What Is Cinema?

It is use in terms and its story and stylistic cinema (the in what I culture.
The cinema ages? Develop these section an new id tend of.
Before the end:

1. Use
2. Text
It is useful to think about the relations between cinema and new media in terms of two vectors. The first vector goes from cinema to new media, and it constitutes the backbone of this book. Chapters 1–5 use the history and theory of cinema to map out the logic driving the technical and stylistic development of new media. I also trace the key role played by cinematic language in new media interfaces—both the traditional HCI (the interface of the operating system and software applications) and what I call "cultural interfaces"—interfaces between the human user and cultural data.

The second vector goes in the opposite direction—from computers to cinema. How does computerization affect our very concept of moving images? Does it offer new possibilities for film language? Has it led to the development of totally new forms of cinema? This last chapter is devoted to these questions. In part I started to address them in the "Compositing" section and the "Illusion" chapter. The main part of that chapter focuses on the new identity of the computer-generated image; it is logical that we now extend our inquiry to include moving images.

Before proceeding, I would like to offer two lists. My first list summarizes the effects of computerization on cinema proper:

1. Use of computer techniques in traditional filmmaking:
   1.2 Digital painting. Example: *Forrest Gump* (Robert Zemeckis, 1994).
   1.3 Virtual sets. Example: *Ada* (Lynn Hershman, 1997).
   1.4 Virtual actors/motion capture. Example: *Titanic*.

2. New forms of computer-based cinema:
   2.1 Motion rides/location-based entertainment. Example: rides produced by Douglas Trumbull.
   2.2 Motion graphics, or what I might call *typographic cinema*: film + graphic design + typography. Example: film title sequences.
   2.3 Net.cinema: films designed exclusively for Internet distribution. Example: New Venue, one of the first online sites devoted to
showcasing short digital films. In 1998 it accepted only Quick-Time files under five Mb.

2.4 Hypermedia interfaces to a film that allows nonlinear access at different scales. Examples: WaxWeb (David Blair, 1994–1999), Stephen Mambet’s database interface to Hitchcock’s Psycho (Mambet, 1996–).

2.5 Interactive movies and games structured around film-like sequences. These sequences can be created using traditional film techniques (example: the Johnny Mnemonic game) or computer animation (example: the Blade Runner game). (The pioneer of interactive cinema is experimental filmmaker Grahame Weinbren, whose laserdiscs Sonata and The Evil King are the true classics of this new form.) Note that it is hard to draw a strict line between such interactive movies and many other games that may not use traditional film sequences yet follow many other conventions of film language in their structure. From this perspective, the majority of the computer games of the 1990s can actually be considered interactive movies.

2.6 Animated, filmed, simulated, or hybrid sequences that follow film language, and appear in HCI, Web sites, computer games, and other areas of new media. Examples: transitions and Quick-Time movies in Myst, FMV (full motion video) openings in Tomb Raider and many other games.

3. Filmmakers’ reactions to the increasing reliance of cinema on computer techniques in postproduction:

3.1 Films by Dogme 95 movement. Example: Celebration (Vinterberg, 1998).

3.2 Films that focus on the new possibilities offered by inexpensive DV (Digital Video) cameras. Example: Time Code (Figgis, 2000).

4. Filmmakers’ reactions to the conventions of new media:

4.1 Conventions of a computer screen. Example: Prospero’s Books (Greenaway).

4.2 Conventions of game narratives. Examples: Run, Lola, Run (Tylkwer, 1999), Sliding Doors (Howitt, 1998).
The first section of this chapter, "Digital Cinema and the History of a Moving Image," will focus on 1.1–1.3. The second section, "New Language of Cinema," will use examples drawn from 2.3–2.6.¹

Note that I do not include on this list new distribution technologies such as digital film projection or network film distribution, which by 1999 was already used in Hollywood on an experimental basis, nor do I mention the growing number of Web sites devoted to distribution of films.² Although all these developments will undoubtedly have an important effect on the economics of film production and distribution, they do not appear to have a direct effect on film language, which is my main concern here.

My second, and highly tentative, list summarizes some of the distinct qualities of a computer-based image. This list pulls together arguments presented throughout the book so far. As I noted in chapter 1, I feel that it is important to pay attention not only to the new properties of a computer image that can be logically deduced from its new "material" status, but also to how images are actually used in computer culture. Therefore, the number of properties on this list reflects the typical usage of images rather than some "essential" properties it may have due to its digital form. It is also legitimate to think of some of these qualities as particular consequences of the oppositions that define the concept of representation, as summarized in the Introduction:

1. The computer-based image is discrete, because it is broken into pixels. This makes it more like a human language (but not in the semiotic sense of having distinct units of meaning).
2. The computer-based image is modular, because it typically consists of a number of layers whose contents often correspond to meaningful parts of the image.
3. The computer-based image consists of two levels, a surface appearance and the underlying code (which may be the pixel values, a mathematical function, or HTML code). In terms of its "surface," an image participates in dialog with other cultural objects. In terms of its code, an image exists on the same conceptual plane as other computer objects. (Surface–code can be

1. The phenomenon of motion rides has already been discussed in detail by Finnish new media theoretician and historian Erkki Huhtamo.
2. For a list of some of these sites as of October 1999, see "Small-Screen Multiplex," Wired 7.10 (October 1999), http://www.wired.com/archive/7.10/multiplex.html.
related to other pairs: signifier—signified, base—superstructure, unconscious—conscious. So just as a signifier exists in a structure with other signifiers of a language, the “surface” of an image, that is, its “contents,” enters into dialog with all other images in a culture.

4. Computer-based images are typically compressed using lossy compression techniques, such as JPEG. Therefore, the presence of noise (in the sense of undesirable artifacts and loss of original information) is its essential, rather than accidental, quality.

5. An image acquires the new role of an interface (for instance, imagemaps on the Web, or the image of a desktop as a whole in GUI). Thus, image becomes image-interface. In this role it functions as a portal into another world, like an icon in the Middle Ages or a mirror in modern literature and cinema. Rather than staying on its surface, we expect to go “into” the image. In effect, every computer user becomes Carroll’s Alice. The image can function as an interface because it can be “wired” to programming code; thus clicking on the image activates a computer program (or its part).

6. The new role of an image as image-interface competes with its older role as representation. Therefore, conceptually, a computer image is situated between two opposing poles—an illusionistic window into a fictional universe and a tool for computer control. The task of new media design and art is to learn how to combine these two competing roles of an image.

7. Visually, this conceptual opposition translates into the opposition between depth and surface, between a window into a fictional universe and a control panel.

8. Along with functioning as image-interfaces, computer images also function as image-instruments. If an image-interface controls a computer, an image-instrument allows the user to remotely affect physical reality in real time. This ability not only to act but to “teleact” distinguishes the new computer-based image-instrument from its predecessors. In addition, if old image-instruments such as maps were clearly distinguished from illusionistic images such as paintings, computer images often combine both functions.

9. A computer image is frequently hyperlinked to other images, texts, and other media elements. Rather than being a self-enclosed entity, it points, leads to, and directs the user outside itself toward something else. A moving image may also include hyperlinks (for instance, in QuickTime format.) We can say that a hyperlinked image, and hypermedia in general, “externalizes” Pierce’s idea of infinite semiosis and Derrida’s concept of infinite deferral of meaning—although this does not mean that this “externalization” automat-
ically legitimizes these concepts. Rather than celebrating "the convergence of technology and critical theory," we should use new media technology as an opportunity to question our accepted critical concepts and models.

10. Variability and automation, these general principles of new media, also apply to images. For example, a designer using a computer program can automatically generate infinite versions of the same image, which can vary in size, resolution, colors, composition, and so on.

11. From a single image that represents the "cultural unit" of a previous period, we move to a database of images. Thus if the hero of Antonioni's *Blow-Up* (1966) was looking for truth within a single photographic image, the equivalent of this operation in a computer age is to work with a whole database of many images, searching and comparing them with each other. (Although many contemporary films include scenes of image search, none of them makes it a subject in the way *Blow-Up* does by zooming into a photograph. From this perspective, it is interesting that fifteen years after *Blow-Up*, *Blade Runner* still applies "old" cinematic logic in relation to the computer-based image. In a well-known scene, the hero uses voice commands to direct a futuristic computer device to pan and zoom into a single image. In reality, the military has used various computer techniques that rely on databases of images to automatically identify objects represented in a single image, detect changes in images over time, and so forth, since the 1950s.) Any unique image that you desire probably already exists on the Internet or in some database. As I have already noted, the problem today is no longer how to create the right image, but how to find an already existing one.

Since a computer-based moving image, like its analog predecessor, is simply a sequence of still images, all these properties apply to it as well. To delineate the new qualities of a computer-based still image, I have compared it with other types of modern images commonly used before it—drawings, maps, paintings, and most importantly, still photographs. It would be logical to begin discussion of the computer-based moving image by also relating it to the two most common types of moving images it replaces in turn—the film image and the animated image. In the first section, "Digital Cinema and

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What is Cinema?
the History of a Moving Image," I attempt precisely this. I ask how the shift
to computer-based representation and production processes redefines the
identity of the moving image and the relationship between cinema and ani-
mation. This section also deals with the question of computer-based illu-
sionism, considering it in relation to animation, analog cinema, and digital
cinema. The following section, "The New Language of Cinema," presents ex-
amples of some new directions for film language—or, more generally, the
language of moving images—opened up by computerization. My examples
come from different areas in which computer-based moving images are
used—digital films, net.films, self-contained hypermedia, and Web sites.
Digital Cinema and the History of a Moving Image

Cinema, the Art of the Index

Most discussions of cinema in the computer age have focused on the possibilities of interactive narrative. It is not hard to understand why: Since the majority of viewers and critics equate cinema with storytelling, computer media is understood as something that will let cinema tell its stories in a new way. Yet as exciting as the idea of a viewer participating in a story, choosing different paths through the narrative space, and interacting with characters may be, it addresses only one aspect of cinema that is neither unique nor, as many will argue, essential to it—narrative.

The challenge that computer media pose to cinema extends far beyond the issue of narrative. Computer media redefine the very identity of cinema. In a symposium that took place in Hollywood in the spring of 1996, one of the participants provocatively referred to movies as "flatties" and to human actors as "organics" and "soft fuzzies." As these terms accurately suggest, what used to be cinema's defining characteristics are now just default options, with many others available. Now that one can "enter" a virtual three-dimensional space, viewing flat images projected on a screen is no longer the

only option. Given enough time and money, almost everything can be simulated on a computer; filming physical reality is but one possibility.

This "crisis" of cinema's identity also affects the terms and categories used to theorize cinema's past. French film theorist Christian Metz wrote in the 1970s that "most films shot today, good or bad, original or not, 'commercial' or not, have as a common characteristic that they tell a story; in this measure they all belong to one and the same genre, which is, rather, a sort of 'super-genre' [super-genre]." In identifying fictional film as a "super-genre" of twentieth-century cinema, Metz did not bother to mention another characteristic of this genre because at that time it was too obvious: Fictional films are live-action films; that is, they largely consist of unmodified photographic recordings of real events that took place in real, physical space. Today, in the age of photorealistic 3-D computer animation and digital compositing, invoking this characteristic becomes crucial in defining the specificity of twentieth-century cinema. From the perspective of a future historian of visual culture, the differences between classical Hollywood films, European art films, and avant-garde films (apart from abstract ones) may appear less significant than this common feature—their reliance on lens-based recordings of reality. This section is concerned with the effect of computerization on cinema as defined by its "super-genre," fictional live-action film.5

During cinema's history, a whole repertoire of techniques (lighting, art direction, the use of different film stocks and lenses, etc.) was developed to modify the basic record obtained by a film apparatus. Yet behind even the most stylized cinematic images, we can discern the bluntness, sterility, and banality of early nineteenth-century photographs. No matter how complex its stylistic innovations, the cinema has found its base in these deposits of reality, these samples obtained by a methodical and prosaic process. Cinema emerged out of the same impulse that engendered naturalism, court stenog-

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6. Cinema as defined by its "super-genre" of fictional live-action film belongs to the media arts, which, in contrast to traditional arts, rely on recordings of reality as their basis. Another term not as popular as "media arts" but perhaps more precise is "recording arts." For the use of this term, see James Monaco, How to Read a Film, rev. ed. (New York: Oxford University Press, 1981), 7.
raphy, and wax museums. Cinema is the art of the index; it is an attempt to make art out of a footprint.

Even for director Andrey Tarkovsky, film-painter par excellence, cinema's identity lies in its ability to record reality. Once, during a public discussion in Moscow sometime in the 1970s, he was asked whether he was interested in making abstract films. He replied that there can be no such thing. Cinema's most basic gesture is to open the shutter and to start the film rolling, recording whatever happens to be in front of the lens. For Tarkovsky, an abstract cinema is thus impossible.

But what happens to cinema's indexical identity if it is now possible to generate photorealistic scenes entirely on a computer using 3-D computer animation; modify individual frames or whole scenes with the help of a digtal paint program; cut, bend, stretch, and stretch digitized film images into something with perfect photographic credibility, even though it was never actually filmed?

This section will address the meaning of these changes in the filmmaking process from the point of view of the larger cultural history of the moving image. Seen in this context, the manual construction of images in digital cinema represents a return to the pro-cinematic practices of the nineteenth century, when images were hand-painted and hand-animated. At the turn of the twentieth century, cinema was to delegate these manual techniques to animation and define itself as a recording medium. As cinema enters the digital age, these techniques are again becoming commonplace in the filmmaking process. Consequently, cinema can no longer be clearly distinguished from animation. It is no longer an indexical media technology but, rather, a subgenre of painting.

This argument will be developed in two stages. I will first follow a historical trajectory from nineteenth-century techniques for creating moving images to twentieth-century cinema and animation. Next I will arrive at a definition of digital cinema by abstracting the common features and interface metaphors of a variety of computer software and hardware that are currently replacing traditional film technology. Seen together, these features and metaphors suggest the distinct logic of a digital moving image. This logic subordinates the photographic and the cinematic to the painterly and the graphic, destroying cinema's identity as a media art. In the beginning of the next section, "New Language of Cinema," I will examine different production contexts that already use digital moving images—Hollywood
films, music videos, CD-ROM–based games, and other stand-alone hypermedia—to see if and how this logic has begun to manifest itself.

A Brief Archaeology of Moving Pictures

As testified by its original names (kinetoscope, cinematograph, moving pictures), cinema was understood from its birth as the art of motion, the art that finally succeeded in creating a convincing illusion of dynamic reality. If we approach cinema in this way (rather than as the art of audio-visual narrative, or the art of the projected image, or the art of collective spectatorship, etc.), we can see how it superseded earlier techniques for creating and displaying moving images.

These earlier techniques share a number of common characteristics. First, they all relied on hand-painted or hand-drawn images. Magic-lantern slides were painted at least until the 1850s, as were the images used in the Phenakistoscope, the Thaumatrope, the Zootrope, the Praxinoscope, the Chorotroscope, and numerous other nineteenth-century pro-cinematic devices. Even Muybridge's celebrated Zoopraxiscope lectures of the 1880s featured not actual photographs but colored drawings painted from photographs.

Not only were the images created manually, they were also manually animated. In Robertson's Phantasmagoria, which premiered in 1799, magic-lantern operators moved behind the screen to make projected images appear to advance and withdraw. More often an exhibitor used only his hands, rather than his whole body, to put the images in motion. One animation technique involved using mechanical slides consisting of a number of layers. An exhibitor would slide the layers to animate the image. Another technique was to move a long slide containing separate images slowly in front of a magic lantern lens. Nineteenth-century optical toys enjoyed in private homes also required manual action to create movement—twirling the strings of the Thaumatrope, rotating the Zootrope's cylinder, turning the Viviscope's handle.

It was not until the last decade of the nineteenth century that the automatic generation of images and automatic projection were finally combined.

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A mechanical eye was coupled with a mechanical heart; photography met the motor. As a result, cinema—a very particular regime of the visible—was born. Irregularity, nonuniformity, the accident, and other traces of the human body that previously had inevitably accompanied moving-image exhibitions, were replaced by the uniformity of machine vision. A machine, like a conveyor belt, now spat out images, all sharing the same appearance and the same size, all moving at the same speed, like a line of marching soldiers.

Cinema also eliminated the discrete character of both space and movement in moving images. Before cinema, the moving element was visually separated from the static background, as with a mechanical slide show or Rémy's Praxinoscope Theater (1892). The movement itself was limited in range and affected only a clearly defined figure rather than the whole image. Thus, typical actions would include a bouncing ball, a raised hand or raised eyes, a butterfly moving back and forth over the heads of fascinated children—simple vectors charted across still fields.

Cinema's most immediate predecessors share something else. As the nineteenth-century obsession with movement intensified, devices that could animate more than just a few images became increasingly popular. All of them—the Zoetrope, Phonoscope, Tachyscope, and Kinetoscope—were based on loops, sequences of images featuring complete actions that can be played repeatedly. Throughout the nineteenth-century, the loops grew progressively longer. The Thaumatrope (1825), in which a disk with two different images painted on each face was rapidly rotated by twirling strings attached to it, was, in essence, a loop in its most minimal form—two elements replacing one another in succession. In the Zoetrope (1867) and its numerous variations, approximately a dozen images were arranged around

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10. The birth of cinema in the 1890s is accompanied by an interesting transformation. While the body as the generator of moving pictures disappears, it simultaneously becomes their new subject. Indeed, one of the key themes of early films produced by Edison is a human body in motion—a man sneezing, the famous bodybuilder Sandow flexing his muscles, an athlete performing a somersault, a woman dancing. Films of boxing matches play a key role in the commercial development of Kinetoscope. See Musser, *The Emergence of Cinema*, 72–79, and David Robinson, *From Peep Show to Palace: The Birth of American Film* (New York: Columbia University Press, 1996), 44–48.
the perimeter of a circle.12 The Mutoscope, popular in America throughout the 1890s, increased the duration of the loop by placing a larger number of images radially on an axle.13 Even Edison's Kinetoscope (1892–1896), the first modern cinematic machine to employ film, continued to arrange images in a loop.14 Fifty feet of film translated to an approximately twenty-second-long presentation—a genre whose potential development was cut short when cinema adopted a much longer narrative form.

From Animation to Cinema

Once the cinema was stabilized as a technology, it cut all references to its origins in artifice. Everything that characterized moving pictures before the twentieth century—the manual construction of images, loop actions, the discrete nature of space and movement—was delegated to cinema’s bastard relative, its supplement and shadow—animation. Twentieth-century animation became a depository for nineteenth-century moving-image techniques left behind by cinema.

The opposition between the styles of animation and cinema defined the culture of the moving image in the twentieth century. Animation foregrounds its artificial character, openly admitting that its images are mere representations. Its visual language is more aligned to the graphic than to the photographic. It is discrete and self-consciously discontinuous—crudely rendered characters moving against a stationary and detailed background, sparsely and irregularly sampled motion (in contrast to the uniform sampling of motion by a film camera—recall Jean-Luc Godard’s definition of cinema as “truth 24 frames per second”), and finally space constructed from separate image layers.

In contrast, cinema works hard to erase any traces of its own production process, including any indication that the images that we see could have been constructed rather than simply recorded. It denies that the reality it shows often does not exist outside the film image, an image arrived at by photographing an already impossible space, itself put together with the use of models, mirrors,

12. This arrangement was previously used in magic lantern projections; it is described in the second edition of Athanasius Kircher’s Ars magna (1671). See Mussner, The Emergence of Cinema, 21–22.
and matte paintings, and then combined with other images through optical
printing. It pretends to be a simple recording of an already existing reality—
both to the viewer and to itself. 15 Cinema's public image stressed the aura of re-
ality "captured" on film, thus implying that cinema was about photographing
what existed before the camera rather than creating the "never-was" of special
effects. 16 Rear-projection and blue-screen photography, matte paintings and
glass shots, mirrors and miniatures, push development, optical effects, and
other techniques that allowed filmmakers to construct and alter moving im-
ages, and thus could reveal that cinema was not really different from anima-
ton were pushed to cinema's periphery by its practitioners, historians, and critics.17

15. The extent of this lie is made clear by the films of Andy Warhol from the early 1960s—
perhaps the only real attempt to create cinema without language.

16. I have borrowed this definition of special effects from David Samuelson, Motion Picture

17. The following examples illustrate this disavowal of special effects; other examples can be eas-
ily found. The first example is from popular discourse on cinema. A section entitled "Making the
Movies" in Kenneth W. Leish's Cinema (New York: Newsweek Books, 1974) contains short sto-
ries from the history of the movie industry. The heroes of these stories are actors, directors, and
producers; special effects artists are mentioned only once. The second example is from an ac-
demic source: The authors of the authoritative Aesthetics of Film state, "The goal of our book is to
summarize from a synthetic and didactic perspective the diverse theoretical attempts at examin-
ing these empirical notions (terms from the lexicon of film technicians), including ideas like
frame vs. shot, terms from production crew's vocabularies, the notion of identification produced
by critical vocabulary, etc." The fact that the text never mentions special effects techniques re-
ffects the general lack of any historical or theoretical interest in the topic by film scholars. Bord-
well and Thompson's Film Art: An Introduction, which is used as a standard textbook in
undergraduate film classes, is a little better as it devotes three of its five hundred pages to special
effects. Finally, a relevant statistic: A library of the University of California, San Diego, contains
4,273 titles catalogued under the subject "motion pictures" and only sixteen titles under "spe-
cial effects cinematography." For the few important works addressing the larger cultural signifi-
cance of special effects by film theoreticians, see Vivian Sobchack and Scott Bukatman. Norman
Klein is currently working on a history of special effects environments. Kenneth W. Leish, Cin-
ema (New York: Newsweek Books, 1974); Jacques Aumont, Alain Bergala, Michel Marie, and
Marc Vernet, Aesthetics of Film, trans. Richard Neupert (Austin: University of Texas Press, 1992); 
7; Bordwell and Thompson, Film Art: Vivian Sobchack, Seeing Space: The American Science Fic-
Display, eds. Lynne Cooke and Peter Wollen (Seattle: Bay Press, 1993).
In the 1990s, with the shift to computer media, these marginalized techniques moved to the center.

**Cinema Redefined**

A visible sign of this shift is the new role that computer-generated special effects have come to play in the Hollywood industry in the 1990s. Many blockbusters have been driven by special effects; feeding on their popularity, Hollywood has even created a new minigenre of "The Making of . . ." videos and books that reveal how special effects are created.

I will use special effects from 1990s' Hollywood films as illustrations of some of the possibilities of digital filmmaking. Until recently, Hollywood studios were the only ones who had the money to pay for digital tools and for the labor involved in producing digital effects. However, the shift to digital media affects not just Hollywood, but filmmaking as a whole. As traditional film technology is universally being replaced by digital technology, the logic of the filmmaking process is being redefined. What I describe below are the new principles of digital filmmaking that are equally valid for individual or collective film productions, regardless of whether they are using the most expensive professional hardware and software or amateur equivalents.

Consider, the following principles of digital filmmaking:

1. Rather than filming physical reality, it is now possible to generate film-like scenes directly on a computer with the help of 3-D computer animation. As a result, live-action footage is displaced from its role as the only possible material from which a film can be constructed.
2. Once live-action footage is digitized (or directly recorded in a digital format), it loses its privileged indexical relationship to prefilmic reality. The computer does not distinguish between an image obtained through a photographic lens, an image created in a paint program, or an image synthesized in a 3-D graphics package, since they are all made from the same material—pixels. And pixels, regardless of their origin, can be easily altered, substituted one for another, and so on. Live-action footage is thus reduced to just another graphic, no different than images created manually. 

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18. For a discussion of the subsumption of the photographic by the graphic, see Peter Lunenfeld, "Art Post-History: Digital Photography and Electronic Semiotics," *Photography after Pop-
3. If live-action footage were left intact in traditional filmmaking, now it functions as raw material for further compositing, animating, and morphing. As a result, while retaining the visual realism unique to the photographic process, film obtains a plasticity that was previously only possible in painting or animation. To use the suggestive title of a popular morphing software, digital filmmakers work with “elastic reality.” For example, the opening shot of Forrest Gump (Zemeckis, Paramount Pictures, 1994; special effects by Industrial Light and Magic) tracks an unusually long and extremely intricate flight of a feather. To create the shot, the real feather was filmed against a blue background in different positions; this material was then animated and composited against shots of a landscape. The result: a new kind of realism, which can be described as “something which looks exactly as if it could have happened, although it really could not.”

4. In traditional filmmaking, editing and special effects were strictly separate activities. An editor worked on ordering sequences of images; any intervention within an image was handled by special-effects specialists. The computer collapses this distinction. The manipulation of individual images via a paint program or algorithmic image-processing becomes as easy as arranging sequences of images in time. Both simply involve “cut and paste.”

As this basic computer command exemplifies, modification of digital images (or other digitized data) is not sensitive to distinctions of time and space or to differences in scale. So, reordering sequences of images in time, compositing them together in space, modifying parts of an individual image, and changing individual pixels become the same operation, conceptually and practically.

Given the preceding principles, we can define digital film in this way:

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digital \text{ film} = \text{ live action material } + \text{ painting } + \text{ image processing } + \text{ compositing } + \text{ 2-D computer animation } + \text{ 3-D computer animation}
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19. For a complete list of people at ILM who worked on this film, see SIGGRAPH 94 Visual Procedings (New York: ACM SIGGRAPH, 1994), 19.
Live-action material can either be recorded on film or video or directly in a digital format. 20 Painting, image processing, and computer animation refer to the processes of modifying already existent images as well as creating new ones. In fact, the very distinction between creation and modification, so clear in film-based media (shooting versus darkroom processes in photography, production versus postproduction in cinema), no longer applies to digital cinema, given that each image, regardless of its origin, goes through a number of programs before making it into the final film. 21

Let us summarize these principles. Live-action footage is now only raw material to be manipulated by hand—animated, combined with 3-D computer generated scenes, and painted over. The final images are constructed manually from different elements, and all the elements are either created entirely from scratch or modified by hand. Now we can finally answer the question “What is digital cinema?” Digital cinema is a particular case of animation that uses live-action footage as one of its many elements.

This can be reread in view of the history of the moving image sketched earlier. Manual construction and animation of images gave birth to cinema and slipped into the margins... only to reappear as the foundation of digital cinema. The history of the moving image thus makes a full circle. Born from animation, cinema pushed animation to its periphery, only in the end to become one particular case of animation.

The relationship between “normal” filmmaking and special effects is similarly reversed. Special effects, which involved human intervention into ma-

20. In this respect, 1995 can be called the last year of digital media. At the 1995 National Association of Broadcasters convention, Avid showed a working model of a digital video camera that records not on a videocassette but directly onto a hard drive. Once digital cameras become widely used, we will no longer have any reason to talk about digital media since the process of digitization will have been eliminated.

21. Here is another, even more radical definition: Digital film = f(x, y, t). This definition would be greeted with joy by the proponents of abstract animation. Since a computer breaks down every frame into pixels, a complete film can be defined as a function that, given the horizontal, vertical, and time location of each pixel, returns its color. This is actually how a computer represents a film, a representation that has a surprising affinity with cinema. For a computer, a film is an abstract arrangement of colors changing in time, rather than something structured by “shots,” “narrative,” “actors,” and so on.
chine-recorded footage and which were therefore delegated to cinema's periphery throughout its history, become the norm of digital filmmaking.

The same logic applies to the relationship between production and postproduction. Cinema traditionally involved arranging physical reality to be filmed through the use of sets, models, art direction, cinematography, and so forth. Occasional manipulation of recorded film (for instance, through optical printing) was negligible compared to the extensive manipulation of reality in front of the camera. In digital filmmaking, shot footage is no longer the final point; it is merely raw material to be manipulated on a computer, where the real construction of a scene will take place. In short, production becomes just the first stage of postproduction.

The following example illustrates this new relationship between different stages of the filmmaking process. Traditional on-set filming for _Star Wars: Episode I—The Phantom Menace_ (Lucas, 1999) was done in just sixty-five days. The postproduction, however, stretched over two years, since ninety-five percent of the film (approximately two thousand shots out of the total 2,200) was constructed on a computer.22

Here are two further examples illustrating the shift from rearranging reality to rearranging its images. From the analog era: for a scene in _Zabriskie Point_ (1970), Michaelangelo Antonioni, trying to achieve a particularly saturated color, ordered a field of grass to be painted. From the digital era: To create the launch sequence in _Apollo 13_ (Howard, 1995; special effects by Digital Domain), the crew shot footage at the original location of the launch at Cape Canaveral. The artists at Digital Domain scanned the film and altered it on computer workstations, removing recent building construction, adding grass to the launch pad and painting the skies to make them more dramatic. This altered film was then mapped onto 3-D planes to create a virtual set that was animated to match a 180-degree dolly movement of a camera following a rising rocket.23

The last example brings us to another conceptualization of digital cinema—as painting. In his study of digital photography, Mitchell focuses our

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attention on what he calls the inherent mutability of the digital image: "The essential characteristic of digital information is that it can be manipulated easily and very rapidly by computer. It is simply a matter of substituting new digits for old . . . Computational tools for transforming, combining, altering, and analyzing images are as essential to the digital artist as brushes and pigments to a painter." As Mitchell points out, this inherent mutability erases the difference between a photograph and a painting. Since a film is a series of photographs, it is appropriate to extend Mitchell's argument to digital film. Given that an artist is easily able to manipulate digitized footage either as a whole or frame by frame, a film in a general sense becomes a series of paintings.

Hand-painting digitized film frames, made possible by a computer, is probably the most dramatic example of the new status of cinema. No longer strictly locked in the photographic, cinema opens itself toward the painterly. Digital hand-painting is also the most obvious example of the return of cinema to its nineteenth-century origins—in this case, the hand-crafted images of magic lantern slides, the Phenakistoscope, and Zootrope.

We usually think of computerization as automation, but here the result is the reverse: What was previously recorded by a camera automatically now has to be painted one frame at a time. And not just a dozen images, as in the nineteenth century, but thousands and thousands. We can draw another parallel with the practice of manually tinting film frames in different colors according to a scene's mood, a practice common in the early days of silent cinema. Today, some of the most visually sophisticated digital effects are often achieved using the same simple method: painstakingly altering thousands of frames by hand. The frames are painted over either to create mattes ("hand-drawn matte extraction") or to change the images directly, as, for instance, in *Forrest Gump*, where President Kennedy is made to speak new sentences by altering the shape of his lips, one frame at a time.

25. The full advantage of mapping time into 2-D space, already present in Edison's first cinema apparatus, is now realized: One can modify events in time by literally painting on a sequence of frames, treating them as a single image.
time. In principle, given enough time and money, one can create what will be the ultimate digital film: 129,600 frames (ninety minutes) completely painted by hand from scratch, but indistinguishable in appearance from live photography.

The concept of digital cinema as painting can also be developed in a different way. I would like to compare the shift from analog to digital filmmaking to the shift from fresco and tempera to oil painting in the early Renaissance. A painter making a fresco has limited time before the paint dries, and once it has dried, no further changes to the image are possible. Similarly, a traditional filmmaker has limited means of modifying images once they are recorded on film. Medieval tempera painting, can be compared to the practice of special effects during the analog period of cinema. A painter working with tempera could modify and rework the image, but the process was painstaking and slow. Medieval and early Renaissance masters would spend up to six months on a painting only a few inches tall. The switch to oils greatly liberated painters by allowing them to quickly create much larger compositions (think, for instance, of the works by Veronese and Titian) as well as to modify them as long as necessary. This change in painting technology led the Renaissance painters to create new kinds of compositions, new pictorial space, and new narratives. Similarly, by allowing a filmmaker to treat a film image as an oil painting, digital technology redefines what can be done with cinema.

If digital compositing and digital painting can be thought of as an extension of cell animation techniques (since composited images are stacked in depth parallel to each other, as cells on a animation stand), the newer method of computer-based postproduction makes filmmaking a subset of animation in a different way. In this method, the live-action photographic stills and/or graphic elements are positioned in a 3-D virtual space, thus giving the director the ability to move the virtual camera freely through this space, dollying and panning. Thus cinematography is subordinated to 3-D computer animation. We may think of this method as an extension of the multiplane animation camera. However, if the camera mounted over a multiplane stand

could only move perpendicular to the images, now it can move in an arbitrary trajectory. An example of a commercial film that relies on this newer method, which one day may become the standard of filmmaking (because it gives the director the most flexibility), is Disney’s Aladdin: an example of an independent work that fully explores the new aesthetic possibilities of this method without subordinating it to traditional cinematic realism is Walczynski’s The Forest.

In the “Compositing” section, I pointed out that digital compositing can be thought of as an intermediary step between 2-D images and 3-D computer representation. The newer postproduction method represents the next logical step toward completely computer-generated 3-D representations. Instead of the 2-D space of “traditional” composite, we now have layers of moving images positioned in a virtual 3-D space.

The reader who has followed my analysis of the new possibilities of digital cinema may wonder why I have stressed the parallels between digital cinema and the pre-cinematic techniques of the nineteenth century, but have not mentioned twentieth-century avant-garde filmmaking. Did not the avant-garde filmmakers already explore many of these new possibilities? To take the notion of cinema as painting, Len Lye, one of the pioneers of abstract animation, was painting directly on film as early as 1935; he was followed by Norman McLaren and Stan Brakhage, the latter extensively covering shot footage with dots, scratches, splattered paint, smears, and lines in an attempt to turn his films into equivalents of Abstract Expressionist paintings. More generally, one of the major impulses in all avant-garde filmmaking from Leger to Godard was to combine the cinematic, the painterly, and the graphic—by using live-action footage and animation within one film or even a single frame, by altering this footage in a variety of ways, or by juxtaposing printed texts and filmed images.

When the avant-garde filmmakers collaged multiple images within a single frame, or painted and scratched film, or revolted against the indexical identity of cinema in other ways, they were working against “normal” filmmaking procedures and the intended uses of film technology. (Film stock was not designed to be painted on.) Thus they operated on the periphery of commercial cinema not only aesthetically but also technically.

One general effect of the digital revolution is that avant-garde aesthetic strategies came to be embedded in the commands and interface metaphors
of computer software. In short, the avant-garde became materialized in a computer. Digital-cinema technology is a case in point. The avant-garde strategy of collage reemerged as the "cut-and-paste" command, the most basic operation one can perform on digital data. The idea of painting on film became embedded in the paint functions of film-editing software. The avant-garde move to combine animation, printed texts, and live-action footage is repeated in the convergence of animation, title generation, paint, compositing, and editing systems into all-in-one packages. Finally, the move to combine a number of film images within one frame (for instance, in Leger's 1924 Ballet Mécanique or in Man with a Movie Camera) also becomes legitimized by technology, given that all editing software, including Photoshop, Premiere, After Effects, Flame, and Cineon, assume by default that a digital image consists of a number of separate image layers. All in all, what used to be exceptions for traditional cinema have become the norm, intended techniques of digital filmmaking, embedded in technology design itself.  

From Kino-Eye to Kino-Brush

In the twentieth century, cinema played two roles at once. As a media technology, its role was to capture and store visible reality. The difficulty of modifying images once recorded was precisely what lent it value as a document, assuring its authenticity. This same rigidity has defined the limits of cinema as a "super-genre" of live-action narrative. Although cinema includes within itself a variety of styles—the result of the efforts of numerous directors, designers, and cinematographers—these styles share a strong family resemblance. They are all children of a recording process that uses lenses, regular sampling of time, and photographic media. They are all children of a machine vision.

The mutability of digital data impairs the value of cinema recordings as documents of reality. In retrospect, we can see that twentieth-century cinema's regime of visual realism, the result of automatically recording

28. See my "Avant-Garde as Software" (http://visarts.ucsd.edu/~marovitch).
visual reality, was only an exception, an isolated accident in the history of visual representation, which has always involved, and now again involves, the manual construction of images. Cinema becomes a particular branch of painting—painting in time. No longer a kino-eye, but a kino-brush.30

The privileged role played by the manual construction of images in digital cinema is one example of a larger trend—the return of pro-cinematic moving-image techniques. Although marginalized by the twentieth-century institution of live-action, narrative cinema, which relegated them to the realms of animation and special effects, these techniques are reemerging as the foundation of digital filmmaking. What was once supplemental to cinema becomes its norm; what was at the periphery comes into the center. Computer media return to us the repressed of the cinema.

As the examples in this section suggest, directions that were closed off at the turn of the century when cinema came to dominate the modern moving-image culture are now again beginning to be explored. The moving-image culture is being redefined once again; cinematic realism is being displaced from the dominant mode to merely one option among many.

30. Dziga Vertov coined the term “kino-eye” in the 1920s to describe the cinematic apparatus’s ability “to record and organize the individual characteristics of life’s phenomena into a whole, an essence, a conclusion.” For Vertov, it was the presentation of film “facts,” based as they were on materialist evidence, that defined the very nature of the cinema. See Kino-Eye: The Writings of Dziga Vertov, ed. Annette Michelson, trans. Kevin O’Brien (Berkeley: University of California Press, 1984). The quotation above is from “Artistic Drama and Kino-Eye,” originally published in 1924, 17–49, 47.
The New Language of Cinema

Cinematic and Graphic: Cinegratography

3-D animation, compositing, mapping, paint retouching: In commercial cinema, these radical new techniques are used mostly to solve technical problems while traditional cinematic language is preserved unchanged. Frames are hand-painted to remove wires that supported an actor during shooting; a flock of birds is added to a landscape; a city street is filled with crowds of simulated extras. Although most Hollywood releases now involve digitally manipulated scenes, the use of computers is always carefully hidden. 31 Appropriately, in Hollywood the practice of simulating traditional film language has received a name—"invisible effects," defined as "computer-enhanced scenes that fool the audience into believing the shots were produced with live actors on location, but are really composed of a mélange of digital and live action footage." 32

Commercial narrative cinema continues to hold on to the classical realist style in which images function as unretouched photographic records of events that took place in front of the camera. So when Hollywood cinema uses computers to create a fantastic, impossible reality, it is done through


the introduction of various nonhuman characters such as aliens, mutants, and robots. We never notice the pure arbitrariness of their colorful mutating bodies, the beams of energy radiating from their eyes, the whirlpools of particles emanating from their wings, because they are perceptually consistent with the set; that is, they look like something that could have existed in a three-dimensional space and, therefore, could have been photographed.

But how do filmmakers justify turning a familiar reality such as a human body or landscape into something physically impossible in our world? Such transformations are motivated by the movie’s narrative. The shiny, metallic body of the Terminator in *Terminator 2* is possible because the Terminator is a cyborg sent from the future; the rubbery body of Jim Carrey in *The Mask* (Russell, 1994) is possible because his character wears a mask with magical powers. Similarly, in *What Dreams May Come* (Ward, special effects by Mass.Illusions and others, 1998) the fantastic landscape made of swirling brushstrokes to which the main hero is transported after his death is motivated by the unique status of this location.

While embracing computers as a productivity tool, cinema refuses to give up its unique cinema-effect, an effect which, according to Christian Metz’s penetrating analysis made in the 1970s, depends upon narrative form, the reality effect, and cinema’s architectural arrangement all working together. Toward the end of his essay, Metz wonders whether in the future nonnarrative films may become more numerous; if this happens, he suggests, cinema will no longer need to manufacture its reality effect. Electronic and digital media have already brought about this transformation. Beginning in the 1980s, we see the emergence of new cinematic forms that are not linear narratives, that are exhibited on a television or computer screen rather than in a movie theater—and that simultaneously give up cinematic realism.

What are these forms? First, there is the music video. Probably not by accident, the genre of the music video came into existence precisely at the time when electronic video-effects devices were entering editing studios. Importantly, just as music videos often incorporate narratives within them but are not linear narratives from start to finish, they rely on film (or video) images but change them beyond the norms of traditional cinematic realism. The

33. Metz, "The Fiction Film and Its Spectator."
manipulation of images through hand-painting and image processing, hidden techniques in Hollywood cinema, is brought into the open on a television screen. Similarly, the construction of an image from heterogeneous sources is not subordinated to the goal of photorealism, but functions as an aesthetic strategy. The genre of music video has served as a laboratory for exploring numerous new possibilities of manipulating photographic images made possible by computers—the numerous points that exist in the space between the 2-D and the 3-D, cinematography and painting, photographic realism and collage. In short, it is a living and constantly expanding textbook for digital cinema.

A detailed analysis of the evolution of music video imagery (or, more generally, broadcast graphics in the electronic age) deserves a separate treatment, and I will not try to take it up here. Instead, I will discuss another new cinematic non-narrative form, CD-ROM-based games, which, in contrast to the music video, has relied on the computer for storage and distribution from the very beginning. And unlike music video designers, who were consciously pushing traditional film or video images into something new, the designers of CD-ROMs arrived at a new visual language unintentionally while attempting to emulate traditional cinema.

In the late 1980s, Apple began to promote the concept of computer multimedia, and in 1991 it released QuickTime software to enable an ordinary personal computer to play movies. During the first few years the computer did not perform its new role very well. First, CD-ROMs could not hold anything close to the length of a standard theatrical film. Second, the computer could not smoothly play a movie larger than the size of a stamp. Finally, the movies had to be compressed, degrading their visual appearance. Only in the case of still images was the computer able to display photographic-like detail at full-screen size.

Because of these particular hardware limitations, the designers of CD-ROMs had to invent a different kind of cinematic language in which a range of strategies, such as discrete motion, loops, and superimposition—previously used in nineteenth-century moving-image presentations, twentieth-century animation, and the avant-garde tradition of graphic cinema—were applied to photographic or synthetic images. This language synthesized cinematic illusionism and the aesthetics of graphic collage, with its characteristic heterogeneity and discontinuity. The photographic and the graphic, divorced when cinema and animation went their separate ways, met again on the computer screen.
The graphic also met the cinematic. The designers of CD-ROMs were aware of the techniques of twentieth-century cinematography and film editing, but they had to adapt these techniques both to an interactive format and to hardware limitations. As a result, the techniques of modern cinema and of nineteenth-century moving-image presentations merged in a new hybrid language that can be called "cinematography."

We can trace the development of this language by analyzing a few well-known CD-ROM titles. The best-selling game Myst unfolds its narrative strictly through still images, a practice that takes us back to magic-lantern shows (and to Chris Marker's La Jetée). But in other ways Myst relies on the techniques of twentieth-century cinema. For instance, the CD-ROM uses simulated camera turns to switch from one image to the next. It also employs the basic technique of film editing to subjectively speed up or slow down time. In the course of the game, the user moves around a fictional island by clicking on a mouse. Each click advances a virtual camera forward, revealing a new view of the 3-D environment. When the user begins to descend into the underground chambers, the spatial distance between the points of view of each two consecutive views sharply decreases. If before, the user was able to cross a whole island with just a few clicks, now it takes a dozen clicks to get to the bottom of the stairs! In other words, just as in traditional cinema, Myst slows down time to create suspense and tension.

In Myst, miniature animations are sometimes embedded within the still images. In the next best-selling CD-ROM, 7th Guest (Virgin Games, 1993), the user is presented with video clips of live actors superimposed over static backgrounds created with 3-D computer graphics. The clips are looped, and the moving human figures clearly stand out against the backgrounds. Both of these features connect the visual language of 7th Guest to nineteenth-century pre-cinematic devices and twentieth-century cartoons rather than to cinematic verisimilitude. But like Myst, 7th Guest also evokes distinctly modern cinematic codes. The environment where all the action takes place (an interior of a house) is rendered using a wide angle lens; to move from one

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34. This twenty-eight-minute film, made in 1962, is composed almost exclusively of still frames. For documentation, see Chris Marker, *La Jetée: Ciné-romans* (New York: Zone Books, 1992).
view to the next, a camera follows a complex curve, as though mounted on a virtual dolly.

Next, consider the CD-ROM *Johnny Mnemonic* (Sony Imagesoft, 1995). Produced to complement the fiction film of the same title, marketed not as a “game” but as an “interactive movie,” and featuring full-screen video throughout, *Johnny Mnemonic* comes closer to cinematic realism than the previous CD-ROMs—yet it is still quite distinct from it. With all action shot against a green screen and then composited with graphic backgrounds, its visual style exists within the space between cinema and collage.

It would not be entirely inappropriate to read this short history of the digital moving image as a teleological development that replays the emergence of cinema a hundred years earlier. Indeed, as the speed of computers keeps increasing, CD-ROM designers have been 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 slide presentations) to moving characters over static backgrounds (as in, for instance, Reynaud’s Praxinoscope Theater) to full motion (the Lumière’s cinematograph). Moreover, the introduction of QuickTime in 1991 can be compared to the introduction of the Kinetoscope in 1892: Both were used to present short loops, both featured images approximately two by three inches in size, both called for private viewing rather than collective exhibition. The two technologies even appear to play a similar cultural role. If in the early 1890s the public patronized Kinetoscope parlors where peep-hole machines presented them with the latest marvel—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 Lumière’s first film screenings of 1895 that shocked their audiences with huge moving images found their parallel in 1995 CD-ROMs in which the moving image finally fills the entire computer screen (for instance, *Johnny Mnemonic*). Thus, exactly a hundred years after cinema was officially “born,” it was reinvented on a computer screen.

35. These parallels are further investigated in my “Little Movies” (http://visarts.ucsd.edu/~manovich/little-movies).
But this is only one reading. We no longer think of the history of cinema as a linear march toward one language, or as a progression toward increasingly accurate verisimilitude. Rather, we have come to see it as a succession of distinct and equally expressive languages, each with its own aesthetic variables, each new language closing off some of the possibilities of the previous one—a cultural logic not dissimilar to Kuhn's analysis of scientific paradigms. Similarly, instead of dismissing the visual strategies of early multimedia titles as the result of technological limitations, we may want to think of them as an alternative to traditional cinematic illusionism, as the beginning of digital cinema's new language.

For the computer/entertainment industries, these strategies represent only a temporary limitation, an annoying drawback that needs to be overcome. This is one important difference between the situation at the end of the nineteenth century and the situation at the end of the twentieth century: If cinema was developing toward a still open horizon of many possibilities, the development of commercial multimedia, and of corresponding computer hardware (compression boards, storage formats such as DVD), was driven by a clearly defined goal—the exact duplication of cinematic realism. So if the computer screen increasingly emulates cinema's screen, this is not an accident, but the result of conscious planning by the computer and entertainment industries. But this drive to turn new media into a simulation of classical film language, which parallels the encoding of cinema's techniques in software interfaces and in the hardware itself, as described in the "Cultural Interfaces" section, is just one direction for new media development among numerous others. I will next examine a number of new media and old media objects that point toward other possible trajectories.

The New Temporality: The Loop as a Narrative Engine
One of the underlying assumptions of this book is that, by looking at the history of visual culture and media, in particular cinema, we can find many strategies and techniques relevant to new media design. Put differently, to develop a new aesthetics of new media, we should pay as much attention to cultural history as to the computer's unique new possibilities to generate, organize, manipulate, and distribute data.

36. Kuhn, The Structure of Scientific Revolutions.
As we scan cultural history (which includes the history of new media up until the time of research), three kinds of situations will be particularly relevant for us:

- An interesting strategy or technique is abandoned or forced "underground" without fully developing its potential.
- A strategy can be understood as a response to technological constraints (I am purposefully using this more technical term instead of the more ideologically loaded "limitations") similar to those of new media.
- A strategy is used in a situation similar to that faced by new media designers. For instance, montage was a strategy for dealing with the modularity of film (how do you join separate shots?) as well as the problem of coordinating different media types such as images and sound. Both of these situations are being faced once again by new media designers.

I have already used these principles in discussing the parallels between nineteenth-century pro-cinematic techniques and the language of new media; they have also guided me in thinking about animation (the "underground" of twentieth-century cinema) as the basis for digital cinema. I will now use a particular parallel between early cinematic and new media technology to highlight another older technique useful to new media—the loop. Characteristically, many new media products, whether cultural objects (such as games) or software (various media players such as QuickTime Player) use loops in their design, while treating them as temporary technological limitations. I, however, want to think about them as a source of new possibilities for new media.

As already mentioned in the previous section, all nineteenth-century pro-cinematic devices, up through Edison's Kinetoscope, were based on short loops. As "the seventh art" began to mature, it banished the loop to the low-art realms of the instructional film, pornographic peep-show, and animated cartoon. In contrast, narrative cinema avoids repetitions; like modern Western fictional

37. My own "Little Movies" explores the aesthetics of digital cinema and draws parallels between the early cinema of the 1890s, the structuralist filmmaking of the 1960s, and the new media of the 1990s.
forms in general, it puts forward a notion of human existence as a linear progression through numerous unique events.

Cinema's birth from a loop form was reenacted at least once during its history. In one of the sequences of *Man with a Movie Camera*, Vortov shows us a cameraman standing in the back of a moving automobile. As he is being carried forward by the automobile, he cranks the handle of his camera. A loop, a repetition, created by the circular movement of the handle, gives birth to a progression of events—a very basic narrative that is also quintessentially modern—a camera moving through space recording whatever is in its way. In what seems to be a reference to cinema's primal scene, these shots are intercut with the shots of a moving train. Vortov even restages the terror that the Lumières' film supposedly provoked in its audience; he positions his camera right along the train track so the train runs over our point of view a number of times, crushing us again and again.

Early digital movies shared the same limitations of storage as nineteenth-century pro-cinematic devices. This is probably why the loop playback function was built into the QuickTime interface, giving it the same weight as the VCR-style "play" function. So, in contrast to films and videotapes, QuickTime movies were supposed to be played forward, backward, or looped. Computer games also heavily relied on loops. Since it was not possible to animate every character in real time, designers stored short loops of a character's motions—for instance, an enemy soldier or a monster walking back and forth—that would be recalled at appropriate times in the game. Internet pornography also heavily relied on loops. Many sites featured numerous "channels" that were supposed to stream either feature-length feature films or "live feeds"; in reality, they would usually play short loops (a minute or so) over and over. Sometimes a few films would be cut into a number of short loops that would become the content of one hundred, five hundred, or one thousand channels.  

The history of new media tells us that hardware limitations never go away. They disappear in one area only to come back in another. One example I have already noted is the hardware limitations of the 1980s in the area of 3-D computer animation. In the 1990s they returned in a new

area—Internet-based real-time virtual worlds. What used to be the slow speed of CPUs became slow bandwidth. As a result, the VRML worlds of the 1990s look like the prerendered animations done ten years earlier.

A similar logic applies to loops. Early QuickTime movies and computer games relied heavily on loops. As the CPU speed increased and larger storage media such as CD-ROM and DVD became available, the use of loops in stand-alone hypermedia declined. However, online virtual worlds such as Active Worlds came to use loops extensively, as they provide a cheap (in terms of bandwidth and computation) means of adding some signs of "life" to their geometric-looking environments. Similarly, we may expect that when digital videos appear on small displays in our cellular phones, personal managers such as Palm Pilot, or other wireless communication devices, they will once again be arranged in short loops because of bandwidth, storage, or CPU limitations.

Can the loop be a new narrative form appropriate for the computer age? It is relevant to recall that the loop gave birth not only to cinema but also to computer programming. Programming involves altering the linear flow of data through control structures, such as "if/then" and "repeat/while"; the loop is the most elementary of these control structures. Most computer programs are based on repetitions of a set number of steps; this repetition is controlled by the program's main loop. So if we strip the computer from its usual interface and follow the execution of a typical computer program, the computer will reveal itself to be another version of Ford's factory, with the loop as its conveyor belt.

As the practice of computer programming illustrates, the loop and the sequential progression do not have to be considered mutually exclusive. A computer program progresses from start to finish by executing a series of loops. Another illustration of how these two temporal forms can work together is Möbius House by the Dutch team UN Studio/Van Berkel & Bos.  

40. Natalie Bookchin's CD-ROM Databank of the Everyday (1996) investigates the loop as a structure of everyday life. Because I did the majority of the cinematography and some interface design for this project, I do not discuss it in the main text.  
41. Riley, The Unhuman House.
In this house a number of functionally different areas are arranged one after another in the form of a Möbius strip, thus forming a loop. As the narrative of the day progresses from one activity to the next, the inhabitants move from area to area.

Traditional cell animation similarly combines a narrative and a loop. In order to save labor, animators arrange many actions, such as movements of characters' legs, eyes, and arms, into short loops and repeat them over and over. Thus, as already mentioned in the previous section, in a typical twentieth-century cartoon, a large proportion of motions involves loops. This principle is taken to the extreme in Rybczynski's Tango. Subjecting live-action footage to the logic of animation, Rybczynski arranges the trajectory of each character through space as a loop. These loops are further composited, resulting in a complex and intricate time-based structure. At the same time, the overall "shape" of this structure is governed by a number of narratives. The film begins in an empty room; next, the loops of a character's trajectories through this room are added, one by one. The end of the film mirrors its beginning as the loops are "deleted" in reverse order, one by one. This metaphor for the progression of a human life (we are born alone, gradually form relations with other humans, and eventually die alone) is also supported by another narrative: The first character to appear in the room is a young boy; the last, an old woman.

The concept of a loop as an "engine" that puts the narrative in motion becomes the foundation of a brilliant interactive TV program Akvaario (Aquarium) by a number of graduate students at Helsinki's University of Art and Design (director Teijo Pellinen, 1999). In contrast to many new media objects that combine the conventions of cinema, print, and HCI, Akvaario aims to preserve the continuous flow of traditional cinema, while adding interactivity to it. Along with an earlier game Johnny Mnemonic (SONY, 1995), as well as the pioneering interactive, laserdisk computer installations by Graham Weinbren done in the 1980s, this project is a rare example of a new media narrative that does not rely on the oscillation between noninteractive and interactive segments.

Using the already familiar convention of games such as Tamagochi (1996--), the program asks TV viewers to "take charge" of a fictional human

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character. Most shots show this character engaged in different activities in his apartment—eating dinner, reading a book, staring into space. The shots replace each other following standard conventions of film and TV editing. The result is something that looks at first like a conventional, although very long, movie (the program was projected to run for three hours every day over the course of a few months), even though the shots are selected in real time by a computer program from a database of a few hundred different shots.

By choosing from one of four buttons always present at the bottom of the screen, the viewer controls the character’s motivation. When a button is pressed, a computer program selects a sequence of particular shots to follow the shot currently playing. Because of the visual, spatial, and referential discontinuity between shots typical of standard editing, the result is something that the viewer interprets as a conventional narrative. A film or television viewer does not expect two consecutive shots to necessarily display the same space or subsequent moments of time. Therefore in Aktaujo a computer program can “weave” an endless narrative by choosing from a database of different shots. What gives the resulting “narrative” a sufficient continuity is that almost all the shots show the same character.

Aktaujo is one of the first examples of what in a previous chapter I called a “database narrative.” It is, in other words, a narrative that fully utilizes many features of the database organization of data. It relies on our abilities to classify database records according to different dimensions, sort through records, quickly retrieve any record, as well as “stream” a number of different records continuously one after another.

In Aktaujo the loop becomes the way to bridge linear narrative and interactive control. When the program begins, a few shots keep following each other in a loop. After the user chooses the character’s motivation by pressing a button, this loop becomes a narrative. Shots stop repeating, and a sequence of new shots is displayed. If no button is pressed again, the narrative turns back into a loop; that is, a few shots start repeating over and over. In Aktaujo a narrative is born from a loop, and it returns back to a loop. The historical birth of modern fictional cinema out of the loop returns as a condition of

45. My analysis is based on a project prototype that I saw in October of 1999. The completed project is projected to have a male and a female character.
cinema’s rebirth as an interactive form. Rather than being an archaic leftover, a reject from cinema’s evolution, the use of the loop in _Akrasia_ suggests a new temporal aesthetics for computer-based cinema.

Jean-Louis Boissier’s _Flora petrinulavis_ realizes some of the possibilities contained in the loop form in a different way. This CD-ROM is based on Rousseau’s _Confessions_. It opens with a white screen, containing a numbered list. Clicking on each item leads us to a screen containing two windows, positioned side by side. Both windows show the same video loop made from a few different shots. The two loops are offset from each other in time. Thus the images appearing in the left window reappear in a moment on the right and vice versa, as though an invisible wave is running through the screen. This wave soon becomes materialized—when we click inside the windows, we are taken to a new screen that also contains two windows, each showing the loop of a rhythmically vibrating water surface. The loops of water surfaces can be thought of as two sine waves offset in phase. This structure, then, functions as a metatext of the structure in the first screen. In other words, the loops of a water surface act as a diagram of the loop structure that controls the correlations between shots in the first screen. Similar to how Marcey and the Gibsons diagrammed human motion in their film studies at the beginning of the twentieth century.

As each mouse click reveals another loop, the viewer becomes an editor, but not in the traditional sense. Rather than constructing a singular narrative sequence and discarding material not used, here the viewer brings to the forefront, one by one, numerous layers of looped actions that seem to be taking place all at once, a multitude of separate but coexisting temporalities. The viewer is not cutting but reshuffling. In a reversal of Vertov’s sequence in which a loop generates a narrative, the viewer’s attempt to create a story in _Flora petrinulavis_ leads to a loop.

It is useful to analyze the loop structure of _Flora petrinulavis_ in terms of montage theory. From this perspective, the repetition of images in two adjoining windows can be interpreted as an example of what Eisenstein called

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44. _Flora petrinulavis_ (1993) is included in the compilation CD-ROM, _Action!_ (Karlsruhe, Germany: ZKM Center for Art and Media, 1994). That and other ZKM publications are available from http://www.zkm.de.
“rhythmic montage.” At the same time, Boissier takes montage apart, so to speak. Shots that in traditional temporal montage would follow each in time here appear next to one other in space. In addition, rather than being “hard-wired” by an editor in only one possible structure, here the shots can appear in different combinations since they are activated by a user moving a mouse across the windows.

It is also possible to find other examples of traditional temporal montage in this work as well—for instance, the move from the first screen, which shows a close-up of a woman, to a second screen, which shows water surfaces, and back to the first screen. This move can be interpreted as traditional parallel editing. In cinema, parallel editing involves alternating between two subjects. For instance, a chase sequence may go back and forth between the images of two cars, one pursuing another. However, in our case the water images are always present “underneath” the first set of images. So the logic here again is coexistence rather than replacement.

The loop that structures *Flora petiolaris* on a number of levels becomes a metaphor for human desire that can never achieve resolution. It can also be read as a comment on cinematic realism. What are the minimal conditions necessary to create the impression of reality? In the case of a field of grass, or a close-up of a plant or stream, just a few looped frames, as Boissier demonstrates, is sufficient to produce the illusion of life and of linear time.

Steven Neale describes how early film demonstrated its authenticity by representing moving nature: "What was lacking [in photographs] was the wind, the very index of real, natural movement. Hence the obsessive contemporary fascination, not just with movement, not just with scale, but also with waves and sea spray, with smoke and spray." What for early cinema was its biggest pride and achievement—a faithful documentation of nature’s movement—becomes for Boissier a subject of ironic and melancholic simulation. As the few frames are looped over and over, we see blades of grass shifting slightly back and forth, rhythmically responding to a nonexistent wind, almost approximated by the noise of a computer reading data from a CD-ROM.

Something else is being simulated here as well, perhaps unintentionally. As you watch the CD-ROM, the computer periodically stuggles, unable to

45. Neale, Cinema and Technology, 52.
maintain consistent data rate. As a result, the images on the screen move in uneven bursts, slowing and speeding up with human-like irregularity. It is as though they are brought to life not by a digital machine but by a human operator, cranking the handle of the Zootrope a century and a half ago . . .

**Spatial Montage and Macrocinema**

Along with taking on a loop, *Flora petriulalis* can also be seen as a step toward what I will call *spatial montage*. Instead of the traditional singular frame of cinema, Bouissier uses two images at once, positioned side by side. This can be thought of as the simplest case of spatial montage. In general, spatial montage could involve a number of images, potentially of different sizes and proportions, appearing on the screen at the same time. This juxtaposition by itself, of course, does not result in montage; it is up to the filmmaker to construct a logic that determines which images appear together, when they appear, and what kind of relationships they enter into with one another.

Spatial montage represents an alternative to traditional cinematic temporal montage, replacing its traditional sequential mode with a spatial one. Ford's assembly line relied on the separation of the production process into sets of simple, repetitive, and sequential activities. The same principle made computer programming possible: a computer program breaks a task into a series of elemental operations to be executed one at a time. Cinema followed this logic of industrial production as well. It replaced all other modes of narration with a sequential narrative, an assembly line of shots that appear on the screen one at a time. This type of narrative turned out to be particularly incompatible with the spatial narrative that had played a prominent role in European visual culture for centuries. From Giotto's fresco cycle at Capella degli Scrovegni in Padua to Courbet's *Burial at Ornans*, artists presented a multitude of separate events within a single space, whether the fictional space of a painting or the physical space that can be taken in by the viewer all at once. In the case of Giotto's fresco cycle and many other fresco and icon cycles, each narrative event is framed separately, but all of them can be viewed together in a single glance. In other cases, different events are represented as taking place within a single pictorial space. Sometimes, events that form one narrative but are separated by time are depicted within a single painting. More often, the painting's subject becomes an excuse to show a number of separate "micronarratives" (for instance, works by Hieronymous Bosch and Peter Bruegel). All in all, in contrast to cinema's sequential nar-
rative, all the "shots" in spatial narrative are accessible to the viewer at once. Like nineteenth-century animation, spatial narrative did not disappear completely in the twentieth century, but rather, like animation, came to be delegated to a minor form of Western culture—comics.

It is not accidental that the marginalization of spatial narrative and the privileging of the sequential mode of narration coincided with the rise of the historical paradigm in human sciences. Cultural geographer Edward Soja has argued that the rise of history in the second half of the nineteenth century coincided with a decline in spatial imagination and a spatial mode of social analysis. According to Soja, it is only in the last decades of the twentieth century that this mode has made a powerful comeback, as exemplified by the growing importance of such concepts as "geopolitics" and "globalization" as well as by the key role that analysis of space plays in theories of postmodernism. Indeed, although some of the best thinkers of the twentieth century, including Freud, Panofsky, and Foucault, were able to combine historical and spatial modes of analysis in their theories, they probably represent exceptions rather than the norm. The same holds for film theory, which, from Eisenstein in the 1920s to Deleuze in the 1980s, focuses on temporal rather than spatial structures of film.

Twentieth-century film practice has elaborated complex techniques of montage with different images replacing each other in time, but the possibility of what can be called a "spatial montage" of simultaneously coexisting images has not been explored as systematically. (Thus, cinema is also given to historical imagination at the expense of spatial imagination.) Notable exceptions include the use of a split screen by Gance Abel in Na\po\li\o\n in the 1920s and also the American experimental filmmaker Stan Van der Beek in the 1960s; some of the works, or rather events, of the "expanded cinema" movement of the 1960s, and last but not least, the legendary multi-image multimedia presentation shown in the Chech Pavilion at the 1967 World Expo. Emil Radok's Di\po\ly\v\an consisted of 112 separate cubes. One hundred and sixty different images could be projected onto each cube. Radok was able to "direct" each cube separately. To the best of my knowledge, no

46. Edward Soja, keynote lecture at the "History and Space" conference, University of Turku, Turku, Finland, October 2, 1999.
one has since attempted to create a spatial montage of this complexity in any technology.

Traditional film and video technology was designed to fill a screen completely with a single image; thus to explore spatial montage a filmmaker had to work "against" the technology. This is part explains why so few have attempted it. But when, in the 1970s, the screen became a bit-mapped computer display, with individual pixels corresponding to memory locations that could be dynamically updated by a computer program, the one image/one screen logic was broken. Since the development of the Xerox PARC Alto workstation, GUI has used multiple windows. It would be logical to expect that cultural forms based on moving images will eventually adopt similar conventions. In the 1990s some computer games such as *Goldeneye* (Nintendo Rare, 1997) already used multiple windows to present the same action simultaneously from different viewpoints. We may expect that computer-based cinema will eventually go in the same direction—especially once the limitations of communication bandwidth disappear and the resolution of displays significantly increases, from the typical 1–2K in 2000 to 4K, 8K, or beyond. I believe that the next generation of cinema—*broadband cinema* or *macrocinema*—will add multiple windows to its language. When this happens, the tradition of spatial narrative that twentieth-century cinema suppressed will reemerge.

Modern visual culture and art offer us many ideas for how spatial narrative might be further developed in a computer; but what about spatial montage? In other words, what will happen if we combine two different cultural traditions—the informationally dense visual narratives of Renaissance and Baroque painters with the "attention demanding" shot juxtapositions of twentieth-century film directors? My *boyfriend came back from war!*, a Web-based work by the young Moscow artist Olga Lialina, can be read as an exploration in this direction. "Using the capability of HTML to create frames within frames, Lialina leads us through a narrative that begins with a single screen. This screen becomes progressively divided into more and more frames as we follow different links. Throughout, an image of a human

couple and a constantly blinking window remain on the left part of the screen. These two images enter into new combinations with texts and images on the right that keep changing as the user interacts with the work. As the narrative activates different parts of the screen, montage in time gives way to montage in space. Put differently, we can say that montage acquires a new spatial dimension. In addition to montage dimensions already explored by cinema (differences in images' content, composition, and movement), we now have a new dimension—the position of images in space in relation to each other. In addition, as images do not replace each other (as in cinema) but remain on the screen throughout the movie, each new image is juxtaposed not just with the image that preceded it but with all the other images present on the screen.

The logic of replacement, characteristic of cinema, gives way to the logic of addition and coexistence. Time becomes spatialized, distributed over the surface of the screen. In spatial montage, nothing need be forgotten, nothing is erased. Just as we use computers to accumulate endless texts, messages, notes, and data, and just as a person, going through life, accumulates more and more memories, with the past slowly acquiring more weight than the future, spatial montage can accumulate events and images as it progresses through its narrative. In contrast to the cinema's screen, which primarily functions as a record of perception, here the computer screen functions as a record of memory.

As I have already noted, spatial montage can also be seen as an aesthetics appropriate to the user experience of multitasking and multiple windows of GUI. In the text of his lecture "Of other spaces," Michel Foucault writes: "We are now in the epoch of simultaneity: we are in the epoch of juxtaposition, the epoch of near and far, of the side-by-side, of the dispersed . . . our experience of the world is less of a long life developing through time that of a network that connects points and intersects with its own skein . . . ." 48 Writing this in the early 1970s, Foucault appears to prefigure not only the network society, exemplified by the Internet ("a network which connects points"), but also GUI ("epoch of simultaneity . . . of the side-by-side"). GUI allows users to run a number of software applications at the same time,

and it uses the convention of multiple overlapping windows to present both data and controls. The construct of the desktop, which presents the user with multiple icons all of which are simultaneously and continuously "active" (since all of them can be clicked at any time), follows the same logic of "simultaneity" and the "side-by-side." On the level of computer programming, this logic corresponds to object-oriented programming. Instead of a single program that, like Ford's assembly line, is executed one statement at a time, the object-oriented paradigm features a number of objects that send messages to each other. These objects are all active simultaneously. The Object-oriented paradigm and multiple windows of GUI work together, the object-oriented approach, in fact, was used to program the original Macintosh GUI that substituted the "one command at a time" logic of DOS with the logic of simultaneity of multiple windows and icons.

The spatial montage of My boyfriend came back from war! follows the logic of simultaneity of the modern GUI. The multiple and simultaneously active icons and windows of GUI become the multiple and simultaneously active frames and hyperlinks of this Web artwork. Just as the GUI user can click on any icon at any time, thereby changing the overall "state" of the computer environment, the user of Lialina's site can activate different hyperlinks that are all simultaneously present. Every action changes either the contents of a single frame or creates a new frame or frames. In either case, the "state" of the screen as a whole is affected. The result is a new cinema in which the diachronic dimension is no longer privileged over the sincronic dimension, time is no longer privileged over space, sequence is no longer privileged over simultaneity, montage in time is no longer privileged over montage within a shot.

Cinema as an Information Space

As I discussed earlier, cinema language, which originally was an interface to narrative taking place in 3-D space, is now becoming an interface to all types of computer data and media. I demonstrated how such elements of this language as rectangular framing, the mobile camera, image transitions, montage in time, and montage within an image reappear in the general purpose HCI, the interfaces of software applications, and cultural interfaces.

Yet another way to think about new media interfaces in relation to cinema is to interpret the latter as information space. If HCI is an interface to computer data, and a book is an interface to text, cinema can be thought of as an interface
to events taking place in 3-D space. Just as painting before it, cinema presents us with familiar images of visible reality—interiors, landscapes, human characters—arranged within a rectangular frame. The aesthetics of these arrangements ranges from extreme scarcity to extreme density. Examples of the former are paintings by Morandi and shots in Late Spring (Yasujiro Ozu, 1949); examples of the latter are paintings by Bosch and Bruegel (and much of Northern Renaissance painting in general), and many shots in Man with a Movie Camera.49 It would take only a small leap to relate this density of "pictorial displays" to the density of contemporary information displays such as Web portals, which may contain a few dozen hyperlinked elements, or the interfaces of popular software packages, which similarly present the user with dozens of commands at once. Can contemporary information designers learn from information displays of the past—particular films, paintings, and other visual forms that follow the aesthetics of density?

In making such a connection, I rely once again on the work of art historian Svetlana Alpers, who claims that Italian Renaissance painting is primarily concerned with narration, whereas Dutch painting of the seventeenth century is focused on description.50 The Italians subordinated details to narrative action, urging the viewer to focus on a main event; in Dutch paintings, particular details and, consequently, the viewer's attention, are more evenly distributed throughout the whole image. While functioning as a window into an illusionary space, the Dutch painting is also a loving catalog of different objects, material surfaces, and light effects painted in minute detail (works by Vermeer, for instance.) The dense surfaces of these paintings can easily be related to contemporary interfaces; in addition, they can also be related to the future aesthetics of the macrocinema when digital displays will move far beyond the resolution of analog television and film.

49. Anne Hollander's Moving Pictures presents parallel compositional and scenographic strategies in painting and cinema, and it can be a useful source for further thinking about them as precursors to contemporary information design. Anne Hollander, Moving Pictures, reprint edition (Cambridge, Mass.: Harvard University Press, 1991). Another useful study that also systematically draws comparisons between the compositional and scenographic strategies of the two media is Jacques Aumont, The Image, trans. Claire Pajaczkowska (London: British Film Institute, 1997).
The trilogy of computer films by Paris-based filmmaker Christian Boustani (graphics and computer effects by Alain Escale) develops such an aesthetics of density. Taking his inspiration from Renaissance Dutch painting as well as classical Japanese art, Boustani uses digital compositing to achieve an information density unprecedented in film. Although this density is typical for the traditions on which he draws, it has never before been achieved in cinema. In Brugge (1995), Boustani recreates the images typical of the winter landscape scenes in Dutch seventeenth-century painting. His next film A Viagem (The Voyage, 1998) achieves even higher information density; some shots of the film use as many as one thousand six hundred separate layers.

This new cinematic aesthetics of density seems to be highly appropriate for our age. If we are surrounded by highly dense information surfaces, from city streets to Web pages, it is appropriate to expect from cinema a similar logic. In similar fashion, we may think of spatial montage as reflecting another contemporary daily experience—working with a number of different applications on a computer at once. If we are now used to switching our attention rapidly from one program to another, from one set of windows and commands to another, we may find multiple streams of audio-visual information presented simultaneously more satisfying than the single stream of traditional cinema.

It is appropriate that some of the densest shots of A Viagem recreate a Renaissance marketplace, a symbol of the emerging capitalism that was probably responsible for the new density of Renaissance painting. (Think, for instance, of Dutch still lifes that function like store display-windows to overwhelm the viewer and seduce her into making a purchase.) In the same way, the commercialization of the Internet in the 1990s was responsible for the new density of Web pages. By the end of the decade, all the home pages of big companies and Internet portals had become indexes containing dozens of entries in small type. If every small area of the screen can potentially contain a lucrative ad or a link to a page with one, this leaves no place for an aesthetics of emptiness and minimalism. Thus it is not surprising that the commercialized Web shares the same aesthetic of information density and competing signs and images that characterizes visual culture in a capitalist society in general.

If Lialina’s spatial montage relies on HTML frames and actions of the user to activate images appearing in these frames, Boustani’s spatial montage is more purely cinematic and painterly. He combines the mobility of the camera and the movement of objects characteristic of cinema with the “hyperrealism” of old Dutch painting, which presented everything “in focus.” In analog cinema, the inevitable “depth of field” artifact acts as a limit to the
information density of an image. The achievement of Boustani is to create images where every detail is in focus and yet the overall image is easily readable. This could only be done through digital compositing. By reducing visible reality to numbers, the computer makes it possible for us to literally see in a new way. If, according to Benjamin, early twentieth-century cinema used the close-up "to bring things 'closer' spatially and humanly," "to get hold of an object at very close range," and, as a result, destroyed their aura, the digital composites of Boustani can be said to bring objects close to a viewer without "extracting" them from their places in the world. (Of course an opposite interpretation is also possible: We can say that Boustani's digital eye is superhuman. His vision can be interpreted as the gaze of a cyborg or a computer vision system that can see things equally well at any distance.)

Scanning the prototypical perceptual spaces of modernity—the factory, the movie theater, the shopping arcade—Walter Benjamin insisted on the contiguity between perceptual experiences in the workplace and those outside it:

Whereas Poe's passers-by cast glances in all directions which still appeared to be aimless, today's pedestrians are obliged to do so in order to keep abreast of traffic signals. Thus technology has subjected the human sensorium to a complex kind of training. There came a day when a new and urgent need for stimuli was met by the film. In a film, perception in the form of shocks was established as a formal principle. That which determines the rhythm of production on a conveyor belt is the basis of the rhythm of reception in the film. 51

For Benjamin, the modern regime of perceptual labor, where the eye is constantly asked to process stimuli, manifests itself equally in work and leisure. The eye is trained to keep pace with the rhythm of industrial production at the factory and to navigate through the complex visual semiosphere beyond the factory gates. It is appropriate to expect that the computer age will follow the same logic, presenting users with similarly structured perceptual experiences at work and home, on computer screens and off. Indeed, as I have already noted, we now use the same interfaces for work and leisure, a condition exemplified most dramatically by Web browsers. Another example is the use of the same interfaces in flight and military simulators, in computer

games modeled after these simulators, and in the actual controls of planes and other vehicles (recall the popular perception of the Gulf War as a "video game war"). But if Benjamin appears to regret that the subjects of industrial society lost their premodern freedom of perception, now regimented by the factory, the modern city, and film, we may instead think of the information density of our own workspaces as a new aesthetic challenge, something to explore rather than condemn. Similarly, we should explore the aesthetic possibilities of all aspects of the user’s experience with a computer, this key experience of modern life—the dynamic windows of GUI, multitasking, search engines, databases, navigable space, and others.

Cinema as a Code

When radically new cultural forms appropriate for the age of wireless telecommunication, multitasking operating systems, and information appliances arrive, what will they look like? How will we even know that they are here? Will future films look like a “data shower” from the movie The Matrix? Does the famous Xerox PARC fountain, whose water stream reflects the strength or weakness of the stock market, with stock data arriving in real time over the Internet, represent the future of public sculpture?

We do not yet know the answers to these questions. However, what artists and critics can do is point out the radically new nature of new media by staging—as opposed to hiding—its new properties. As my last example, I will discuss Vuk Cosic’s ASCII films, which effectively stage one characteristic of computer-based moving images—their identity as computer code. 52

It is worthwhile to relate Cosic’s films to both Zuse’s “found footage movies” from the 1930s, which I invoked in the beginning of this book, and to the first all-digital feature-length movie made sixty years later—Lucas’s Star Wars: Episode I—The Phantom Menace. 53 Zuse superimposes digital code over the film images. Lucas follows the opposite logic: In his film, digital

53. The reason that I refer to Star Wars: Episode I—The Phantom Menace as the first all-digital film, as opposed to reserving this title for Toy Story, the first feature-length animation by Pixar (1995), is that the former relies on human actors and real sets, supplementing them with computer animation. It is, in other words, a traditional live-action film simulated on computers, in contrast to Toy Story, whose reference is cartoons and the tradition of computer animation.
code "lies under" his images; that is, most images in the film were put together on computer workstations; during the postproduction process, they were pure digital data. The frames were made from numbers rather than bodies, faces, and landscapes. *The Phantom Menace*, therefore, can be called the first feature-length commercial abstract film—two hours worth of frames made from a matrix of numbers. But this is hidden from the audience.

What Lucas hides, Cosic reveals. His ASCII films "perform" the new status of media as digital data. The ASCII code that results when an image is digitized is displayed on the screen. The result is as satisfying poetically as it is conceptually—for what we get is a double image—a recognizable film image and an abstract code together. Both are visible at once. Thus rather than erasing the image in favor of the code as in Zuse's film, or hiding the code from us as in Lucas's film, code and image coexist.

Like the VinylVideo project by Gebhard Sengmüller, which records TV programs and films on old vinyl disks,34 Cosic's ASCII initiative35 is a systematic program of translating media content from one obsolete format into another. These projects remind us that since at least the 1960s the operation of media translation has been at the core of our culture. Films transferred to video, video transferred from one video format to another, video transferred to digital data, digital data transferred from one format to another—from floppy disks to Jaz drives, from CD-ROMs to DVDs, and so on, indefinitely. Artists noticed this new logic of culture early on: By the 1960s, Roy Lichtenstein and Andy Warhol had already made media translation the basis of their art. Sengmüller and Cosic understand that the only way to deal with the built-in media obsolescence of a modern society is by ironically resurrecting dead media. Sengmüller translates old TV programs into vinyl disks; Cosic translates old films into ASCII images.36

Why do I call ASCII images an obsolete media format? Before the printers capable of outputting raster digital images became widely available toward the end of the 1980s, it was commonplace to make printouts of images on dot matrix printers by converting the images into ASCII code. In

55. www.vuk.org/ascii-aae.html
56. See also Bruce Sterling's Dead Media Project http://eff.bilkent.edu.tr/pcb/Net_culture-Folklore_Dead_Media_Project.
1999 I was surprised to still find the appropriate program on my UNIX system. Called simply "toascii," the command, according to the UNIX system manual page for the program, "prints textual characters that represent the black and white image used as input."

The reference to the early days of computing is not unique to Cosic, but is shared by other net.artists. Jodi.org, the famous net.art project created by the artistic team of Joan Heemskerk and Dirk Paesmans, often evokes DOS commands and the characteristic green color of computer terminals from the 1980s; Russian net.artist Alexei Shulgin has performed music in the late 1990s using an old 386PC. But in the case of ASCII code, its use evokes not only a peculiar episode in the history of computer culture but a number of earlier forms of media and communication technologies as well. ASCII is the acronym of "American Standard Code for Information Interchange." The code was originally developed for teleprinters and was only later adopted for computers in the 1960s. A teleprinter was a twentieth-century telegraph system that translated the input from a typewriter keyboard into a series of coded electric impulses, that were then transmitted over communications lines to a receiving system that decoded the pulses and printed the message onto a paper tape or other medium. Teleprinters were introduced in the 1920s and were widely used until the 1980s (Telex being the most popular system), when they were gradually replaced by fax and computer networks.

ASCII code was itself an extension of an earlier code invented by Jean-Maurice-Emile Baudot in 1874. In Baudot code, each letter of an alphabet is represented by a five-unit combination of current-on or current-off signals of equal duration. ASCII code extends Baudot code by using eight-unit combinations (that is, eight "bits" or one "byte") to represent 256 different symbols. Baudot code itself was an improvement over the Morse code invented for early electric telegraph systems in the 1830s.

The history of ASCII code thus compresses a number of technological and conceptual developments that lead to (but I am sure will not stop at) mod-
ern digital computers—cryptography, real-time communication, communication network technology, coding systems. By juxtaposing ASCII code with the history of cinema, Cosic accomplishes what can be called an "artistic compression"; that is, along with staging the new status of moving images as a computer code, he also "encodes" many key issues of computer culture and new media art in these images.

As this book has argued, in a computer age, cinema, along with other established cultural forms, indeed becomes precisely a code. It is now used to communicate all types of data and experiences, and its language is encoded in the interfaces and defaults of software programs and in the hardware itself. Yet while new media strengthens existing cultural forms and languages, including the language of cinema, it simultaneously opens them up for redefinition. Elements of their interfaces become separated from the types of data to which they were traditionally connected. Further, cultural possibilities that were previously in the background, on the periphery, come into the center. For instance, animation comes to challenge live cinema; spatial montage comes to challenge temporal montage; database comes to challenge narrative; the search engine comes to challenge the encyclopedia; and, last but not least, online distribution of culture challenges traditional "off-line" formats. To use a metaphor from computer culture, new media transforms all culture and cultural theory into an "open source." This opening up of cultural techniques, conventions, forms, and concepts is ultimately the most promising cultural effect of computerization—an opportunity to see the world and the human being anew, in ways that were not available to "a man with a movie camera."