

# From Processing to Design

## Open Source Culture and the Redefinition of Contemporary Graphic Design Practice

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## Abstract

This thesis analyzes how the free open source culture has, over the last two decades, reshaped the graphic design practice and redefined the contemporary graphic designer's position. After having contextualized and juxtaposed the start-up and the free open source cultures, this research investigates how Processing, coding language and programming environment, has contributed to the reappropriation of creative tools and fostered a radical stance against the commodification of design culture imposed by tech monopolies. Giving new meaning to the expression "open source," the project Processing has promoted accessibility and decentralized collaboration, expanding these concepts to fields beyond software development. Since its first release in 2001, Processing shifted from being a creative platform towards representing a system of values, and its influence on design and designers has immensely contributed to the emergence of new patterns in the graphic design field. Driven by Processing's core values—access, community, free—graphic design has acquired a social and political dimension. In addition to distancing their productions from standardized esthetics through the reappropriation of their creative tools, graphic designers have revealed alternative methodologies that encompass values of accessibility and inclusion as a critical part of their work. These methodologies, including the hybridization of production tools, DIY distribution methods, participatory generative design, and the use of cyberspace as a free framework, became valid propositions for a practice renewal based on responsibility and flexibility.

## Keywords

Graphic Design, Design Practice, Processing, Free Open Source, Programming



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## Introduction

[1] **Graphisme En France 2012: Code <> Outils <> Design**, trans. Lucrezia Russo (Paris: Centre national des arts plastiques, 2012).>  
 [2] *idem*, 5.  
 [3] *idem*, 6.  
 [4] *idem*, 9.  
 [5] *idem*, 8.  
 [6] 2017 CAST Symposium BEING MATERIAL: Ben Fry and Casey Reas. [www.youtube.com/watch?v=9BtqBjGEpA0](http://www.youtube.com/watch?v=9BtqBjGEpA0).  
 [7] *ibid.*  
 [8] CAST Symposium BEING MATERIAL.  
 [9] Casey Reas, "Thoughts on Software for the Visual Arts," *Medium*, January 27, 2019, <https://medium.com/@REAS/thoughts-on-software-for-the-visual-arts-690ea7bfc8b6>.

Over the last three decades, the exponential development of technology has impacted all creative practices and has radically changed graphic design perspectives. The revolution brought about by the rise of the personal computer, particularly the release of the first Macintosh in 1984, created new opportunities for graphic design research and production, opening the path to methodological and esthetical experimentations. Nevertheless, the transition between the two centuries marked a pivot and revealed the exhaustion of that momentum, which mutated into a manifest crisis of creative methodologies. Companies like Apple, Adobe, and, years later, Google have been the driving force behind the technological revolution in design. However, in their effort to provide access to easy-to-use computers, interfaces, and tools, they have participated in the standardization of design esthetics, and fostered the commodification of design culture instead of its democratization. In 2012, Kevin Donnot published the article "Code = design," [11] an excerpt of his master's thesis "Outils numériques et design graphique" (Digital Tools and Graphic Design). The essay questions the tools largely employed in the graphic design practice and, by extension, the practice itself. Restrained by the limitations of the massified software and submitted to the monopolization of devices that occurred in the early 2000s, the graphic designer must reclaim, Donnot stated, his status as a craftsperson and reappropriate the tools of creation. [12] Indeed, the standardization of the tools would translate to a normalization of graphic production and its esthetic. [13] To foster originality the graphic designer must become the maker of the creative tools. Programming and free software seem a possible alternative to reclaim this active role: "The interest of the free software [is that] the designer can integrate new functions and, above all, understand how the software works. Then, s/he is not lowered to a role of 'user' or 'consumer' and condemned to technical passivity. S/he moves from the status of consumer to the

one of creator." [14] Ten years after its release, Donnot mentioned Processing as being one of the programming languages and environments, within the free software movement, which represented an interesting alternative for graphic design: "The software proposes a new space for visual experimentation where the design is controlled by code. [...] This alternative approach implies alternative creative processes and, therefore, alternative graphical propositions." [15] Finally, Processing had crossed the Atlantic and was recognized as ambassador of the free and open source software movement, and as legitimate tool for the graphic design practice.

Conceived at the Massachusetts Institute of Technology (MIT) by Casey Reas and Ben Fry and built on the shoulders of prestigious predecessors such as Muriel Cooper and John Maeda, the first version of Processing was released in 2001. An easy-to-use, accessible coding language and programming environment, Processing was created to provide an educational tool for learning the graphic design principles, such as color and composition, through the medium of computation. [16] Intended for artists and designers, Reas and Fry's proposition fostered the idea of "learning to create software" as opposed to "learning to use software," suggesting a practical solution to the crisis of design methodologies of the late 1990s. [17] From the onset, Processing was quickly adopted by professionals who embraced its potential as a modular, expandable, and customizable kit. [18] Its auto-productive methodology echoed Do It Yourself (DIY) and hackers' approaches and it opened the path to a renewal of the crafts in the design practice, resulting in a hybridization of analog and digital methods of productions. Nevertheless, the core idea of Processing is even more radical, and its moral extent that "emerged within the culture of free software" [19] defines its approach and "differentiates [it] from proprietary, consumer-driven software." Processing

stands alongside the free/libre and open source software ideology and promotes the ideas of freedom and accessibility as essential. This position distances the project from purely esthetic considerations, adding a moral dimension in extending methodology to ideology. In the last decade, a community has grown. The work done by the community has provided new meanings to the expression “open source,” and has fostered a new vision of shared and decentralized collaboration, in fields that not only deal with software development.

Within this context, this thesis investigates, through the prism of graphic design, how Processing and the community built around it have transformed the design field and influenced the current generation of designers. Providing new perspectives to expand creativity and stand against the normalization of design imposed by design monopolies, Processing can be considered a pivot, this research postulates, in the dialectic opposition between the free open source and the start-up cultures, both interlaced within the graphic design field. The first chapter defines and contextualizes the opposition between start-up and free open source cultures, which arose in Silicon Valley and MIT between the 1970s and the beginning of the new century. The analysis of cases such as Apple Computer, Adobe Systems, and Google Design exemplifies the paradox of the start-up model, highlighting its metamorphosis from a counterculture into a monopoly. The review of core texts by the leading actors of the hacker, free software, and open source movements clarifies the misconception of free and open source culture and recognizes Processing as an advocate for a free and decentralized

approach. The second part of this research focuses on Processing and the community developed around it over the last twenty years. From Muriel Cooper and John Maeda to Casey Reas and Ben Fry, this chapter first describes Processing’s origins at MIT. By analyzing the platform’s main components—language, environment, community—the chapter examines how Processing has expanded the concept of accessibility, questioning its economic, social, and political aspects, and has fostered values of inclusion as a critical part of the project. Finally, this research describes in its third chapter how the free open source culture and the system of values fostered by Processing influenced contemporary designers, contributing to the emergence of new patterns in the graphic design field. Through the reappropriation of the creative tools, contemporary designers distance their productions from standardized esthetics and reveal alternative methodologies that encompass values of accessibility and inclusion as a central part of their work. These methodologies, including the hybridization of production tools, DIY distribution methods, participatory generative design, and the use of cyberspace as a free framework, are valid propositions for a practice renewal based on responsibility and flexibility. To solve the perpetual struggle of graphic designers’ position, often tugged between radical polarities—design research on one side and design industry on the other—this thesis highlights alternative perspectives encompassing the acceptance of the profession’s paradox and the awareness of the designers’ responsibility in contemporary society.



# 1. Start-up vs. Free Open Source: Contrasting Cultures

[10] 2016\_All  
Over\_interview Vera  
Molnar, trans.  
Lucrezia Russo, 2016,  
<https://vimeo.com/384470661>.

[11] MuDA, Vera  
Molnar: Randomness,  
2019, <https://vimeo.com/372579247>.

[12] Karl Gerstner,  
Karl Gerstner  
Designing  
Programmes (Zürich:  
Lars Muller  
Publishers, 2019).

[13] "Emigre:  
Magazine #11,"  
accessed September  
26, 2021,  
<https://www.emigre.com/Magazine/11>.

Graphic Design history cannot be dissociated from the technological evolution of tools: from the invention of the movable-type printing press, that shaped a new relationship to alphabets and, therefore, to typography, till the creation of the offset printing or the photocopy machine, which liberated the production and distribution of artist books and fanzines, new design esthetics and methodologies have always been empowered by new technological devices. Computational machines, the precursors of personal computers, joined the list of tools that have informed and reformed the way artists and designers conceived and produced images. By the 1970s, we observed a rising interest in merging art and mathematics through the medium of computation. Artists such as Vera Molnár, Manfred Mohr, and Frieder Nake pioneered the exploration of algorithmic thinking as a practical methodology for the arts. In a recent interview, Vera Molnár reiterated her approach: "In order to detect this extraordinary moment when the art arises, we do not have enough time and strength to craft it. It would mean to make millions and billions of variations. [...] Here, you have a slave that follows your wishes. [The computer] allows you to materialize very quickly your visual thoughts which you could not have created because of lack of time or strength, or visual acuteness." [10] Working with computation, Molnár pursued a part of the research developed by artists like Sol Lewitt, based on conceiving instructions to create a work of art. Giving instructions to the machine through code and randomizing some variables, she was, therefore, expanding intuition and enriching her senses: "There is a thing that can replace intuition. It's randomness. Because [...] it will show you billions of possibilities of which, with your limited imagination, you could not have thought of." [11] The concept of expanding the potential of creation, using computers and code, is not limited to this radical artistic

research. Mirroring the niche of computational art, the graphic design scene of central Europe of the 1960s developed design research that explored the potential of computation. Karl Gerstner, a prominent figure of the Swiss graphic design scene of post-WWII, was one of the first graphic designers who foresaw the opportunities brought by computers for a rational and functional graphic design production. In 1963, he published *Designing Programmes*, in which he compiled his efforts for automatizing processes and applying scientific methodologies to design. The designer needed a set of rules to select and arrange the different design components (typography, images, color). The computer could help create systems that enlarge the range of solutions, within which the designer could identify the best one. [12] If the work of Gerstner or Molnár was situated at a time when computational machines were essentially accessible for scientific or military research, the release of the first Macintosh in 1984 was a pivot towards the extension of access to computers for graphic designers, and, in the following years, for a bigger audience. The American graphic designer April Greiman—who did part of her studies in Basel in the 1970s and was immersed in the swiss graphic design approach—was one of the first designers to openly embrace the opportunities created by the Macintosh. Interviewed by the magazine *Emigre* in 1988, she echoed Vera Molnár: "What I experience is rather than just doing something quickly, we're looking at more possibilities. Instead of doing more work, we are seeing more options. [...] With the Mac, once the information is stored, you can just look at seventy-two thousand variations. And then the accidents happen, and you say, 'Oh that's so much better, why don't you go that way?'" [13] The iteration of graphic results offered by the machine was promoted as a sustainable methodology for design. Furthermore, Greiman adopted the esthetical language of the computer as a

[14] *ibid.*

[15] In this thesis, we refer to Steve Jobs's definition of this acronym: "What you saw on the screen was what you'd get when you printed it out."

Walter Isaacson, *Steve Jobs* (London: Abacus, 2015), 91.

[17] Richard Barbrook and Andy Cameron, "The Californian Ideology," *Science as Culture* 6, no. 1 (January 1996): 44-72, <https://doi.org/10.1080/09505439609526455>.

[18] "Cyberspace and the American Dream: A Magna Carta for the Knowledge Age," *Future Insight*, Aug. 1994," accessed August 16, 2021, <http://www.pff.org/issues-pubs/futureinsights/fil.2magnacarta.html>.

[19] Cédric Durand, *Technoféodalisme* (Paris: Zones, 2020), 16.

[20] Marshall McLuhan, Quentin Fiore, and Jerome Agel, *The Medium is the Message: An Inventory of Effects*. (London: Penguin Classics, 2008), 63.

[21] "All Watched Over by Machines of Loving Grace-Episode 1-Love and Power.Cs.Subs on Vimeo," 2011, <https://vimeo.com/515004292>.

new opportunity for graphic design expression: the pixel, the raster of the screen, transparency and superposition, as well as the simultaneous presence of visual elements became core elements of her production. These new esthetics could, according to Greiman, empower personal and collective manifestation: "Everybody is visual; it's in the collective soul, and the Mac will empower and help a lot of these people to express themselves. I like the idea that so many people will have a common language [...]. And this tool has its own language!" [14] Despite this optimistic vision, we witnessed, starting the mid-1990s, a slow but consistent shift towards a different use of the computer. If it was true that in the late 1980s computers were considered tools submitted to human beings to expand perception and production, during the following decade this trend faded away. In the early 2000s, it resulted in the massification of visual language's esthetics due to a standardization of the tools and, therefore, of the graphic design practice. So, what happened between the end of the 1980s and the beginning of the 2000s? What were the reasons for the shift of the graphic design practice towards standardized methodologies? Radical design research based on the exploration of computer depth through the medium of computation was still pursued in institutions such as MIT. Nevertheless, in the 1990s, the professional graphic design field was deeply impacted by the rise of the "What-You-See-Is-What-You-Get" (WYSIWYG) [15] interfaces that became popular as a way of emancipating oneself from the required understanding of the machine to be able to make design, allowing a more intuitive approach to graphic composition. Two opposite approaches developed in parallel and drew the main characteristics of what this thesis has defined as "start-up and free open source cultures." In the following sections, we clarify their origins and highlight their radical opposition that resulted, at the very beginning of twenty-first century, with the birth of Processing.

## 1.1 From Counterculture to Monopoly: A Silicon Valley Story

Narrowing down the geographical context in which the technological evolution of the end of the twentieth century occurred, we observe that devices and programs massively employed, on a worldwide scale, for graphic design production were created in the Silicon Valley. The binomial Apple Computer and Adobe Systems intersected in this economic region located in Northern California in the United States. [16] This region, pervaded by the "Californian Ideology," represented the biggest cultural paradox of modern history, and the contemporary design's culture has been molded mirroring this paradox.

*The Californian Ideology promiscuously combines the free-wheeling spirit of the hippies and the entrepreneurial zeal of the yuppies. This amalgamation of opposites has been achieved through a profound faith in the emancipatory potential of the new information technologies. In the digital utopia, everybody will be both hip and rich. Not surprisingly, this optimistic vision of the future has been enthusiastically embraced by computer nerds, slacker students, innovative capitalists, social activists, trendy academics, futurist bureaucrats and opportunistic politicians across the USA.* [17]

In the transition from the Industrial into the Knowledge Age, [18] cyberspace, the internet, and computers were seen as tools for emancipation from the established power and hierarchy. Colonizing this new immaterial space is an exciting opportunity for freedom and liberation. The Californian counterculture of the 1960s was reshaped, during the following decades, into a paradoxical ideology connecting two opposite but equally powerful aspirations: the collective adventure enabled by the new reach of global communications and a complete professional autonomy thriving on personal success. [19] Marshall McLuhan's global village theory [20] and the libertarianism promoted by Ayn Rand's allegories [21] were hybridized in the start-up culture which, in the name of innovation, does not perceive, or refuse to admit, the discrepancies of its economic model. Between the 1980s and the end

[22] Durand, *Technoféodalisme*, 33.  
 [23] Gochronicles, *Computer Chronicles S01E18 Computer Ergonomics*, 2019, <https://www.youtube.com/watch?v=BdqvXokbtAk>.  
 [24] *ibid.*  
 [25] Isaacson, Steve Jobs, 89.  
 [26] Don Norman, *The Design of Everyday Things: Revised and Expanded Edition* (New York: Basic Books, 2013), 162.  
 [27] Gianni Barbacetto, *Design Interface: How Man and Machine Communicate*; Olivetti Design Research by King and Miranda (Milano: Arcadia, 1987), 11.

of the twentieth century, cyberspace is still a place where market regulations are inapplicable or unapplied. Therefore, we witnessed the surge of contrasting visions for the possible missions of the internet. The philosophy of the free exchange of knowledge—brought about by activists such as Aaron Swartz—which fosters openness and collaboration, sets aside the liberal ideal of the conquest of cyberspace as a new market, denying any empathy or collaborative spirit, and promoting one's personal success at any price. [22] The aftermath of this paradoxical conjunction was the advent of start-ups companies born as opponents of powerful economic giants that have metamorphosed into giant infrastructures. Apple Computer and Adobe Systems—companies hardly avoidable in the professional graphic design field—are striking examples. Both corporations initially thriving for innovation with the mission of offering technological autonomy to their customers, have progressively been transformed into market dominators, forbidding any emancipation from their products.

### 1.1.1 Apple Computer

Invited by the TV show *The Computer Chronicles*, “icon designer” Susan Kare and Product Design Manager Jerry Manock presented, in 1985, the newly released Apple computer. Ergonomically studied to be light, portable, and user-friendly, the Macintosh was designed to be used by the “99th percentile of males, females, and children,” Maddock stated. [23] Developed to allow comprehensive accessibility, the interface system and icons were created to be clearly and quickly understood and assimilated. Susan Kare shared during the interview that “one of the best experiences,” was how to easily teach in roughly twenty minutes to use the Macintosh to those who have never used a computer before. This was made possible because the function of each icon does not need additional verbal explanation. [24] Interface and object's ergonomics translated into reality what Steve Jobs foresaw few years earlier: “bringing computers to the people, with the cheerful but affordable design of an Eichler home and the ease of use of a sleek kitchen appliance.” [25] It is paramount to

remember that, considering the historical and geographical context in which the Macintosh was conceived, its design was inherently western centered. With its focus positioned on the wealthy majority, Apple partially ignored any inclusive design principle devoted to minorities or “special people,” [26] fundamentals outlined, a few years later, by Don Norman in his *The Design of Everyday Things*. Nevertheless, “accessibility” and “affordability” were at the center of Apple's communication. The seeds of Apple's worldwide triumph of the following decades were grounded in these few concepts, as well as its paradox. Describing the interface, Susan Kare highlighted the similarities between Macintosh icons and daily life objects: the interface mimicked the interactions with our surroundings. We could easily recognize a “document” that we organized in a “folder.” If we saw clock hands turning, we could understand that we had to wait for time to pass. We calculated simple operations with a pocket calculator, and we put it in the trash can documents that we wanted to throw away. Since the creation of the personal computer, this intuitive strategy for computer interaction was groundbreaking, emancipating users from the need for a deep understanding of inherent machine language. The space between the human being and the machine was now inhabited by an interface that functioned as a translator. Interface design, thus, became strategic.

*The concept [of the interface] lies across a critical boundary—between material and immaterial reality. [...] interface is also the immaterial meeting place between two states of reality, previously extraneous, that merge to exchange information, to interact. [...] Around the concept of the interface, the relationship between man and machine calls up the problem of access—man must have access to the machine, and the machine must have access to the men, in a process that aims at attaining specific objectives.* [27]

The “specific objective” was evidently to facilitate the use of the machine, yet in a consumerist-driven effort to conquer a new market. Here resided the paradox: in the trajectory towards innovative accessibility, tech corporations have interposed an interface between the human and the

[28] Computer History Museum, Adobe Systems. The Founders' Perspective, 2002, <https://www.youtube.com/watch?v=pl0GthyD3f0>. [29] Ibid.

machine which, while facilitating comprehension of the functions, undermined the user's personal responsibility of understanding, and learning the machine's language. The result was users' lack of autonomy, with a consequent submission and dependence on technology. The accessibility, presented as a pedagogical gesture to emancipate users from the computer's complexity, resulted instead in their disempowerment. The pedagogical preoccupation was thus solely to educate a bigger audience, with the objective of attracting customers. Observing the evolution of Apple's interfaces from its early stages till the beginning of the 2000s, we recognize a development towards a skeuomorphic visual language that brought, in parallel, a progressive closure of the operating system. Although Apple's first Macintosh, included a "program to make programs" such as HyperCard which allowed its users to actively engage with the computer, this interactivity has become increasingly less accessible in newer machines. With the release of macOS X, the customization of graphic software through the installation of plug-ins became almost a quest. The fast, powerful, and fancy Apple computers of the beginning of the new century almost completely lost their modularity and customizability. Despite mimicking a three-dimensional space, their interfaces induced, instead, a linear and flat use of the device, preventing any in-depth interaction.

### 1.1.2 Adobe Systems

Founded in 1982, Adobe (originally Adobe Systems) has been Apple's entrepreneurial companion from its early stages. From creating the Postscript printing protocol, which allowed Apple to succeed in the desktop publishing industry, to developing the early versions of Illustrator for the Macintosh environment only, Adobe has been Apple's wing person in its entrepreneurial journey. Adobe's founders John Warnock and Charles Geschke shared the story and philosophy of the company during its twentieth-anniversary celebration in 2002. Grounded in the Silicon Valley ideology, Adobe echoes the entrepreneurial vision of the start-up culture. At a time, in the early 1980s, in

which the desktop printing market—the first territory of their intervention—was not yet defined or understood, Adobe has always thrived on innovation, focusing their efforts on groundbreaking products, designed to anticipate trends and market's demands. [28] The advent of the PostScript protocol, Adobe's first product and precursor of the open and standard PDF format, marked a new printing revolution. Bridging the screen and the paper—the "what-you-see" to the "what-you-get"—the PostScript language, implemented in the LaserWriter produced by Apple, profoundly reformed the graphic design industry, joining the immateriality of the screen to the materiality of the page and showing a concrete use of the computer to create graphics that could be converted in a quality tangible output. During the conference "Adobe Systems: The Founder's Perspective," Geschke addressed the two main points of Adobe's philosophy of the time: "Everybody should have their own computer. [...] A computer is not primarily used to calculate; it's used to communicate." [29] Giving access to technology to a wider market remains, as for Apple, one of the initial preoccupations of the company. And giving them the opportunity to imagine a pragmatic use of the machine computer with the connection to a printer was a breakthrough. Nevertheless, from an entrepreneurial standpoint, diversifying their product was critical for the company's survival. In 1986, Adobe released the first version of Adobe Illustrator, betting on the new and unlikely graphic design field: apart from cutting-edge experimentations of the few, most of the graphic designers had not yet, at the time, appropriated and integrated the computer as a production device. Quickly, Adobe Photoshop joined its fellow Illustrator and, together, they started conquering designers' fantasies. Selling the illusion of condensing, inside the computer box, and behind the screen, all graphical experimentations previously envisioned in the material realm, Adobe designated the computer as the new, compact, mono-tool for the visual arts. The expansion, during the 1990s, of graphic design programs undeniably empowered for a while the graphic design production pushing further the postmodernist experimentations like those initiated by designers such as the



[30] Rhonda Rubinstein, “Eye Magazine | Feature | Reputations: Zuzana Licko,” accessed October 15, 2021, <http://www.eyemagazine.com/feature/article/reputations-zuzana-licko>.

[31] Michael Grothaus, “Adobe Shuts down Photoshop in Venezuela Because of Trump’s Sanctions,” Fast Company, October 8, 2019, <https://www.fastcompany.com/90414653/adobe-shuts-down-photoshop-in-venezuela-because-of-trumps-sanctions>.

Swiss Wolfgang Weingart. The binomial computer/software allowed to de-structure, decompose, recompose, and reimagine elements (typography, grids, and layout) in newer, faster, easier, unexpected ways, contributing to establishing a different temporality for the projects and reforming the design process. The work of designers like David Carson, Neville Brody, or Rudy VanderLans, and Zuzana Licko exploited these new frontiers and pushed the boundaries of their research focused on hybrid forms on the edge between traditional and unconventional design: “We both [VanderLans and Licko], each in our own way, really enjoyed this machine. It forced us to question everything we had learnt about design. We both enjoyed that process of exploration, of how far you could push the limits.” [30] At the beginning of the twenty-first century, the major success of their products led Adobe to progress exponentially. Expanding the offer and acquiring competitors’ products and companies, the corporation-to-be set a new trajectory for conquering the market—a market they helped define—and assembled an entire armada of design programs. These years marked a pivot, shifting Adobe from a dynamic start-up that injected new perspectives for the design practice to a colossal infrastructure dominating the graphic design production. The visual excitement of the 1990s faded away, replaced by the feeling of being trapped in a conventional and expensive “golden cage,” with no possibility of expression out of the standardized path drawn by Adobe’s programs and interfaces.

Over time, Adobe’s interfaces have developed the same inherent structure, offering a global, consistent, and comforting environment for their users. Enabled to quickly recognize the graphic setting of the programs and easily appropriate the new functionalities, users felt in control of the workflow. However, the comfort of a recognizable interface generated a standardization of the esthetics of graphic design productions and a conformity in the methodological patterns of creation. Employing the same tools, with the same interfaces, engendered the harmonization of the mechanical gestures and behaviors during the design process. Furthermore, the acceleration of the

temporality of production, caused by a hyper-consumerist market, encouraged the designers to take advantage of the comfort of Adobe’s environment, and prevented any further design exploration of forms or tools. The conformity of design esthetics engendered by the standardization of the design tools is critical. However, to better frame the implication of Adobe becoming a monopoly, the question of affordability, and thus of accessibility, is crucial. Since the release of the first programs, the cost of the products has been prohibitive for most visual artists and designers, rejecting the economic minorities from the profession. Being a graphic designer was (and still is) a privilege, as it implies having the capacity of buying a computer (Apple) and the programs (Adobe for the most part) needed to create artwork. An underground market of cracked software provided, for years, the solution for some designers to start their activity until, in 2013, Adobe moved to a subscription-only model, removing any standalone versions. The customers are not the owners of the programs they use, and they pay a monthly subscription to access them. If the subscription model can be legitimate for commodities such as video on demand, the model becomes questionable when applied to professional tools required for working. In October 2019, Adobe temporarily blocked the access to Venezuelan customers to their products and enabled their customers to access their work on the Creative Cloud. The decision came in conformity with the US government’s decision of prohibiting transactions and services between companies of the United States and Venezuela [31] and dramatically revealed the flaw of their subscription-only business model. After month of negotiations with the US government, Adobe was able to restore the Venezuelan customers’ access to the Cloud. Nevertheless, the incident revealed the fragility of designers’ freedom and independence from the Adobe’s monopoly, and shown some inconsistencies between the philosophy of the company and its actions:

*The other philosophy that we have internally [...] in the way that our company should operate [is based on] one rule: if you are confused [about] how to deal with a fellow employee, a customer, a shareholder, or someone out there in the*

[32] Computer History Museum, Adobe Systems.  
 [33] *ibid.*  
 [34] Graphéine, “La ville de Paris revoit son identité visuelle,” January 13, 2019, <https://www.grapheine.com/actulogo/nouvelle-identite-visuelle-pour-paris>.  
 [35] Google Design, *Making Material Design*, 2015. <https://www.youtube.com/watch?v=rrT6v5sOwJg>.  
 [36] *ibid.*

community that you are interfacing with, just treat the individual the way you'd like to be treated. [...] That would be the Adobe way. Because when you are in business, your customers, in many cases, have their business critically dependent on your ability to deliver a quality product on time when you promise it. [32]

### 1.1.3 Google Design

We have observed how Apple and Adobe contributed to creating and developing the computer and software market in the graphic design field. Providing tools which simplified the intellectual access to the computers, they have educated, during the years, designers as well as a broader audience, and enabled them to appropriate the computer—till that moment seen as a computational machine for calculations—as a tool for communication and visual creation. [33] Both Apple and Adobe's efforts towards accessibility translated into creating environments and interfaces that were easy to use and understand. However, the temporary users' understanding of the personal computer's functions has metamorphosized into a lack of autonomy in front of the ever-changing technology. From the middle of the 1980s to the beginning of the 2000s, we witnessed the increase of the separation between the user and the computer, which concretized in the standardization of the design methodologies caused by the extended offer of programs relying on same interactive patterns. Google can be identified as the third actor that heavily contributed to the normalization of graphic design esthetics and methodologies. With the release of Google Fonts (originally Google Web Fonts), Google began a new business model for tech companies proposing free graphic design components distributed on the internet. This gesture towards a sharing strategy that echoes the open source model has democratized the access to design yet fostered the commodification of the design culture through the standardization of its esthetics. This event was critical in redefining the concept of accessibility. Google Font provided young designers and design students an affordable alternative to access, explore, and use typography; yet, it started colonizing the graphic design field, with professionals and agencies taking

advantage of the easy-to-use and free offer, forgoing the singularity and uniqueness that typographers used to bring to each design project. In January 2019, the branding agency Carré Noir redesigned the city of Paris' logo and identity, using the font Montserrat as its main typeface—one of Google Font's best sellers. [34] Is this business model a simple gesture to emancipate the users? The paradox of innovation of the start-up culture is still current. The shift toward a more open business model seems to benefit the tech corporation that, in providing commodities, retains its customers in its comforting cybercommunity. The complexity of defining “accessibility” is critical. Does Google's “accessibility” mean providing access to products or providing tools for autonomy? Is accessibility equal to emancipation, or just another way to conquer the market? In 2015, Google released Material Design, a comprehensive catalog of design components to create interactive applications, and published the documentation and specs online as an open platform. Material Design was thought to give consistency to the interactive interfaces of Android products (Apple's competitor). Giving open access to design tools with the mission of providing accessibility to a better design seemed innovative and far-sighted. If we watch the teaser *Making Material Design* published online for the release, we can identify some keywords such as “collaboration,” “community,” “experiment” that are repositioning the philosophy of Google towards a place close to the free open source approach. [35] The proposition is appealing. Nevertheless, the main consequences of Google's proposition are the esthetical uniformity of interaction design products', and the weakening of designers' legitimacy as professional experts. Presenting the color palettes of Material Design, Google's Senior Designer Rachel Been stated: “[with] this really simplified and easy-to-use system, [...] someone who never took a color theory class could create a combination of colors within their products that felt harmonious.” [36] Google has drastically contributed to the commodification of design practice and culture, fostering an ideal of “universal design” open to

[37] Google Design, Making Material Design.

[38] OSHWA, 2016 Opening Keynote-Allison Parrish, 2016, <https://vimeo.com/187595174>.

[39] *ibid.*

[40] *ibid.*

[41] Eric S. Raymond, "How To Become A Hacker, Eric Steven Raymond (Revision 1.23 , 27 Oct 2003)," accessed November 9, 2020, <http://vadeker.net/articles/hacker-howto.html>.

everyone, for everyone, by everyone, dramatically undermining the importance of designing with a focus on singularities. Matias Duarte, Vice-President of Material Design, reiterated their ideal of proposing principles of design that "should be timeless" in order to achieve a universal framework. [37] The concepts of universality and accessibility are, thus, central to this thesis' investigations. For years, the free open source culture's communities have pursued a parallel path, observing the development of the tech giants and, sometimes, raising their voice to expose the injustices created by the new hierarchies they have put into place. Processing's community has contributed the most to a critical approach to design aimed to empower the user instead of having them be submitted to a passive stance. Before diving into Processing's story, the next section will retrace the path of the free open source culture and communities situating them historically and geographically.

## 1.2 From Hackers to FLOSS (Free/Libre Open Source Software): A Moral Debate

For years in the shadow, often misunderstood and stigmatized, the legacy inherited from programmers and software developers has tremendously influenced the approach fostered by the Processing community. Between the 1960s and the 2000s, hacking, free software, and open source grew in parallel with the start-up culture, countering the capitalistic and consumer-driven orientation that was colonizing the field of software development at the time. Despite the fact that hackers and open source methodologies are now actively inspiring the contemporary design fields, the terminology referring to those cultures is often misused or, worse, misunderstood. To better frame the meaning of "free open source culture" employed in this research, this section analyzes some of the central texts that modeled the cultures of hackers, free software, and open source, and clarifies their terminology. Through the following literature review, this research retraces the path connecting the hackers' ethics rooted

in the MIT of the 1950s, through the open source methodology established in the late 1990s, till the contemporary definition of FLOSS (Free/Libre Open Source Software), and continues further to reveal the sour debate about the ethics of software development and distribution, that emerged at the end of the last century.

### 1.2.1 Hackers: A Matter of Jargon

Allison Parrish, programmer, artist, and educator introduced her opening keynote at the Open Hardware Summit 2016 as following: "Every practice, whether technical or artistic, has a history and a culture, and you can't understand the tools without understanding the culture and vice-versa. Computer programming is no different. [...] Part of the challenge of teaching computer programming is making the history and culture available to my students so they can better understand the tools I'm teaching them to use." [38] History and culture are inherently related to language and vocabulary. Parrish exemplifies this in her keynote, describing how, as a teenager, young programmer, and computer passionate, she relied on the software developer Eric S. Raymond's "Jargon File" to feel like she belonged to "the glory days of hacking and the computer revolution." [39] Born in 1981, she was too young to have lived the era, between the 1950s and the 1980s, during which hackers' terminology and their values were rooted. She thus consciously adopted the "Jargon File" as her own culture." [40] First published in the early 1990s, the informal web text the "Jargon File" is still considered one of the primary references to define hacker's terminology. Raymond is one of the most influential and prolific theorists who thoroughly contributed to defining, promoting, and supporting the hacker's community and the open source development model. In 1996, he published *How to Become a Hacker*: "As editor of the 'Jargon File' and author of a few other well-known documents of similar nature, I often get email requests from enthusiastic network newbies asking (in effect) 'how can I learn to be a wizardly hacker?' Oddly enough there don't seem to be any other FAQs or web documents that address this vital question, so here's mine." [41] What is a hacker, then?

[42] Eric S. Raymond, "How To Become A Hacker."

[43] *ibid.*

[44] *ibid.*

[45] OSHWA.

[46] Steven Levy, *Hackers: Heroes of the Computer Revolution-25th Anniversary Edition*, 1er édition (O'Reilly Media, 2010), ix.

[47] *idem*, 31.

[48] *idem*, 34.

[49] "Why Open Source

Misses the Point of Free Software

-GNU Project-

Free Software

Foundation,"

accessed August 9,

2021, [https://](https://www.gnu.org/philosophy/open-source-misses-the-point.en.html)

[www.gnu.org/](https://www.gnu.org/philosophy/open-source-misses-the-point.en.html)

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[point.en.html](https://www.gnu.org/philosophy/open-source-misses-the-point.en.html).

[50] Linus Torvalds and David Diamond, *Just for Fun: The Story of an Accidental Revolutionary* (Harper Business, 2002), ix.

[51] *Idem*, 94.

First, to demystify the communal belief about hackers, it is essential to make a clear distinction between the concept of "hackers" and the one of "crackers." [42] The media have often wrongly depicted hackers as people employing their skills to steal credit card numbers or sell confidential information. But if we refer to hackers' literature on the internet, we understand that this behavior is considered, by the hacker community itself, as "lazy, irresponsible, and not very bright." [43] In *How to Become a Hacker*, Eric Raymond stated that "being able to break security doesn't make you a hacker any more than being able to hotwire cars makes you an automotive engineer. [...] The basic difference is this: hackers build things, crackers break them." [44] A few years earlier, in 1984, writer and journalist Steven Levy published *Hackers. Heroes of the Computer Revolution*. Levy portrayed the "the glory days of hacking and the computer revolution" [45] dreamed by Allison Parrish and retraced the origins of the term "hacker" and narrated the community's early pranks in the rooms of MIT. In the preface to the 2010 edition, Levy stated:

*I was first drawn to writing about hackers—those computer programmers and designers who regard computing as the most important thing in the world—because they were such fascinating people. Though some in the field used the term "hacker" as a form of derision, implying that hackers were either nerdy social outcasts or "unprofessional" programmers who wrote dirty, "nonstandard" computer code, I found them quite different. Beneath their often unimposing exteriors, they were adventurers, visionaries, risk-takers, artists... and the ones who most clearly saw why the computer was a truly revolutionary tool. [...] I came to understand why true hackers consider the term an appellation of honor rather than a pejorative.* [46]

To restore that vision of the community, Levy listed the Hacker Ethic, a series of principles that are still claimed, by the contemporary programming community, as their foundation: unlimited access to computers, freedom of information, decentralization of power, and anti-academic position. Levy concluded the list with: "You can create art and beauty on a computer" [47] and "Computers can change

your life for the better." [48] Although certain aspects remain controversial, Levy's Hacker Ethic still reflected the building blocks not only of the hacker culture, but of the communities that have been inspired by the free software and open source models.

### 1.2.2 Open Source and Free Software: A Fracture

Hackers' approach, based on decentralization, collaboration, and free access to computers, programs, and information, continue to inspire parts of the contemporary design scene. Nevertheless, probably to distance themselves from a community too quickly stigmatized, the contemporary promoters of these principles prefer to define themselves as part of the open source movement. Over the last fifteen years, the term "open source" has increasingly gained notability, and its use has been "stretched [to] activities, such as government, education, and science, where there is no such thing as source code." [49] The open source methodology is built on decentralization and collaboration; yet "open source" does not imply freedom of access, use, replication, and distribution. The arise of the term "open source" is inherently connected to Linus Torvalds's lifetime work, the open source operating system Linux, still considered one of the "world's largest collaborative projects." [50] His work was an essential contribution in exposing the open source model—and in consequentially defining it—but also caused the fracture between the free software and the open source movements, in opposition about the ethics of software distribution. The story of Linux is summarized in Torvalds's auto-biographical book *Just for Fun. The Story of an Accidental Revolutionary*. The book title alludes to Torvalds's position regarding his work and the reasons for its success. Educated in Finland, a culture where "greediness was perceived as suspicious," and raised by a "diehard communist father," [51] Torvalds never thought of his work as commercially valuable. The intellectual aspect of it and the excitement of proposing a working piece of software were his driving forces. Sharing his code with others to collectively develop and solve problems simply seemed practical to him. His intention was not to



[52] Eric S. Raymond, *The Cathedral & the Bazaar* (Beijing; Cambridge: O'Reilly, 2001).

[53] The Open Source Initiative is a non-profit corporation with global scope formed to educate about and advocate for the benefits of open source and to build bridges among different constituencies in the open source community. "About the Open Source Initiative | Open Source Initiative," accessed August 22, 2021, <https://opensource.org/about>.

[54] "Shut Up And Show Them The Code," accessed August 14, 2021, <http://www.catb.org/~esr/writings/shut-up-and-show-them.html>.

[55] "Why Open Source Misses the Point of Free Software -GNU Project -Free Software Foundation."

[56] Torvalds and Diamond, *Just for Fun*, 196.

[57] Casey Reas, "Processing and FLOSS," Medium, January 27, 2019, <https://medium.com/@REAS/processing-and-floss-402108ff9d92>.

[58] *ibid.*

[59] *ibid.*

create a worldwide example of collaborative work or to build his career. He made it Just for Fun, the result of an intellectual, not strictly commercial, vocation. Inspired by Linus Torvalds's work, Eric Raymond wrote in the late 1990s, *The Cathedral & the Bazaar*, published in 2001. Central in defining the open-source methodology, Raymond's essay theorized about the bazaar's bottom-up methodology based on decentralization and collaboration and juxtaposed it to the cathedral's top-down design, typical of traditional development models. [52] With the foundation in 1998 of the Open Source Initiative (OSI) [51], Raymond distanced himself from the radical position of the Free Software Foundation, founded in 1986 and led by Richard Stallman:

*If [Stallman's] rhetoric had been effective outside the hacker community, we'd have gotten where we are now five or ten years sooner, and OSI would have been completely unnecessary (and I could be writing code, which I'd much rather be doing than this...). [...] So, when RMS insists that we talk about 'computer users' rights,' he's issuing a dangerously attractive invitation to us to repeat old failures. It's one we should reject -- not because his principles are wrong, but because that kind of language, applied to software, simply does not persuade anybody but us. In fact, it confuses and repels most people outside our culture.* [54]

Stallman clearly stated his disagreement with the Open Source Initiative in his critical text "Why Open Source Misses the Point of Free Software":

*The terms 'free software' and 'open source' stand for almost the same range of programs. However, they say deeply different things about those programs, based on different values. The free software movement campaigns for freedom for the users of computing; it is a movement for freedom and justice. By contrast, the open source idea values mainly practical advantage and does not campaign for principles. This is why we do not agree with open source and do not use that term.* [55]

If the debate is legitimate, paradoxically, Torvalds's decentralized model did not have any ethical implications, *per se*. In his book *Just for Fun*, Torvalds distance himself from the moral debate between open source and

free software, rejecting any label that Stallman or Raymond would put on him. He admits admiring and respecting both opponents but does not want to engage in the controversy. [56] The fracture between the open-source and free software ideologies (or rhetoric) is still a contemporary and relevant debate. Language often defines cultures and claiming to stand for the open source, or the free software model could have profound moral, ethical, and political implications.

### 1.2.3 FLOS Software and FLOS Culture for the Visual Arts

The controversy that emerged twenty years ago around software accessibility is still relevant and has infiltrated fields not explicitly connected to software development. The acronym FLOSS that stands for Free/Libre Open Source Software has been coined to partially "bridge the [free software and open source] communities and their differing opinions." [57] Casey Reas, co-creator of the Processing environment, published in 2017 the article "Processing and FLOSS," which revamped the debate, extending it to the visual arts. It also served to clarify the Processing community's moral position on this matter. He adopted a position of neutrality in front of the radical opposition of free software and open source, while underlining the Processing community's commitment for accessibility and free (libre) exchange: "Many people in the Free Software community argue with people who promote Open-Source software about fundamental ideas and vice versa. [...] The acronym FLOSS is sometimes used to bridge the communities and their differing opinions. The word libre is added to free to make the goal of 'free as in freedom,' the ideals of liberty, more clear." [58] Reas refers to Stallman's article "Why Open Source Misses the Point of Free Software," and clarifies his position about software for the visual arts, reiterating the importance of the tools' authorship, which allows to shape our work as we intend, without relying to corporations and ready-made platforms. He concludes: "We believe in the fundamental freedoms of Free Software and that is our path." [59] As this research will investigate in the following chapters,

[60] Casey Reas, "Thoughts on Software for the Visual Arts," Medium, January 27, 2019, <https://medium.com/@REAS/thoughts-on-software-for-the-visual-arts-690ea7bfc8b6>.

[61] Isaacson, Steve Jobs, 85.

[62] 2017 CAST Symposium BEING MATERIAL.

[63] "Cyberspace and the American Dream: A Magna Carta for the Knowledge Age," *Future Insight*, Aug. 1994."

moral commitment is crucial for the community which has developed around the Processing environment. The idea of a community fostering the principles of freedom and accessibility is an aspiration Reas reiterates in his "Thoughts on Software for the Visual Arts": "I have seen independent creators build local and networked communities to share intellectual resources and tools. [...] It's an aspiration toward a way of making and sharing that has been strongest in one area of the visual arts, the world of creator-programmers. I want to try to scale it within that context and I also want to know if it's applicable to other areas." [60] Based on Reas's postulate, we can legitimately use "free open source" to describe not only software programming but also cultures and communities built on the idea of decentralization, collaboration, and free access to information. If "free" is intended as "freedom" and "source" as "documentation," it is possible to make the transition from "free open source software" to "free open source culture."

### 1.3 Conclusion: Joining the Dots

Since the end of the twentieth century, Silicon Valley and its economic success have driven the imagination of young companies worldwide and have established new objectives for innovation in the economy of knowledge. The excitement of the new economic frontiers brought about by new technologies has shaped generations of young entrepreneurs, inspired by tech corporations' pioneers like Steve Jobs: "We are inventing the future. Think about surfing on the front edge of a wave. It's really exhilarating. [...] Come down here and make a dent in the universe." [61] Nevertheless, this optimistic vision has been recognized as a false promise. The hope of emancipation from the social and economic establishment brought about by computers and the internet has resulted in a re-centralization of the economic power in the tech giants' hands. Technology is unavoidable and especially the technological infrastructures that have colonized cyberspace. Design practices have particularly suffered from this new

paradigm: the professional graphic design market employing the tools offered by companies such as Apple and Adobe, struggled to find viable alternatives to their products. The monopolization of the tools for graphic design, in a pretended effort for universal accessibility—alas too often focused on the wealthy majority—have instead fostered progressive inaccessibility of the core of the technology itself, removing the necessity of learning the machine's language, and trapping its users in a "golden cage." This paradoxical situation has created a standardization of the production (the same tools produce the same esthetics) and, as Casey Reas highlighted in the CAST Symposium of 2017 "Being Material," [62] it has generated the crisis of creative methodologies. Nevertheless, alternative production models emerged in the legacy of hackers and open source cultures. As the report or the Progress and Freedom Foundation foresaw in 1994, "It is clear [...] that cyberspace will play an important role knitting together in the diverse communities of tomorrow, facilitating the creation of 'electronic neighborhoods' bound together not by geography but by shared interests." [63] These communities brought together by the virtual space of the internet provided a new vision in the quest for alternatives to the centralized power, detached by consumerist ambitions and converging towards a radical exploration of new forms of production and distribution. The free and open source dynamics have inspired new designers and initiated their emancipation, concretized in the self-production of tools and in a revamping of social and political engagements. If we identify the Silicon Valley as the cradle of the start-up culture, the free open source culture's would be MIT, where the roots of hackers and DIY cultures can be found. Towards the end of the twentieth century, compelling explorations emerged within this space for research, in the form of an in-depth investigation of the potentiality of new computational machines. MIT's open and exploratory approach catalyzed designers, artists, and researchers who were looking for new, radical dynamics. It was in this context of experimental research and embracing the principles of the free open source culture rooted in cyberspace, that Processing set its moral

**[64] Reas, “Thoughts on Software.”**

position. “The web extended values from decades prior,” Reas stated, “it accelerated the promise of more universal access to information, of creating new kinds of communities, and of breaking down hierarchies. These values are shared with the origins of Processing.” **[64]** Following

the path of Muriel Cooper and John Maeda, and through the discovery of Casey Reas and Ben Fry’s work, the next chapter will reveal Processing’s origins and describes its evolution from a programming language to a community fostering diversity and inclusion.

## 2. Processing: from Code to Platform

[65] Reas, “Thoughts on Software.” >

[66] Processing Foundation, “A Modern Prometheus,” Medium, June 8, 2018, <https://medium.com/processing-foundation/a-modern-prometheus-59aed94abe85>.

[67] Reas, “Thoughts on Software.”

[68] Charles P. Snow, “The Two Cultures,” The Rede Lecture, Cambridge: Cambridge University Press, 1959.

[69] Processing Foundation, “A Modern Prometheus.”

It’s hard to pin down what Processing is, precisely. I admit, it can be confusing, but here it is: it’s both a programming environment and a programming language, but it’s also an approach to building a software tool that incorporates its community into the definition. It’s more accurate to call Processing a platform—a platform for experimentation, thinking, and learning. It’s a foundation and beginning more than a conclusion. [65]

— Casey Reas, “Thoughts on Software for the Visual Arts,” 2019.

Processing is complex to define, and the risk of reducing it to a coding language would undermine its scope. The project’s complexity represents its richness and translates the multiplicity of influences and intents. In the first chapter, we exemplified how the triad “computer-software-internet” has been ruled by tech giants such as Apple, Adobe, and Google, and how these monopolies have chained graphic design professionals into closed workspaces, generating a standardization of the esthetics and a crisis in design methodologies. Processing’s proposition of “language-environment-community” [66] seems to provide alternatives to these dynamics and to reverse the paradigm of creation in the visual arts, allowing the designer to become the actor of a tool’s production and a work’s distribution. This chapter investigates the path that led to the birth of Processing and clarifies how its coding language and programming environment has evolved into a “platform,” inspiring artists and designers and empowering their practice. We first unveil the dialogue between Processing and its predecessors to show evidence of the tight connection with MIT and the graphic design practice. Through the analysis of the platform’s main components—language, environment, community—this chapter examines how Processing has expanded the concept of accessibility, questioning its economic, social, and political aspects, and has fostered values of inclusion as a critical part of the project.

### 2.1 MIT’s Heritage

Processing [...] was born at the MIT Media Lab, a place where C. P. Snow’s two cultures (the humanities and the sciences) could synthesize. [...] Processing wasn’t pulled from the air; it was deeply rooted in decades of prior work. [67]  
— Casey Reas, “Thoughts on Software for the Visual Arts,” 2019.

Processing’s complexity and relevance result from the combination of several influences, most of which are rooted at MIT. The connection between Processing and the free open source culture, also partially originated at MIT, was exemplified in the previous chapter: hackers, open source, and FLOSS approaches jointly informed Processing’s sharing model and initiated a new investigation about “accessibility.” Nevertheless, the thread connecting Processing to MIT consolidated between the mid-1970s and the late 1990s, when the MIT Media Lab, a space of groundbreaking experimental research, became the cradle of humanities and science’s conjunction. [68] Muriel Cooper’s Visual Language Workshop (VLW), followed by John Maeda’s Aesthetics and Computation Group (ACG), both part of the Media Lab, are undoubtedly the two laboratories that provided the building blocks of Processing’s platform. [69] Both Cooper’s interdisciplinary experimentation, informed by her graphic design background, and Maeda’s approach to code as a creative tool bloomed in 2001 in Processing.

#### 2.1.1 Muriel Cooper: from Visual Language Workshop to Information Landscapes

In 1994, a few months before suddenly passing away, Muriel Cooper, graphic designer and researcher, presented, at TED5 Conference, her project *Information Landscapes*, the result of the Visual Language Workshop’s research of the prior decade. The Visual Language Workshop (VLW) was founded by Cooper in 1974.



[70] Richard A. Bolt, “Finding Data,” *Spatial Data-Management, Massachusetts Institute of Technology*, 1979, 13.

[71] MIT Media Lab, *Information Landscapes: Muriel Cooper at the TED5 Conference*, 2018, <https://www.youtube.com/watch?v=BhrZHkdc2rU>.

[72] *ibid.*

[73] McLuhan, Fiore, and Agel, *The Medium is the Message*, III.

[74] *Observing Fig. 1.5, p. 9, we notice that Apple added, with the release of the Snow Leopard Operating System in 2009, a black background simulating the outer space. Nevertheless, the desktop was an illustration, a decoration, with no functional intent of deeper interaction with the inner architecture of the computer system itself.*

[75] “How Computer Code Became a Modern Design Medium—an Oral History,” *Eye on Design*, December 5, 2019, <https://eyeondesign.aiga.org/how-an-mit-research-group-turned-computer-code-into-a-modern-design-medium/>.

After having worked for over twenty years as a designer and art director at MIT Press, Cooper moved towards education and created a hybrid space, in which teaching and research intersected: the transdisciplinary approach inspired by the Bauhaus and the rigorous graphic investigations of the Swiss Style equally permeated her projects’ development. With the assistance of her students, Cooper cross-referenced media, materials, and processes, echoing the explorations of European postmodernist graphic designers of the same period, such as Weingart or Gerstner. Operating within MIT, the cradle of computer science, gave Cooper the opportunity to rapidly access powerful computers. She embraced these as an additional experimentation tool: *Information Landscapes* represents one of the most remarkable results and a groundbreaking moment of her career. Adding graphic design preoccupations, such as legibility and typographic arrangement, to data selection and fruition—a field equally explored within MIT through the research project DataLand [70]—Cooper focused on the three-dimensionality and depth of the inherent architecture of the computer. She foresaw this space as a means to develop interfaces that embraced the simultaneity and superposition of information and expanded the potentiality of human perception. [71] Cooper’s purpose was to redefine graphic design, [72] integrating McLuhan’s theories of simultaneous relationships “where a visual space is an organized continuum of a uniform connected kind.” [73] With her investigation, Cooper showed alternatives to Adobe and Apple’s linearity and flatness: the black background opposed the white page simulated by the WYSIWYG interfaces (see fig. 1.7); Cooper’s zoom-in brought you “inside” the interface itself and not “closer” to the page’s surface (see fig. 1.5); the interaction with the information was flexible and multiplied the observer’s possible points of view, countering the constraint and rigidity of Apple’s desktop space. [74] This thesis postulates that this flexibility has opened interesting paths for design research based on “multiversality” as opposed to mainstream design research focusing on “universality.” This flexibility reflects the ideals of inclusion and openness which were developed throughout the

Processing community years later, as this thesis exemplifies in later sections. Muriel Cooper’s work informed Processing and inspired its creators on several levels. Ben Fry’s work—as part of the contemporary Information Design and Data Visualization scene—reflected formally and conceptually Cooper’s effort of connecting to the inner architecture of the computer to translate data into compelling and relevant visuals, allowing access to complex information. Additionally, Cooper’s methodological approach, resonating with the Bauhaus’, has greatly influenced the pedagogical perspective that shaped Processing creation: “the idea of traditional foundational studies was really important to Processing. I thought it was another Bauhaus moment. I thought, in the same way that during the Bauhaus era we moved from arts-and-crafts production into industrialized production, it was time to move from industrial production into the computer software, information-based production.” [75] Another element completing the creation of the multifaceted Processing came from computational design. Cooper’s practice, impregnated by experimentation and trans-disciplinarity, opened the path for implementing computation as a means for visual expression.

### 2.1.2 John Maeda: from Aesthetics + Computation Group to Design by Numbers

The Aesthetics + Computation Group (ACG) was founded by John Maeda in 1996 to continue the work put in place by Muriel Cooper. Back to the United States following his graphic design studies in Japan, John Maeda wanted to further explore the intersection of art, design, and technology. The particularity of Maeda’s lab proposal was the use of programming as a creative tool to explore new forms in graphic design. At the time, programming was a territory almost exclusively related to computer science and mathematics. Despite the pioneer exploration initiated in the 1970s by a fringe of artists, the idea of programming as a visual tool had not yet been implemented in any research institution or program. Attracted by this unconventional approach, Reas and Fry decided to join the program and, working

[76] “Processing: The Software That Shaped Creative Coding,” Eye on Design, October 28, 2021, <https://eyeondesign.aiga.org/processing-the-software-that-shaped-creative-coding/>.  
 [77] *ibid.*  
 [78] John Maeda, *Design by Numbers* (Cambridge: MIT Press, 1999), 13.  
 [79] “How Computer Code Became a Modern Design Medium.”  
 [80] *ibid.*  
 [81] *ibid.*  
 [82] See section 1.1.1.

seeds of Processing. “I don’t think Processing would exist without John Maeda. The story starts there. Ben and I both came to MIT to study with John specifically because he was bridging ideas of computer science and design together,” said Reas. [76] To teach programming to designers and visual artists with no coding skills, Maeda developed a simple, accessible, and easy-to-use digital tool, Design by Numbers (DBN), implementing elementary commands to create dynamic images in a black and white 100x100 pixel screen canvas. [77] Through its simplicity, DBN had already integrated the concept of accessibility that Processing would come to develop years later. The concise and friendly interface was equipped with few buttons, and the concept “code, push play, and see” foresaw how visual people could seize and appropriate programming, quickly visualize the result of their work, and avoid the tedious labor with text and math. Maeda pushed his undertaking even further: alongside his mission to educate designers to use code as a tool for visual expression, he unveiled the inner structure of software thus inviting the students to appropriate digital tools. “My intent is to help build a basic understanding of the process behind creating a computer program. [...] You probably won’t be able to program the next competitor to Adobe’s last arsenal, but you will at least be able to appreciate the hidden alphanumeric chaos that underlies the digital design tools that many designers take for granted.” [78] His work, imbued with the preoccupation of countering Adobe’s “arsenal,” sought to equip new generations of designers with the necessary understanding of software development, so as to shape their critical eye regarding the digital tools that were colonizing the graphic design field.

### 2.1.3 Casey Reas and Ben Fry: Processing

While David Carson and Neville Brody were experimenting with Photoshop and Illustrator and exploring their creative potential, Casey Reas and Ben Fry were already questioning the methodological limitations inherent to these tools. Visual artists with different practices, both interested in challenging their work through the intersection of art and science,

Reas and Fry were aware of the constraints of the ready-made digital tools that appeared and arose at the end of the twentieth century. According to Fry, “tools like Photoshop and Illustrator [...] allow you to build things, but really they separate you from the medium in a way that’s not always helpful. More importantly, you’re restricted by what the companies building those tools are making available to you. That’s a significant problem in terms of your creative output being controlled by a company whose priorities might not be aligned with yours and your best, most interesting, and most challenging work.” [79] The creative process, framed by the functions that software companies made available to designers, was tied and submitted to tools’ limitations. Reas’s additional preoccupation was to change the way software was being integrated into art and design education: “I thought that the way schools were teaching students how to use Photoshop and Illustrator was entirely surface and didn’t even begin to explore the possibilities of new media. I wanted there to be a deeper understanding of the medium, rather than just using it as a tool.” [80] Finally, a third concern permeated Reas and Fry’s research: the question of accessibility. If the interface proposed by Adobe and Apple allowed the users to quickly grasp computer and software’s functions, their cost was prohibitive for most artists and designers. On the other hand, the code available as an open source resource, thus completely free, represented a complex tool to apprehend without a formal training in computer science and programming. As teaching assistants at ACG, Reas and Fry had the opportunity to run workshops introducing Design by Numbers to designers. That was a breakthrough moment for recognizing the importance of a user-friendly interface to communicate a coding tool: “Those workshops really opened my eyes. We could sit with a group of people who had never coded before—people who were designers—and within an hour, they were making stuff.” [81] This sentence echoes Susan Kare’s claim about the time needed to learn how to use a Macintosh. [82] Learning from that experience, Reas and Fry decided to bring DBN to another level and expand the potential of the tool: “Processing tried to take the minimal aspects of DBN but also

[83] “Processing: The Software That Shaped Creative Coding.”

[84] Processing Foundation, “A Modern Prometheus.”

[85] “Processing: The Software That Shaped Creative Coding.”

allow it to extend to the point where it was no longer purely a learning environment, but actually a full design and studio environment.” [83]

## 2.2 Processing: Language, Environment, Community

As a synthesis of Cooper’s design approach, Maeda’s use of computational design, and the open source sharing model, the first version of Processing, was released in 2001. Processing’s purpose was to create an intuitive system like Maeda’s Design by Numbers, but expandable as a toolkit: adding color, changing size of the canvas, but also evolving with additional libraries the tool allowed to envision more complex and ambitious creative outcomes. Moreover, the program was available online as a free software, easy to download and, once installed, it was functioning as a self-contained programming environment. Any user, even a beginner, did not need extra features (not even an internet connection) to start “sketching” with code. The idea of “sketching” is central to understand the project’s essence. Unlike traditional coding methodologies, Processing wanted to focus on process more than on outcome. The user could visualize their code-generated images almost instantaneously, instead of having to write a complete program before seeing the results; this meant giving room for unexpected results to emerge, and ultimately embracing mistakes and failure as an active part of the learning. These components made Processing the perfect pedagogical tool for foundational Art and Design studies and a powerful device for creative professionals. The interface of Processing 1.0 was similar to the one developed for DBN (and never fundamentally evolved); it was composed of two windows: one in which to write code and one, activated by the “play” button, in which to “run” (visualize) the sketch. References and examples were available on the Processing website, which was used as an open documentation platform to support users in navigating the environment. Finally, Processing, like the operating system Linux years earlier, took advantage of a community of developers,

creatives, and aficionados to expand and grow. In 2018, with the publication of “A Modern Prometheus” Casey Reas and Ben Fry summarized almost two decades of Processing history and reframed it as having been built on three main interlaced components: language, environment, community. [84] In the following sections, we will unveil how these components embeds different and interwoven moral values, and propose a different way to apprehend the triad internet, computer, and software.

### 2.2.1 Language: Code, Emergence and Multiverse

*A lot of people would say that having to write the code to produce the page and images is actually a huge step backward from having a tool to do it. But one of the ways John [Maeda] put it that always struck me was this idea that you wouldn’t have a painter who doesn’t know how to mix paint themselves or work within their medium.*

[85]

— Ben Fry, “Processing: The Software That Shaped Creative Coding”, 2021.

Code is a system of symbols and rules used to communicate instructions to a computer. It can be considered the raw material, the alphabet, of programming language. Software is a digital medium that, programmed with code in a specific language, allows—in the case of creative software—to express and visualize ideas. When we use ready-made software like Adobe’s, we use functionalities that have been chosen and compiled by Adobe’s software developers to allow users to execute specific tasks. For instance, using Photoshop, we can change the contrast of a picture by sliding a cursor or modifying a curve on a graph. This action is possible because someone who “speaks the code” (the software developer) has provided an interface that eases the communication between users and machines: we can give instructions to a computer without typing them in its inherent language. Designers have been living with the illusion (and students have been educated with the conviction) that ready-made software, because of its interface, was the quickest and easiest means to digitally draw and visualize ideas. Nevertheless, taking the example of motion graphics programs like Adobe After Effects, the interface is so



[86] **The Creators Project, How To Draw With Code** | Casey Reas, 2012, [https://www.youtube.com/watch?v=\\_8DMEHxOLQE](https://www.youtube.com/watch?v=_8DMEHxOLQE).  
 [87] *ibid.*  
 [88] *ibid.*  
 [89] See chapter 1, section 1.  
 [90] “How Computer Code Became a Modern Design Medium.”  
 [91] Reas, “Thoughts on Software.”  
 [92] Aaron Swartz, *The Boy Who Could Change the World* (New York: The New Press, 2015), 21.

complex that a deep understanding of the software becomes highly laborious and time-consuming. The interface does not automatically shorten the digital visual work’s creation learning curve. Moreover, the pre-chosen features may prevent discovering unexpected outcomes. Despite slick interfaces’ support, graphic design productions are, as a result, often standardized because of a superficial knowledge of the complexity of the programs and, consequently, of a limited use of the multiple features of ready-made software. Casey Reas, in his interview “How to Draw with Code,” related his method of laying out ideas and sketching: his process included pencil and paper, but also a text editor in which, instead of writing notes for essays, poetry, or fiction, he organized logic and procedures. [86] He wrote code to sketch; he sketched code. Within Reas’s research about “emergence,” [87] culminated in his *Process Series*, a few lines of code and simple rules sufficed to visualize unexpected and compelling results that evolved following different combinations and variables. The rigid frame of ready-made software would not allow the flexibility and malleability that programming provides and, furthermore, would prevent the discovery of serendipitous accidents. Comparing his software to a music score, Reas explained that every time the program ran, it was performed differently, and new elements emerged and unfolded. “I think this is a very exciting way to work with computers because, stereotypically, they are such calculating precise machines, but being able to allow unexpected things to happen.” [88] Embracing the infinite possibilities of each software’s performance echoes with Molnár’s expansion of the creative spectrum with the use of randomness. [89] Both processes, allowed by the flexibility of the code and the potential of algorithmic procedural design, encapsulating the acceptance of different, divergent, and eventually contradictory results. Accepting every instance as part of the whole makes their approach naturally inclined to include diversity. As Muriel Cooper already suggested with *Information Landscape*’s design, this trajectory opposes the “universal” design supported by contemporary mainstream design trends. Instead of creating rigid frameworks,

containing a limited number of possibilities (and structurally excluding some), a flexible design, centered on the idea of “multiverse,” would create, this thesis postulates, spaces for inclusion, and would open the path for a new design paradigm.

## 2.2.2 Environment: An Expanded Field

*P5.js* is a reinterpretation of Processing. It takes the initial goals of Processing and asks, “What does that mean for today?” [...] Instead of trying to retrofit those ideas into a project, we wondered: Can we try to build values of diversity and inclusion into the code from the get-go? We were making decisions in every moment, asking who are we privileging here? Who are we excluding? Who are we including? How do we make our message more explicit? [90]  
 — Lauren McCarthy, “How Computer Code Became a Modern Design Medium”, 2018.

In addition to the flexibility of the coding language, The Processing Development Environment (PDE)—the original software environment allowing beginners to start writing sketches—contributed to building a platform fostering values of inclusion. With the PDE, Processing’s creators aspired “to make the interface easy to use and the documentation clear and free of unnecessary technical jargon.” [91] Proposing code-based software with a clear and comprehensible interface was a novelty in the free software development culture. Free and open source software, rooted in the text-based Unix programming philosophy, had very poor User Interfaces (UI). Culturally, free software developers were programming for themselves and other “experts” of the community, who did not need efficient UIs to navigate the software. [92] The PDE was the first step to shift the paradigm of the free open source culture; it opened programming to communities, as the one of designers, that culturally did not “belong.” A huge step forward in shifting Processing toward a more inclusive environment was accomplished with Lauren McCarthy’s contribution: the JavaScript web library *p5.js*. Aware of the lack of diversity in programming communities, McCarthy joined Processing’s leading team in 2013 to expand the environment to become more inclusive. “One of the things we thought about really early on with *p5* was



[93] “Processing: The Software That Shaped Creative Coding, Part II,” *Eye on Design*, November 1, 2021, <https://eyeondesign.aiga.org/an-oral-history-of-processing-part-two/>.  
 [94] Swartz, Boy Who Could Change, 87.  
 [95] Processing Foundation, “A Modern Prometheus.”  
 [96] New Media Intersections, Daniel Shiffman: Processing and Pedagogy, 2014, <https://vimeo.com/86964553>.

the culture on GitHub, which is like the main place where the code base is developed. A lot of the conversations can be very aggressive, and you have to put yourself forward as an expert in order to be listened to. And we just really wanted to change that dynamic.” [93] With the p5.js JavaScript library, Processing was transferred from the local PDE to the web, opening access to programming to an expanded community of non-expert eager of learning creative coding. The potential of cyberspace envisioned by web activist Aaron Swartz a few years earlier, as a place for “rather than retreating into a ‘cathedral’ of elite programmers, [...] making the creation, distribution, and freedom of information as easy and frictionless as possible” [94] was fully exploited by the Processing community with the release of the p5.js web editor, developed by Cassie Tarakajian in 2018. This move allowed to broaden Processing’s teaching and learning community, including high and middle school educational institutions that could now take advantage of the browser’s accessibility to introduce coding to younger students, without having to download and install software.

### 2.2.3 Community: A Platform for Education

Observing the evolution of the Processing environment from the local PDE to the more accessible browser, education has been proven central for the Processing platform. This pedagogical interest shaped the community that grew around the project, defining a dynamic that distanced itself from the general open source methodology based on the collaboration for interest. Open source software development has, classically, a communal aim of creating, through a collective mind, a more efficient piece of software. In the case of Processing, the community comes together in its joint mission of providing tools and platforms for sharing knowledge. Processing community’s expansion leaned on the generous and relentless work of individuals, who contributed to the growth of the project, always in the spirit of sharing learning opportunities:

*The longest-running and most prominent effort is Sinan Ascioğlu’s OpenProcessing, which recently*

*launched a new interface that is compatible with p5.js sketches. Earlier initiatives include the Free Art Bureau’s Processing Cities initiatives to start user groups in cities around the world, Tom Carden and Karsten Schmidt’s Processing Hacks wiki, and Tom Carden’s blog aggregator. Early social media sites created community and energy around Processing through tags used within sites like Del.ici.ous and Flickr. OpenProcessing is going strong, but these other initiatives have changed as the web and the community has shifted.* [95]

Looking back at the project’s origins, the most influential figure who contributed to the expansion of Processing was—and still is—Dan Shiffman. Adjunct professor at ITP—a two-year Master’s program at Tisch School of the Arts, New York University—Shiffman joined the project right after his graduation at ITP in 2003. Processing was, at the time, a new tool for introducing programming to artists and designers. Within his research of unorthodox ways to teach programming and to unfold the potential of coding, Shiffman embraced Processing as an opportunity to develop new curricula at ITP. Wanting to experiment with reversed pedagogy (lectures at home; exercises in class) and foreseeing the potential of the web as an accessible platform for sharing pedagogical content, he started recording his lectures and sharing them with his student on Vimeo. [96] These videos were not intended to become pedagogical material for a more extensive community, nor were they introductory tutorials to Processing; yet, they were accessible to anyone who wanted to discover the potential of the new coding language. The interest around Shiffman’s videos grew exponentially, revealing the promise of the web as a pedagogical platform and the potential of Processing as a pedagogical tool. Dan Shiffman became the most prominent ambassador of Processing, bringing together a community of people eager to learn and share the new tool. Born as an experiment, Shiffman’s videos created the building blocks for future development on the web. Hello Processing, a one-hour coding tutorial, was the precursor of Cassie Tarakajian’s web editor, featuring, for first time, a window for coding embedded in the browser. The YouTube channel The Coding Train was the most influential project that followed.

[97] Processing Foundation, “A Modern Prometheus.”

[98] “Processing Foundation,” accessed December 6, 2021, <https://processingfoundation.org/>.

With more than a million followers, The Coding Train is still the primary reference for learning creative coding, from the basics to more advanced features. The pedagogical implication of this phenomenon is, of course, non-negligible. Furthermore, The Coding Train contributed tremendously to building the Processing community. Without a doubt, part of the YouTube channel’s success is Dan Shiffman’s personality—an undeniably critical aspect in the construction of any community. The concept of accessibility, central to Processing development, brings with it the meaning of closeness to others. “Most essentially, Processing is about people. It’s about individuals and collective learning and exploration; it’s about sharing ideas and giving what you can.” [97]

## 2.3 Conclusion: From Platform to System of Values

Considering the dramatic development of technology over the last twenty years, questioning the relevance of Processing as a digital tool in the contemporary software realm seems legitimate. By observing its trajectory and the steps undertaken by its creators, ambassadors, and community, it’s clear that Processing has evolved far beyond

being a platform, to become a carrier of values. Initiated embedding visions of interdisciplinarity, collaboration and radical exploration in the field of the arts, Processing pursued its path regularly reassessing its core values. The flexibility of the coding language, the use of internet as an open and accessible sharing platform, and the focus on inclusive education, continue to contribute to shifting the meaning of “free open source” beyond software programming culture. Processing was able to bring together communities of non-coders, and in doing so, it opened programming to anyone interested in exploring alternative ways to approach design. Processing gave the opportunity to marginalized and unrepresented communities to exist outside the standardized and expensive design realm offered by mainstream tech infrastructures, continually embodying their spirit of openness and inclusion. In 2011, the creation of the Processing Foundation formalized the missions of its community, centered around values of diversity and inclusion: “The Processing Foundation is specifically invested in expanding the communities of technology and the arts to include and support those who have not had equal access because of their race, gender, class, sexuality, and/or disability.” [98]

### 3. From Processing to (Graphic) Design

[99] Reas, “Thoughts on Software.”

[100] Mathieu Triclot “Philosophie Des Jeux Vidéos,” Zone, accessed December 21, 2020, <https://www.editions-zones.fr/lyber?philosophie-des-jeux-video#chapitre4>.

In 2017, Casey Reas reassessed the core values of Processing, synthesized in the triad “access-community-free.” [99] These principles have spread in the graphic design field, creating new territories in which design development focuses on inclusive and democratic methodologies. In the previous chapter, the three components, “language-environment-community,” provided a prism of analysis to explain the complexity of Processing as a platform. In this chapter, we exemplify the design shift, proposing a prism of observation based on Processing’s triad of values. Since the middle of the 2000s, graphic designers have questioned their position within the production chain and redefined their practice accordingly. Three patterns emerged, stressing Processing’s core values each in a different way. First, the rise of hybrid practices, which merged analog and digital tools, showed how the free open source sharing model and DIY methodologies had empowered accessibility and democratized design conception and production. Moreover, the influence of generative design and creative coding revealed a new path towards a design focusing on the “multiple,” as opposed to the “universal,” that opened conversations with diverse communities. Finally, the reappropriation of the publishing realm, leaning on free open source software and the web, subverted the graphic and editorial design’s chain of production, and provided new perspectives in these fields. These three axes are emblematic of the designers’ new stance in providing methodologies which now foster accessibility and inclusion, going against the standardization of design imposed by tech monopolies.

#### 3.1 Access: Hybrid Practices

Inspired by the free open source and Do It Yourself (DIY) cultures, contemporary graphic designers and graphic design studios have embraced, over the last two decades, unorthodox project methodologies

and, through the self-production of devices, have developed hybrid practices that mix analog, digital, and computational tools. After decades of staring at screens and claiming the death of paper and printing, the rise of these unconventional practices revealed how new technologies can improve graphic design esthetics and generate new opportunities for revamping traditional, and sometimes obsolete, printing methods. DIY, open source, and hacker cultures are actively providing valid methodologies to achieve this improvement. Today, we witness the conception of community and spaces built around objects of creation such as a RISO duplicator or a letterpress, set aside laser cutters, plotters, and 3d printers. “Hacking,” intended in its more contemporary meaning of “ingenious combination, or invention,” [100] is crucial and provides relevant experimentations intersecting new technologies with traditional techniques. This unorthodox attitude embraces the lesson taught by Processing and restores the role of computers as tools serving the design practice, instead of controlling the practice itself. As a result, compelling combinations of realms, previously considered in opposition, are blooming, and altering the graphic design esthetics.

##### 3.1.1 Digital Fabrication and Traditional Printing Techniques

By investigating the crossing of analog and digital processes, two patterns emerged as the most relevant in contemporary design practice, both aiming to emancipate designers from the esthetics’ normalization and commodification. The community grown around Processing and creative coding pursued its mission of developing digital easy-to-use tools and providing alternative software and platforms for the visual arts. Their work is often focused on building interactive devices and installations, frequently found on the frontier between art and design. The connection between creative coding

[101] “Making Our Own Type,” a98p, accessed December 26, 2020, <https://www.p98a.com/>, <https://www.p98a.com/collection/making-our-own-type>.

[102] Amber Weaver, “New North Press. AHP Six,” *People of Print* (blog), accessed December 24, 2020, <https://www.peopleofprint.com/letterpress/new-north-press-ahp-six/>.

[103] “Our Story,” *Open Press Project*, accessed December 28, 2020, <https://openpressproject.com/pages/about-us>.

[104] *ibid.*

[105] Enzo Mari, *Autoprogettazione, bilingual édition* (Mantova: Corraini, 2014).

[106] “‘Cyberspace and the American Dream: A Magna Carta for the Knowledge Age,’ *Future Insight*, Aug. 1994.”

and printing has been translated into the development of libraries that help transfer generated drawings on paper using mainly RISO duplicators, drawing machines such as pen-plotters, and eventually obsolete machines which have been hacked to add materiality to code-generated patterns. The results of these explorations, albeit sometimes facing issues of resolution and scale, have led to some fascinating processes. Louis Eveillard’s experimentations with his hacked embroider machine Tricodeur (a project developed in collaboration with 2roq and Sew&Laine in Bordeaux) and Licia He’s generated pen-plotted paintings both prove that young generations of artists and designers are susceptible to these opportunities and are, without inhibitions, dismantling the traditional separation between the space of screens and the one of studios. If emerging models connected to the realm of creative coding are growing within a territory where art and design intersect, digital fabrication has played a critical role in developing the professional graphic design practice, relying on DIY methodologies for the auto-production of tools from a professional production standpoint. Digital fabrication processes—intended as laser cutting and 3d printing techniques—have successfully contributed to giving new perspectives to traditional printing methods, and particularly to the letterpress. Since the middle of the 2010s, printers and designers have explored new production territories to expand their typefaces collections for letterpress printing. In 2016, the Berlin-based experimental letterpress workshop a98p had “tried it all: plexi, maple, pear, resin, magnesium, polymer, formica. CNC milling, 3D-printing, pantograph cutting, etched metal, vacuum-forming.” [101] Between 2014 and 2017, the London-based letterpress printer and design studio New North Press developed compelling experimentations, such as the 3d printed typeface A23D or the laser cut hexagonal woodblocks system AHP Six, both projects aimed at capitalizing on new technologies to empower professional productions in traditional printing. [102] Over the last few years, the development of affordable and valid desktop laser cutters and 3d printers has pushed the boundaries of graphic experimentation even further, allowing a

disinhibited typographical approach, defying classical typesetting canons. The work of printers and designers like the British Thomas Mayo or the American Ryan Molloy are examples of how digital fabrication, particularly that of laser cutting, has been organically implemented in graphic design practice as an active part of the design process. Digital fabrication could legitimately be considered one of the main advancements of letterpress since the adoption of photopolymer plates in the 1980s; these have contributed to expanding the community of designers around letterpress, providing a renewal of tradition and the development of a new craft in opposition to over-digitalized contemporary design productions.

### 3.1.2 The Open Source Sharing Model and the New Craft

Within the context of this new craft, some cases have proven how the open source model of free exchange and collaboration is relevant to other fields such as traditional printing. In 2018, Martin Schneider and Dominik Schmitz published the plans of The Open Press Project, a “tiny 3D-printed etching press that will let you use these techniques outdoors, in your living room or small studio.” [103] The two designers from Cologne, Germany, aware of the challenge of accessing an etching press, “wanted to give more people the option to use them for their art in places where printmaking was not possible before.” [104] The project received extraordinary support, and a community proliferated around it, proving the relevance of enabling easy access to printing tools. New sharing opportunities brought by the internet offered a new dimension to the democratization of design foresaw by Enzo Mari in *Autoprogettazione*? Mari’s reappropriation of the objects and its conception and design, and the demystification of the industrial production [105] are both empowered by the cyberspace and “electronic neighborhoods.” [106] Looking from this perspective, the model of free exchange of knowledge for printing opportunities bloomed during the global health crisis in 2020. During the COVID19 pandemic, the portable letterpress Provisional Press proved the relevance of implementing DIY methodologies to create affordable tools to



[107] “Home,” Provisional Press, accessed December 24, 2020, <https://www.provisionalpress.com>.  
 [108] *ibid.*  
 [109] “Laser Cut Plans,” Provisional Press, accessed December 28, 2020, <https://www.provisionalpress.com/laser-cut-plans>.  
 [110] 2017 CAST Symposium BEING MATERIAL.  
 [111] Martin Lorenz, “Des identités visuelles statiques aux identités visuelles flexibles,” *Graphisme en France 2017 : Logo & identités visuelles*, (Centre national des arts plastiques, 2017), 29.  
 [112] R. Roger Remington, “Un regard historique sur l’identité visuelles,” *Graphisme En France 2017 : Logo & identités visuelles* (Centre national des arts plastiques, 2017), 4-9.  
 [113] Paul Rand, “Logos, Flags, Escucheons,” *Aiga Journal of Graphic Design*, vol. 9, n°3, 1991.

empower online teaching. Considering student’s financial and space restrictions, Steve Garst along with his wife Liz Garst, and in collaboration with Scott Moore of Moore Wood Type, designed a kit that could “be built by someone with little woodshop skills but access to a laser cutter.” [107] This press offered “an inexpensive alternative that [could] act as a transitional press to enable students to make prints when they may not have access to a large steel press.” [108] All plans and instructions are available online and, faithful to the open source free-exchange spirit, “free for anyone to use and modify as they experiment with building their own press.” [109] These ideas resonate with the “modular, expandable, and customizable kit” [110] proposed by Casey Reas and Ben Fry with Processing and have been transferred from digital to analog, from screen to print. The concept of accessibility is, thus, crucial: the auto-productive and auto-didactic approach inspired by the free open source sharing model fosters accessibility not only in the conception and production of design, but also for educational purposes, inside and outside of institutions.

## 3.2 Community: Generative Identities

Since the beginning of the 2000s, we have noticed a shift in corporate identity design towards visual identities called “flexible,” [111] in which the classical pyramidal structure of companies’ language—from logo to applications—has been replaced by a multiplicity of signs communicating different facets of the brand. In post-WWII era, industrial production shifted from the manufacture of war supplies to commercial goods, and the importance of “branding” the companies to make them recognizable and sellable became central. [112] Designers such as Massimo Vignelli and Paul Rand appropriated and applied, in the United States of the 1960s-1970s, the “design of systems,”—developed by figures of the Swiss Style such as Josef Müller-Brockmann—to shape commercial communication. The “Logo” (with a capital L) became the focus of corporate identity

design with the mission of encapsulating the brand’s values as being timeless and universal. [113] The classical corporate identity manual designed to set companies’ visual language, was built on one sign, spreading from top to bottom in a pyramid of applications. The logo at the top had to be respected as a dogma. At the beginning of the 2000s, the relationship with costumers radically changed due to the establishment of new channels of commercial communication, those mainly provided by the internet. Companies faced a newly fragmented market, in which larger communities—made up of different ages, origins, and statuses—had access to products and brands. The pyramidal communication with the “Logo” positioned at the top became obsolete and its values of timelessness and universality were questioned. Flexible identities established a system of communication based on variations and iterations of signs, bringing the brands’ visual language towards a horizontal, transversal and network-based system. The identity of the brand became a choral idiom, addressing a message of openness and flexible complexity to a broader and more diverse audience.

### 3.2.1 From Flexible to Generative Identities

In this context, generative design—visual creations generated with code—has conveyed interesting methodologies to create iterations of signs addressing larger communities and emphasizing the concept of “multiversal design.” Generative identities have been proven particularly relevant for cultural institutions, museums, and cities as a means to transmit sets of values and to open conversations with diverse communities, sometimes allowing for active participation in defining the entity’s visual language. The first emblematic example of generative design used to conceive flexible visual communication is the identity for Casa da Musica, a music hall in Porto, Portugal. Designed in 2007 by the New-Yorker graphic design studio Sagmeister & Walsh, the identity pioneered the idea of using creative coding to expand the design system, and this at a time when creative coding was gaining a reputation as a tool for mainly artistic expression. The identity

[114] Sagmeister, Stefan. *The Power of Time Off*, TedGlobal, 2009, [https://www.ted.com/talks/stefan\\_sagmeister\\_the\\_power\\_of\\_time\\_off](https://www.ted.com/talks/stefan_sagmeister_the_power_of_time_off). [115] *ibid.* [116] “Visit Nordkyn,” Neue (blog), accessed November 21, 2021, <https://neue.no/work/visit-nordkyn/>. [117] *ibid.* [118] TheGreenEyl, “MIT Media Lab” accessed November 20, 2021, <http://thegreeneyl.com/mit-media-lab>. [119] *ibid.* [120] “Bologna City Branding — Studio Michele Pastore,” Michele Pastore (blog), Accessed November 21, 2021, <https://www.visualpastore.it/bologna-city-branding/>. [121] *ibid.*

systems’ inspiration came from Rem Koolhaas’s presentation of the building to the city of Porto, in which he defined the architecture as a “conglomeration of many layers of meanings.” [114] The building naturally became the logo’s shape, representing this conglomeration. The logo design is based on different views of the building—north, south, east, west, top, and bottom—and its color palette varies, generated by a piece of software, the Logo Generator, created for the client. Scanning the image representing the current event or concert, the software can identify and apply to the logo a color palette in harmony with the image, and consistent with the event’s communication. Potentially, the instances of the logo are infinite, corresponding to each event and speaking to any public Casa da Musica would like to reach. Sagmeister & Walsh intended, with this work, to create an appealing and dynamic visual language which distanced communication from a “overrated sameness” [115] and not specific to the idea of opening conversations and embracing communities. Nevertheless, their project unveiled new applications for creative coding within the graphic design practice, in foreseeing opportunities for inclusive “multiversal” design. Several notable projects following Casa da Musica, took advantage of these new opportunities. Studio Neue designed in 2010 the communication and visual identity for the peninsula of Nordkin, striving to increase the tourism in the area. Leaning on the concept of “The Mercy of the Elements” [116] the studio was able to unite the different municipalities, overriding conflicts of interests, and proposed a logo generated by the changes of wind and temperature. These communal natural elements served to connect the peninsula’s different identities. [117] That same year, for the celebration of its twenty-fifth anniversary, MIT entrusted the Berliner design studio TheGreeEyl and E Ron Kang, founder of Math Practice, with the redesign of its Media Lab’s visual identity. The identity wanted to manifest MIT’s spirit of transparency, mutual inspiration, and collaboration. [118] Conceived with Processing, the visual language is composed of 45,000 possible algorithmic variations, stressing the diversity of the MIT community. [119]

### 3.2.2 Generative Design and Participatory Practices

If previous cases were able to introduce creative coding as a tool for a more flexible communication, the most striking example, thus far, of generative identity used for participatory design is the Bologna City Branding. In response to the open call for the redesign of the Italian city’s communication, Michele Pastore and Matteo Bartoli proposed a graphic system that embraced Bologna’s plurality, aimed at illustrating the different realities of its inhabitants and tourists alike. To translate the richness and complexity of the city, the designers conceived an alphabet of geometrical elements, using the architectural archetypes of the city itself. The key element of the city’s identity is the online logo generator “ebolagna.it,” which allows the citizens to participate in the creation of a visual language: “Through the online logo generator, anyone can become actor of the process of creation, adding a personal ‘fragment’ to the global identity of the city. The communication of Bologna is thus propelled in a new and unexplored dimension. This isn’t just a flexible identity system, it is—maybe for the first time—participatory.” [120] According to 2019 data, 36,276 generated logos were shared online, 137 different logos were adopted by the municipality, and 183 generated logos were used by private companies on the territory. [121] The idea of designing for the “multiverse” regains all its meaning: the community is involved in the process of communicating their city; citizens feel part of a whole, in respect of their identity and their voice; and the municipality opens dialogue and participation. Design thus becomes a tool fostering diversity and inclusion.

## 3.3 Free: Independent Publishing

Additional proposals for redefining the graphic designers’ position came from the independent publishing realm. Since the beginning of the 2000s, graphic designers, particularly in Europe, have questioned the editorial design practice and reappropriated printed objects as territories for research and experimentation.

[122] Johanna Drucker, *The Century of Artists' Books* (New York: Granary Books, 2004), 72.

[123] "Rollo Press," accessed November 23, 2021, <https://www.rollo-press.com>.

[124] "About," Unit Editions, accessed November 28, 2021, <https://www.uniteditions.com/pages/about-unit-editions>.

[125] "OSP (Open Source Publishing)," accessed October 12, 2020, <http://osp.kitchen/about>.

This approach is comparable to the artists' emancipation, which occurred between the 1960s and the 1970s through the "democratic multiple" [122] and made possible by newly accessible and less expensive printing techniques. The printed object's democratization experienced a rebirth in the contemporary graphic design scene, thanks to the advent of the internet. Graphic designers, mastering the editorial production's chain from conception to production, began colonizing the publishing realm and adopted e-commerce to be set free from the economic and logistic burden of distribution. Furthermore, they embraced the web as an experimental publishing framework, including the use of cyberspace and free software as production tools, thus shaping unconventional visual expression.

### 3.3.1 The Contemporary "Democratic Multiple"

Relying on DIY methodologies for production and distribution, marginal micro-publishing realities have emerged over the last fifteen years, giving a new impetus to the independent publishing market and revamping the book as a democratic object of communication. The Swiss publishing project Rollo Press, founded at the end of 2007 by the graphic designer Urs Lehni, happened "accidentally" after Lehni decided to purchase a second-hand RISO duplicator on eBay. [123] Since then, Rollo Press has served as a publishing house and printing platform for contemporary artists. Embracing the rough esthetic of the Risograph technique and, leaning on the graphic design skills of its founder, the micro-publishing house has already distributed more than sixty titles. Rollo Press is one of many cases showing how graphic designers have extended their role, from conception to production. Using their practice to support and distribute contemporary artists' work, they have undertaken the roles of editor and publisher in addition to that of designer. This approach shifted the "democratic multiple" from a means of self-expression to a tool for collaboration and curatorship. In some cases, independent editorial entities—once just experiments—have now established themselves as realities and have

grown to become references in the field of publishing "by graphic designers, for graphic designers." The publishing houses B42 in France and Unit Edition in the UK are striking examples of this dynamic. Both were founded by accomplished graphic design studios—respectively by DeValence in 2008 and by Spin Studio alongside Adrian Shaughnessy in 2009—and have developed extended catalogs of books exploring different facets of the graphic design practice. Although B42 focuses on critical texts, and Unit Edition on graphic design productions, there are common threads to their practices, particularly in terms of their efforts to present "subjects that are either neglected or ignored by mainstream publishers." [124] They also both capitalized on online distribution to create a sustainable business model. Their endeavors have contributed to the democratization of the graphic design culture, without compromising on the quality of their publications.

### 3.3.2 Independent Tools for Independent Publishing

A more radical approach towards an uncompromised practice came at the beginning of the 2000s from entities committed to the Free/Libre Open Source Software (FLOSS). Founded in Brussels in 2006, Open Source Publishing (OSP) is one of the first graphic design collectives that committed to exclusively using FLOSS as a tool for a work's production, and free open license for publication. Convinced of the limitation of dominant software's interfaces (such as Adobe) often restricting the user to standardized design gestures, they questioned the influence of digital tools on their practice and looked for alternative graphic design studios' models. [125] Inspired by open source software development, they also conceived alternative tools for graphic design to facilitate collaboration. In 2014, they initiated the free software Visual Culture that allows keeping track, visualizing, and sharing the visual history of in-progress files without losing the current version of the work. Inspired by the Git branching model used in open source software development they expanded its collaborative methodology to visual practices as graphic design.

[126] “Visual Culture Open Source Publishing, Git et Le Design Graphique,” Strabic, accessed November 22, 2021, <http://strabic.fr/OSP-Visual-Culture>.

[127] “Workshop PrePostPrint Chercher, Manipuler, Partager, Imprimer,” Strabic, accessed November 22, 2021, <http://strabic.fr/Workshop-PrePostPrint>.

[128] “PrePostPrint,” accessed November 29, 2021, <https://prepostprint.org/>.

[129] “Visual Culture Open Source Publishing, Git et Le Design Graphique,” trans. Lucrezia Russo.

Visual Culture became thus an invitation for collaborations between professionals. Questioning the economic dependence on mainstream software, Open Source Publishing challenges graphic designers and educational institutions to act and dismantle this paradigm. [126] Responding to OSP’s invitation, Raphaël Bastide and Sarah Garcin started in 2017 PrePostPrint, a platform gathering experimental editorial projects conceived using FLOSS. Focusing on publishing, the French designers’ ambition is to promote graphic design explorations based on unorthodox design methodologies relying on non-traditional and affordable tools of production. [127] Using the web as an alternative platform for creating layouts using HTML and CSS coding languages, they propose a production chain that allows the designer’s complete autonomy from traditional software. Their practice embraced the spirit of sharing knowledge through organizing workshops in schools, giving lectures, and gathering information about people, projects, and studios working with similar preoccupations. [128] Open Source Publishing and PrePostPrint are compelling examples of radical propositions to stand up against the tech giants’ monopolies and regain autonomy and freedom in the graphic design practice. Furthermore, this radicality has undeniably generated an array of original visual propositions, marking a break from conventional and standardized results obtained with mainstream digital tools. Nevertheless, regaining autonomy using the free software seems still complicated to implement on a regular basis in a graphic design practice, which often remains chained to a market ruled by standardized tools. Furthermore, the functionalities of unorthodox software such as Visual Culture or the possibility of web-to-print practices are still a mystery for the average designer, who is more at ease faced with Adobe interfaces than before two lines of code. Can this radical approach be implemented in everyday design practice? Open Source Publishing proposes the following:

*How could we dismantle the dominant logic [of closed software] if we do not react? In the closed*

*environment in which the students are trained for their own alienation, schools have an essential role to play to change the world promised by the software industry. We dream of schools dedicating their budgets to free software creation, instructors’ training, and studio materials; schools that would build and redistribute free software, using it—why not?—as a means of communication. How many failures do we need to open our eyes, finally?* [129]

### 3.4 Conclusion: Towards a Practice Renewal

Now that graphic design is tightly interwoven with tech giants’ infrastructures, designers struggle to identify alternative processes and tools to regain independence in their practice. In response to mainstream tools and standardized visual patterns imposed by the market’s rules, some designers have embraced the values promoted by Processing and found alternative processes to differentiate their work from normalized dynamics and shift their practice towards a more inclusive and responsible design. Nevertheless, each proposition has been shown to partially tackle the multi-faceted design dilemma: the practice is so entangled with tools and culture provided by the tech monopolies that a radical approach to extract the designers from this reality does not seem to solve the tension between original visual research and commercial production. To explore new trajectories for a practice renewal, graphic designers can, thus, take advantage of a multiplicity of tools and a combination of approaches belonging to different and sometimes divergent realms in the effort of apprehending the paradox of the design practice and compromising with it. Furthermore, as Processing has shown with its trajectory, and Open Source Publishing reiterated in their interview with Strabic, pedagogy is key for dismantling the dominant dynamic of the monopolies. Educational institutions have an essential role in identifying new methodologies for sharing knowledge and showing alternative frameworks of production.



## Conclusion

[130] Durand,  
Technoféodalisme, 42.  
[131] Isaacson, Steve  
Jobs, 89.

Drastically reformed by the mainstream digital tools that arose at the end of the twentieth century, the graphic design practice is experiencing a critical methodological crisis. The armada of ready-made tools provided by companies shaped within the Silicon Valley paradox [130] has ruled the graphic design field, trapping graphic designers in an inextricable dilemma. The intuitive interfaces, software, and design components provided by Apple, Adobe, and Google allowed “bringing computers to the people,” [131] yet were responsible for commodifying the design tools and culture. Graphic designers are now tugged between the necessity of being part of a market and exiting the standardized visual pattern induced by the tech monopolies. Easy access to computers and software weakened the creative process, shifting the profession towards a technical skills compilation, emptied of critical skills. Furthermore, in the effort of conquering a broader market, the “access” provided by tech infrastructures focused on giving the visual keys to communicate and interact with the computer, forgetting “affordability” as its critical connotation. Mainstream digital tools are expensive and hardly affordable by independent designers, consolidating graphic design as a practice for privileged communities. In this context, two forces have counter powered this trend: radical design research and the free open source culture. Observing MIT’s trajectory of the end of the twentieth century, we have identified the roots of these two counterpowers in its research laboratories. The hackers’ culture—that have informed the open source sharing methods—and Muriel Cooper and John Maeda’s radical approach have fused into Casey Reas and Ben Fry’s project Processing. A pivotal event for the design field, Processing immensely contributed to reappropriating the graphic design practice as a critical process and redefining the graphic designers’ position, shifting the practice towards a design of diversity and inclusion. Processing has shown how, changing the paradigm of production and

distribution, designers can integrate a prism of observation based on “multiversality” instead of “universality.” Furthermore, “accessibility” retrieves its economic, social, and political connotation, and the free and open access to digital tools and the free framework for sharing and learning become fundamental. By giving access to design tools to unprivileged communities, Processing fosters democratization of design instead of its pauperization. Some designers have invested in Processing as a tool and a system of values, reassessing their gaze on design production and integrating the social and political dimension as central. New methodologies, including the hybridization of production tools, DIY distribution methods, participatory generative design, and the use of cyberspace as a free framework, were invested as valid alternatives in their practice renewal. However, these approaches are still exceptions. In contemporary society, being a designer remains a privilege, and designing is still inherently perceived as an act of exclusion. When we design, we work to solve specific problems, focusing on specific audiences, responding to specific briefs of specific clients. So, how can designers work actively to define a more responsible and inclusive practice? Throughout this thesis, we have opposed start-up and free open source cultures, identifying polarities that arose from this dichotomy: close versus open; universal versus multiversal; centralized versus decentralized. How should the designers position themselves tugged between these opposite forces? This thesis proposes to refuse any alliance to a radical stance. The designer can create flexible responses to design questions by shifting the cursors between opposite dualities and regularly inspecting their work and position. The designer’s practice can be enriched by different combinations of values, becoming modifiable, dynamic, and adjusted for each project. Who are we designing for? Who are we forgetting? Who are we excluding intentionally or unintentionally? How can

**[132]** “Education,” accessed December 30, 2021, <https://processingfoundation.org/education>.

we force the cursor towards one specific direction? These are some of the questions that may help designers navigate their practice. This proposition is not exhaustive, and the list of polarities can be extended and completed. Moreover, to enhance this proposition, it is paramount to focus on the intersection of “accessibility” and “inclusion.” As shown throughout this thesis, “accessibility” can be legitimately used to describe Apple and Adobe interfaces (user friendly, but not affordable), as well as a source code (free of use, but not easily understandable for non-coders). These two objects are both accessible but, considering the economic connotation of the term, represent different levels of inclusion. The crossing between the term “accessibility” and “inclusion” unfolds a semiotic territory that designers can explore to better visualize their project’s stance. To integrate in their practice a more responsible posture, designers are invited to get inspired by the Processing community that has been able, throughout the years, to regularly reassess their focus and shift from a position of radical research to open and flexible inclusivity. Designers must grow in the same direction. A paradox is embedded in designers’ professional practice, and this dilemma cannot and does not have to be solved. Yet, it should be apprehended. As a

privileged community, designers have the responsibility of developing and breeding awareness and critical thinking for a more inclusive design. Moreover, Art and Design educational institutions are also responsible for integrating this prism in their teaching to equip students—professionals-to-be—with the critical eye necessary to confront the contemporary design dilemma. Some independent pedagogical projects have successfully created diverse and inclusive spaces for critical thinking and responsible creation. The Processing Foundation has developed an educational section gathering pedagogical material free to use: “Rather than endorse a specific curriculum, we’ve engaged with a variety of educators from our community, ranging from K12 teachers, to folks who lead workshops at hackerspaces, to university professors in interdisciplinary departments. We’ve asked them to share their teaching materials here, which anyone can use.” **[132]** Institutions cannot ignore the major shift that occurred in the design practice and, following the example of Processing, must learn from the free open source culture communities and integrate methodologies based on openness, decentralization, and horizontal collaboration.

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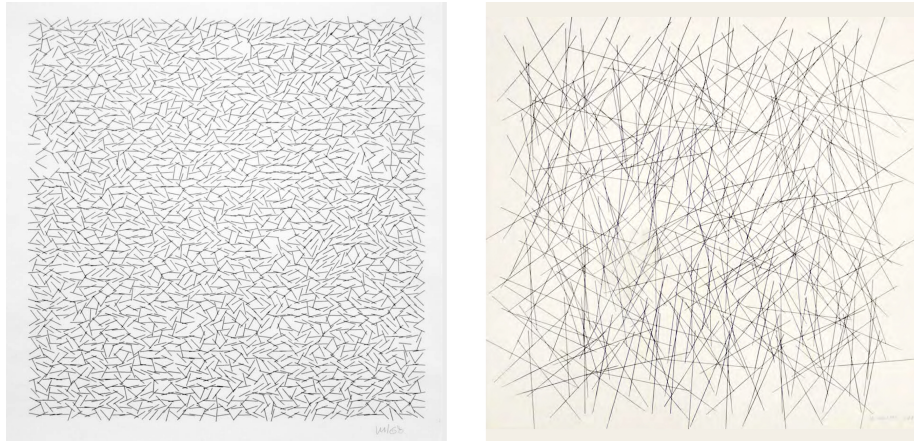
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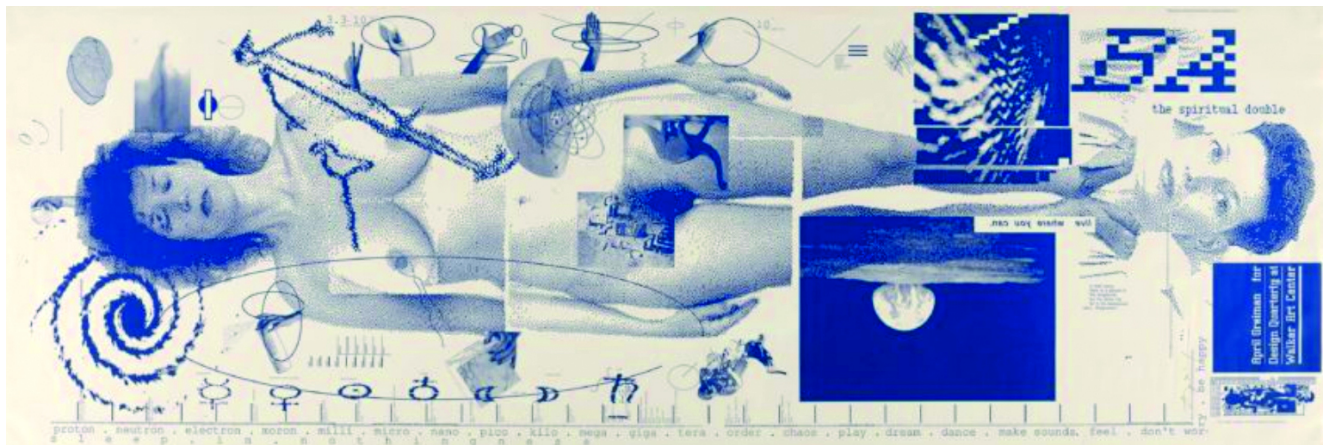
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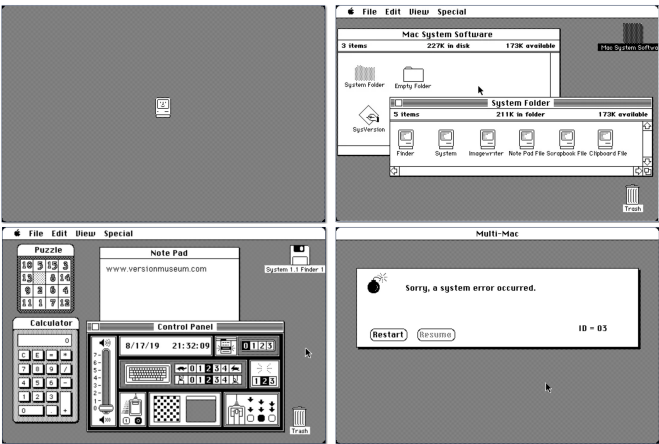
## Figures



**[Fig. 1.1]** Vera Molnár, *Interruptions*, 1968, computer generated graphic in ink on Benson plotter paper, 34.6 x 32.4 cm. **[Fig. 1.2]** Vera Molnár, *Inclinaisons*, 1971, computer generated graphic in ink on Benson plotter paper, 50 x 50 cm.



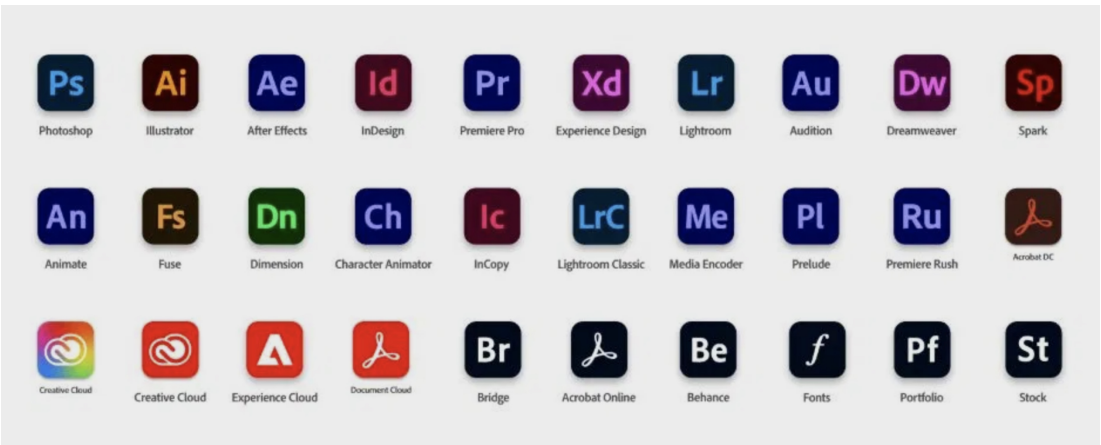
**[Fig. 1.3]** April Greiman, *Design Quarterly issue 133 poster*, 1986, offset lithograph, 64.8 x 193 cm. Collection SFMOMA, <https://www.sfmoma.org/artwork/96.366>.



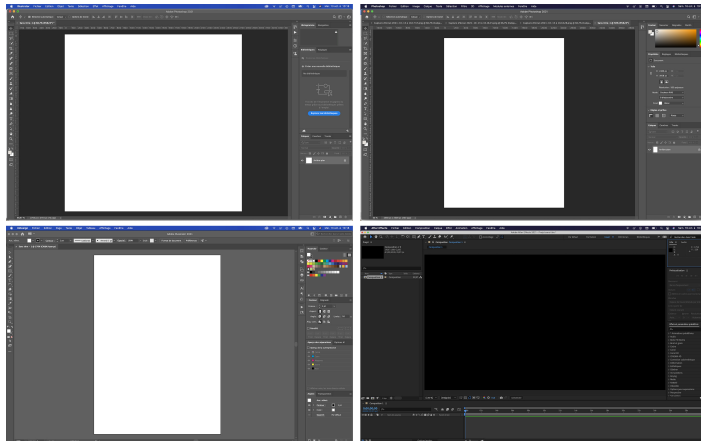
[Fig. 1.4] Mac OS System 1. Welcome Screen, Desktop, Control Panel, System Error Bomb, 1984.  
<https://www.versionmuseum.com/history-of/classic-mac-os>.



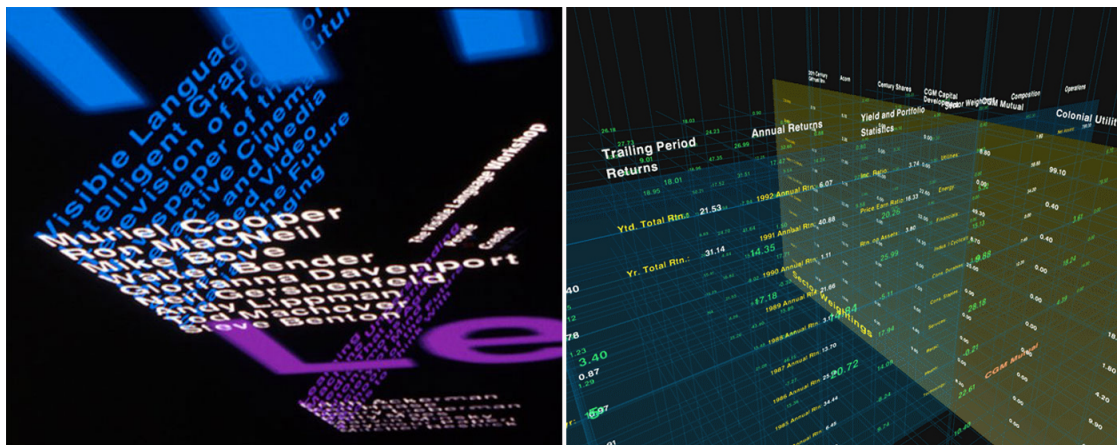
[Fig. 1.5] Mac OS X 10.6 Snow Leopard, About Dialog Box, Dashboard Feature, Finder Cover Flow, 2009.  
<https://www.versionmuseum.com/history-of/classic-mac-os>.



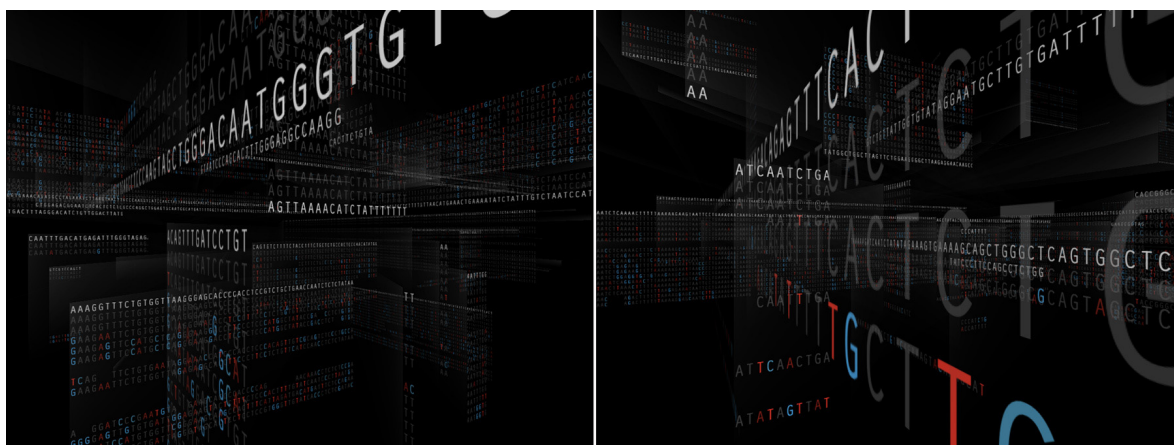
[Fig. 1.6] Adobe, Products Icons, 2021. <https://365webresources.com/adobe-product-app-icon-sets>.



[Fig. 1.7] Adobe, Software Environment. Illustrator, Photoshop, InDesign, After Effects, 2021.

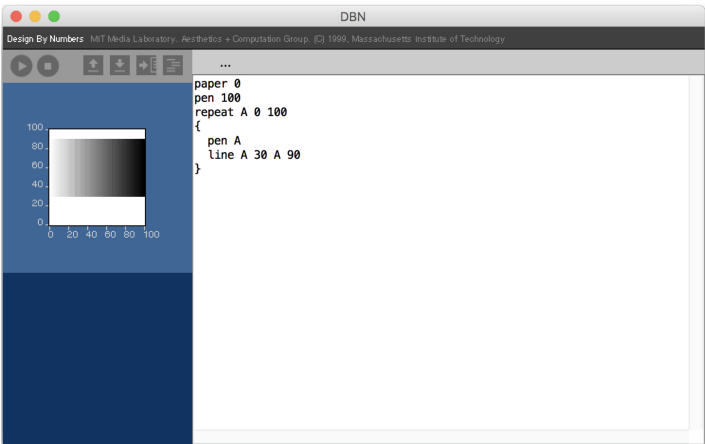


[Fig. 2.1] Muriel Cooper, Information Landscapes, 1994.

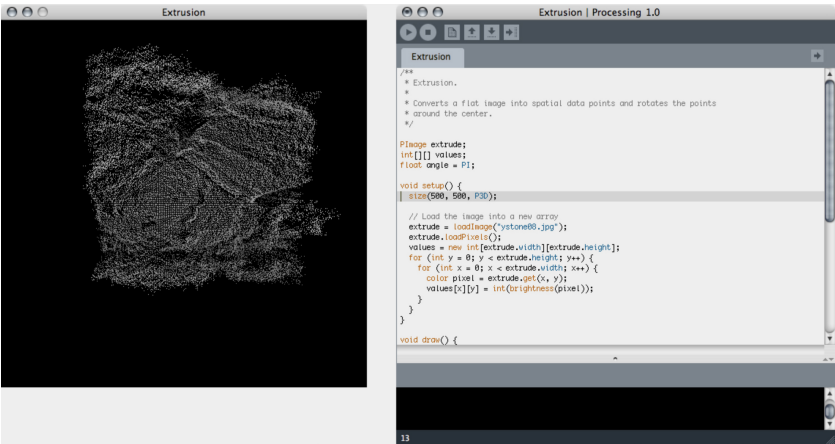


[Fig. 2.2] Ben Fry, Aligning Humans and Mammals, 2008. <https://benfry.com/infoseed/>.

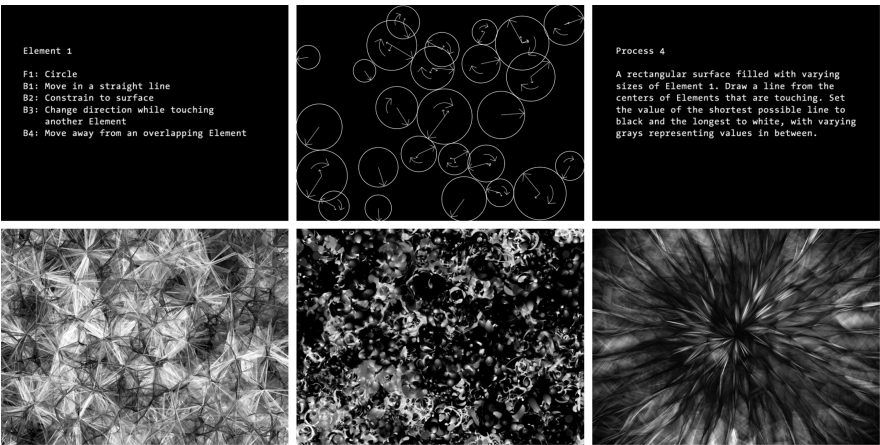




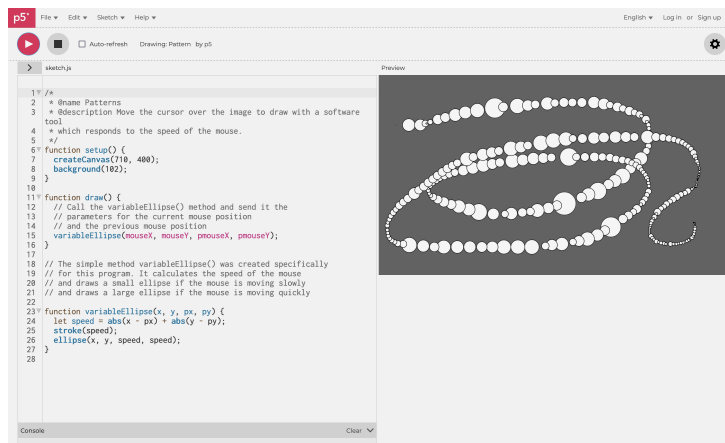
[Fig. 2.3] John Maeda, Design by Number’s interface, 1999. <https://maeda.pm/2017/12/01/design-by-numbers-in-2017/>.



[Fig. 2.4] Processing 1.0 interface, 2001. <https://medium.com/processing-foundation/a-modern-prometheus-59aed94abe85>.



[Fig. 2.5] Casey Reas, Process Series, 2004–2010.



[Fig. 2.6] p5.js web editor, accessed December 4, 2021. <https://editor.p5js.org>.

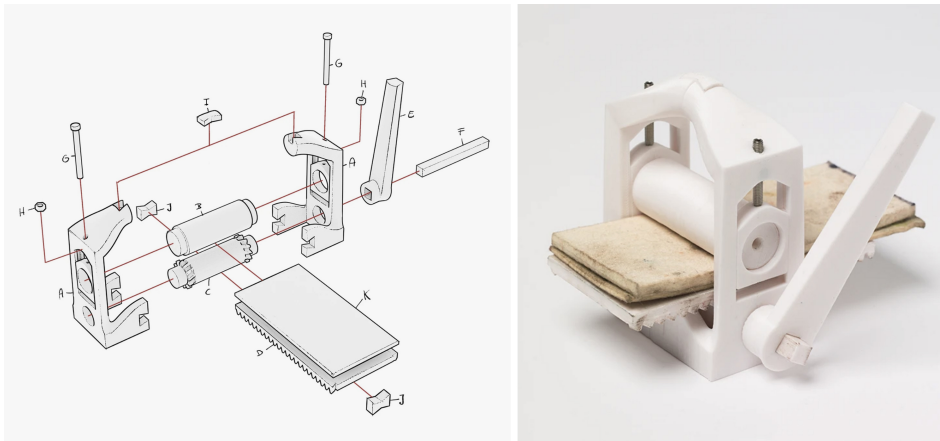


[Fig. 3.1] Louis Eveillard, *Tricodeur*, 2014–2015. <https://www.louiseveillard.com/projets/1e-tricodeur>.

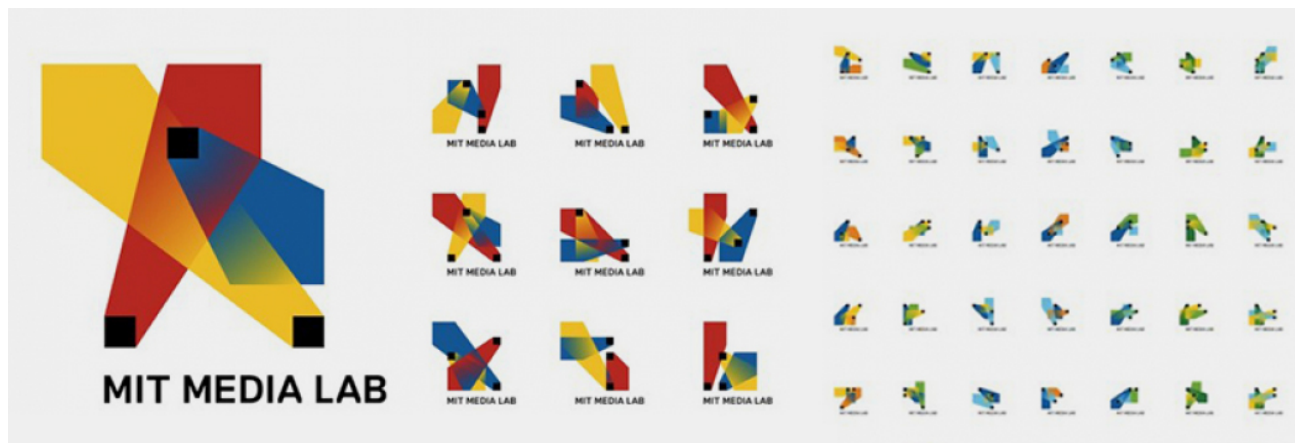


[Fig. 3.2] New North Press, *A23D*, 2014–2017.

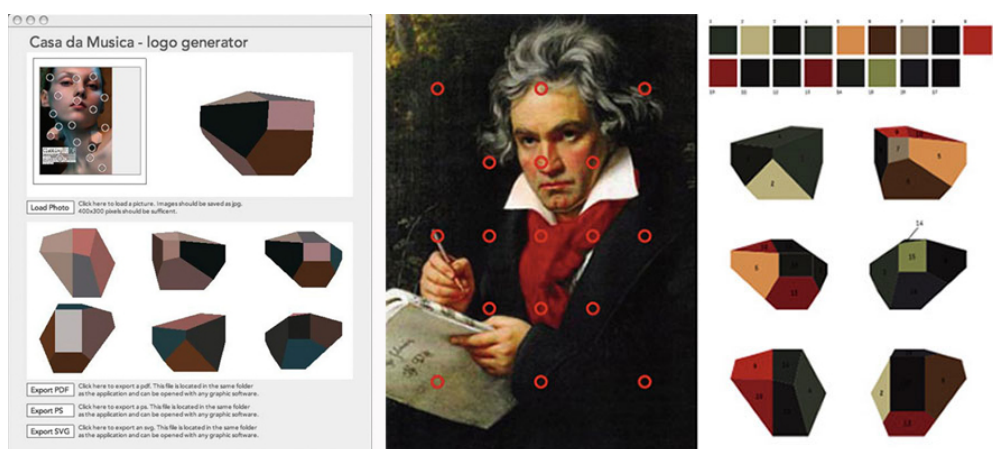




[Fig. 3.3] Martin Schneider and Dominik Schmitz, Open Press Project, 2018.  
<https://openpressproject.com/blogs/news/how-to-3d-print-your-own-printing-press>.



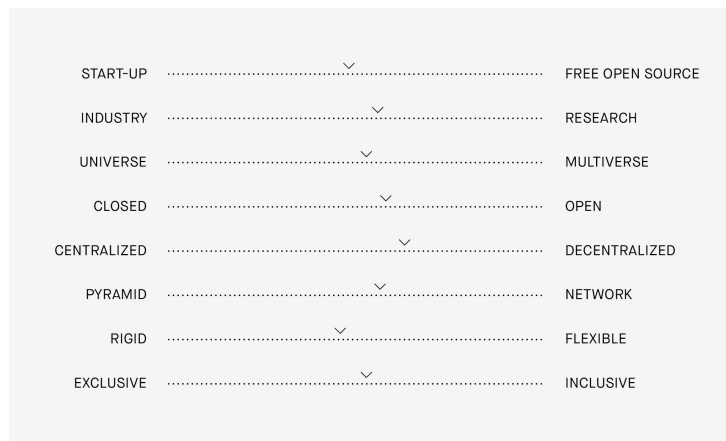
[Fig. 3.4] Sagmeister & Walsh, Casa da Musica visual identity, 2007. The Logo Generator was programmed by Ralph Hammer.



[Fig. 3.5] TheGreenEy1 and E Ron Kang, MIT Media Lab logo and iterations, 2011.



[Fig. 3.6] Michele Pastore and Matteo Bertoli, Bologna City Branding, 2013.  
<https://www.visualpastore.it/bologna-city-branding/>.



[Fig. 4.1] Lucrezia Russo, Proposition for a system of polarities, 2021.



[Fig. 4.2] Lucrezia Russo, Proposition for a semiotic square, 2021.