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What is new media?, by Lev Manovich

What is new media? We may begin answering this question by listing the categories commonly discussed under this topic in the popular press: the Internet, Web sites, computer multimedia, computer games, CD-ROMs and DVD, virtual reality. Is this all there is to new media? What about television programs shot on digital video and edited on computer workstations? Or feature films that use 3-D animation and digital compositing? Shall we also count these as new media? What about images and text-image compositions – photographs, illustrations, layouts, ads – created on computers and then printed on paper? Where shall we stop?

As can be seen from these examples, the popular understanding of new media identifies it with the use of a computer for distribution and exhibition rather than production. Accordingly, texts distributed on a computer (Web sites and electronic books) are considered to be new media, whereas texts distributed on paper are not. Similarly, photographs that are put on a CD-ROM and require a computer to be viewed are considered new media; the same photographs printed in a book are not.

Shall we accept this definition? If we want to understand the effects of computerization on culture as a whole, I think it is too limiting. There is no reason to privilege the computer as a machine for the exhibition and distribution of media over the computer as a tool for media production or as a media storage device. All have the same potential to change existing cultural languages. And all have the same potential to leave culture as it is.

The last scenario is unlikely, however. What is more likely is that just as the printing press in the fourteenth century and photography in the nineteenth century had a revolutionary impact on the development of modern society and culture, today we are in the middle of a new media revolution – the shift of all culture to computer-mediated forms of production, distribution, and communication. This new revolution is arguably more profound than the previous ones, and we are just beginning to register its initial effects. Indeed, the introduction of the printing press affected only one stage of cultural communication – the distribution of media. Similarly, the introduction of photography affected only one type of cultural communication – still images. In contrast, the computer media revolution affects all stages of communication, including acquisition, manipulation, storage, and distribution; it

also affects all types of media – texts, still images, moving images, sound, and spatial constructions.

How shall we begin to map out the effects of this fundamental shift? What are the ways in which the use of computers to record, store, create, and distribute media makes it “new”?

In the section “Media and Computation,” I show that new media represents a convergence of two separate historical trajectories: computing and media technologies. Both begin in the 1830s with Babbage’s Analytical Engine and Daguerre’s daguerreotype. Eventually, in the middle of the twentieth century, a modern digital computer is developed to perform calculations on numerical data more efficiently; it takes over from numerous mechanical tabulators and calculators widely employed by companies and governments since the turn of the century. In a parallel movement, we witness the rise of modern media technologies that allow the storage of images, image sequences, sounds, and text using different material forms – photographic plates, film stocks, gramophone records, etc. The synthesis of these two histories? The translation of all existing media into numerical data accessible through computers. The result is new media – graphics, moving images, sounds, shapes, spaces, and texts that have become computable; that is, they comprise simply another set of computer data. In “Principles of New Media,” I look at the key consequences of this new status of media. Rather than focusing on familiar categories such as interactivity or hypermedia, I suggest a different list. This list reduces all principles of new media to five – numerical representation, modularity, automation, variability, and cultural transcoding. In the last section, “What New Media Is Not,” I address other principles that are often attributed to new media. I show that these principles can already be found at work in older cultural forms and media technologies such as cinema, and therefore in and of themselves are in sufficient to distinguish new media from old.

How media became new

On August 19, 1839, the Palace of the Institute in Paris was filled with curious Parisians who had come to hear the formal description of the new reproduction process invented by Louis Daguerre. Daguerre, already well known for his Diorama, called the new process *daguerreotype*. According to a contemporary, “a few days later, opticians’ shops were crowded with amateurs panting for daguerreotype apparatus, and everywhere cameras were trained on buildings. Everyone wanted to record the view from his window, and he was lucky who at first trial got a silhouette of roof tops against the sky.”¹ The media frenzy had begun. Within five months more than thirty different descriptions of the technique had been published around the world – Barcelona, Edinburgh, Naples, Philadelphia, St. Petersburg, Stockholm. At first, daguerreotypes of architecture and landscapes dominated the public’s imagination; two years later, after various technical improvements to the process had been made, portrait galleries had opened everywhere – and everyone rushed to have her picture taken by the new media machine.²

In 1833 Charles Babbage began designing a device he called “the Analytical Engine.” The Engine contained most of the key features of the modern digital computer. Punch cards were used to enter both data and instructions. This information

was stored in the Engine's memory. A processing unit, which Babbage referred to as a "mill," performed operations on the data and wrote the results to memory; final results were to be printed out on a printer. The Engine was designed to be capable of doing any mathematical operation; not only would it follow the program fed into it by cards, but it would also decide which instructions to execute next, based on intermediate results. However, in contrast to the daguerreotype, not a single copy of the Engine was completed. While the invention of the daguerreotype, a modern media tool for the reproduction of reality, impacted society immediately, the impact of the computer was yet to be seen.

Interestingly, Babbage borrowed the idea of using punch cards to store information from an earlier programmed machine. Around 1800, J. M. Jacquard invented a loom that was automatically controlled by punched paper cards. The loom was used to weave intricate figurative images, including Jacquard's portrait. This specialized graphics computer, so to speak, inspired Babbage in his work on the Analytical Engine, a general computer for numerical calculations. As Ada Augusta, Babbage's supporter and the first computer programmer, put it, "The Analytical Engine weaves algebraical patterns just as the Jacquard loom weaves flowers and leaves."³ Thus a programmed machine was already synthesizing images even before it was put to processing numbers. The connection between the Jacquard loom and the Analytical Engine is not something historians of computers make much of, since for them computer image synthesis represents just one application of the modern digital computer among thousands of others, but for a historian of new media, it is full of significance.

We should not be surprised that both trajectories – the development of modern media and the development of computers – begin around the same time. Both media machines and computing machines were absolutely necessary for the functioning of modern mass societies. The ability to disseminate the same texts, images, and sounds to millions of citizens – thus assuring the same ideological beliefs – was as essential as the ability to keep track of their birth records, employment records, medical records, and police records. Photography, film, the offset printing press, radio, and television made the former possible while computers made possible the latter. Mass media and data processing are complementary technologies; they appear together and develop side by side, making modern mass society possible.

For a long time the two trajectories ran in parallel without ever crossing paths. Throughout the nineteenth and the early twentieth centuries, numerous mechanical and electrical tabulators and calculators were developed; they gradually became faster and their use more widespread. In a parallel movement, we witness the rise of modern media that allow the storage of images, image sequences, sounds, and texts in different material forms – photographic plates, film stock, gramophone records, etc.

Let us continue tracing this joint history. In the 1890s modern media took another step forward as still photographs were put in motion. In January 1893, the first movie studio – Edison's "Black Maria" – started producing twenty-second shorts that were shown in special Kinetoscope parlors. Two years later the Lumière brothers showed their new Cinématographie camera/projection hybrid, first to a scientific audience and later, in December 1895, to the paying public. Within a year, audiences in Johannesburg, Bombay, Rio de Janeiro, Melbourne, Mexico City, and Osaka were subjected to the new media machine, and they found it irresistible.⁴ Gradually scenes

grew longer, the staging of reality before the camera and the subsequent editing of samples became more intricate, and copies multiplied. In Chicago and Calcutta, London and St. Petersburg, Tokyo and Berlin, and thousands of smaller places, film images would soothe movie audiences, who were facing an increasingly dense information environment outside the theater, an environment that no longer could be adequately handled by their own sampling and data processing systems (i.e., their brains). Periodic trips into the dark relaxation chambers of movie theaters became a routine survival technique for the subjects of modern society.

The 1890s was the crucial decade not only for the development of media, but also for computing. If individual brains were overwhelmed by the amount of information they had to process, the same was true of corporations and of governments. In 1887, the U.S. Census Bureau was still interpreting figures from the 1880 census. For the 1890 census, the Census Bureau adopted electric tabulating machines designed by Herman Hollerith. The data collected on every person was punched into cards; 46,804 enumerators completed forms for a total population of 62,979,766. The Hollerith tabulator opened the door for the adoption of calculating machines by business; during the next decade electric tabulators became standard equipment in insurance companies, public utility companies, railroad offices, and accounting departments. In 1911, Hollerith's Tabulating Machine Company was merged with three other companies to form the Computing-Tabulating-Recording Company; in 1914, Thomas J. Watson was chosen as its head. Ten years later its business tripled, and Watson renamed the company the "International Business Machines Corporation," or IBM.⁵

Moving into the twentieth century, the key year for the history of media and computing is 1936. British mathematician Alan Turing wrote a seminal paper entitled "On Computable Numbers." In it he provided a theoretical description of a general-purpose computer later named after its inventor: "the Universal Turing Machine." Even though it was capable of only four operations, the machine could perform any calculation that could be done by a human and could also imitate any other computing machine. The machine operated by reading and writing numbers on an endless tape. At every step the tape would be advanced to retrieve the next command, read the data, or write the result. Its diagram looks suspiciously like a film projector. Is this a coincidence?

If we believe the word *cinematograph*, which means "writing movement," the essence of cinema is recording and storing visible data in a material form. A film camera records data on film; a film projector reads it off. This cinematic apparatus is similar to a computer in one key respect: A computer's program and data also have to be stored in some medium. This is why the Universal Turing Machine looks like a film projector. It is a kind of film camera and film projector at once, reading instructions and data stored on endless tape and writing them in other locations on this tape. In fact, the development of a suitable storage medium and a method for coding data represent important parts of the prehistory of both cinema and the computer. As we know, the inventors of cinema eventually settled on using discrete images recorded on a strip of celluloid; the inventors of the computer – which needed much greater speed of access as well as the ability to quickly read and write data – eventually decided to store it electronically in a binary code.

The histories of media and computing became further entwined when German

engineer Konrad Zuse began building a computer in the living room of his parents' apartment in Berlin – the same year that Turing wrote his seminal paper. Zuse's computer was the first working digital computer. One of his innovations was using punched tape to control computer programs. The tape Zuse used was actually discarded 35 mm movie film.⁶

One of the surviving pieces of this film shows binary code punched over the original frames of an interior shot. A typical movie scene – two people in a room involved in some action – becomes a support for a set of computer commands. Whatever meaning and emotion was contained in this movie scene has been wiped out by its new function as data carrier. The pretense of modern media to create simulations of sensible reality is similarly canceled; media are reduced to their original condition as information carrier, nothing less, nothing more. In a technological remake of the Oedipal complex, a son murders his father. The iconic code of cinema is discarded in favor of the more efficient binary one. Cinema becomes a slave to the computer.

But this is not yet the end of the story. Our story has a new twist – a happy one. Zuse's film, with its strange superimposition of binary over iconic code, anticipates the convergence that will follow half a century later. The two separate historical trajectories finally meet. Media and computer – Daguerre's daguerreotype and Babbage's Analytical Engine, the Lumière Cinématographie and Hollerith's tabulator – merge into one. All existing media are translated into numerical data accessible for the computer. The result: graphics, moving images, sounds, shapes, spaces, and texts become computable, that is, simply sets of computer data. In short, media become new media.

This meeting changes the identity of both media and the computer itself. No longer just a calculator, control mechanism, or communication device, the computer becomes a media processor. Before, the computer could read a row of numbers, outputting a statistical result or a gun trajectory. Now it can read pixel values, blurring the image, adjusting its contrast, or checking whether it contains an outline of an object. Building on these lower-level operations, it can also perform more ambitious ones – searching image databases for images similar in composition or content to an input image, detecting shot changes in a movie, or synthesizing the movie shot itself, complete with setting and actors. In a historical loop, the computer has returned to its origins. No longer just an Analytical Engine, suitable only for crunching numbers, it has become Jacquard's loom – a media synthesizer and manipulator.

Principles of new media

The identity of media has changed even more dramatically than that of the computer. Below I summarize some of the key differences between old and new media. In compiling this list of differences, I tried to arrange them in a logical order. That is, the last three principles are dependent on the first two. This is not dissimilar to axiomatic logic, in which certain axioms are taken as starting points and further theorems are proved on their basis.

Not every new media object obeys these principles. They should be considered not as absolute laws but rather as general tendencies of a culture undergoing

computerization. As computerization affects deeper and deeper layers of culture, these tendencies will increasingly manifest themselves.

1 Numerical representation

All new media objects, whether created from scratch on computers or converted from analog media sources, are composed of digital code; they are numerical representations. This fact has two key consequences:

- 1 A new media object can be described formally (mathematically). For instance, an image or a shape can be described using a mathematical function.
- 2 A new media object is subject to algorithmic manipulation. For instance, by applying appropriate algorithms, we can automatically remove “noise” from a photograph, improve its contrast, locate the edges of the shapes, or change its proportions. In short, *media becomes programmable*.

Notes

- 1 Quoted in Beaumont Newhall, *The History of Photography from 1839 to the Present Day*, 4th ed. (New York: Museum of Modern Art, 1964), 18.
- 2 Newhall, *The History of Photography*, 17–22.
- 3 Charles Eames, *A Computer Perspective: Background to the Computer Age* (Cambridge, Mass: Harvard University Press, 1990), 18.
- 4 David Bordwell and Kristin Thompson, *Film Art: An Introduction*, 5th ed. (New York: McGraw-Hill), 15.
- 5 Eames, *A Computer Perspective*, 22–27, 46–51, 90–91.
- 6 *Ibid.*, 120.

