0.000001 GB Matter Matters

PROTOROOM

1KB?

Today, when we mention 1KB of data, many people find it difficult to grasp just how small that is. A single document or a small photo often exceeds several megabytes (MB, 10^6), and it is only when exchanging files in the gigabyte (GB, 10^9) range that data size feels tangible. In this context, the kilobyte (KB, 10^3) is no longer a meaningful unit for perceiving the scale of digital data.

1KB = 0.000001GB

In an age where massive amounts of data in quettabytes (QB, 10^{30}) are constantly being generated, accumulated, erased, and forgotten, the difference of a single kilobyte can feel imperceptible. Is there still meaning today in sensing, observing, and contemplating these dust-like fragments of data that seem too small to do anything with? In reality, we find ourselves frantically following the flow of data with our eyes as it streams endlessly beneath our fingertips, rarely having the time to ask why we should be following it.

What Can We Do with 0.000001GB?

Unlike today, the computing environment of the past was limited in every aspect. Developers created visual effects using short formulas and reused a single graphic asset in multiple ways, creatively overcoming technological constraints the whole time. Although these practices are now a part of a digital subculture, the philosophy behind them still holds relevance. In an era when layered and black-boxed digital systems are embedded in everything around us—yet only a select few can read their structures and processes—our work began with questions about the alternate uses of seemingly insignificant data and minor gaps.

((t>>16)*7 | (t>>a)*8 | (t>>b)*7 & (t>>7) = ?

This formula is merely a string of characters. Yet the moment a computer executes it, the variable t—representing time—changes thousands of times per second, producing a continuous stream of calculations. It is like an animation, where a different image appears with each tick of the second hand of a clock. When another variable is introduced, the resulting data can generate an unexpected range of variation. However, the act of computation itself carries no inherent meaning. By watching the complex numerical changes emerge from such a simple formula, we encountered a shift in perspective—like discovering a tiny particle hidden in white noise that was previously unrecognized.

Calculating Instrument

The aforementioned formula was embedded into a physical device. Calculated in real time, it produces repetition and variation in numbers. These numbers resemble the waveforms of sound. What would have been difficult to perceive as mere sequences of numbers is transformed into sound: unpredictable noise, repetitive mechanical tones, or, to some, meaningful rhythms. Generated by an interface that allows real-time variation of the formula and hardware that imposes constraints, for us the noise and glitches became subjects of exploration rather than elements to be eliminated.

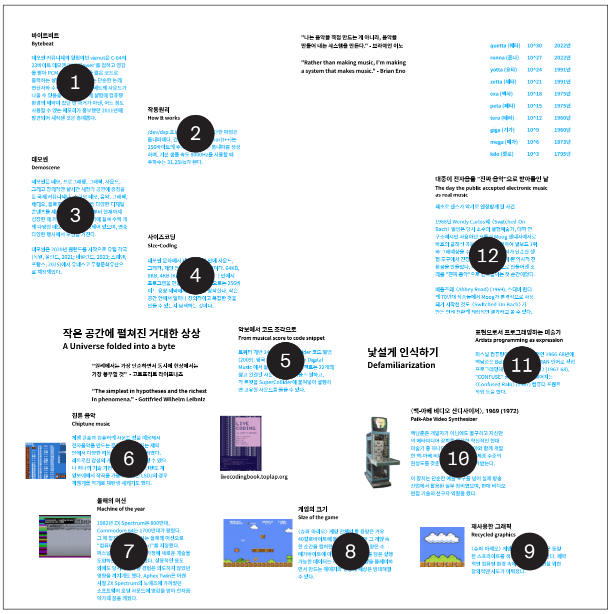
Exploratory Composition

Multiple calculating instruments brought together in one place. Sounds of different bit depths overlapped to form harmonies at times, or scattered into noise at others. Within pure noise and natural glitches, we searched for and selected rhythms that carried meaning. Although these sounds were already latent within the computational possibilities of the formulas, layer by layer they accumulated into a piece of music, like tuning a radio dial and stumbling upon an unfamiliar broadcast, or like a stone worn smooth over time by flowing water to become a unique suiseki (viewing stone). This is why this process is called exploratory composition.

Awaiting Exploration…

Do not be alarmed by sounds that are loud, broken in rhythm, or even unsettling.
Our device was not designed to play only pleasant tones. It is true that a harmonious moment may stand out more vividly amid what seems like chaos. But if that chaos is worth listening to, then we can share joy together. With endless possibilities still lying ahead, listen closely and explore. It is our sincere hope that you come to experience the moment when a small, seemingly insignificant presence—and a bit of noise—takes on meaning for you.

It matters.



1

Bytebeat
In 2011, Viznut, a member of the Demoscene community, was inspired by the 23-byte C-64 demo Wallflower and began experimenting with generating PCM audio data using very short code. Through this process, he discovered that rich 8-bit sound could be produced using nothing more than simple logical operators and mathematical formulas. Interestingly, this experiment did not emerge in the distant past when computing environments were in their infancy, but in fact a mere fourteen years ago, a time when relatively ample memory was already available.

2

How it works
In a /dev/dsp program, the simplest waveform is the sawtooth wave. A basic loop like `for(;;) putchar(t++)` generates a sawtooth wave with a cycle length of 256 bytes. At the default sample rate of 8000 Hz, this results in a frequency of 31.25 Hz.

3

Demoscene
Demoscene is an international community focused on demos, programming, graphics, sound, and creative real-time audiovisual performances. It produces a wide range of digital content, including small-scale demos, music, graphics, videos, floppy disks, and games. Having grown since the 1980s, the community is made up of hundreds of demo groups across Europe and holds gatherings throughout the year at various events. Beginning with Finland in 2020, the Demoscene has been inscribed as UNESCO Intangible Cultural Heritage in several European countries, including Germany and Poland in 2021, the Netherlands in 2023, and Sweden and France in 2025.

4

Size-Coding
In Demoscene culture, this refers to the technique of creating sound, graphics, games, and other content within strict file size limitations. Programs are developed within 64KB, 8KB, or 4KB (kilobytes), and in more extreme cases, within just 256 bytes. Size-coding is an exploration of how creatively and complexly one can express ideas within such a small amount of data-storage space.

5

From musical score to code snippet
A Twitter-based album of 140-character SuperCollider code (2009), the SC140 project, presented by the Centre for Digital Music at Queen Mary University of London in the UK, consists of twenty-two short and self-contained sound code snippets shared as tweets. When each tweet is copied and pasted into SuperCollider, it generates a unique sound.

6

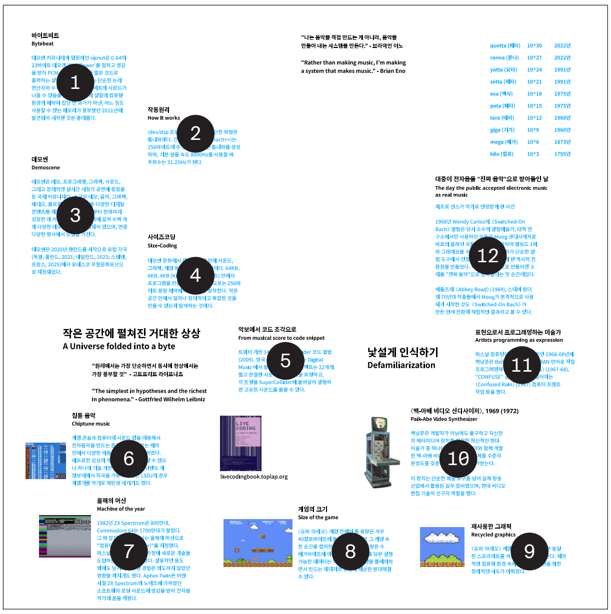
Chiptune music
Using the sound chips from game consoles and computers, chiptune music embodies a culture of creating electronic music. Within the limitations of 8-bit systems, artists experiment with a wide array of rhythms and melodies. While it may be perceived as retro-style game music, it is in fact a form of sound art grounded in technology. In the case of LSDJ, a composition tool for the Nintendo Game Boy, chiptune music actually transformed the gaming device into a musical instrument.

7

Machine of the year
In 1982, the ZX Spectrum sold 8 million units, while sales of the Commodore 64 reached 17 million units. That same year, Time named "The Computer" as Machine of the Year (in place of the magazine's traditional Man of the Year or Woman of the Year). Personal computers played a major role in introducing new technologies to middle-class households. Beyond their practical uses, computing experiences at the time also had unexpected influences. Inspired by the software loading sounds of the ZX Spectrum—sounds that were more like noise—the British musician and composer Aphex Twin pursued his dream of becoming an electronic musician.

8

Size of the game
The entire ROM size of the Super Mario Bros. game is only 40 kilobytes. However, a single image capturing just one moment from the game can take up several megabytes. While the executable data containing the game's logic is small, the world of images and videos created through playing the game can become vast.



12

The first time a synthesizer was recognized as a musical instrument
Wendy Carlos's 1968 album *Switched-On Bach* marked a historic turning point in music history by perfectly recreating Bach's classical compositions using the modular Moog synthesizer—an instrument that had, up until then, been used only by a handful of experimental artists and university labs.
The album topped the Billboard charts and won a Grammy Award, establishing the synthesizer as a true musical instrument rather than merely an experimental tool. Indeed, it was the first moment the public accepted electronically generated sounds as "real music."
The widespread use of the Moog synthesizer in The Beatles' *Abbey Road* (1969) and Stevie Wonder's works throughout the 1970s can be seen as a direct result of the shift in perception brought about by *Switched-On Bach*.

9

Recycled graphics
In the Super Mario Bros. game, the clouds and bushes are created using the same sprite, simply with different colors. This is an example of the creative strategies that were employed to achieve visual variety within the constraints of the limited computing environment of the time.

10

***Paik-Abe Video Synthesizer*, 1969 (1972)**
Nam June Paik was one of the few innovative contemporary artists who, despite not being a developer, created his own meta-media devices. The *Paik-Abe Video Synthesizer*, developed in collaboration with Shuya Abe, is regarded as a prime example of a product-level, fully realized video synthesizer. This device was more than just an artistic tool; it functioned as a professional instrument used in the broadcasting industry and played a pioneering role in early video editing technology.

11

Artists programming as expression
Before personal computing became widespread, Nam June Paik created works between 1966 and 1968 using the FORTRAN programming language at Bell Labs. These included *Etude 1* (1967–1968), programmed by Paik himself, and *Confused Rain* (1967), a computer graphic artwork in which the letters "C-O-N-F-U-S-E" fall like rain on paper.

Matter Matters: Awaiting Exploration Website