Fig. 11. Aerial view of the Stanford Linear Accelerator Center (SLAC), California, USA.



Fig. 12. Homebrew Computer Club meeting, in the SLAC auditorium, 1978.



Thus, the linear accelerator (linac) is the longest modern building on Earth (Fig. 11). The building above ground, nearly 2 miles long, houses klystrons that generate powerful microwaves. Below ground, these waves accelerate electrons to nearly the speed of light. Today the accelerator is divided into three sections that generate high-energy electrons for three facilities: the Linac Coherent Light Source (LCLS); LCLS-II, an upgrade to LCLS now under construction; and the Facility for Advanced Accelerator Experimental Tests (FACET-II) [93], **see the videos [59; 104]**.

The original Homebrew members stood on the shoulders of giants like English Mathematician Alan Turing (1912–1954), a pioneer in the field of computer science, (Fig. 13, 14) [23] and John Backus (1924–2007), an American mathematician best known for the invention of FORTRAN and for the BNF notation for describing the syntax of a programming language (Fig. 15) **(the video [47])**, who in turn stood upon the shoulders of pioneers like Pascal, Lovelace, Babbage and even those in the 17th century like Leibniz. From the invention of the wheel to the invention of the microprocessor, humanity has always built upon the greatness created by previous generations. The Homebrew meetings represented a moment in history when brilliant minds came together and were able to see further into the future than perhaps any single era in the history of human innovation [28], **see the video [115]**.



Fig. 13. The sculpture of Alan Turing in Bletchley Park, England, Britain



Fig. 14. Alan Turing, 1935.

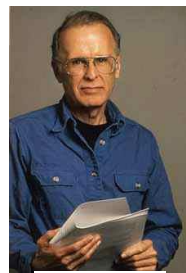


Fig. 15. John Backus.

Most of the members Homebrew Computer Club were hobbyists but had an electronic engineering or computer programming background. They came to the meetings to talk about the Altair 8800, to review other technical topics, and to exchange schematics and programming tips. From the ranks of this club came the founders of many microcomputer companies, including **Steve Wozniak** and **Steve Jobs** (*Apple Computer*) **(see the videos [86; 87])**, **Harry Garland** and **Roger Melen** (*Cromemco*), **Thomas "Todd" Fischer** (*IMSAI Division, Fischer-Freitas Company*), **George Morrow** (*Morrow Designs*), **Paul Terrell** (*Byte Shop*), **Adam Osborne** (*Osborne Computer*) [10], and **Bob Marsh** (*Processor Technology*). **John**

**Draper** was a member of the club, as was **Jerry Lawson** (creator of the first cartridge-based video game system, (*Fairchild Channel F*). **Li-Chen Wang**, developer of *Palo Alto Tiny Basic* and graphics software for the *Cromemco Dazzler*, was a club member, and **Lee Felsenstein** was moderator of the club meetings [23]. **Steve Inness** was a primary designer of one of the early cell phone touch screens as well as a business partner with **John Draper**. **Liza Loop** was an early member and the first woman to join (**see the video [29]**).

Others went on to other pursuits, such as **Dan Werthimer** who is a researcher in the search for extraterrestrial intelligence [37], (**see the parts of the movie [106; 107; 108; 109]**).

Homebrew was special because it created an amazing innovation platform from which a whole new (PC) industry was born. Here are a few characteristics of Homebrew :

Homebrew members were all passionate about one thing: making home computer (which was an unmet customer need at that point of time).

Many of them were expert hackers and playing with circuits by hand themselves (Steve Jobs would go visit some of them and fix their circuit problems)

Members also included component traders and people who ran businesses (and some who closed them) and it gives an interesting business perspective to this geeky game (Steve writes, occasionally somebody would show up and say "Is there anyone here from Intel? No? Well, I've got some Intel chips we want to raffle off"), **see the video [31]**.

Takeaway: (a) Having a common binding vision which is linked with unmet customer need (b) having expert and passionate practitioners as members and; (c) having members with business perspective (like component traders) it was an ideal combination of an innovation platform [22], **see the video [94]**.

When Jobs and Steve Wozniak started Apple in the garage, they agreed Jobs would do the marketing and Wozniak would build the computers. Although not as technically savvy, according to Wozniak, Jobs was deeply involved in the design of the first computer housing. Jobs was adamant about the aesthetics. He wanted the computer to be attractive to future common buyer [15, p. 68], **see the video [88]**.

In fact, we recommend watch a guest lecture by Steve Jobs giving a wide-ranging talk to a group of MIT Sloan School of Management students in the spring of 1992. Jobs shares his professional vision and personal anecdotes, from his role at the time as president and CEO of NeXT Computer Corporation, to the thrilling challenges of co-creating Apple Computer, and subsequent disappointments at his ousting. In conversational exchanges with audience members Jobs underscores the value of direct experience in the field (**see the video [91]**).

His commitment to perfection remained throughout his career and he demanded it from others.

Jobs stated in his commencement speech to Stanford graduates in 2005, "Your work is going to fill a large part of your life, and the only way to be truly

satisfied is to do what you believe is great work. And the only way to do great work is to love what you do... Don't settle" Jobs created a vision for employees to come to Apple Computer and do great work. [15, p. 70], **see the video [26]**.

The Homebrew Computer Club was a group of computer enthusiasts who met in Silicon Valley in the 1970s. The group was known for its informal and collaborative atmosphere, where members shared knowledge and ideas about building and using personal computers. Some of the most famous members of the Homebrew Computer Club include **Steve Wozniak, Steve Jobs, and Bill Gates** (Fig. 16, 17) (**see the video [88]**). They were all early pioneers of the personal computer industry, and many of them went on to found successful companies in the field. The Homebrew Computer Club played a significant role in the development of the personal computer and the rise of the technology industry in Silicon Valley (**see the video [34]**). one of the most important groups in the history of the technology industry (**see the film [91]**).



Fig. 16. Bill Gates and Steve Jobs

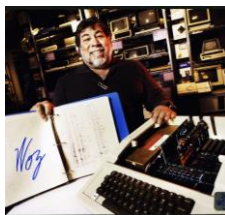


Fig. 17. Steve Wozniak

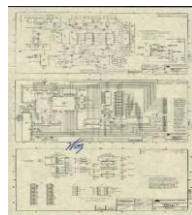


Fig. 18. Apple I Computer Schematic

Steve Jobs was 20 years old when he and Steve Wozniak founded Apple Computer, which in 10 years grew into a \$2 billion company with 4,000 employees [74], **see the video [36]**.

**Bill Gates**, the co-founder of Microsoft, was not a regular member of the Homebrew Computer Club but did attend a few meetings. Gates was primarily focused on software development and had a vision of a future where personal computers would be powered by his software. He recognized the potential of the personal computer revolution and actively sought opportunities to collaborate with other like-minded individuals, including members of the Homebrew Computer Club [38], **see the video [101]**.

*The Homebrew Computer Club had a profound impact on the personal computer industry and the broader technology landscape. Here are some key ways in which the club influenced the industry:*

**Software Development:** The Homebrew Computer Club fostered a culture of software development. Members shared software programs, coding tips, and techniques, contributing to the growth of software ecosystems. This

collaborative environment nurtured the development of early operating systems, programming languages, and applications [38].

**Entrepreneurial Spirit:** The club was a breeding ground for entrepreneurs. Founders like Steve Jobs, Steve Wozniak, and Bill Gates were members of the Homebrew Computer Club. The club provided a supportive network for aspiring entrepreneurs, enabling them to connect, collaborate, and eventually launch successful technology companies [38; 53].

**Networking and Collaboration:** The Homebrew Computer Club served as a meeting place for individuals passionate about computing (Fig. 21). It facilitated networking and collaboration among like-minded individuals, leading to the exchange of ideas and the formation of partnerships. These connections and collaborations laid the groundwork for future advancements in the industry.

Overall, the Homebrew Computer Club played a crucial role in shaping the personal computer industry by fostering a culture of innovation, collaboration, and entrepreneurship. It helped pave the way for the technological revolution that followed and set the stage for the modern computing landscape [38], **see the video [98]**.

Founding member Fred Moore created the Homebrew Club's first, single-page newsletter. Moore expressed the shared excitement of the group: "I expect home computers will be used in unconventional ways – most of which no one has thought of yet" (Fig. 19) [27].



Fig. 19. First Issue of the Homebrew Computing Club newsletter, March 15, 1975



Fig. 20. Issue Number Two, 1975 [97]



Fig. 21. The Homebrew Computer Club served as a meeting place for individuals passionate about computing, in the SLAC auditorium

**The Homebrew Computer Club newsletter:** The club's newsletter, published by Lee Felsenstein, served as a platform for sharing information and ideas among members. It featured articles on hardware designs, software programming, and discussions about the future of personal computing. The newsletter played a crucial role in fostering collaboration and disseminating knowledge within the club [38] (Fig. 19, 20, 22)



Fig. 22. Homebrew Computer Club newsletter. Vol. 2. Issue 14, cover

The first issue of the Homebrew Computer Club Newsletter was published just 10 days after its initial meeting and was one of the most influential forces in the formation of Silicon Valley culture (Fig. 19). Created and edited by its members, it played a critical role in connecting members and circulating ideas. The newsletter reported on the lively meetings, described breakthroughs and inventions, and listed local resources and contacts. One notable entry was the publication of Bill Gates's seminal "Open Letter to Hobbyists" in 1976 [30]. Within its pages, the idea of the personal computing revolution was unleashed. The newsletter perfectly encapsulates the creativity and vitality of these early renegades that would change the world [97].

**Accessible Computing:** The Homebrew Computer Club popularized the idea of accessible and affordable personal computers. Members shared knowledge, resources, and ideas, inspiring others to build their own computers. This ethos of openness and collaboration helped democratize computing, making it accessible to a wider audience [38].

The most famous issue, January 1975, had the Altair 8800 computer on the cover and ignited the home computer revolution (Fig. 25). This computer was developed and constructed by Ed Roberts (Fig. 23). Paul Allen showed that issue to Bill Gates (Fig. 24). They wrote a BASIC interpreter for the Altair computer and started Microsoft (see the video [99]).

The Altair 8800 computer was a break-even sale for MITS (Fig. 27). They needed to sell additional memory boards, I/O boards and other options to make a profit. The system came with a "1024 word" (1024 byte) memory board populated with 256 bytes. The BASIC language was announced in July 1975 and it required one or two 4096 word memory boards and an interface board [3], see the video [105].

**Steve Dompier** (Fig. 26), who in 1975 was a 30-year-old carpenter in Berkeley and the hobbyist credited with having assembled the first working

MITS Altair from a kit, does acknowledge being present in the demonstration room [63; 65] (Fig. 28), **see the full** interview of members' HC [49]. They also talk about Bill Gates and his open letter to the computer community. Gates wrote the 8080 machine language code for the BASIC language interpreter.



Fig. 23. Ed Roberts in the 1970s



Fig. 24. Bill Gates and Paul Allen

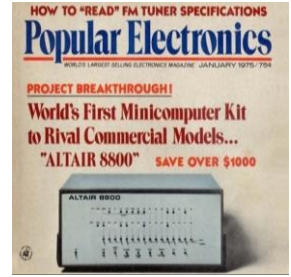


Fig. 25. The Altair 8800 computer



Fig. 26. Bob Marsh, Steve Dompier and Lee Felsenstein talking, 1977



Fig. 27. The Altair 8800 computer



Fig. 28. Paul Terrell, Roger Melen, Steve Dompier (November 2013)

Under \$500, Altair became the leading "homebrew" computer. The Altair 8800: This was the first commercially successful personal computer kit, developed by Ed Roberts of MITS (Micro Instrumentation and Telemetry Systems). The Altair 8800 inspired many Homebrew Computer Club members, including Bill Gates and Paul Allen, to develop software for it. This led to the creation of Microsoft, which started by developing a version of the BASIC programming language for the Altair [38] (Fig. 27), **see the video** [2].

In a word, in 1977 (two years after its founding) the Club was thriving, with over 1,500 names on its mailing list. That spring, "The First West Coast Computer Faire" in San Francisco, organized by members Jim Warren and Bob Reiling, attracted 180 exhibitors and 12,000 attendees [44].

**Hardware Innovations:** The Homebrew Computer Club was a breeding ground for innovative projects and ideas. Several notable projects and developments emerged from the club, including: The Apple I and Apple II:



Steve Wozniak, a Homebrew Computer Club member, designed and built the Apple I computer, which was Apple's first product (Fig. 29, 30). The Apple I (1976) was followed by the Apple II (1977) (Fig. 31, 32), which became one of the most popular and influential computers of the time. These early Apple computers laid the foundation for Apple's success and its eventual transformation into a major technology company. The club served as a platform for showcasing hardware innovations. Members like Steve Wozniak demonstrated their creations, including the Apple I and Apple II computers, which laid the foundation for Apple's success (see the video [49]). These innovations pushed the boundaries of what was possible with personal computers and inspired others to experiment and innovate [38], (see the video in it Apple co-founder Steve Wozniak signed a 1976 Apple I motherboard he built decades ago. The video captured in 2021 [6]).



Fig. 29. The Apple I (1976) [33]



Fig. 30. Steve Wozniak, right, co-founder of Apple, and Wendell Sander, left, one of Apple's early employees, talks about Apple I computer on June 18, 2013 at History San Jose

Steve Jobs and Steve Wozniak, the co-founders of Apple Inc., were active members of the Homebrew Computer Club. Steve Wozniak was particularly involved in the club's activities and presentations. He would often showcase his creations, including **the Apple I and Apple II** computers, at the club's meetings. Wozniak's technical expertise and innovative designs were highly regarded by the club's members [38].

In April 23, 1984: Apple executives Steve Wozniak, Steve Jobs and John Sculley introduce the Apple II at the "Apple II Forever" event at Moscone Center in San Francisco (Fig. 32), see the videos [110; 89].

Steve Jobs, on the other hand, played a somewhat different role in the Homebrew Computer Club. While he was not as technically oriented as Wozniak, Jobs had a keen interest in the potential of personal computers and was highly motivated to turn their ideas into successful products. He used his charismatic personality and marketing skills to promote their projects and generate interest in their work [38], see the video [90]).

Computer Club had access to early prototypes of **the Xerox Alto** (Fig. 33), a groundbreaking computer developed at Xerox's Palo Alto Research Center (PARC). The Alto featured a graphical user interface, mouse, and networking capabilities, which were revolutionary at the time. The ideas and concepts demonstrated by the Xerox Alto influenced the development of future personal computers, including the Apple Macintosh (**see the video [6]**) [103].



Fig. 31. The Apple II.



Fig. 32. Introducing the Apple II, 1984.

Developed by Xerox as a research system, the Alto marked a radical leap in the evolution of how computers interact with people, leading the way to today's computers. A mouse. Removable data storage. Networking. A visual user interface. Easy-to-use graphics software. "What You See Is What You Get" (WYSIWYG) printing, with printed documents matching what users saw on screen. E-mail. Alto for the first time combined these and other now-familiar elements in one small computer [113], **the video [114]**.

So, The Xerox Alto was created in 1972 at the Xerox Palo Alto Research Center (PARC) by **Butler Lampson** (Fig. 34) and **Charles P. (Chuck) Thacker** (Fig. 35), **see the video [4]**. (*Release Date: 1st March 1973, original Price was \$32,000*). The Xerox Alto encompassed a variety of Programming Facilities and Software Applications. The Alto was the first system to have all of the contemporary Graphical User Interface components (GUI). The Alto had a significant impact on the design of PCs in the decades that followed, particularly the Macintosh (**see the video [10]**) and the first Sun workstations [12], **see the video [43]**.



Fig. 33. The Xerox Alto



Fig. 34. Butler Lampson



Fig. 35. Charles P. Thacker



**Lee Felsenstein** (Fig. 8, 36, 37), a BSc in Electrical Engineering and Computer Science at the University of California, Berkeley, (1972), and a friend of Marsh from the University (Marsh was an alumnus of the class of '68) and Homebrew Computer Club (an early computer hobbyist users' group in Silicon Valley, CA), already worked for Processor Technology on the project for building a plug-in video terminal board for Altair. He became the main designer of Sol-20, working in cooperation with Marsh himself (who designed the power supply and the audio cassette interface) and **Gordon French** (project manager and mechanical designer (Fig. 8, 39) [23]. Lee Felsenstein is a true visionary, an original member of the legendary Homebrew Computer Club alongside his peers like Woz, he was the designer of the first popular portable computer – **The Osborne 1** (Fig. 38), he joins us for an incredible insight into the earliest days of personal computing. Created by the Homebrew Computer Club's Lee Felsenstein (Fig. 26, 36, 37), the Osborne 1 was the world's first mass-produced portable computer (Fig. 38) [94], **see the videos [4; 10]**. The Osborne Effect (Fig. 40) is now an implicit part of big business. Have you ever wondered why Apple's keynotes come out weeks before their new iPhone's launch? You thing, you don't want sales of your current models to drop (**see the videos [32; 117]**).



Fig. 36. Lee Felsenstein, 2013



Fig. 37. Lee Felsenstein, in 1970s



Fig. 38. The Osborne 1, 1981



Fig. 39. Gordon French in 1970s

**George Morrow** (1934–2003) was a computer programmer, an entrepreneur, and a leader in the development of the personal computer industry in the 1970s and 1980s (Fig. 41, 44). He obtained a B.S. in physics from Stanford University and a master's degree in mathematics from the University of Oklahoma. He then entered a doctoral program at the University of California at Berkeley's mathematics department. In the early 1970s, he was a programmer at Berkeley's computer laboratory and soon devoted much of his attention to computing. He attended meetings at the Bay Area's Homebrew Computer Club, an incubator for dozens of companies at the center of the booming personal computer industry of the 1970s [95].

Morrow Designs resisted leading trends in the mid-1980s PC industry. Morrow failed to shift from 8-bit to 16-bit computers and declined to adopt the emerging IBM standard, fearing that his company would simply become another maker of computer clones [95], **see the video [16]**.

As the founder of Thinker Toys (Fig. 41, 45, 46) [105], Morrow's Micro Stuff, and Morrow Design, all of his earlier system designs were S-100 or CP/M based. After the IBM-PC became the apparent market leader, CP/M fell out of fashion, as most new systems started to run Microsoft MS-DOS..



Fig. 40. Adam Osborne with the "Osborne Executive" (see the videos [58; 71])



Fig. 41. George Morrow in 1970s.

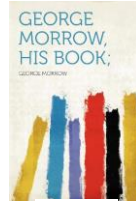


Fig. 42. George Morrow's books.



Fig. 43. Morrow Pivot, 1984.

In 1985, Morrow released its first IBM-compatible computer, a portable portable lunchbox known as **the Morrow Pivot** (Fig. 43) (based on its unique form factor in which neither keyboard nor monitor folded the case) [67]. Produced by a third-party OEM, the same model was licensed to Morrow by Zenith Data Systems, which sold it as the Z-171. In addition to lower cost and a better known brand name, Zenith won an extremely lucrative contract to sell the computers to the U.S. government after the president of Morrow Designs left to work for Zenith. By the end of the year, Morrow had declared bankruptcy. Morrow Pivot was also introduced if one of the TV-series called "*Computer Chronicles*" alongside with other portable computers of its time [95; 67; 80] (see the videos [16; 17; 18; 19; 20]).



Fig. 44. Morrow Pivot, 1984

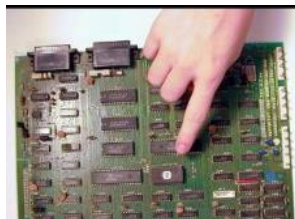


Fig. 45. Micro Decision Circuit Board



Fig. 46. Thinker Toys Keyed Up 8080

George Morrow himself was one of the legendary hero's of the S-100 era (Fig. 44) . He was an active member of many user groups and probably was the person most responsible for the design, specification and approval of the IEEE-696 standard. He was well known for his enthusiasm and his sense of humor within the computer industry [66].

At last, today, the idea of selling computers in a store makes perfect sense. But back in the 1970s, things certainly weren't so straightforward. This was a time when personal computers were geeky, hobbyist projects that came in DIY kits. Apple co-founder Wozniak seriously considered giving away blueprints for his nascent Apple computer so anyone with enough patience could build one for themselves [24] (Fig. 47), (see the video [1]).

December 8, 1975 Paul Terrell (Fig. 47, 48) opened the Byte Shop in Mountain View, California (Fig. 49). He was an American businessman who founded the first personal computer retailer shop and one of the influencers in popularization of personal computers (see the video [60]).



Fig. 47. Woz with Paul Terrell and Paul Allen



Fig. 48. Paul Terrell at the Byte Shop, 1975



Fig. 49. The Byte Shop, 1975

By January, he was approached by individuals who wanted to open their own stores. He signed dealership agreements with them, whereby he would take a percentage of their profits, and soon there were Byte Shops in Santa Clara, San Jose, Palo Alto, Fresno, and Portland, Oregon [73].

Paul Terrell thought different. Modeling his business on Radio Shack, he opened his first Byte Shop in Mountain View, California, on this day in 1975. By the end of 1976, he successfully expanded to 58 stores. Unfortunately, he ran into problems that year. The most popular personal computer at the time was the Altair 8800. It kick-started the boom in personal computers and inspired a generation of techies. In fact, Terrell's success pushing the Altair as an independent salesman convinced him to open a physical store in the first place [24].

The Byte Shop was the first retailer of the original Apple I computer. At the time Steve Jobs was planning to sell bare circuit boards for \$40, but Terrell told him that he would be interested in the machine only if it came fully assembled, and promised to order 50 of the machines and pay \$500.00 each on delivery. Steve Jobs and Steve Wozniak and their small crew spent day and night building and testing the computers and delivered to Terrell on time to pay his suppliers (Fig. 50, 51, 52, 53) Steve Jobs had found a way to finance his soon-to-be multimillion-dollar company without giving away one share of stock or ownership [75], see the videos [5; 51]).



Fig. 50. First Deal with Paul Terrell (Jobs, 2013)



Fig. 51. Steve Jobs and Woz (Jobs, 2013)



Fig. 52. Ashton Kutcher as Steve Jobs (Jobs, 2013)



Fig. 53. Steve Jobs and Woz in 1970s

Later Paul Terrell started *ComputerMania Inc.* which was a chain of computer stores created with the purpose of renting computers and software [73], see the video [39].

In the film *Pirates of Silicon Valley* (1999), founders of Apple Computer, Steve Jobs and Steve Wozniak take their Apple 1 computer to the local Homebrew Computer Club at Berkely, and make an impression (see the video [1]) also like in the movie *Jobs* (2013) [52].

*The Homebrew Computer Club* is depicted in some films.

The 1999 made-for-television movie *Pirates of Silicon Valley* (and the book on which it is based, *Fire in the Valley: The Making of the Personal Computer*) describes the role the Homebrew Computer Club played in creating the first personal computers, although the movie took the liberty of placing the meeting in Berkeley and misrepresented the meeting process [37] (Fig. 55).

*Pirates of Silicon Valley* (1999, United States). Directed by Martyn Burke. Casts: Anthony Michael Hall, Noah Wyle, Joey Slotnick. The movie based on the book "Fire in the Valley" by Paul Freiberger and Michael Swaine (Osborne/McGraw-Hill, 1984, 288 p.), see the movie [78].



Fig. 54. Triumph of the Nerds, 1996

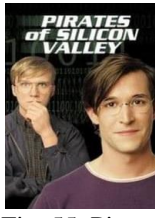


Fig. 55. Pirates of Silicon Valley, 1999

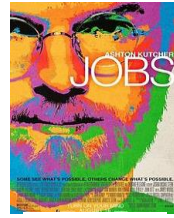


Fig. 56. Jobs, 2013



Fig. 57. Steve Jobs, 2015

*Triumph of the Nerds: The Rise of Accidental Empires* (1996) (Fig. 54) zooms backwards on the information superhighway to show in vivid detail how youthful amateurs, hippies and self-proclaimed "nerds" accidentally changed the world. The three-hour program chronicles the birth and growth of Silicon Valley's personal computer industry. Three part documentary series (see the series [107; 108; 109]) that tells the story of the birth of the personal computer,

with the candid recollections of PC pioneers, like Steve Wozniak, Steve Jobs and Bill Gates (see the full documentary [106]).

*Jobs* is a 2013 American biographical drama film based on the life of Steve Jobs (Fig. 56), from 1974 while a student at Reed College to the introduction of the iPod in 2001. The story of Steve Jobs' ascension from college dropout into one of the most revered creative entrepreneurs of the 20th century, a renowned businessman, faces problems in his personal and professional life while trying to launch three products in the market. movie biopic about Steve Jobs is a brilliant idea. The creators had the opportunity to make a significant, informative film with their character study of the man who formed such a powerful company. But this one was a failure. The movie is supposed to be a character study. But honestly this movie doesn't teach us much about Jobs, moreover it gives us a basic time line of his life and company. This film is Steve Jobs' biography, the genius of a man and Apple Corporation. [50]. *Jobs* (2013) is directed by Joshua Michael Stern, written by Matt Whiteley, and produced by Stern and Mark Hulme. Steve Jobs is portrayed by Ashton Kutcher, with Josh Gad as Apple Computer's co-founder Steve Wozniak (see the video [84]).

*Steve Jobs (2015)* (Fig. 57, 58). Dir. Aaron Sorkin/Danny Boyle (see the film [83]). This biopic of Steve Jobs (*Michael Fassbender*) (Fig. 58) centers on three product launches; Apple Macintosh in 1984, NeXT Computer in 1988, and iMac in 1998 [85]. Her daughter Liza was 5, 10 and 19 years old. Joanna Hoffman (*Kate Winslet*) is his ever-present right-hand man. John Sculley (Jeff Daniels) is his father figure and CEO of Apple. Steve Wozniak (Seth Rogen) is always vying for acknowledgment of the Apple II. Chrisann Brennan (Katherine Waterston) is the mother of Jobs' daughter Lisa (Fig. 58, 59).

*In summary.* In the midst of the technological boom that was the 1970s, a small group of computer enthusiasts gathered in the heart of Silicon Valley, unknowingly laying the foundation for the personal computer industry. *The Homebrew Computer Club*, established in 1975, became an incubator for the development of the personal computer and a breeding ground for future technology leaders. In this article, we will explore the origins, accomplishments, and lasting impact of the Homebrew Computer Club on the world of technology [55].



Fig. 58. Michael Fassbender as Steve Jobs, with daughter Lisa (Steve Jobs, 2015)

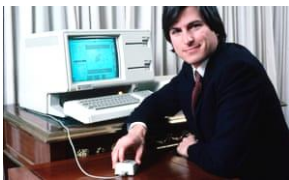


Fig. 59. Steve Jobs and the Apple Lisa computer, 1983



Fig. 60. Dinner with President Obama, 2011

In February 2011, Jobs was among a select group of technology executives who met for dinner with President Obama to discuss the state of education and the economy in the United States. In this picture, he's in the black shirt with his back to the camera, to the left of the president. (Facebook's Mark Zuckerberg is to the president's right). Among the others at the dinner were Google's Eric Schmidt, Cisco Systems' John Chambers, Oracle's Larry Ellison, and Yahoo's Carol Bartz [81], (Fig. 60).

The Homebrew Computer Club provided a supportive environment for members to exchange ideas, collaborate, and push the boundaries of what was possible with personal computers. These projects, among others, helped shape the personal computer industry and laid the groundwork for the technological advancements we see today [38], **see the videos [40]**.

Although their specific roles varied, all individuals played significant roles in the early personal computer industry and went on to achieve tremendous success in their respective careers [38], **see the videos [41; 42]**.

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<b>Цап М., Катанюк І. ВИКОРИСТАННЯ ТЕХНОЛОГІЙ ДОПОВНЕНОЇ РЕАЛЬНОСТІ ДЛЯ ПРИЙНЯТТЯ РІШЕНЬ В СІЛЬСЬКОМУ ГОСПОДАРСТВІ.....</b>	<b>456</b>
<b>Черніков Д., Лясковська С. АЛГОРИТМ ПОШУКУ ЗОБРАЖЕНЬ НА ОСНОВІ ХЕШУ, ЧУТЛИВОГО ДО ЛОКАЛЬНОСТІ, З ВИКОРИСТАННЯМ ЗГОРТКОВОЇ НЕЙРОННОЇ МЕРЕЖІ ТА МЕХАНІЗМУ УВАГИ.....</b>	<b>459</b>
<b>Чмир Т., Бурак Н. СХОВИЩА ДАНИХ ЯК НАСТУПНИЙ ЕТАП РОЗВИТКУ БАЗ ДАНИХ.....</b>	<b>462</b>
<b>Шарко А., Гаврись А. МОДЕЛЬ УПРАВЛІННЯ РИЗИКАМИ ВИНИКНЕННЯ ЗАТОПЛЕННЯ ТЕРИТОРІЙ НА РІВНІ ОБ'ЄДНАНИХ ТЕРИТОРІАЛЬНИХ ГРОМАД.....</b>	<b>465</b>
<b>Шопський О., Придатко О. МОДЕЛЬ КЛАСТЕРИЗАЦІЇ ДАНИХ ДЛЯ ФОРМУВАННЯ ВИБІРКИ З МЕТОЮ ПРОГНОЗУВАННЯ РИЗИКОВИХ СИТУАЦІЙ.....</b>	<b>466</b>
<b>Шуригін К., Сокольський А., Бровко А. ПРОГРАМНЕ ЗАБЕЗПЕЧЕННЯ ДЛЯ РЕКОМЕНДАЦІЇ КНИГ ІЗ ВИКОРИСТАННЯМ МОДУЛЯ ІШ.....</b>	<b>469</b>
<b>Яковчук В., Придатко О. ВИКОРИСТАННЯ ВІРТУАЛЬНОЇ РЕАЛЬНОСТІ У НАВЧАЛЬНИХ ПРОЦЕСАХ.....</b>	<b>473</b>
<b>Яремко Р. ГЕНДЕР У ПРОФЕСІЙНІЙ САМОРЕАЛІЗАЦІЇ МАЙБУТНІХ РЯТУВАЛЬНИКІВ.....</b>	<b>476</b>
<b>Ковальчук О. ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ В УПРАВЛІННІ НRM ПРОЄКТАМИ.....</b>	<b>481</b>
<b>Litovchenko V., Pet'ko L.THE HOMEBREW COMPUTER CLUB IN THE HISTORY OF HUMAN INNOVATION.....</b>	<b>483</b>