Computational Formalism

Art History and Machine Learning

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Citation:

Computational Formalism: Art History and Machine Learning
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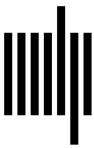
DOI: 10.7551/mitpress/14268.001.0001
ISBN (electronic): 9780262374736
Publisher: The MIT Press
Published: 2023



The MIT Press

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Conclusion: Man, Machine, Metaphor

On July 20, 1969, the first humans landed on the moon as part of the Apollo 11 mission. One often-told narrative in the wake of the mission was that, when the lunar module was nearing its landing target, a program alarm went off and the computer began to reboot. Astronaut Neil Armstrong was then forced to turn off the computer and safely land the vehicle manually, seeming to have demonstrated the superiority of man versus machine. In concluding this book, which highlights some of the confluence and conflicts between art history and data science, I see the story of Apollo 11 as a metaphor for interdisciplinarity. So often, collaborations between qualitative and quantitative research set up a relationship of "man versus machine," but on reflection, it is far more fruitful to think about the relationship as that of "man *in* the machine," neither fully mechanized nor fully humanized.

The Apollo 11 narrative of human triumph and machinic unreliability played well into the American ideological agenda of the time. It became part of the greater narrative of American rugged individualism and pioneer spirit, portraying the astronaut as the cowboy, the master of *his* own destiny. For the Americans, the astronaut was not a cog in a communal state machine, but an independent individual who would not be rationalized or engineered through modern technology. The ideological narrative of Apollo, which conveniently omits the essential work of teams of hardware and software developers, speaks not only to the politics of the time but reflects a broader distrust of complex computational tools that persists today. Both at the time of Apollo 11 and today, in the age of machine learning, gut instinct and craft are held up to be more human and therefore reliable. Rather than scientific knowledge and craft being interrelated,

working together in tandem, the old trope of man *versus* machine is reinforced and the distinct humanness of the system is unacknowledged.

In the book *Digital Apollo*, David A. Mindell investigates the engineering and computer systems that aided the success of the Apollo space program.[1] In an interview, he recounts the reaction to the story of Apollo 11's computer failure:

> As I began doing the research on the book and I talked to the engineers who built that computer, they were all highly offended by that version of the story. They felt that there had been a problem that had been actually caused by the astronauts following a checklist that was in error. And the computer had done all kinds of wonderful things in order to save the mission. And the real bug in the system overall was not in a piece of computer code, but it was a bug in the complex human organizational system on the ground that created this very rich, complicated technology.[2]

Whichever way one looks at it, whether it is the human or the machine that is believed to be superior in this scenario, the *versus* relationship remains.

In the subsequent six Apollo missions, astronauts found similar reasons to take over manual control of the spacecraft. The pilots-turned-astronauts felt that they had a valuable skill as pilots and that their ability to judge and sensorially perceive their surroundings placed them in a superior position when it came to landing on the moon. They did not want to become "spam in a can," little more than cargo, and let an automated computer system guide their path. The reality, however, was that the moon landing was achieved through cooperation. It was a joint effort to create hardware, software, and trained operators—human and machine inextricably intertwined.

In 1967, conceptual artist Sol LeWitt said, "The idea becomes the machine that makes the art." Systems art and many types of conceptual art employ programmatic thinking, proposing a series of directives to be followed or completed. Although they do not necessarily make use of literal computers, they nevertheless utilize the logic and language of systems, computing and programming. It is not a coincidence that artists were inspired by systems theory in the 1960s. As Michael Corris argues,

> The concept of a "system," which became part of the *lingua franca* of the 1960s, was not destined to remain the exclusive property of a

> technologically minded elite of engineers, scientists and mathematicians. In the hands of intellectuals, artists and political activists, it would become a key ideological component of the "cultural revolution."[3]

People began to understand themselves as part of a myriad of systems—political, social, and cultural. What might have initially been seen as a corruption of engineering principles is now an intrinsic part of how the broader shape of society is understood. Social *systems* are a metaphor more than a reality; they provide a neat concept for understanding the complexity of human organizational structures, in which the component parts are positioned as necessary actors in the function of the whole. If one of these component parts is faulty, the social system fails.

Systems artists embraced the rationalism and neatness of programmatic thinking as a way to reflect on whether the role of the artist is more pilot or engineer, to use the dichotomy set up by the Apollo mission. Ultimately, artists, creators, and thinkers are always both. One of the major points of criticism that systems and conceptual art faced was that there is no skill or craft involved. By seeming to discard skill—which is at the etymological root of artistic practice—it abandoned the most "human" of all pursuits. This was never a question of either/or, however. On the contrary, much of systems and conceptual art reveals the entanglement of the man in the machine. It embraced the system—but as a metaphor.

In order to understand the human mind, both scientists and the public tend to use metaphor. More often than not, these metaphors are a reflection of the technology and/or dominant beliefs of any given period in history.[4] In recent times, the brain as a computer has become the dominant metaphor. Thoughts are *processed*, information is *retrieved*, memories are *stored*. Computational neural networks like those discussed in this book are, in a way, a reverse of this common computer-mind metaphor: the computer is thought of as a human brain rather than the brain as a computer. Thus, the computer-mind metaphor has become something of a tautology: the computer can be understood as a brain and the brain as a computer despite the fact that they are not generally thought of as equivalent. This can mean that computers are humanized and people dehumanized; the computer is brought to life and the human demoted to fleshy automaton. Fear of dehumanization or human obsolescence lies at the heart of the opposition between man and machine.

The technology that facilitates space travel, both hardware and software, embodies the potential distance between what the human body alone can do versus what technology stretches it to do. Simple tools, such as a pencil, seem relatively safe. We have no fear that pencils will overtake humans because they remain close to our bodies and they augment our ability to write but do not do so to such an extent that the body's movement is abstracted beyond recognition. The pencil responds to commands of the brain telling the fingers to control it. Once we automate this process, however, it starts to feel threatening. Once it requires several people rather than an individual to create the program, it begins to feel even more threatening. Somehow this machine acquires the power of a community of people rather than the individual intellect of the lone human being. Collaboration introduces scale and the sublime fear that entails.

Deep learning systems often function as black boxes, meaning that we do not know the inner "thought process" through which the system arrives at its output. Although researchers are now studying how the inner workings of these black boxes might be visualized or otherwise explained, there are still many applications of deep learning that remain opaque, even to their creators. This may seem like we have relinquished control to the machine, but in reality these systems can work only with the input given to them—the data. To quote Andrew G. Ferguson again, "Data is us, just reduced to binary code."[5] Often, data is many, many, many of us—so many that we may forget that it is a representation of the collective, albeit a very large collective.

The fear of artificial intelligence or the battle of man versus machine somehow boils down to the fear that no single person can compete with or against the automated product of communal activity. All academic research disciplines, however, have always fluctuated between communal and individual achievement, neither of which is more or less human. Digital humanists often argue that quantitative methods allow researchers to "read" and compare thousands (or even millions) more books or artworks than they would otherwise be able to. As noted, however, Nan Z. Da argues that this ignores the cumulative and collaborative nature of traditional humanities research in which masses of material are already collaboratively analyzed, through the readings and accumulated knowledge of many, many researchers.[6]

The term "artificial intelligence" is laden with baggage. Whereas it may describe a specific area of computer science research, it has long been compromised by both utopian and dystopian fantasies. Much like the example of systems and conceptual art above, the fear for humanists is that the application of so-called artificial intelligence in humanities disciplines removes the human from the equation. What are we left with then? It is for this reason that any such discussions need to recognize the human origins, biases, and drivers in any quantitative system, especially those labeled as artificial intelligence. Instead of sentient machines devoid of the human biases or individual failures that may color traditional humanities methods, they should be seen as augmented—albeit abstracted and distant—human thought or gesture that unites cumulative craft and knowledge. In other words, we might look at the relationship between the humanities and the technical sciences not as a question of man versus machine but as a question of the man in the machine.

There is a long history of human competition with machinic creations leading up to the Apollo 11 story. Amazon's piecework system, Mechanical Turk, takes its name from one of the most famous early examples of an automaton competing against human opponents. The original Mechanical Turk was a chess-playing automaton that toured the royal courts of Europe in the eighteenth century, competing against and besting human competitors along the way. The machine was later revealed to be a hoax, however—an actual human chess player was hiding inside it, working the mechanisms. Amazon's system is aptly named, then, as it "contains" the thousands of workers whose labor power is necessary to make many of the automated or artificial intelligence systems of today function.

Viewed from this perspective, automation functions more as a metaphor than a reality. Yes, there are processes that actually proceed automatically, many of which have been profiled in this book. Some even proceed in wholly unknown or unexpected ways, as is the case in many deep learning experiments. However, each of these automated processes is based on human input and data curation/creation. To a lesser or greater extent, there is always a man in the machine.

The aim of this book has been to address a body of research in computer science that introduces new machine learning methodologies for the analysis of artworks. This research has, until now, received little attention

from the academic discipline(s) devoted to the study of art, art history, and visual studies. In the past decade, more and more studies analyzing images of artworks have been published in the fields of machine learning and computer vision. These studies approach art from a very different perspective from that of most art historians. Given this, I set out to analyze a sampling of this area of research from an art historian's perspective, tracing the relationship between these new methods and the historiographic traditions of the discipline. The implication of doing so reasserts the presence of the man in the machine as described above. In other words, the preceding chapters demystify the human role in both creation and analysis of artworks as data in recent machine learning applications. The supposed lack of humanity in quantitative research is held up as both a virtue and a serious failing, but the reality is that humans and humanist issues are present in such methods every step of the way: from the analog repositories or collections of artworks to their digitization, from data creation/curation to metadata, and from the development of algorithms/computational processes to their eventual interpretation.

Although the hybrid field of digital art history borrows from the methods developed in computer science, it has struggled to maintain a connection to the humanist methods at the core of its mother discipline, art history. One of the side effects of putting computational methods under an art-historical lens is that art history methods and practice are, in turn, called into question. The first chapter of this book looked at the unremarked bias and issues of art datasets used by computer science researchers, particularly in their labeling of period/movement style and analysis by that parameter. The faults in this, however, do not originate with unwitting computer scientists, but rather are rooted in a much longer history. The discipline of art history has struggled for decades to understand and rectify the dominance of a certain version of the Western canon of art. However, as it is defined through existing museum collections and art historians alike, the canon has become an unshakeable monolith and part of the global brand of Western art. The second chapter of this book likewise looks at how deep learning is applied in artwork identification, particularly in cases of authentication and forgery. Although academic art historians are often keen to ignore the long shadow of the art market over the discipline, the application of machine learning techniques to this arena places a spotlight

on how value and authenticity are continually redefined and propped up by museums and art historians alike.

The question that remains, then, is how to proceed in interdisciplinary research so that a genuine interface of communication is established across the epistemological divide. As it stands in digital art history, methods are typically ceded to computer science and subject matter to art history. Alternatively, computational methods are presented as a starting point and humanist interpretation is layered thereafter. The university discipline of art history began as a positivist, taxonomy-obsessed discipline. In its over one hundred years of existence, however, it has evolved to incorporate a variety of critiques to its initial formulation and has supplemented existing methodologies with a body of critical frameworks for analyzing works of art and material culture. Whereas the positivist and taxonomical aspects of art history have never gone away, they have waned considerably in importance over the last fifty years. How do we bridge the methodological gap?

The Rise of the Humanities Lab

The lab is the symbol and embodiment of research in the natural sciences, and its introduction into humanities research has created discomfort and debate among humanists. As discussed in the introduction to this book, the use of computational methods for the study of culture has been popularized over the past decade under the banner of the digital humanities (DH). Given the diverging skill sets often required for such research, many projects are conducted by teams consisting of humanists and data/computer scientists. This has led to the creation of digital humanities labs at universities all over the world. For DH acolytes, this is where the interdisciplinary magic happens. But is the "humanities lab" an oxymoron?

In traditional humanities departments, coauthorship is still rare, let alone authorship among half a dozen to a dozen collaborators (as is common in the sciences). Although all scholarship functions as a collaborative endeavor, humanities scholarship maintains the illusion that it is a solitary pursuit. Or, as Brian Greenspan terms it, "the monastic myth of the isolated (tenured) scholar as ideal."[7] Likewise, Geoffrey Rockwell and Stéfan Sinclair contrast their computational methods with the those of Descartes—a stand-in for traditional humanities methods—in order "to

confront the privilege of solitary reflection in academic practice."[8] The ongoing debates over methodological choices in the humanities, in which this book will certainly enter, often boil down to a competition over which methods are more progressive. Digital humanists will point to new technology as a progressive force in humanities disciplines, whereas critics claim that their complicity with business interests and managerial thinking is in fact a reactionary force that quashes criticality.[9]

The funding of digital humanities labs has elicited concern that universities no longer value the traditional methods of humanities researchers, which do not generally require huge budgets, complex equipment, and additional support staff. For instance, Daniel Allington, Sarah Brouillette, and David Golumbia take direct aim at the idea that humanities scholarship should be project- or lab-based. They argue:

> What Digital Humanities is *not* about, despite its explicit claims, is the use of digital or quantitative methodologies to answer research questions in the humanities. It is, instead, about the promotion of project-based learning and lab-based research over reading and writing, the rebranding of insecure campus employment as an empowering "alt-ac" career choice, and the redefinition of technical expertise as a form (indeed, the superior form) of humanist knowledge.[10]

These scholars make many valid points about the politics involved in promoting digital humanities initiatives and the types of labor valorized within such collaborations. However, in their characterization, the old Cold War propaganda stereotype that collective work is communist and individual achievements are capitalist has been turned around. Labs and collaborative labor are positioned as facets of neoliberal capitalism and individual, traditional scholarship is a force for the political Left.

Nevertheless, many humanists see collaboration as a positive development. It allows researchers to explore topics beyond their limited expertise and skill set and to communicate to a wider audience. For digital humanities projects, automation offers humanists the ability to sort through material in new ways. Given the high level of specialization among academic disciplines, however, bringing researchers from different fields together is not always a harmonious affair. There may be no middle ground when conflicting norms in academic culture and approach present themselves.

Digital humanities initiatives are often praised for their interdisciplinarity. However, the assumption that digital humanities research is

interdisciplinary by default has been questioned by Tanya Clement.[11] She argues that it is more useful to think of interdisciplinarity as a situated practice rather than an all-seeing, all-knowing mastering of disciplines or metadisciplinary perspective. Art historian Koenraad Brosens, on the other hand, contends that terms like "interdisciplinary" and "multidisciplinary" have outgrown their usefulness in their ubiquity:

> Not only has their meaning been depleted by years of (ab)(mis)use, they also suggest that a domain expert (the art historian) should also be an expert . . . in other fields . . . the data and knowledge (r)evolution that started in the 1980s makes it difficult, if not impossible, for most researchers to become and remain an expert (even an expert *light*) in more than one field.[12]

Even if this assessment—that expertise in multiple fields is impossible—is overly pessimistic, the fact remains that contemporary academia is not set up for collaboration. Despite administrative push toward interdisciplinarity, researchers may not truly have the opportunity to operate in multiple disciplines until they have long been active in their field. Ideally, interdisciplinary work would start at the undergraduate or, at the latest, the doctoral level. However, truly interdisciplinary programs are still rare and often struggle to be taken seriously by purists in established disciplines.

Keeping criticism of the term "interdisciplinary" in mind, the humanities lab—if not an oxymoron—is nothing like a traditional academic research lab, which tends to stick to a specialized field shared by all the researchers involved. The humanities lab is, instead, built on interdisciplinarity. By characterizing the humanities lab as an instrument of governmental or corporate influence in academia, the implication is that research at such labs is rigid and utilitarian. The reality is that humanities labs often are defined by the lab as a metaphor rather than strict physical reality. This means that researchers are not always actively engaged shoulder to shoulder working at the DH equivalent of lab benches, but rather that the lab is a signifier of the desire to *experiment*.

Foreign Metaphors as Interdisciplinary Tool

Humanities labs may be the site of interdisciplinary collaboration—but what, then, are the tools? What academic language is spoken? Critics have asserted that the humanities are methodologically subservient to

the digital in DH projects.[13] In this scenario, humanists are forced the speak the language of computing, whereas computer scientists avoid the language of humanists. It may be tempting for each discipline involved in collaborative research to keep their own disciplinary purity—to publish in their discipline's journals and speak to their discipline's unique concerns and theory while operating as part of the collective project. It is far riskier for researchers to venture into each other's disciplinary territory. How can research claim to be interdisciplinary if no one takes this risk, though?

Just as computer scientists today seek to quantify culture, humanists are increasingly looking at ways to qualify computation. A comparison of the interdisciplinary research of two art historians—James Elkins and George Kubler—provides an example of two ways to approach scientific work as an art historian. Elkins, on one hand, seeks to maintain the purity of the outside discipline, taking care not to import "foreign" concepts. Kubler, on the other hand, embraced one of the most useful yet controversial tools in the humanist arsenal: metaphor.

James Elkins has investigated the image-making practices of researchers from a wide range of academic disciplines, profiling the differences in how humanists and scientists use images and visualizations in their work.[14] His research complicates the claims that art history and visual studies have on the study of images through in-depth discussion of the visualizations created and used in other disciplines, notably those in the natural sciences. Elkins's methodological stance is that these images should be discussed in a "noncausal" way.[15] In other words, he argues that commonly used visual studies methods that couch scientific illustration in terms of critical theory or historical context largely ignore the native languages of scientific disciplines and therefore ignore readers outside of the humanities.[16] Instead, he sets out to analyze these images in such a way as to appeal more or less equally to both humanities and natural science audiences, and he claims that he can build these cross-disciplinary bridges by avoiding metaphors "not found in the primary texts."[17] He writes, "It is crucial, I think to resist the desire to create continuous narratives out of specific practices, to decline the temptation to soften jargon, to refuse—at least temporarily—to assign meaning to apparently inarticulate computational practices."[18] This stance—and the struggle that he describes in avoiding interpretation, overarching frameworks, or metaphors for his

writing—suggests that Elkins is aiming for a positivist ideal that he finds lacking in contemporary visual studies. This implies that the given "non-causal" method is virtuous insofar as it avoids "foreign metaphors."[19]

On the other hand, George Kubler, an art historian who challenged dominant art historical methods and theories of style with his influential book *The Shape of Time* (1962), employed metaphor liberally in his work. According to Reva Wolf, Kubler's use of metaphor was not only a "tool" that he used to understand historical processes but was central to his art-historical epistemology.[20] Wolf argues that metaphor is not incidental to Kubler's writing, but rather the methodology itself—a "methodology of metaphor." This is partly due to the emphasis that Kubler places on comparison in the history of art, but it goes much further than this. Metaphor brings together "one realm of experience with another."[21] For Kubler, metaphor was absolutely fundamental to the construction of his arguments. More specifically, metaphor was the means by which he could communicate his thoughts on pre-Columbian art to colleagues saturated by Western bias in art history. Metaphor is not a simple translation or a whimsical insertion of "foreign" terms into a separate discipline; it is a concrete means by which knowledge can be created. It opens new doors and pathways in our field of understanding.

Although Elkins argues at length that those in the natural sciences misunderstand or misuse philosophical/art historical terms like "beauty," he also appears to make his own assumptions about the nature of scientific imagery. At the outset of his research for an exhibition of images "across the university," he seems to proceed from the assumption that visualizations and images in the natural sciences are "useful" and yield direct scientific findings through their visual manifestation—another implied positivist virtue that would set scientific imagery apart from fine art. After discussing the images he collected with the researchers who created them, Elkins seems surprised to find that these researchers very often "abuse the visual" by creating "useless" images that do not actually aid in the effort to discover, measure, or quantify their research findings. Instead, the images are employed primarily for the (it is implied, degraded) purpose of publicity, to attract interest in the research from funders, administrators, and journals.[22] Elkins takes his positivist methods a step further still in attempting to create an encompassing taxonomy of the diverse image-making practices he

describes, despite his repeated assertions that the images should not be polluted by interpretation outside the confines of their specific milieu.[23]

But why are researchers so afraid of this kind of methodological and interpretative pollution? The goal of interdisciplinary collaboration is to conduct research that benefits from differences in expertise. Bringing in untrained and unschooled members of one discipline to try to mimic the methods of a discipline outside of their own does not serve this purpose. Neither does applying one discipline's method to another's subject matter without acknowledging or learning from previous or existing research on that subject. More often than not, this is what leads to misunderstandings and recrimination between experts in different fields, who feel that someone unqualified is encroaching on their territory. An answer—if not a solution—to this is that researchers of different fields must "pollute" their subject matter in tandem. Interdisciplinary research may, therefore, harness the tool of metaphor as a way to reach across the epistemological divide. Perhaps such a tool can open up new pathways not only to understanding a particular subject but also to cultivating broader understanding across disciplines. Metaphor is a bridge that facilitates useful impurity in achieving collaborative goals.

Drawing from the analysis of machine learning in art history described in this book, one might begin to reimagine "digital" art history outside of the technology-specific paradigm in which it has been placed. What if it included the type of criticality toward new technology that disciplines like media studies have long employed without shying away from the "hard" science? What if interdisciplinary or transdisciplinary were multidirectional rather than the subsummation of the topics of one discipline within the methods of another? Metaphor is a powerful tool—not only for understanding the world around us but also for translating one paradigm of understanding into another. To assume that it is a mistake or an "abuse of science" is to miss the opportunity to foster a deeper level of interdisciplinary collaboration.[24] Achieving the goals of such collaborations does not mean taking turns dabbling in another field. Instead, researchers must harness the tools available to them in order to open *simultaneous* lines of communication between disciplines, built on mutual open-mindedness.

The MIT Press would like to thank the anonymous peer reviewers who provided comments on drafts of this book. The generous work of academic experts is essential for establishing the authority and quality of our publications. We acknowledge with gratitude the contributions of these otherwise uncredited readers.

This book was set in Stone by Westchester Publishing Services, Danbury, CT. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data
Names: Wasielewski, Amanda, author.
Title: Computational formalism : art history and machine learning / Amanda Wasielewski.
Description: Cambridge, Massachusetts : The MIT Press, [2023] | Series: Leonardo | Includes bibliographical references and index.
Identifiers: LCCN 2022029684 (print) | LCCN 2022029685 (ebook) | ISBN 9780262545648 (paperback) | ISBN 9780262374743 (epub) | ISBN 9780262374736 (pdf)
Subjects: LCSH: Art—Historiography—Data processing. | Art—Expertising—Methodology.
Classification: LCC N380 .W37 2023 (print) | LCC N380 (ebook) | DDC 702.85—dc23/eng/20220812
LC record available at https://lccn.loc.gov/2022029684
LC ebook record available at https://lccn.loc.gov/2022029685

10 9 8 7 6 5 4 3 2 1