Praxis

Endless loop: A brief history of chiptunes

Kevin Driscoll and Joshua Diaz

Cambridge, Massachusetts, United States

[0.1] *Abstract*—Chiptune refers to a collection of related music production and performance practices sharing a history with video game soundtracks. The evolution of early chiptune music tells an alternate narrative about the hardware, software, and social practices of personal computing in the 1980s and 1990s. By digging into the interviews, text files, and dispersed ephemera that have made their way to the Web, we identify some of the common folk-historical threads among the commercial, noncommercial, and ambiguously commercial producers of chiptunes with an eye toward the present-day confusion surrounding the term *chiptune.* Using the language of affordances and constraints, we hope to avoid a technocratic view of the inventive and creative but nevertheless highly technical process of creating music on computer game hardware.

[0.2] *Keywords*—Adaptation; BBS; Cracking; Demo scene; DJ; Game Boy; Gaming; Hacking; Music; Participatory culture; Personal computing; Piracy; Programming; Rave; Remix; Sampling; Sound synthesis; Subculture; Teenagers; Tracking; Video game; VJ; Youth

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1. Introduction

[1.1] Raw, noisy, forbidding, industrial, illegal, outdated, subversive, underground. These adjectives color Malcolm McLaren's account of working with chiptunes artists in a 2003 feature for *Wired* magazine. In his portrait of young musicians who prefer 1980s home computers to the latest digital audio workstations, McLaren declared that "chip music" is both "the next step in the evolution of rock and roll" and the antidote to "moribund electronica." Such a gushing piece sufficiently raised the suspicion of its subjects to elicit an open letter from chiptunes community leader Gareth Morris (2004) questioning McLaren's "motives" for crafting such an "inaccurate" portrayal. Unfortunately, despite his claims of an "already well developed" style with "25 years of chip music history," Morris's letter does little to clarify McLaren's image of a "video arcade gone mad."

[1.2] In its strictest use, the term *chiptunes* refers to music composed for the microchip-based audio hardware of early home computers and gaming consoles. The best of these chips exposed a sophisticated polyphonic synthesizer to composers who were willing to learn to program them. By experimenting with the chips' oscillating voices and noise generator, chiptunes artists in the 1980s—many of them creating music for video games—developed a rich palette of sounds with which to emulate popular styles like heavy metal, techno, ragtime, and (for lack of a better term) Western classical. Born out of technical limitation, their soaring flutelike melodies, buzzing square wave bass, rapid arpeggios, and noisy gated percussion eventually came to define a style of its own, which is being called forth by today's pop composers as a matter of preference rather than necessity.

[1.3] The study of games suggests comparison with a variety of cultural traditions: games as moving images (King and Krzywinska 2002), as stages for theatrical performance (Laurel 1991), and as literature (Murray 1998), but the role of music, sound, and noise in computer games remains relatively underexamined. By observing the interrelated constraints, aesthetics, and compositional strategies of chiptunes, we illustrate a creative transforming and repurposing of technology that resonates widely in contemporary gaming and computing cultures. To produce music in the ways we document reflects a preference derived from, but no longer limited to, games.

[1.4] As the exchange between McLaren and Morris reveals, the term *chiptunes* does not refer simply to video game soundtracks or compositions for early home computers. Rather, it is currently applied to a broad, and occasionally confusing, array of communities, practices, and technologies. We chronologically trace the migration of chiptunes, in name and aesthetic, across four historical moments that came to bear on the contemporary use of the term. In doing so, we document cultural phenomena that have not yet received significant scholarly attention and further clarify the term *chiptunes.*

[1.5] The development of chiptunes draws on the interrelated histories of home computing, video gaming, bulletin board systems (BBS) and Internet communications, and electronic music. We focus largely on events that take place in Europe and the United States to the exclusion of contemporaneous developments in other parts of the globe. Many paths remain to be followed from the mass production of programmable sound chips. In particular, we look forward to future scholarship on the role that computer music and video game audio play in Japanese popular culture.

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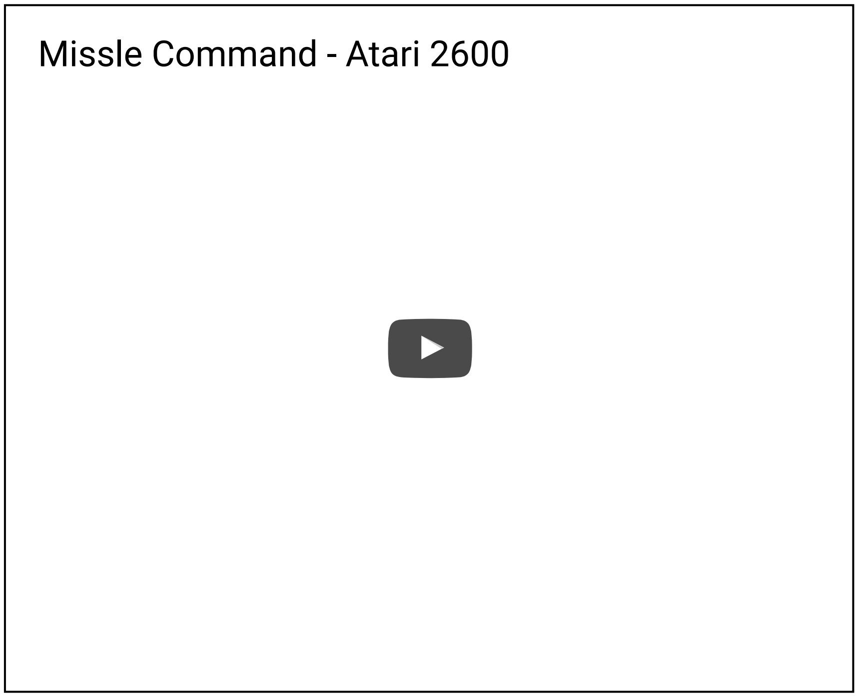
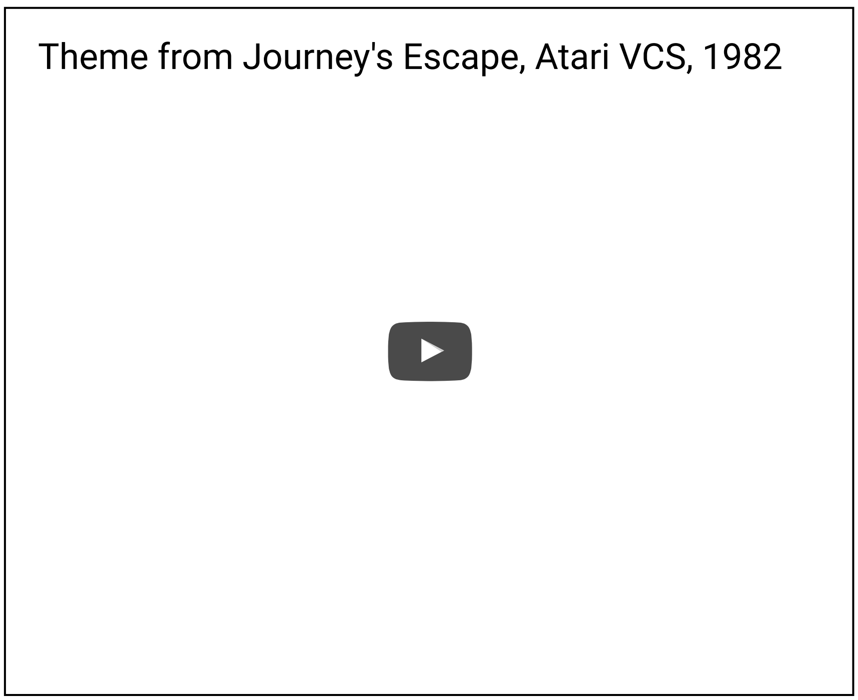
2. Home computers

[2.1] Before the appearance of microcomputers at the end of the 1970s, digital arcade games provided the primary computing experience for people outside of financial data centers, university labs, and military research facilities. Installed in loud public spaces like bars and roller-skating rinks, the experience of playing these games was likely accompanied by the sound of a nearby radio, DJ, or jukebox playing the latest disco and progressive rock. In the early 1980s, computer gaming followed computers into the privacy of the home. The sound produced by arcade cabinets might have competed with other environmental noises, but many of the earliest home computer games included only a brief theme, a few sound effects, or no sound at all. The general-purpose home platforms were not as well suited to audio reproduction as the custom-built arcade cabinets. Nevertheless, during the first few years of the 1980s, the number of platforms diversified, and each new design provided a different set of affordances for the growing number of computer music composers to explore.

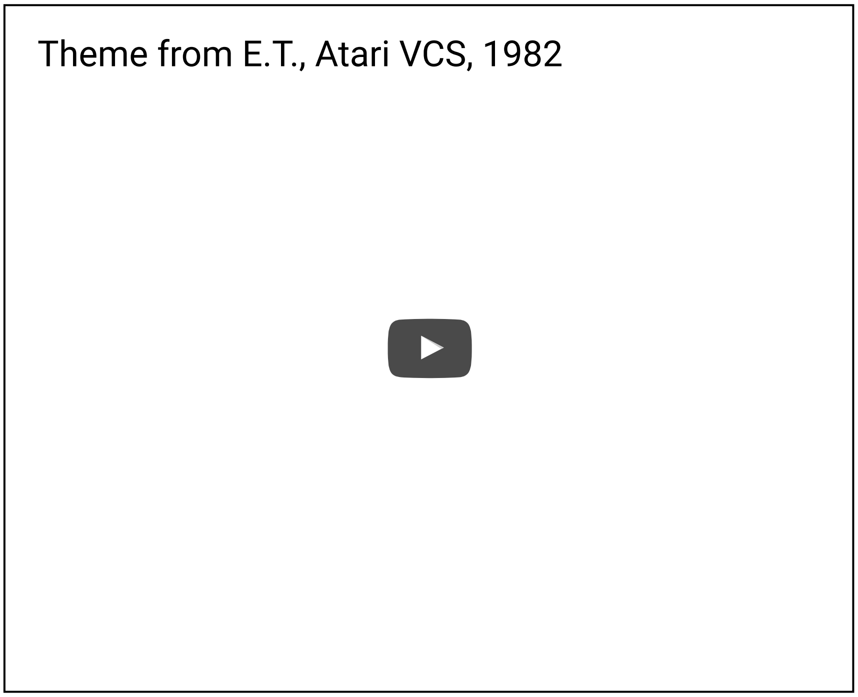
[2.2] The Apple II home computer, released in 1977, included a single speaker inside of its case that could be programmed to play simple musical phrases or sound effects (Weyhrich 2008). In-game music was very rare as memory storage for audio data was limited and audio playback was costly in terms of the central processing unit (CPU) cycles (note 1). The Atari VCS game console, released the same year as the Apple II, was designed to be attached to a television. Its television interface adapter (TIA) controlled both the audio and video output signal. Although the TIA could produce two voices simultaneously, it was notoriously difficult to tune (Slocum 2003). Rather than include multivoice harmonic passages for a machine with unpredictable playback capacity, games such as Atari's *Missile Command* implemented rhythmic themes using controlled bursts of noise for percussion instruments (Fulop 1981). Programmers charged with interpreting recognizable musical themes from arcade games, films, or pop groups were less free to experiment. Data Age's *Journey Escape* (1982), billed as "the first rock video game," struggled against the tonal limitations of the TIA in its squeaky interpretation of Journey's hit song "Don't Stop Believing," while Atari's *E.T.: The Extra-Terrestrial* (1982) presented a harmonically accurate re-creation of the original theme.



Video 1. *Game play from Atari's Missile Command (1981).*

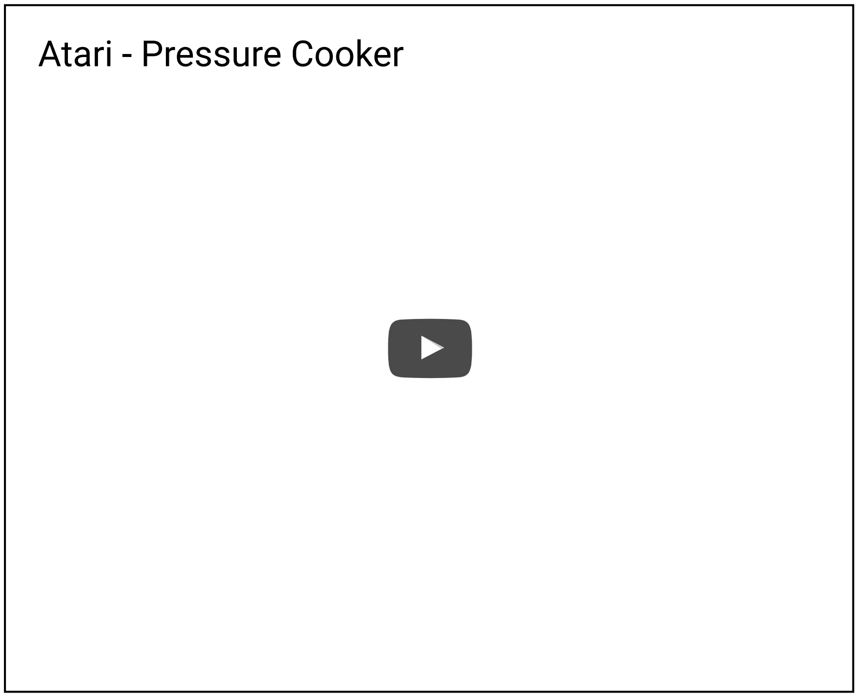


Video 2. *Theme from Journey Escape (Data Age, 1982).*



Video 3. *Theme from Atari's E.T.: The Extra-Terrestrial (1982).*

[2.3] Despite (or perhaps because of) the challenges presented, some developers embraced the limitations of these early home computing platforms. In preparation for the development of Activision's *Pressure Cooker* in 1983, Garry Kitchen determined a set of pitches that the Atari TIA could reliably reproduce. He then hired a professional jingle writer to compose theme music using only those available pitches (note 2). The resulting song is heard playing in two-part harmony on both TIA audio channels during the title screen. *Pressure Cooker* further challenged the audio conventions of the Atari VCS by including a nonstop soundtrack during game play. One of the TIA's voices repeats a simple, two-bar bass line, while the other is free to produce sound effects in response to in-game events.



Video 4. *Title screen and game play from Activision's Pressure Cooker (1983).*

[2.4] *Pressure Cooker* was an ambitious exception among its contemporaries. In 1980, most home computer music remained limited to single-voice melodies and lacked dynamic range. Robert "Bob" Yannes, a self-described "electronic music hobbyist," saw the sound hardware in first-generation microcomputers as "primitive" and suggested that they had been "designed by people who knew nothing about music" (Yannes 1996). In 1981, he began to design a new audio chip for MOS Technology called the SID (Sound Interface Device). In contrast to the kludgy Atari TIA, Yannes intended the SID to be as useful in professional synthesizers as it would be in microcomputers. Later that year, Commodore decided to include MOS Technology's new SID alongside a dedicated graphics chip in its next microcomputer, the Commodore 64. Unlike the Atari architecture, in which a single piece of hardware controlled both audio and video output, the Commodore machine afforded programmers greater flexibility in their implementation of graphics and sound (figure 1).

Figure 1. *Sound Interface Device (SID), MOS Technology, 1981. (Photo courtesy Chris Hand, 2008; http://flickr.com/photos/pixelfrenzy/2229900479.)*

[2.5] Technically, the SID enables a broad sonic palette at a low cost to the attendant CPU by implementing common synthesizer features in hardware. The chip consists of three oscillators, each capable of producing four different waveforms—square, triangle, sawtooth, and noise (note 3). The output of each oscillator is then passed through an envelope generator to vary the timbre of the sound from short plucks to long, droning notes. A variety of modulation effects may be applied to the sounds by the use of a set of programmable filters to create, for example, the ringing sounds of bells or chimes.

[2.6] Several peripherals and cartridges were developed to take advantage of the music-making possibilities of the Commodore 64's SID chip, but even the best of these products (note 4) could not match the flexibility and freedom of working with the chip's features directly by writing programs in 6502 assembly language (Pickens and Clark 2001). Of course, although the SID's implementation of sound synthesis would be familiar to electronic musicians of the time, programming in assembly was a very different experience from turning the knobs and sliding the faders of a comparable commercial synthesizer like the Roland Juno-6 (figure 2; Friedman 2008b). Early Commodore 64 composers had to write not only the music, but also the software to play it back.

Figure 2. *Roland Juno-6 synthesizer.*

[2.7] In a 1993 article for *C=Hacking* magazine, Anthony McSweeney offered a window into the practices of early chiptune composers through an analysis of Rob Hubbard's SID routines. McSweeney suggested that not only was the same routine implemented across the majority of the Hubbard oeuvre, but that other composers reverse-engineered the routine for use in their own projects (McSweeney 1993). As Hubbard composed the music for more than 75 Commodore 64 games between 1985 and 1989, the code quoted in McSweeney's article is likely representative of the code seen by many SID composers (MobyGames 2008). To understand the high barrier of entry to early SID programming, one need only look at an example pattern from Hubbard's *Monty on the Run* (Gremlin Graphics, 1985):

[2.8] ptn34=*

byt $03,$4a,$03,$4a,$a3,$f8,$48,$03

byt $4a,$03,$4a,$03,$4a,$a3,$f8,$48

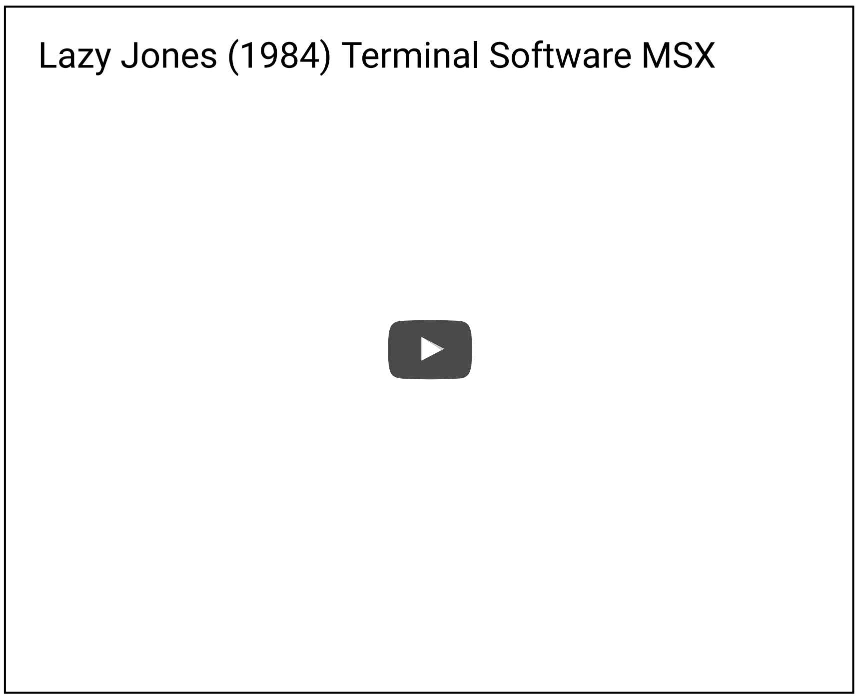
byt $03,$4a,$ff'

[2.9]   This sequence of bytes follows a set of rules in which each hexadecimal number corresponds to series of binary bits indicating various characteristics of the note to be played (duration, instrument, pitch, effect). Instrument definitions use a similar system in which hexadecimal numbers represent the values of pulse width, waveform, envelope, filter, vibrato, and effect that would be set with knobs or switches on the face of a traditional synthesizer.

Video 5. *Game play from Gremlin Graphics's Monty on the Run (1985); music composed by Rob Hubbard.*

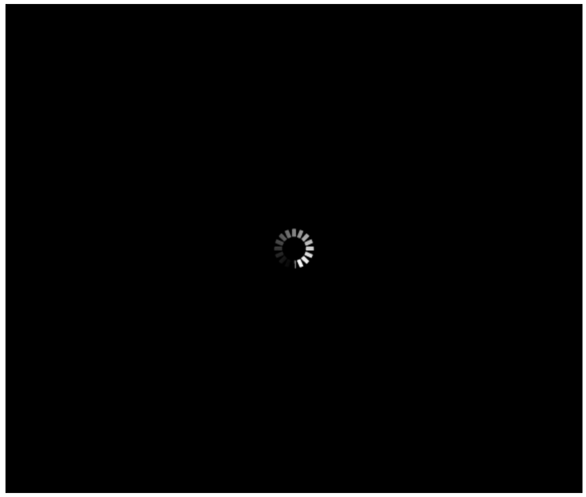
[2.10]   Working in code affected the composition strategies of early chiptunes artists. Hubbard describes setting up his computer to repeatedly loop four bars of a song. While the passage played repeatedly, he would "sit on a hex editor…changing numbers" and listening for the results (Hubbard 2002). This repetitious methodology is reflected in the unique needs of game scoring. Unlike a film score, background music for computer games in this era was designed to loop endlessly along with highly repetitious game play. To govern the interaction and repetition of multiple loops within a single piece of game music, a master loop dictates the order in which sequences of phrase-length "microloops" are recalled (Collins 2006).

[2.11] The most accomplished loop composers layer, randomize, and stretch their loops to create a variety of sequences and combinations. For Terminal Software's *Lazy Jones* (1984), David Whittaker created 21 related but distinct patterns, each approximately 7 seconds in length. As players move their character through the on-screen rooms of the game, the background music subtly shifts according to their location (Collins 2006). The sequence and number of repetitions in which these tiny loops are played is determined dynamically according to player behavior. There can be no definitive score or recording of the background music for *Lazy Jones.* Like the music performed by marching bands in a parade, Whittaker's composition includes a collection of musical passages and a set of instructions to guide their selection and repetition.



Video 6. *Game play from Terminal Software's Lazy Jones (1984); music composed by David Whittaker.*

[2.12] In the mid-1980s, chiptunes and computer game music appeared largely indistinguishable. The game music was not distinct from the rest of pop music, however: the songs reflected the musical interests of their composers. Most of the composers discussed here were young men living in Europe and the United States, and the influence of heavy metal, electro, New Wave pop, and progressive rock were prevalent throughout the 1980s. By assigning a distinct timbre to each of the voices, the SID could emulate the conventional instrumentation of a four-piece rock band: drums, guitar, bass, and voice (Collins 2006). For example, Martin Galway's 11-minute title track for Origin System's *Times of Lore* (1988) reflects the influence of classical guitar in heavy metal (note 5). Like the opening section of Metallica's "Fade to Black"



Commodore 64 was a home computer that happened to be well suited to gaming, whereas the NES was strictly a gaming console. The Commodore 64 shipped with programming tools, a QWERTY keyboard, and rewriteable diskette storage that enabled experimentation. The NES, by contrast, operated more like a VCR and loaded games from read-only cartridges.

[2.14] The NES was introduced in Europe in 1986 but never achieved the success it found in the United States (Nintendo 2008). As the decade came to a close, European gamers appear to have favored programmable home computers like the Atari ST, Amiga, and IBM PC-compatible machines to the closed game consoles like the NES, Game Boy, and Sega Genesis. This divide in platform preferences explains why, in comments made in 2002, composer Rob Hubbard recalled "[missing] out on a lot of [chiptune] developments" by moving to the United States in 1987 (Hubbard 2002).

3. The tracking, cracking, and demo scenes

[3.1] In 1987, Karsten Obarski built a tool called *The Ultimate Soundtracker* for his Amiga A500 to help him in his job composing music for Rainbow Arts, a German game development company (Wright 1998). Because he was tired of coding computer music by hand, Obarski designed a tool that graphically represents the four channels of sound on the Amiga's sound chip like a vertical piano roll. The piano roll metaphor elegantly matched the looping structure common to nearly all music playback subroutines of the SID period. Most importantly, *Soundtracker* provided an environment in which nonprogrammers could access the sophisticated music tools in their home computers without needing to learn a programming language (figure 3).

Figure 3. *Screenshot from Karsten Obarski's software The Ultimate Soundtracker (1987).*

[3.2] Tracking tools for the Commodore Amiga, Atari ST, and MS-DOS personal computers share a few common features. They all inherited the conceptual structure of looping patterns from Hubbard's generation of SID programmers but represented them in the form of on-screen piano rolls rather than as lines of assembly code. Because they play back digitally sampled sounds rather than relying on hardware synthesis, tracker tunes no longer meet the strictest definition of chiptune. Yet despite the freedom to sample from any source, many tracker composers chose to continue using the triangle waves, noisy percussion, and synthesized bass tones that characterized the SID chiptunes. Tracker software developers likewise implemented the same hexadecimal notation used by SID programmers to indicate effects like portamento, vibrato, and arpeggiator.

[3.3] Just as the barriers to making computer music lowered with the availability of tracking tools, so did chiptunes composers create a new space for sharing their work. In the 1980s, commercial computer games typically included additional software to limit their unauthorized reproduction. With each release, adept reverse engineers set about circumventing the new constraints. By the end of the decade, the practice of *cracking* the copy protection code and redistributing commercial software had developed into a competitive global culture complete with group rivalries, codes of conduct, and complex communication networks. Cracker groups used BBS to trade software, communicate with friendly users, and taunt others (*BBS* 2004). Eager to inflate their reputations, cracking groups began to insert identifying information into the software they distributed. Initially, these edits were little more than tags on a title screen, but as cracking grew more competitive in the late 1980s, the little tags grew into complex multimedia demonstrations complete with sophisticated animations, lengthy scrolling texts, and custom music. These *intros* to cracked software gave amateur chiptunes artists a new stage for their work. As competition among cracking groups grew more fierce, intros became increasingly ornate and migrated away from the cracked software into stand-alone *demos* (Tasajärvi 2004).

Video 9. *Montage of intros by Commodore 64 software cracking groups.*

[3.4] Members of the emerging *demo scenes* of Scandinavia and Western Europe adopted tracker software like *Soundtracker* to compose the background music for their productions (Tasajärvi 2004). Trackers were distributed free of cost and often were used as playback software among fans. In contrast to the more popular MIDI format, which contains only the musical notation, the file formats for distributing tracker music contain both the patterns and samples used in a song. Furthermore, unlike compressed digital audio files like MP3s, when tracker files are opened in a compatible tracker, the patterns and instruments are rendered as openly readable, editable data. This architecture enabled a type of situated learning for novices and blurred the barriers between artists and fans in much the same way that the View Source feature of the NCSA Mosaic Web browser encouraged the rapid growth of the early World Wide Web by exposing the underlying markup language of Web pages to future publishers.

[3.5] In the 1990s, spurred on by big rave-like parties in Europe, online competition, and the explosive growth of international communication via Fidonet and the Internet, tracker music and chiptunes became increasingly independent of their origins as the backgrounds of games and demos. Musicians and groups released collections of tracker music called *musicdisks* or *musicpacks,* complete with artwork, liner notes, and customized players. In 1997, a tracker contest sponsored by the Hornet Archive fielded over 300 entries, and the next year, they estimated that over 500 users participated (Snowman 1998). Shortly afterward, the momentum of the tracking community mysteriously ended, despite the continued growth of the demo scene. Necros, one of the best-known trackers, speculated publicly that tracking was disappearing as a result of "slowly merging into the 'internet music scene,'" though he struggled to define what that might mean, other than he felt the sense of community being "reduced to the sum of our technology" (Necros 1998).

[3.6] From 1988 to 1998, chiptunes experienced two important migrations. First, the introduction of sample-based tracker software unhinged the chip from the tune. Although SID programmers were able to create a vast array of sounds from their chips, they always had been limited by the constraints of their hardware platform. However, tracker-based chiptune composers were selecting SID-like samples because of aesthetic preference rather than technical constraint. The second migration was away from the backgrounds and title screens of computer games and into the illicit intros appended by crackers. As the demo scene established its independence, chiptunes were carried out of the gaming sphere altogether to finally establish their own stand-alone format: the downloadable musicdisk.

4. Micromusic.net and the Game Boy musician

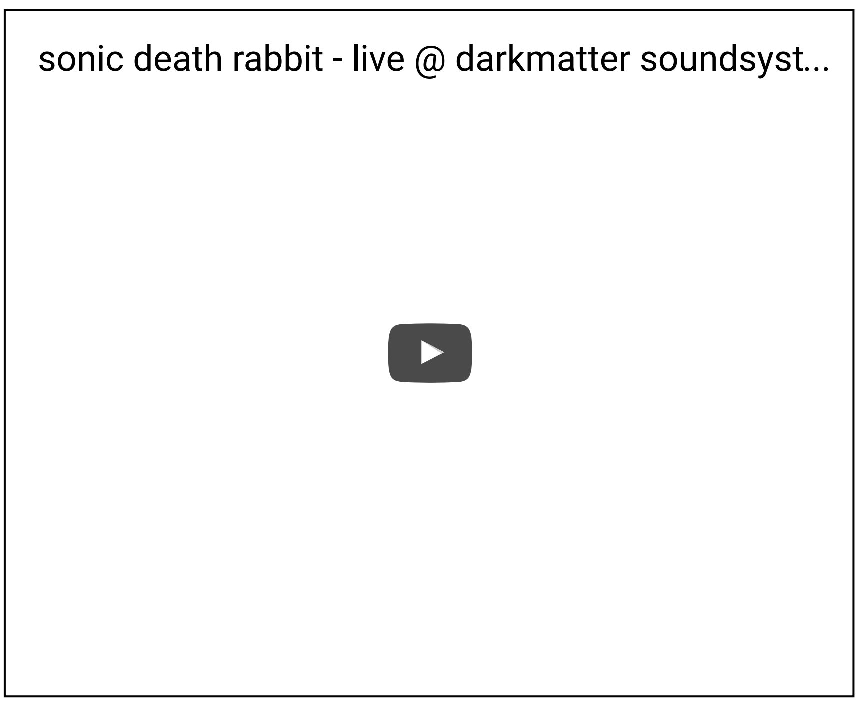
[4.1] In 1998, the same year that the Europe-based tracking scene hit its peak then all but disappeared, chiptunes *netlabels* emerged that appeared to build on the concept of the musicdisk. Micromusic.net, one of the largest netlabels, describes itself as "an underground sound community, a digital lifestyle platform" (Micromusic.net 2008). Users are encouraged to upload their own works, to advertise local functions, and to comment and interact as a global but intimate group of creators. The structure of the site makes explicit the many different forms of production in the chiptunes scene: music, clothing, and hardware are available in the "microshop," software tools are found in the "microwarez" section, "microradio" continuously streams user-contributed material, and "microhype" hosts video content.

[4.2] Unlike Micromusic.net's community model, newer netlabels like 8bitpeoples and Jahtari serve a more traditional role as tastemakers and distribution nodes for chiptunes music. The mission of 8bitpeoples is to provide digital copies of "quality" chiptunes music along with sales of chiptunes in the traditional pop formats of vinyl and compact disc. Jahtari, a free netlabel specializing in what it calls "digital laptop reggae," explains its aesthetic mission in terms of innovation on an older form, "not… emulating old classics with new technology but about doing something to dub that hasn't or couldn't [have] been done before" (Disrupt 2005).

[4.3] Unlike the SID programmers and demo scene trackers, however, the tools used by artists on these netlabels are no longer cutting edge. Calls for innovation on older themes or for quality music do not suffice to explain why so many of these producers choose to use home computers and game consoles from the 1980s. The Australian hardcore techno label Bloody Fist Productions explains that the use of trackers and

Amiga computers among its artists is because the machines offer "incredibly cheap methods of making noise" (Newlands 1997).

[4.4] Although Los Angeles–based producer Baseck also notes cost as an influence on his choice to use a Nintendo Game Boy in production and performance, cost alone clearly isn't the deciding factor (Ohanesian 2008). Commonly pirated music production software like Ableton Live (Ableton) and FL Studio (Image-Line Software) far undercut the Game Boy in terms of cost, flexibility, learning curve, and ease of use. The reactions of audiences to chiptune artists suggest another powerful motive for using game consoles. Contemporary chiptune artists wield their repurposed gaming hardware in a ritual attempt to activate the personal attachments that many young people have formed with these objects. Artists whose compositions might fall into other genres distinguish themselves from performers who use a laptop or a sampler by deploying familiar but seemingly childish pieces of technology in a highly visible and surprising way. Even Sonic Death Rabbit, Baseck's collaboration with metal musician Cristina Fuentes, uses Nintendo Game Boys alongside children's toy guitars and turntables. Their live show revolves not just around the use of technology but also the performance of it in a way that relies on the audience's understanding of the cultural weight of those objects and attitudes (Sonic Death Rabbit 2006).



Video 10. *Sonic Death Rabbit, live performance.*

[4.5] The Game Boy enjoys peculiar prominence among contemporary chiptunes artists (Blip Festival 2008). The handheld gaming console is perhaps the most common gaming platform in the world, with global sales of over 200 million compatible Game Boy systems (Nintendo 2008), but popularity is not enough to explain its dominance.

Tracking software had enabled a wider diversity of musicians to compose chiptunes independent of game development, programming, and cracking. The cost of this independence was an intimacy with the audio hardware experienced by composers of SID music. Although home computers and game consoles had stopped shipping with synthesizers by the mid-1990s, the Game Boy continued to include its polyphonic sound synthesis architecture across its many hardware revisions and rereleases. Thus, the Game Boy is not only the most widely available gaming platform in the world, but it also may be the most widely available synthesizer.

[4.6] Game Boy, like the NES, is designed to be a read-only system. By the 1990s, however, enthusiasts using special rewritable cartridges began to reverse engineer the Game Boy platform and document their findings on the Web (Morgan 2008). One of the first widely distributed applications for this newly opened platform was Nanoloop, a synthesizer and sequencer application released in 1998 (Wittchow 2008). Nanoloop was followed shortly after by a second music application called Little Sound DJ (LSDJ), which continues to be widely used by chiptunes artists today (figure 4).

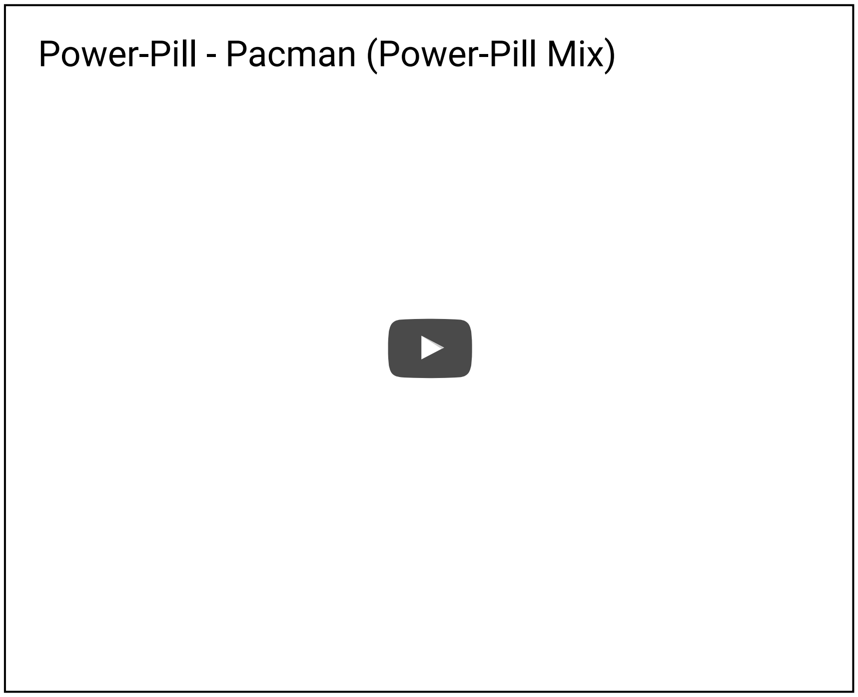
Figure 4. *Cartridge for the Nintendo Game Boy with space for custom erasable programmable read-only memory (EPROM) chip (Handheld Museum, 2008).*

[4.7] Little Sound DJ embodies the history of chiptunes in software. It gives composers direct access to the four-voice polyphony of the Game Boy sound architecture like Hubbard's SID routines, yet it also implements the digital sample playback and a piano roll sequencer introduced in Obarski's *Soundtracker.* Since the late 1990s, the LSDJ software has implemented MIDI compatibility for those users who solder their own hardware interface (Morris 2002). This feature highlights the biggest distinction between the Game Boy/netlabel community of chiptunes artists and those from the tracker/musicdisk era. Although tracker software enabled nonprogrammers to create music with their computers, it remained largely isolated from conventional recording studio technology. By adding a MIDI interface to a game console, a tool like LSDJ connects chiptunes to the traditional electronic music world. Not only can nonprogramming musicians make music with their game console, they can now integrate the console with their existing studio practice (note 6).

5. 8-bit cover bands

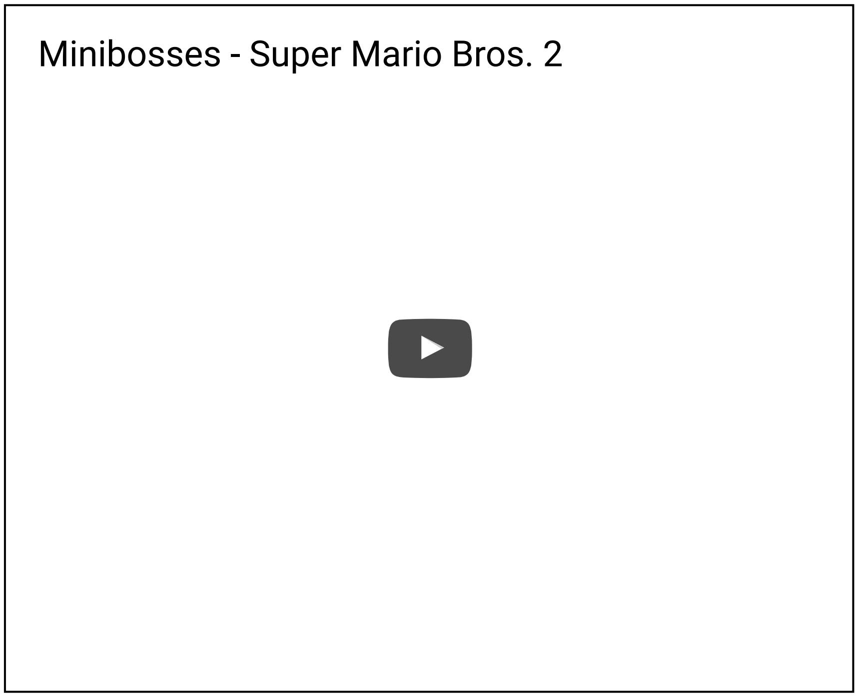
[5.1] One reason that the term *chiptunes* is more confusing today than it might have been in 1987 is due in no small part to the many different forms in which video gaming appears in popular music. There are songs that reference games, either lyrically or through the use of recorded samples; groups who interpret music from games in different arrangements; and artists who deploy the same production technologies as game music. The barriers between these practices are porous and are complicated by either a lack of clear information or by the choices of a given artist.

[5.2] In 1982, the American pop musicians Jerry Buckner and Gary Garcia had a hit with "Pac-Man Fever" (1981) (http://www.youtube.com/watch?v=0-MONIvP6kI). No indication was made that the duo regarded the sonics of Namco's *Pac-Man* as music in its own right. Samples from the Namco game are deployed only as nonmusical dressing for a conventional guitar-based rock song that portrays video gaming as an addictive novelty. In contrast to Buckner and Garcia's disdainful treatment of gaming as a ridiculous fad, the *Pac-Man* theme reappeared 10 years after its U.S. release in a track by Richard D. James under the alias Power-Pill. Simply called "Pac-Man" (1992), James's piece used sound effects and sampled elements of the game's soundtrack as essential musical materials in the song's composition.



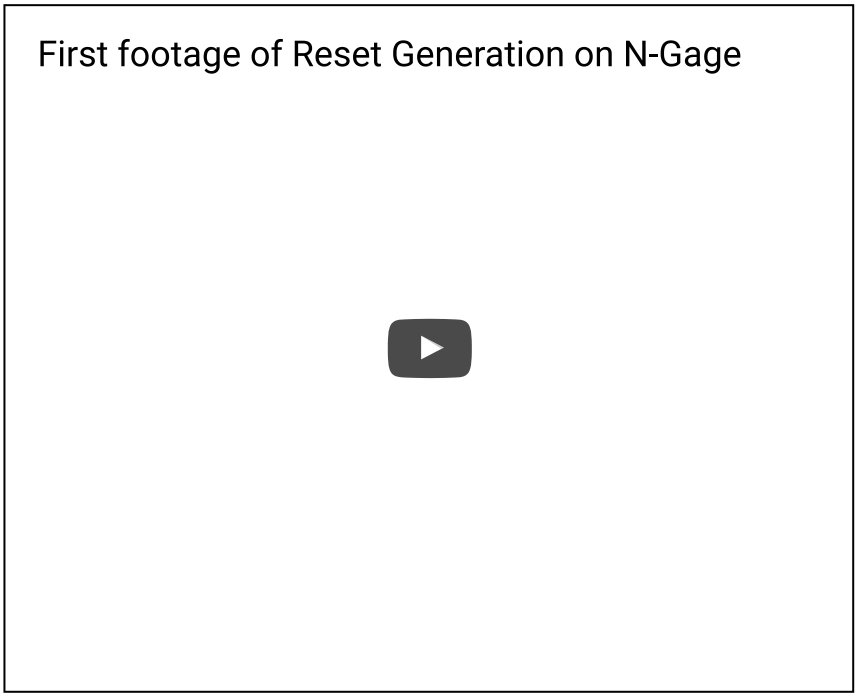
Video 11. *Power-Pill, "Pac-Man" (1992).*

[5.3] At the end of the 1990s, bands like the Minibosses, Press Play On Tape, and The Advantage began to record progressive rock interpretations of themes from NES and Commodore 64 computer games. While James's "Pac-Man" drew materially from the *Pac-Man* arcade game by sampling its sound effects, these bands appropriate only the compositions from the games they reference. The technical apparatus and resulting sound of the chiptune is divorced from its composition. In contrast to the contemporary Game Boy artist whose performance incorporates the physical artifacts of game culture, the cover bands present themselves on stage like traditional rock bands, with electric guitars and acoustic drums (Advantage 2006). By using conventional instrumentation, these cover bands offer fans of rock music an opportunity to experience computer game music within a familiar aesthetic framework. Unfortunately, this accessibility sacrifices the chiptunes' dynamic looping structures and rich aural palette. Though these bands exist to celebrate the work of early chiptune musicians working in games, their validation excludes the music's material innovations.



Video 12. *The Minibosses performing music from Super Mario Bros 2 at the 2006 Penny Arcade Gaming Expo.*

[5.4] The group 8 Bit Weapon is a three-person band that plays a type of synth pop they describe as "8-bit rock." Like Sonic Death Rabbit, their live performance relies on the visual significance of 1980s hardware—home computers, electronic learning toys, calculators, and game consoles—in combination with the more conventional pop instrumentation of keyboards and acoustic drums (8 Bit Weapon 2001). In a curious moment of cultural recursion, Nokia recently hired the band to score a handheld game called *Reset Generation.* The game's marketing copy states, "Welcome back to the playground of your youth" and features numerous references to popular computer games of the mid-1980s (Nokia 2008). Like *Reset Generation,* 8 Bit Weapon invites listeners back to a 1980s "playground" that may or may not have ever existed. Whereas both the Game Boy hackers and 8 Bit Weapon modify 1980s platforms, 8 Bit Weapon's rock band format embraces a sense of retro kitsch while the chiptunes artists appear to see themselves working with a living medium.



Video 13. *Advertisement for Nokia's Reset Generation (2008); music by 8 Bit Weapon.*

[5.5] Songs that interpret or appropriate chiptunes do not appeal only to audiences with gaming experience. In 1999, Zombie Nation's "Kernkraft 400" became a club hit in Europe and eventually the United States (Zombie Nation 2000). The song uses the melody line from "Stardust," one of David Whittaker's 21 *Lazy Jones* loops (Whittaker 1984). Rather than creating a sample from the game, it is likely that Zombie Nation used a MIDI module containing a SID chip to replay the short melodic phrase (Zombie Nation 2008). The widespread popularity of "Kernkraft 400" suggests that the appeal wasn't dependent on recognizing obscure game references or compositional effects but on the strength of Whittaker's original chiptune.

Video 14. *Zombie Nation, "Kernkraft 400 (Original Mix)" (2000).*

6. The endless loop

[6.1]   The strictest definition of chiptune refers to a song composed exclusively for performance by a microchip capable of synthesizing sound. The chiptune culture that emerged from the wildly prolific SID era of the 1980s has taken the term and aesthetics far beyond that simple definition. By migrating first away from hardware synthesis and then away from gaming, the tracker scene demonstrated the ability of chiptunes to stand on their own. The Game Boy generation then brought the chiptune back to bear on a microchip without losing the affordances of the tracker interface or the freedom of digital sampling. Finally, examples of today's retro 8-bit aesthetic demonstrate the durability and accessibility of the chiptune by alternately denying and mobilizing it within existing the paradigms of rock and dance music.

[6.2]   The artists of the Game Boy generation may be the last for whom chiptunes can hold a nostalgic appeal. Will their fans simply age with them, or will the chirping arpeggios, square waves, and creative spirit of chiptune music similarly captivate a younger audience reared on Playstation and the Xbox?

7. Notes

1. In this early period, digital sample playback was not entirely unheard of. For a stunning example, consider the introduction to Tom Snyder and Omar Khudari's *The Halley Project* (Mindscape, 1985) for the Apple. The audio represents a two-way radio

transmission, so its crackly, low-fidelity playback is consistent with the game's "star pilot" fiction.

2. As related during an interview with Nick Montfort, in Cambridge, Massachusetts, November 13, 2008.

3. The illusion of greater polyphony was achieved in some particularly elegant programs by rapidly switching the instruments being sounded on a single channel.

4. For examples of the Commodore SFX series of music products, see Zimmerman (n.d.).

5. Unfortunately, few players likely heard the entire Galway composition for *Times of Lore,* as it only played during the game's title screen (Bagnall 2007).

6. The development of the MIDI-compatible SidStation in 1999 allowed Bob Yannes's chip the same integration (Friedman 2008a).

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