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Commodore 64

Past, Present, and Future of a Home Computer

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0 Introduction

Stefan Höltgen, Torsten Roeder, Jens Schröter

In early July 2025, a press release went through the media, bringing the (company) name Commodore once again to the centre of discourse. This time, however, it was not an anniversary to celebrate (the platform was ›odd‹ 43 years old at this point), but its re-release as the C64 Ultimate[1]: a computer in the well-known breadbox shape available in three different versions, based on an FPGA chip that replicates the now rare microelectronic components of the original C64. Equipped with the most important ›historical‹ and numerous modern interfaces (HDMI, USB, audio jack, Ethernet, USB power supply) as well as comparatively large memory (128 MB RAM and 16 MB Flash), the C64 is experiencing its revival 30 years after the bankruptcy of the company Commodore. This is not the first C64 that has been released since then; what distinguishes this one from the previous ones is that the company Commodore is behind the release again: At the initiative of a retro computing YouTuber, a group has come together that has acquired the rights to the brand, the company name, the logos, and anything else that was related to Commodore. So, there is once again a Commodore, and one can be curious about what will become of the company and the idea.

From a technical and computer historical perspective, a re-enactment is taking place here that shows that history, memory, and technology stand in a special temporal tension: Is it something old that is being thought and created a new

1 http://rtro.de/c64b56

here—or, on the contrary, is it something new that is meant to appear old? Taking a look into the case of the C64 Ultimate (or simply looking through the case of the transparent version), one primarily sees a lot of empty space. The microelectronics, which didn't take up much space in the original device, have here been ›shrunk‹ once again. This ›compression‹, which is part of the master narratives in the history of technology (a kind of ›miniaturization‹ in the sense of Moore's law), and which can also be found in the history of ideas[2], repeats a historical event on a smaller scale. This event is called computing and its re-enactment retrocomputing. In computing, which always takes place in the ›present‹ of the system and its users, the presence of technical knowledge is evident. In retrocomputing, two of these presents intersect and comment on each other (not without a hint of irony): the knowledge of the time about the C64, its possibilities, its limits, and how to transform supposed limits into new possibilities (via hacking) meets today's knowledge, which sublates[3] the past in a threefold sense: it suspends (by renewing hardware and software), it elevates (through the re-enactment of the historical), and it preserves (the mere idea of the C64).

What impact the re-establishment of Commodore and the reappearance of the (thus ›triple sublated‹) C64 will have on the future of the platform remains to be seen. However, in the contributions of this book, which was created when the C64 Ultimate did not yet exist, it already becomes evident how the past, present, and (possible) futures of the C64 intersect and what relevance the platform possesses. It is these temporal confrontations that characterize retrocomputing and make the emergence of a computer like the C64 Ultimate (as well as all previous re-enactments) seem profitable and meaningful.

When it was introduced, the C64 was one of the first digital media devices to find its way into households. At that time, the term ›digital‹ was mainly used in everyday language[4] to refer to watches that displayed the time numerically rather than with dials, early pocket calculators (such as the HP-35 introduced by Hewlett-Packard in 1972, which was not the first pocket calculator, however) and, of course, the CD player, which was introduced

2 Horst Völz clarifies this compression through the compactification of theories regarding the span of their existence: Today, every high school student understands what Einstein's formula $E=mc^2$ means, for which thick books were written at the time of its emergence, understanding of which was limited to professional physicists (Cf. Völz 2025, 201).

3 A translation from the Hegelian term »(dialektische) Aufhebung« (cf. Hegel 1978, 57f.).

4 In philosophy, for example, there were already elaborate discussions at this time, see e.g. Goodman (1969, 159–164) or Lewis (1971).

in 1982 and replaced the now ›analogue‹ medium, the record player. But the C64 was even more, one of the first ›computers‹ to enter households; it was a ›homecomputer‹. It was not the only homecomputer (there was, for example, its predecessor, the VIC 1001 or VIC-20 or VC-20, which was first sold in Japan in 1980, or the Sinclair ZX-80, which was also introduced in 1980), but it was a relatively powerful one. An important prerequisite for the success of these homecomputers was their (literal) connection to media already established in the household: The computers were connected to the television set via a suitable modulator to display the images and sound. Data was stored using the Datassette on established audio compact cassettes, which was cumbersome but inexpensive and familiar (on the domestication of technologies, see Silverstone/Hirsch 1992 and Höltgen 2025).

The arrival of such computers in households was accompanied by a series of new terms and practices, such as ›joystick‹, ›program‹, ›crash‹, ›memory‹, and soon, replacing the Datassette, ›floppy disk‹, ›directory‹, and many more. Young people were thus slowly introduced to the emerging computer culture and the use of calculating machines as multimedia devices. This is an important site where the computer-as-medium emerges.[5] The C64 was so successful as a computing device because it combined outstanding graphics for its time with the equally impressive sound of the SID chip—and the burgeoning C64 computer game industry built on this. Computer games were already a familiar form from arcade games, but being able to play them at home was new. Through this increasingly popular activity, which was certainly an important reason for the popularity of the C64, young computer users (although the vast majority were young men) also came into contact with another practice that would shape the further use of the computer-as-a-medium to this day: the illegal use of commercially scarce software, made possible by cracking and piracy. Since a computer-as-a-medium also needs content, which was provided by commercial providers, but many users could not or did not want to afford it, the (soon to become illegal) copying of software and the exchange of floppy disks in schoolyards quickly became established. Such practices of overcoming scarcity and ignoring copyright still exist in

5 This is the title of an influential book from 1994 (Bolz/Kittler/Tholen 1994)—in which, however, neither homecomputers nor the C64 were discussed as important, early, and popular manifestations of the computer as a medium. The same applies to Robben (2006)—it is problematic that a book published in 2006 completely ignores this history. There are of course well-known earlier conceptualizations of the computer as a medium, in writings of J. C. R. Licklider and Robert Taylor, Michael Noll and even in Marshall McLuhans famous book »Understanding Media« from 1964—but none of them was really widespread and even popular as was the multimedia practice of the C64 a few years later.

other forms today; people still access media content illegally (music via YouTube, books via shadow libraries, etc.). The conflict between media potential and capitalist economy, which is characteristic of copyable media content—and digital content can in principle be copied without loss—became visible and tangible here at an early stage. Pocket calculators, CD players, and early homecomputers were the first signs of what would come to be known as the ›digital revolution‹ after the 1990s and the emergence of the internet.

The C64 was also a virtual place for a vibrant community that created an immense amount of digital cultural artifacts. Software, and especially coding, was not seen as an individual form of art before, not even in the gaming scene: It was meant to make efficient and targeted use of a machine (which could of course be achieved by creative ways) and it was meant to be sold. With the C64 and its coevals, coding emerged as a new popular cultural technique, driven forward through print magazines which contained pages and pages of code to be copied manually by the readers into their computers. By doing so, some programmers actually learnt computer code like a natural language (cf. Swalwell 2008).

But especially the C64 with its sluggish built-in V2 interpreter motivated young programmers to go beyond BASIC and learn assembler, which allowed, for example, much faster and dynamic routines. It also allowed them to manipulate existing programs and, for example, remove copy protection mechanisms from games. Soon, cracker groups coded their individual intros into their highly unofficial re-releases of commercial games and other software like graffiti on a digital wall (cf. Alberts/Oldenziel 2014). Not much later, a subscene of democoders emerged to celebrate the coding as an art itself (cf. Botz 2011; Reunanen 2017). Coders were soon able to create musical masterpieces from the very popular SID chip with its unusual complex possibilities for its time, which are still being discovered by enthusiasts until today. Assembler was also the key to exploit the C64's limited graphic capabilities, introducing and defining new genres like point-and-click-adventures.

Such a huge cultural production of digital cultural objects on dispositives like the C64 poses the question of their long-term preservation. Many digital artefacts of the era have not yet been catalogued or stored by archives and libraries on a sustainability level comparable to paper media (cf. Suchodoletz 2010), while a good part of the hardware and media preservation is achieved by museums and private collectors. But for how long will the original hardware be available, and media still be readable? To what extent can remakes and

emulators become a part of preservation strategies (cf. Guttenbrunner/Rauber 2012)? And what is required to archive the material in formats that are still decipherable and processable by today's and tomorrow's systems? Data migration plays a crucial part in the game of keeping legacy formats interoperable, in order to guarantee research and teaching for future generations.

1. Overview

Why did the Commodore 64 become so popular and live so long? Drawing on extensive studies of C64 magazines, popular software titles, and interviews with Commodore engineers, this presentation argues that though the C64 was not functionally upgraded during its 40 years of history, users imagined the C64 to be many entirely different computers, from a serious computer for BASIC programming, to a game computer, to a demoscene computer for technical tricks, to a computer struggling to keep up with newer competitors, to a now comfortable platform whose limitations are charming. Paradoxically, microscopic design decisions and hardware bugs collaborated concretely with C64 users in reimagining the C64. **Jesper Juul's** chapter not only explores new aspects of C64 history, but also challenges our understanding of computer and video game history. It is based on his MIT Press Platform Studies book »Too Much Fun« about the C64, released in November 2024.

The homecomputer is strategic in the history of how we have engaged with the digital world. It was the original device through which we became familiar with the multi-functional computer and discovered how such a device could have a role in our lives, paving the way for laptops, the internet and the smartphone. This is the device on which people learnt basic digital skills, such as navigation, vital for using subsequent devices and platforms. And homecomputers provided the installed base for accessing the internet once the latter became mainstream. Given the power and sophistication of current machines it is easy to assume that the original homecomputers would be instantly attractive. However, there was initially little interest in developing a microcomputer at all. Once office microcomputers became established, there were still questions about whether such a device could cross over into the home. And even when sales of homecomputers were rising, doubts remained about the future of this device. **Leslie Haddon's** chapter charts this troubled history, initially looking at the US then focussing on the UK, as seen through the perspective of the company Commodore.

Around 1986 a strange technology emerged: the »Freeze Frame«. This was a hardware cartridge that could be inserted into the cartridge slot of the C64 and be used to interrupt (nearly) any program and to save it to tape or disc. In that way, it could be used for cracking software easily. There were several different forms of such cartridges with somewhat different properties. **Jens Schröter** describes why the emergence of a commercially available technology that could be used for such an, on first sight, illegal activity is an interesting problem. In the first part of the paper, the question of media technology, reproducibility and property is discussed—of which the practice of cracking and reproducing protected computer games is a special case. Then some material related to cracking cartridges from the 1980s is analysed, reconstructing their emergence and some related practices. Finally, some theoretical positions regarding the emergence and politics of technology are discussed, and it is asked how it is possible that a technology seemingly tailored to oppositional uses (in this case: cracking copy protected software) can be commercially available.

There were a few C compilers for the C64 computer. One of them was »Super-C«. **Franz Hauck's** article describes how »Super-C« came to live. It sheds some light on the history but also on the features of the compiler. »Super-C« was not only a compiler but an entire programming environment with editor, linker and many helper programs bound together by a shell that allowed to conveniently start all necessary components of a software development process including starting the resulting program.

In his chapter, **Patryk Wasiak** focuses on the role of specific types of utilities used as tools in game design and later discusses how these tools were appropriated by the cracking and demoscene communities. He argues that the popularity of the C64 utilities used to make and modify code was a crucial, yet overlooked, factor in the popularity and cultural significance of the C64 as a hardware platform. His discussion seeks to achieve two objectives. First, he aims to highlight the role of such software as a subject of scholarly inquiry into the history of game production. Second, he seeks to expand our understanding of the prolific C64 cracking and demoscene. He discusses the types of utilities used in creating and modifying software, commonly referred to as »tools«. He considers these tools to be key elements of the broader environment that shaped the diverse C64 homebrew programming cultures.

Torsten Roeder's article explores the value of early 1990s video game charts as sources for canon formation within digital games culture. Focusing

on reader and sales charts for the Commodore 64—published in German-language magazines such as »64'er«, »Game On«, and »ASM«—it reconstructs which titles were considered significant at the time and how such evaluations were produced. The findings suggest that reader charts tended to reaffirm established preferences and were shaped by external factors such as magazine affiliation or prize incentives, while sales charts followed different dynamics. Both types of charts exhibit selective mechanisms that limit their reliability as bases for historical canon formation. Instead, the article proposes understanding game charts as indicators of popular evaluative practices and reflects on the methodological implications of a pluralistic concept of the canon.

The Commodore 64's sound chip, the Sound Interface Device (SID), is highly regarded for the depth of its features and the richness of its sound. These strengths have seen the SID remain a powerful conduit for musical creativity long after the end of the Commodore 64's commercial life, as evidenced by the demoscene, a computer art subculture where the SID is used in ways that reach beyond the hardware's official technical specification. While much of the discourse around chipmusic is centred on technostalgia, **Thomas Bridgewater's** focus as a composer is on the idea that engagement with the SID can be forward-looking, pushing the hardware in resourceful ways to replicate a range of contemporary music genres. His Commodore 64 music collection »Get in the Van« demonstrates how the SID can deliver the aesthetics of guitar-based styles through the use of modern cross-platform development tools.

Processors from the MOS65xx series and computers based upon these, such as the Commodore 64, are some of the most frequently emulated systems. While the simplicity of the 6502 architecture seems to make emulation an easy task, the ubiquity of the architecture and related systems resulted in programmers exploring and using all sorts of undocumented tricks and side effects for their software, such as undocumented opcodes, subtle timing effects or hardware glitches. **Michael Engel's** chapter gives an overview of the implementation and the increasing complexity of emulating 65xx and C64 systems starting from a simple interpretation of opcodes and just-in-time translation of binary code to using reverse engineered hardware models of the 6502 in software and also hardware replacing 6502 CPUs in real systems. In addition to giving insights into some deep technical details, the chapter will also analyse the ever-increasing effort required to perfectly emulate a system in real time.

The rapid development of digital culture began towards the end of the 20th century. However, the availability of numerous possibilities for storing and sharing electronic resources does not save that culture from fragility—the typical problem of its classical forms. The early born-digital culture is also particularly affected by this. Electronic journals on floppy disks, also known as *diskmags*, are an impressive example of the fragile nature of digital culture. German-language periodicals on floppies are part of this too and, apart from a small circle of enthusiasts and researchers, remain either ignored or forgotten. Accordingly, **Thomash Shtohryn's** article reconstructs an attempt to preserve this phenomenon and highlights its importance by creating a text corpus of German-language *diskmags* using their digital images, which are scattered worldwide across the web.

Point-and-click adventure games have secured a niche in the gaming industry with their engaging narratives, challenging puzzles, and immersive worlds, and the Commodore 64, one of the most popular homecomputers of its time, played a central role in shaping this genre. The pioneering titles »Maniac Mansion« (1987) and »Zak McKracken« (1988) laid the groundwork for point-and-click adventures, influencing game development for decades. The C64 and its hardware limitations shaped the genre's defining games and led to the development of the famous »SCUMM« engine, offering cinematic experiences with complex, non-linear narratives and multiplayer-character dynamics, enriched by cut-scenes and autonomous character behaviour. **Martin Wendt** describes the technical challenges and innovations, such as the character movement and rendering, and puts the game »Maniac Mansion«, that set a standard for narrative-driven games, into historical context.

Stefan Höltgen documents the teaching of programming for media studies students using 6502-based platforms in assembler, as it took place between 2012 and 2022 at the *Humboldt University of Berlin* and later at the *University of Bonn*. The text is intended both as a theoretical and didactic reflection on the motivation, structuring, and implementation of a semester-long program for assembler programming, and as a guide for the development of similar programming courses inspired by media studies. The target platform in focus, the Commodore 64 is presented in terms of the characteristics that have made it a popular teaching platform for five decades. The use of the C64 is presented both as a media-historical re-enactment and as a computer-archaeological approach (or ›objectification‹) to the digital computer.

The chapter from **Michael Steil** details the 2024ff. digitization project of the German home-computer magazine »64'er«, commemorating the 40th anniversary of its inaugural issue. It begins with historical context and an overview of the magazine's original content. The article then reviews earlier scanning and OCR efforts and presents the 2024 workflow in detail: A3 scanning at 2,400 dpi, de-screening and colour correction, OCR, and the creation of a static website featuring full-text search, inline images, downloadable listings, commenting, an RSS feed, and »Mastodon« integration. It also reflects on key insights from the magazine's early years, including contributor backgrounds and thematic focus. Finally, the article outlines future plans for the project.

The chapter from **Melanie Swalwell, Helen Stuckey**, **Nick Richardson**, and **Denise de Vries** acknowledges the challenges of exhibiting historical video games and the importance of understanding video games as experiences. They propose that in seeking to address these challenges, museums might learn from the practices of retro gamers who for decades have been collecting and displaying material online. Two retro gaming sites are discussed in relation to their approaches to documenting video games and their opportunities for community participation. The chapter discusses how exhibiting playable video games in the browser can present further opportunity for engaging audiences: how presenting historical games as experiences in this context might make them more accessible to contemporary audiences than historic hardware in the gallery.

When investigating the history of platforms such as the C64, standard methods are interviews with former as well as current users including fans or analysing existing material such as forums. However, such approaches are also subject to criticism: firstly, that (former) fans would lack the distance to their beloved objects, the community that formed around them as well as its practices because of their affective relationship, and secondly—and following from the first aspect—that their view on the history was tinged with emotions. These issues are of particular interest in cases when the researcher used to be or still is identifying as a fan themselves, becoming an »acafan«—the academic who is also a fan. **Melanie Fritsch's** chapter reflects on how the personal relatedness and involvedness of fans (and former fans) as well as their subjective view could not only be addressed but usefully included in platform studies by building on approaches from the field of Fan Studies.

John Walker's contribution presents an early implementation of a neural network for pattern recognition, written in BASIC for the Commodore 64.

Walker originally developed this program in 1987 and submitted it to computer magazines for publication, but it was rejected at the time as »too esoteric«. The visionary nature of his work is underscored not only by current developments in artificial intelligence, but also by other contributions in this volume that associate the topic of AI with the Commodore 64. Walker's article includes the complete BASIC source code, which demonstrates the didactic advantages of the language—even for conveying the principles behind more complex software. Sadly, the author passed away in the spring of 2024 and was therefore unable to speak about his work with the Commodore 64 at the conference upon which this volume is based. We are grateful to his widow, Roxie Walker, who kindly granted permission for the publication of both the article and the program.

Does the Commodore 64 have a place in computer vision? Absolutely not! But that didn't stop **Jesse Shakarji** and his colleagues from trying. In April 2022, he was part of a team that participated in a hackathon named »Bitcamp« at the *University of Maryland*, where the team aimed to do just that. This chapter will go over the hurdles that had to be overcome to create a face generator using the Commodore 64 while working under the strong time restrictions of a 36-hour hackathon. Shakarji will also go over improvements that were made after the hackathon to further explore the sheer power of the Commodore 64.

Jean-Michel Sellier is academically engaged with quantum physical problems related to quantum computing. In his spare time, he runs a YouTube channel dedicated to retro computing, where he also describes applications of quantum computing and quantum logic that can be implemented with simple tools (for instance, in BASIC). In an interview for this book, he discusses the theoretical backgrounds and the didactic advantages that the Commodore 64 and BASIC offer for this subject. He presents small transcription programs that enable readers to replicate the experiments either in an emulator or on the original platform.

The last article is actually an invitation to a somehow sportive activity. »Code Golf« is played neither with a golf club nor on the green, but with a keyboard and on the screen: A given challenge must be solved with as few keystrokes as possible. The winning programs often use complex workarounds to save a line of code or to make it even shorter, and the processing is sometimes hard to understand for human readers. Compressed and without any self-documentation, which would cost valuable space, it is actually the contrary of what professionals would call »good code«; at the same time, code-golf programs

can also be seen as aesthetic expressions of computational capabilities. The article by **Torsten Roeder** presents 16 challenges and the winning solution by **Berni** from a C64 BASIC Code Golf event in 2024.

2. Acknowledgments

Several contributions to this volume are based on presentations delivered at the conference »Commodore 64—Past, Present, and Future of a Homecomputer«, which took place at the *Department of Media Studies* at the *University of Bonn* on July 5–7, 2024. In order to draw attention to topics that could not be accommodated within the conference program due to time constraints—and to broaden the thematic scope to include areas such as artificial intelligence, except from the paper by Walker and Shakarji, digital humanities, and the history of software—we, the editors, invited additional authors to contribute to this volume.

We extend our sincere thanks to all authors for their commitment and valuable contributions to this publication. We are especially grateful to our editor, **Leonard Huse**, who reviewed all submissions, adapted them to the stylesheet of the book series, and oversaw the final typesetting process. The cover photograph and the layout of the volume were executed by **Sebastian Bach**. Editorial work and layout were funded by the *DFG* project »Computerphilologie« (**Stefan Höltgen**), with additional support from the association *Digital Humanities im deutschsprachigen Raum e.V.* and departmental resources provided by **Prof. Dr. Jens Schröter**.

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Register

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Keywords

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Platforms

The Commodore 64 is the most significant computer of its era. From 1982 to 1994, a total of 27 million units were sold—more than any other computer from a single manufacturer afterwards. Due to its widespread use as well as its technical features, the C64 has a huge international following—even to this day. The 19 contributions compiled in this book illustrate the significance of the platform for the digitalization of society, the general public's computer science knowledge, as well as digital art and culture—both in the past, present, and also in the future. Volume 5 of the »Computer Archaeology« series is partly based on the conference of the same name held in 2024 at the *University of Bonn* and has here been supplemented with additional contributions from the fields of artificial intelligence, quantum computing, and digital humanities.

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