

memory and what is left behind are always behind the times. It may take a few decades or even longer for a new field which is making an important contribution to modern culture to "make it" into museums, books, and other official registers of cultural memory. In general, our official cultural histories tend to privilege art (understood in a romantic sense as individual products of individual artists) over mass industrial culture. For instance, while modern graphical and industrial designers do have some level of cultural visibility, their names, with the exception of a few contemporary celebrity designers such as Bruce Mau and Philip Stark, are generally not as known as the names of fine artists or fiction writers. Some examples of key contemporary fields that so far have not been given their due are music videos, cinematography, set design, and industrial design. But no cultural field so far has remained more unrecognized than computer science and, in particular, its specific branch of human-computer interaction, or HCI (also called human-computer interface design).

It is time that we treat the people who have articulated fundamental ideas of human-computer interaction as the major modern artists. Not only did they invent new ways to represent any data (and thus, by default, all data which has to do with "culture," i.e. the human experience in the world and the symbolic representations of this experience) but they have also radically redefined our interactions with all of old culture. As the window of a Web browser comes to supplement the cinema screen, museum space, CD player, book, and library, the new situation manifests itself: all culture, past and present, is being filtered through the computer, with its particular human-computer interface. Human-computer interface comes to act as a new form through which all older forms of cultural production are being mediated.

The New Media Reader contains essential articles by some of the key interface and software designers in the history of computing so far, from Engelbart to Berners-Lee. Thus in my view this book is not just an anthology of new media but also the first example of a radically new history of modern culture—a view from the future when more people will recognize that the true cultural innovators of the last decades of the twentieth century were interface designers, computer game designers, music video directors and DJs — rather

than painters, filmmakers, or fiction writers, whose fields remained relatively stable during this historical period.

What Is New Media? Eight Propositions

Having discussed the particular perspective adopted by *The New Media Reader* in relation to the larger cultural context we may want to place new media in—the notion of parallel developments in modern art and in computing—I now want to go through other possible concepts of new media and its histories (including a few proposed by the present author elsewhere). Here are eight answers; without a doubt, more can be invented if desired.

1 New Media versus Cyberculture

To begin with, we may distinguish between new media and cyberculture. In my view they represent two distinct fields of research. I would define cyberculture as the study of various social phenomena associated with the Internet and other new forms of network communication. Examples of what falls under cyberculture studies are online communities, online multi-player gaming, the issue of online identity, the sociology and the ethnography of email usage, cell phone usage in various communities, the issues of gender and ethnicity in Internet usage, and so on.¹ Notice that the emphasis is on the *social* phenomena; cyberculture does not directly deal with new cultural objects enabled by network communication technologies. The study of these objects is the domain of new media. In addition, new media is concerned with cultural objects and paradigms enabled by all forms of computing and not just by networking. To summarize: cyberculture is focused on the social and on networking; new media is focused on the cultural and computing.

2 New Media as Computer Technology Used as a Distribution Platform

What are these new cultural objects? Given that digital computing is now used in most areas of cultural production, from publishing and advertising to filmmaking and architecture, how can we single out the area of culture that specifically owes its existence to computing? In my *The Language of New Media* I begin the discussion of new media by invoking its definition which can be deduced from how the term is used in popular press: new media are the cultural objects which use digital computer technology for

Manovich, Lev. "New Media from Borges to HTML." *The New Media Reader*. Ed. Nick Montfort and Noah Wardrip-Fruin. Cambridge, Mass. MIT, 2003. 13-25. Print.

distribution and exhibition.² Thus, Internet, Web sites, computer multimedia, computer games, CD-ROMs and DVDs, virtual reality, and computer-generated special effects all fall under new media. Other cultural objects which use computing for production and storage but not for final distribution—television programs, feature films, magazines, books and other paper-based publications, etc.—are not new media.)

The problems with this definition are three-fold. Firstly, it has to be revised every few years, as yet another part of culture comes to rely on computing technology for distribution (for instance, the shift from analog to digital television; the shift from film-based to digital projection of feature films in movie theatres; e-books, and so on) Secondly, we may suspect that eventually most forms of culture will use computer distribution, and therefore the term "new media" defined in this way will lose any specificity. Thirdly, this definition does not tell us anything about the possible effects of computer-based distribution on the aesthetics of what is being distributed. In other words, do Web sites, computer multimedia, computer games, CD-ROMs, and virtual reality all have something in common because they are delivered to the user via a computer? Only if the answer is at least a partial yes does it make sense to think about new media as a useful theoretical category.

3 New Media as Digital Data Controlled by Software

The Language of New Media is based on the assumption that, in fact, all cultural objects that rely on digital representation and computer-based delivery do share a number of common qualities. In the book I articulate a number of principles of new media: numerical representation, modularity, automation, variability, and transcoding. I do not assume that any computer-based cultural object will necessarily be structured according to these principles today. Rather, these are tendencies of a culture undergoing computerization that gradually will manifest themselves more and more. For instance, the principle of variability states that a new media cultural object may exist in potentially infinitely many different states. Today the examples of variability are commercial Web sites programmed to customize Web pages for each user as she is accessing the site, or DJs remixes of already existing recordings; tomorrow the principle of

variability may also structure a digital film which will similarly exist in multiple versions.

I deduce these principles, or tendencies, from the basic fact of digital representation of media. New media is reduced to digital data that can be manipulated by software as any other data. This allows automating many media operations, to generate multiple versions of the same object, etc. For instance, once an image is represented as a matrix of numbers, it can be manipulated or even generated automatically by running various algorithms, such as sharpen, blue, colorize, change contrast, etc.

More generally, extending what I proposed in my book, I could say that two basic ways in which computers model reality—through data structures and algorithms—can also be applied to media once it is represented digitally. In other words, given that new media is digital data controlled by particular "cultural" software, it make sense to think of any new media object in terms of particular data structures and/or particular algorithms it embodies.³ Here are examples of data structures: an image can be thought of as a two-dimensional array (x, y), while a movie can be thought of as a three-dimensional array (x, y, t). Thinking about digital media in terms of algorithms, we discover that many of these algorithms can be applied to any media (such as copy, cut, paste, compress, find, match) while some still retain media specificity. For instance, one can easily search for a particular text string in a text but not for a particular object in an image. Conversely, one can composite a number of still or moving images together but not different texts. These differences have to do with different semiotic logics of different media in our culture: for example, we are ready to read practically any image or a composite of images as being meaningful, while for a text string to be meaningful we require that it obey the laws of grammar. On the other hand, language has a priori discrete structure (a sentence consists of words which consist if morphemes, and so on) that makes it very easily to automate various operations on it (such as search, match, replace, index), while digital representation of images does not by itself allow for automation of semantic operations.

4 New Media as the Mix Between Existing Cultural Conventions and the Conventions of Software

As a particular type of media is turned into digital data controlled by software, we may expect that eventually it will fully obey the principles of modularity, variability, and automation. However, in practice these processes may take a long time and they do not proceed in a linear fashion—rather, we witness “uneven development.” For instance, today some media are already totally automated while in other cases this automation hardly exists—even though technologically it can be easily implemented.

Let us take as the example contemporary Hollywood film production. Logically we could have expected something like the following scenario. An individual viewer receives a customized version of the film that takes into account her/his previous viewing preferences, current preferences, and marketing profile. The film is completely assembled on the fly by AI software using pre-defined script schemas. The software also generates, again on the fly, characters, dialog, and sets (this makes product placement particularly easy) that are taken from a massive “assets” database.

The reality today is quite different. Software is used in some areas of film production but not in others. While some visuals may be created using computer animation, cinema still centers on the system of human stars whose salaries account for a large percent of a film budget. Similarly, script writing (and countless re-writing) is also trusted to humans. In short, the computer is kept out of the key “creative” decisions, and is delegated to the position of a technician.

If we look at another type of contemporary media—computer games—we will discover that they follow the principle of automation much more thoroughly. Game characters are modeled in 3D; they move and speak under software control. Software also decides what happens next in the game, generating new characters, spaces, and scenarios in response to user’s behavior. It is not hard to understand why automation in computer games is much more advanced than in cinema. Computer games are one of the few cultural forms “native” to computers; they began as singular computer programs (before turning into a complex multimedia production which they are today)—rather than being an already established medium (such as cinema) which is now slowly undergoing computerization.

Given that the principles of modularity, automation, variability and transcoding are tendencies that slowly and unevenly manifest themselves, is there a more precise way to describe new media, as it exists today? *The Language of New Media* analyzes the language of contemporary new media (or, to put this differently, “early new media”) as the mix (we can also use software metaphors of “morph” or “composite”) between two different sets of cultural forces, or cultural conventions: on the one hand, the conventions of already mature cultural forms (such as a page, a rectangular frame, a mobile point of view) and, on the other hand, the conventions of computer software and, in particular, of HCI, as they have developed until now.

Let me illustrate this idea with two examples. In modern visual culture a representational image was something one gazed at, rather than interacted with. An image was also one continuous representational field, i.e. a single scene. In the 1980s the graphical user interface (GUI) redefined an image as a figure-ground opposition between a non-interactive, passive ground (typically a desktop pattern) and active icons and hyperlinks (such as the icons of documents and applications appearing on the desktop). The treatment of representational images in new media represents a mix between these two very different conventions. An image retains its representational function while at the same time is treated as a set of hot spots (“image-map”). This is the standard convention in interactive multimedia, computer games, and Web pages. So while visually an image still appears as a single continuous field, in fact it is broken into a number of regions with hyperlinks connected to these regions, so clicking on a region opens a new page, or re-starts the game narrative, etc.

This example illustrates how a HCI convention is “superimposed” (in this case, both metaphorically and literally, as a designer places hot spots over an existing image) over an older representational convention. Another way to think about this is to say that a technique normally used for control and data management is mixed with a technique of fictional representation and fictional narration. I will use another example to illustrate the opposite process: how a cultural convention normally used for fictional representation and narration is “superimposed” over software techniques of data management and presentation.

The cultural convention in this example is the mobile camera model borrowed from cinema. In *The Language of New Media* I analyze how it became a generic interface used to access any type of data:

Originally developed as part of 3D computer graphics technology for such applications as computer-aided design, flight simulators, and computer movie making, during the 1980s and 1990s the camera model became as much of an interface convention as scrollable windows or cut and paste operations. It became an accepted way for interacting with any data which is represented in three dimensions—which, in a computer culture, means literally anything and everything: the results of a physical simulation, an architectural site, design of a new molecule, statistical data, the structure of a computer network and so on. As computer culture is gradually spatializing all representations and experiences, they become subjected to the camera's particular grammar of data access. Zoom, tilt, pan, and track: we now use these operations to interact with data spaces, models, objects and bodies.⁴

To sum up: new media today can be understood as the mix between older cultural conventions for data representation, access, and manipulation and newer conventions of data representation, access, and manipulation. The "old" data are representations of visual reality and human experience, i.e., images, text-based and audio-visual narratives—what we normally understand by "culture." The "new" data is numerical data.

As a result of this mix, we get such strange hybrids as clickable "image-maps," navigable landscapes of financial data, QuickTime (which was defined as the format to represent any time-based data but which in practice is used exclusively for digital video), animated icons—a kind of micro-movies of computer culture—and so on.

As can be seen, this particular approach to new media assumes the existence of historically particular aesthetics that characterize new media, or "early new media," today. (We may also call it the "aesthetics of early information culture.") This aesthetics results from the convergence of historically particular cultural forces: already existing cultural conventions and the conventions of HCI. Therefore, it could not have existed in the past and it unlikely to stay without

changes for a long time. But we can also define new media in the opposite way: as specific aesthetic features which keep re-appearing at an early stage of deployment of every new modern media and telecommunication technology.

5 New Media as the Aesthetics that Accompanies the Early Stage of Every New Modern Media and Communication Technology

Rather than reserving the term "new media" to refer to the cultural uses of current computer and computer-based network technologies, some authors have suggested that every modern media and telecommunication technology passes through its "new media stage." In other words, at some point photography, telephones, cinema, and television each were "new media." This perspective redirects our research efforts: rather than trying to identify what is unique about digital computers functioning as media creation, media distribution and telecommunication devices, we may instead look for certain aesthetic techniques and ideological tropes which accompany every new modern media and telecommunication technology at the initial stage of their introduction and dissemination. Here are a few examples of such ideological tropes: new technology will allow for "better democracy;" it will give us a better access to the "real" (by offering "more immediacy" and/or the possibility "to represent what before could not be represented"); it will contribute to "the erosion of moral values"; it will destroy the "natural relationship between humans and the world" by "eliminating the distance" between the observer and the observed.

And here are two examples of aesthetic strategies that seem to often accompany the appearance of a new media and telecommunication technology (not surprisingly, these aesthetic strategies are directly related to ideological tropes I just mentioned). In the mid 1990s a number of filmmakers started to use inexpensive digital cameras (DV) to create films characterized by a documentary style (for instance, *Timecode*, *Celebration*, *Mifune*). Rather than treating live action as a raw material to be later re-arranged in post-production, these filmmakers placed premier importance on the authenticity of the actors' performances. DV equipment is small enough to allow a filmmaker to literally be inside the action as it unfolds. In addition to adopting a more intimate filmic approach, a filmmaker can keep shooting for a whole

duration of a 60 or 120 minute DV tape as opposed to the standard ten-minute film roll. This gives the filmmaker and the actors more freedom to improvise around a theme, rather than being shackled to the tightly scripted short shots of traditional filmmaking. (In fact the length of *Timecode* exactly corresponds to the length of a standard DV tape.)

These aesthetic strategies for representing the real, which at first may appear to be unique to digital revolution in cinema, are in fact not unique. DV-style filmmaking has a predecessor in an international filmmaking movement that begun in the late 1950s and unfolded throughout the 1960s. Called "direct cinema," "candid" cinema, "uncontrolled" cinema, "observational" cinema, or *cinéma vérité* ("cinema truth"), it also involved filmmakers using lighter and more mobile (in comparison to what was available before) equipment. Like today's "DV realists," the 1960s "direct cinema" proponents avoided tight staging and scripting, preferring to let events unfold naturally. Both then and now, the filmmakers used new filmmaking technology to revolt against the existing cinema conventions that were perceived as being too artificial. Both then and now, the key word of this revolt was the same: "immediacy."

My second example of similar aesthetic strategies re-appearing deals with the development of moving image technology throughout the nineteenth century and the development of digital technologies to display moving images on a computer desktop during the 1990s. In the first part of the 1990s, as computers' speed kept gradually increasing, CD-ROM designers were able to go from a slide show format to the superimposition of small moving elements over static backgrounds and finally to full-frame moving images. (This evolution repeats the nineteenth century progression: from sequences of still images (magic lantern slides presentations) to moving characters over static backgrounds (for instance, in Reynaud's *Praxinoscope Theater*) to full motion (the Lumieres' cinematograph). Moreover, the introduction of QuickTime by Apple in 1991 can be compared to the introduction of the Kinetoscope in 1892: both were used to present short loops, both featured the images approximately two by three inches in size, both called for private viewing rather than collective exhibition. Culturally, the two technologies also functioned similarly: as the latest technological "marvel." If in the early 1890s the public patronized Kinetoscope parlors where peep-hole

machines presented them with the latest invention—tiny moving photographs arranged in short loops; exactly a hundred years later, computer users were equally fascinated with tiny QuickTime movies that turned a computer in a film projector, however imperfect. Finally, the Lumieres' first film screenings of 1895 which shocked their audiences with huge moving images found their parallel in 1995 CD-ROM titles where the moving image finally fills the entire computer screen (for instance, in the *Johnny Mnemonic* computer game, based on the film by the same title). Thus, exactly a hundred years after cinema was officially "born," it was reinvented on a computer screen.

Interesting as they are, these two examples also illustrate the limitations of thinking about new media in terms of historically recurrent aesthetic strategies and ideological tropes. While ideological tropes indeed seem to be reappearing rather regularly, many aesthetic strategies may only reappear two or three times. Moreover, some strategies and/or tropes can be already found in the first part of the nineteenth century while others only made their first appearance much more recently.⁵ In order for this approach to be truly useful it would be insufficient to simply name the strategies and tropes and to record the moments of their appearance; instead, we would have to develop a much more comprehensive analysis which would correlate the history of technology with social, political, and economical histories of the modern period.

So far my definitions of new media have focused on technology; the next three definitions will consider new media as material re-articulation, or encoding, of purely cultural tendencies—in short, as ideas rather than technologies.

6 New Media as Faster Execution of Algorithms Previously Executed Manually or through Other Technologies

A modern digital computer is a programmable machine. This simply means that the same computer can execute different algorithms. An algorithm is a sequence of steps that need to be followed to accomplish a task. Digital computers execute most algorithms very quickly—however in principle an algorithm, since it is just a sequence of simple steps, can also be executed by a human, although much more slowly. For instance, a human can sort files in a particular order, or count the number of words in a text, or cut a part of an image and paste it in a different place.

This realization gives us a new way to think about both digital computing, in general, and new media in particular as a massive speed-up of various manual techniques that all have already existed. Consider, for instance, the computer's ability to represent objects in linear perspective and to animate such representations. When you move your character through the world in a first person shooter computer game (such as *Quake*), or when you move your viewpoint around a 3D architectural model, a computer recalculates perspectival views for all the objects in the frame many times every second (in the case of current desktop hardware, frame rates of 80 frames a second are not uncommon). But we should remember that the algorithm itself was codified during the Renaissance in Italy, and that, before digital computers came along (that is, for about five hundred years) it was executed by human draftsmen. Similarly, behind many other new media techniques there is an algorithm that, before computing, was executed manually. (Of course since art has always involved some technology—even as simple as a stylus for making marks on stone—what I mean by “manually” is that a human had to systematically go through every step of an algorithm himself, even if he was assisted by some image making tools.) Consider, for instance, another very popular new media technique: making a composite from different photographs. Soon after photography was invented, such nineteenth century photographers as Henry Peach Robinson and Oscar G. Rejlander were already creating smooth “combination prints” by putting together multiple photographs.

While this approach to thinking about new media takes us away from thinking about it purely in technological terms, it has a number of problems of its own. Substantially speeding up the execution of an algorithm by implementing this algorithm in software does not just leave things as they are. The basic point of dialectics is that a substantial change in quantity (i.e., in speed of execution in this case) leads to the emergence of qualitatively new phenomena. The example of automation of linear perspective is a case in point. Dramatically speeding up the execution of a perspectival algorithm makes possible previously non-existent representational technique: smooth movement through a perspectival space. In other words, we get not only quickly produced perspectival drawings but also computer-generated movies and interactive computer graphics.

The technological shifts in the history of “combination prints” also illustrate the cultural dialectics of transformation of quantity into quality. In the nineteenth century, painstakingly crafted “combination prints” represented an exception rather than the norm. In the twentieth century, new photographic technologies made possible photomontage that quickly became one of the basic representational techniques of modern visual culture. And finally the arrival of digital photography via software like Photoshop as well as scanners and digital cameras, in the late 1980s and 1990s, not only made photomontage much more omnipresent than before but it also fundamentally altered its visual characteristics. In place of graphic and hard-edge compositions pioneered by Moholy-Nagy and Rodchenko we now have smooth multi-image composites which use transparency, blur, colorization, and other easily available digital manipulations and which often incorporate typography that is subjected to exactly the same manipulations (thus in post-Photoshop visual culture the type becomes a subset of a photo-based image). To see this dramatic change, it is enough to compare a typical music video from 1985 and a typical music video from 1995: within ten years, the visual aesthetics of photomontage had undergone a fundamental change.

Finally, thinking about new media as speeding up of algorithms which previously were executed by hand foregrounds the use of computers for fast algorithm execution, but ignores two other essential uses: real-time network communication and real-time control. The abilities to interact with or control remotely located data in real time, to communicate with other human beings in real time, and control various technologies (sensors, motors, other computers) in real time constitute the very foundation of our information society—phone communications, Internet, financial networking, industrial control, the use of micro-controllers in numerous modern machines and devices, and so on. They also make possible many forms of new media art and culture: interactive net art, interactive computer installations, interactive multimedia, computer games, real-time music synthesis.

While non-real-time media generation and manipulation via digital computers can be thought of as speeding up of previously existing artistic techniques, *real-time* networking and control seem to constitute qualitatively new phenomena.

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When we use Photoshop to quickly combine photographs together, or when we compose a text using a Microsoft Word, we simply do much faster what before we were doing either completely manually or assisted by some technologies (such as a typewriter). However, in the cases when a computer interprets or synthesizes human speech in real time, monitors sensors and modifies programs based on their input in real-time, or controls other devices, again in real-time, this is something which simply could not be done before. So while it is important to remember that, on one level, a modern digital computer is just a faster calculator, we should not ignore its other identity: that of a cybernetic control device. To put this in different way, while new media theory should pay tributes to Alan Turing (003), it should not forget about its other conceptual father—Norbert Wiener (004).

7 New Media as the Encoding of Modernist Avant-Garde; New Media as Metamedia

The approach to new media just discussed does not foreground any particular cultural period as the source of algorithms that are eventually encoded in computer software. In my article "Avant-Garde as Software" I have proposed that, in fact, a particular historical period is more relevant to new media than any other—that of the 1920s (more precisely, the years between 1915 and 1928).⁶ During this period the avant-garde artists and designers invented a whole new set of visual and spatial languages and communication techniques that we still use today. According to my hypothesis,

With new media, 1920s communication techniques acquire a new status. Thus new media does represent a new stage of the avant-garde. The techniques invented by the 1920s Left artists became embedded in the commands and interface metaphors of computer software. In short, the avant-garde vision became materialized in a computer. All the strategies developed to awaken audiences from a dream-existence of bourgeois society (constructivist design, New Typography, avant-garde cinematography and film editing, photo-montage, etc.) now define the basic routine of a post-industrial society: the interaction with a computer. For example, the avant-garde strategy of collage reemerged as a "cut and paste" command, the most basic operation one can perform on any computer data. In another example, the dynamic windows, pull-down menus, and HTML

tables all allow a computer user to simultaneously work with practically unrestricted amount of information despite the limited surface of the computer screen. This strategy can be traced to Lissitzky's use of movable frames in his 1926 exhibition design for the International Art Exhibition in Dresden.

The encoding of the 1920s avant-garde techniques in software does not mean that new media simply quantitatively extends the techniques which already existed. Just as it is the case with the phenomenon of real-time computation that I discussed above, tracing new media heritage in the 1920s avant-garde reveals a qualitative change as well. The modernist avant-garde was concerned with "filtering" visible reality in new ways. The artists were concerned with representing the outside world, with "seeing" it in as many different ways as possible. Of course some artists already began to react to the emerging media environment by making collages and photo-montages consisting of newspaper clippings, existing photographs, pieces of posters, and so on; yet these practices of manipulating existing media were not yet central. But a number of decades later they have moved to the foreground of cultural production. To put this differently, after a century and a half of media culture, already existing media records (or "media assets," to use the Hollywood term) become the new raw material for software-based cultural production and artistic practice. Many decades of analog media production resulted in a huge media archive and it is the contents of this archive—television programs, films, audio recordings, etc.—which became the raw data to be processed, re-articulated, mined and re-packaged through digital software—rather than raw reality. In my article I formulate this as follows:

New media indeed represents the new avant-garde, and its innovations are at least as radical as the formal innovations of the 1920s. But if we are to look for these innovations in the realm of forms, this traditional area of cultural evolution, we will not find them there. For the new avant-garde is radically different from the old:

1. The old media avant-garde of the 1920s came up with new forms, new ways to represent reality and new ways to see the world. The new media avant-garde is about new ways of accessing and manipulating information. Its techniques are

hypermedia, databases, search engines, data mining, image processing, visualization, and simulation.

2. The new avant-garde is no longer concerned with seeing or representing the world in new ways but rather with accessing and using in new ways previously accumulated media. In this respect new media is post-media or meta-media, as it uses old media as its primary material.

My concept of "meta-media" is related to a more familiar notion of "postmodernism"—the recognition that by the 1980s the culture became more concerned with reworking already existing content, idioms and style, rather than genially creating new ones. What I would like to stress (and what I think the original theorists of post-modernism in the 1980s have not stressed enough) is the key role played by the material factors in the shift towards postmodernist aesthetics: the accumulation of huge media assets and the arrival of new electronic and digital tools which made it very easy to access and re-work these assets. This is another example of quantity changing into quality in media history: the gradual accumulation of media records and the gradual automation of media management and manipulation techniques eventually recoded modernist aesthetics into a very different postmodern aesthetics.

8 New Media as Parallel Articulation of Similar Ideas in Post-WWII Art and Modern Computing

Along with the 1920s, we can think of other cultural periods that generated ideas and sensibilities particularly relevant to new media. In the 1980s a number of writers looked at the connections between Baroque and post-modern sensibilities; given the close link between post-modernism and new media I just briefly discussed, it would be logical if parallels between the Baroque and new media can also be established.⁷ It can also be argued that in many ways new media returns us to a pre-modernist cultural logic of the eighteenth century: consider for instance, the parallel between eighteenth-century communities of readers who were also all writers and participants in Internet newsgroups and mailing lists who are also both readers and writers.

In the twentieth century, along with the 1920s, which for me represents the cultural peak of this century (because during this period more radically new aesthetic techniques were prototyped than in any other period of similar duration), the second cultural peak—the 1960s—also seems

to contain many of new media's genes. A number of writers such as Söke Dinkla have argued that interactive computer art (from the 1980s on) further develops ideas already contained in the new art of the 1960s (happenings, performances, installation): active participation of the audience, an artwork as a temporal process rather than as a fixed object, an artwork as an open system.⁸ This connection makes even more sense when we remember that some of the most influential figures in new media art (Jeffrey Shaw, Roy Ascott (◊10)) started their art careers in the 1960s and only later moved to computing and networking technologies. For instance, at the end of the 1960s Jeffrey Shaw was working on inflatable structures for film projections and performances which were big enough to contain a small audience inside—something which he later came back to in many of his VR installations, and even more directly in the EVE project.⁹

There is another aesthetic project of the 1960s that also can be linked to new media not only conceptually but also historically, since the artists who pursued this project with computers (such as Manfred Mohr) knew of minimalist artists who during the same decade pursued the same project "manually" (most notably, Sol LeWitt).¹⁰ This project can be called "combinatorics."¹¹ It involves creating images and/or objects by systematically varying a single parameter or by systematically creating all possible combinations of a small number of elements.¹² "Combinatorics" in computer art and minimalist art of the 1960s led to the creation of remarkably similar images and spatial structures; it illustrates well that the algorithms, this essential part of new media, do not depend on technology but can be executed by humans.

Four Decades of New Media

Along with the ones I already mentioned, more connections between 1960s cultural imaginations and new media exist. As with another recent important anthology on new media (Randall Packer and Ken Jordan's *Multimedia: From Wagner to Virtual Reality*), *The New Media Reader* contains a number of important texts by the radical artists and writers from the 1960s which have conceptual affinity to the logic of computing technology: those of Allan Kaprow (◊06), William Burroughs (◊07); the Oulipo (◊12) (whose members pursued the combinatorics project in relation to literature), Nam June Paik (◊15) and others. Section I, "The Complex, the

Changing, and the Intermediate" and section II, "Collective Media, Personal Media," present what is to date the most comprehensive set of cultural texts from the 1960s. These ideas particularly resonate with the developments in computing in the same period.

Although modern computing has many conceptual fathers and mothers, from Leibnitz to Ada Lovelace, and its prehistory spans many centuries, I would argue that the paradigm that still defines our understanding and usage of computing was defined in the 1960s. During the 1960s the principles of the modern interactive GUI were given clear articulation (although the practical implementation and refinement of these ideas took place later, in the 1970s at Xerox PARC). The articles by Licklider (005), Sutherland (009), Nelson (011, 021, 030), and Engelbart (008, 017) from the 1960s included in the reader are the essential documents of our time; one day the historians of culture will rate them on the same scale of importance as texts by Marx, Freud, and Saussure. (Other key developments that also took place in the 1960s and early 1970s were the Internet, Unix, and object-oriented programming. A number of other essential ideas of modern computing such as networking itself, the use of computers for real-time control, and the graphical interactive display were articulated earlier, in the second part of the 1940s and the first part of the 1950s.)¹³

The first two sections of the reader take us into the end of the 1970s; during the time period covered in section II the key principles of modern computing and the GUI had already been practically implemented and refined by the developers at Xerox PARC but they were not yet commercially available to consumers. The third section, "Design, Activity, and Action," runs from the end of the 1970s into the 1980s. Near the end of this period the Macintosh (released in 1984) popularized the GUI; it also shipped with a simple drawing and painting programs which emphasized the new role of a computer as a creative tool; finally, it was the first inexpensive computer which came with a bit-mapped display. Atari computers made computer-based sound manipulation affordable; computer games achieved a new level of popularity; cinema started to use computers for special effects (*Tron*, released by Disney in 1982, contained seventeen minutes of 3-D computer generated scenes); towards the very end of the decade, Photoshop, which can be called the key software application of postmodernism, was

finally released. All these developments of the 1980s created a new set of roles for the modern digital computer: a manipulator of existing media (Photoshop); a media synthesizer (film special effects, sound software); and a new medium (or rather, more than one new media) in its own right (computer games). *The New Media Reader* collects essential articles by computer scientists from the 1980s that articulate ideas behind these new roles of a computer (Bolt (029), Shneiderman (033), Laurel (038) and others).

As computing left the strict realm of big business, the military, the government, and the university and entered society at large, cultural theorists begin to think about its effects, and it is appropriate that *The New Media Reader* also reprints key theoretical statements from the 1980s (e.g., Sherry Turkle (034), Donna Haraway (035)). I should note here that European cultural theorists reacted to computerization earlier than the Americans: both Jean-François Lyotard's *The Post-Modern Condition* (1979) and Jean Baudrillard's *Simulacra and Simulations* (1981) contain detailed discussions of computing, something which their 1980s American admirers did not seem to notice.

The last section of the reader, "Revolution, Resistance, and the Launch of the Web" continues to weave texts by computer scientists, social researchers, cultural theorists, and critics from the end of the 1980s onward; it also takes us into the early 1990s when the rise of the Web redefined computing one again. If the 1980s gradually made visible the new role of a computer as a media manipulator and an interface to media—the developments which eventually were codified around 1990 in the term "new media"—in the 1990s another role of a digital computer (which was already present since the late 1940s) came to the foreground: that of a foundation for real-time multimedia networking, available not just for selected researchers and the military (as it was for decades) but for millions of people.

In the 1960s we can find strong conceptual connections between computing and radical art of the period, but with the sole exception of Ted Nelson (the conceptual father of hypertext) no computer scientist was directly applying radical political ideas of the times to computer design. In fact these ideas had a strong effect on the field, but it was delayed until the 1970s when Alan Kay (026) and his colleagues at Xerox PARC pursued the vision of personal computer workstation that would empower an individual rather than a

big organization. In the late 1980s and early 1990s, however, we seem to witness a different kind of parallel between social changes and computer design. Although causally unrelated, conceptually it makes sense that the end of Cold War and the design of the Web took place at exactly the same time. The first development ended the separation of the world into parts closed off from each other, making it a single global system; the second development connected world's computers into a single network. The early Web (i.e., before it came to be dominated by big commercial portals towards the end of the 1990s) also practically implemented a radically horizontal, non-hierarchical model of human existence in which no idea, no ideology, and no value system can dominate the rest—thus providing a perfect metaphor for a new post-Cold-War sensibility.

The emergence of new media studies as a field testifies to our recognition of the key cultural role played by digital computers and computer-enabled networking in our global society. For a field in its infancy, we are very lucky to now have such a comprehensive record of its origins as the one provided by *The New Media Reader*; I believe that its readers will continue to think about both the ideas in its individual texts and the endless connections which can be found between different texts for many years to come.

1. For a good example of cyberculture paradigm, see the Resource Center for Cyberculture Studies, <<http://www.com.washington.edu/rccs/>>
2. Lev Manovich, *The Language of New Media* (Cambridge: MIT Press, 2001).
3. I don't mean here the actual data structures and algorithms which may be used by particular software—rather, I am thinking of them in a more abstract way: what is the structure of a cultural object and what kind of operations it enables for the user.
4. Manovich, *The Language of New Media*, 80.
5. I believe that the same problems apply to Erkki Huhtamo's very interesting theory of media archeology which is close to the approach presented here and which advocates the study of tropes which accompany the history of modern media technology, both the ones which were realized and the ones which were only imagined.
6. Lev Manovich, "Avant-Garde as Software," in *Ostranenie*, edited by Stephen Kovats (Frankfurt: Campus Verlag, 1999). <http://www.manovich.net/docs/avantgarde_as_software.doc> (Quotations are from the online text.)
7. Norman Klein is currently completing a book entitled *From Vatican to Las Vegas: A History of Special Effects* that is discussing in detail the connections between the treatment of space in the Baroque and in cyberculture.
8. See for instance Söke Dinkla, "From Participation to Interaction: Towards the Origins of Interactive Art," in *Clicking In: Hots Links to a Digital Culture*, edited by Lynn Herhman Leeson (Seattle: Bay Press, 1996).
9. Jeffrey Shaw, ed., *Jeffrey Shaw—A User's Manual* (DAP, 1997).
10. Information on Manfred Mohr can be found online at <<http://www.emohr.com/>>.
11. Frank Dietrich has used the term "combinatorics" to talk about a particular direction in the early computer art of the 1960s. See Dietrich, Frank, "Visual Intelligence: The First Decade of Computer Art," *Computer Graphics*, 1985.
12. It is interesting that Sol LeWitt was able to produce works "by hand" which often consisted of more systematic variations of the same elements than similar works done by other artists who used computers. In other words, we can say that Sol LeWitt was better in executing certain minimalist algorithms than the computers of the time.
13. See Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge: MIT Press, 1997).