

# The Muse of Coding

## Computer Programming as Art



**Richard Garfinkle**



**CRC Press**  
Taylor & Francis Group

A CHAPMAN & HALL BOOK

# The Muse of Coding

This book gives students and experienced programmers a way to see coding as an art and themselves as artists whose personal views, experiences, and ways of thinking can make their programs better for themselves and their users.

This book shows in a good-humored and sympathetic way how the artistic and practical sides of programming are the same, delving into the methods of coding, the history of art, and the ways in which artists and audiences interact and benefit each other.

Not confined to a single language or style of coding, this book provides a widely applicable framework for people to learn what languages and styles work best for them at present and as the field evolves. It can be used as a classroom text or for personal study and enrichment.

**Richard Garfinkle** is a computer programmer and author of science and math popularizations and science fiction and fantasy novels. He is married to a visual artist. Richard attended the University of Chicago and majored in mathematics. He has been programming since the era of punch cards and paper tapes.



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*This book is dedicated to my late aunt, Barbara Feigenbaum, who brooked no nonsense and delighted in the diverse paths the later generations in her family took.*



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## *Acknowledgments*

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This book owes its existence to my wife, Alessandra Kelley. The two of us come from very different backgrounds and practice very different arts. We have spent nearly four decades getting closer to each other, learning to understand each other's arts and perspectives, and coming to see how the human world is both practical and artistic and that both of those views are one and the same.

This book also owes its existence to our children, who grew up in a house of mathematics, visual art, coding, writing, and music. Each of them developed their own arts, and we are always excited and interested to see what they make and what we can learn from them.

I also owe thanks to my brother David, with whom I co-authored one science and one math popularization. Working together to present the insides and outsides of math and science was invaluable in developing this text.

Lastly, I would like to thank my publishers and editors for making this book possible.

## **Section I**

# **Everything Humans Do Is Art**



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# 1

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## *All Art Everywhere since Time Began*

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Humans make things and humans use what humans make. These facts underly both art and engineering. Humans explore, humans experiment, and humans reveal the results of exploration and experimentation. These facts underly both art and science. Humans abstract and humans model reality with their abstractions. These facts underly both art and mathematics.

In recent years, art and STEM (Science, Technology, Engineering, and Mathematics) have been viewed as in opposition, as if there were some conflicts between the illuminatingly beautiful and the illuminatingly practical. For some people, this supposed opposition deepens so far that they assert that the concepts of beauty and practicality are themselves in conflict so that the more beautiful a thing is the less useful it is and vice versa.

The origins of this illusory conflict can and should be studied. But that's not what this book is about. This text is about erasing this false dichotomy and introducing the practitioners of one of the most recent fields of art, computer programming, to the awareness that they are practicing an art. The goal of this book is to help programmers see their field and their personal work as an artistic endeavor because this view will help them do better work and more enjoy the doing of it.

To begin, we will, as all wise artists do, take a step back to gain some perspectives on art, humanity, and practicality.

---

### **Art History**

As of 2023 CE, the oldest identifiable tools that archeologists have found are more than three million years old. These tools were stone scrapers and cutting tools made by our prehuman ancestors. The oldest objects that people are willing to call visual artworks are around 50,000 years old. The oldest known musical instrument is about the same age. The oldest evidence of humans wearing clothes is from around 180,000 years ago.

But these labels, tools and artworks, can mislead. They imply that art comes millions of years after tools. But what were our prehuman ancestors doing with those tools? What were they making? And what were they doing with those things that they made? And what kind of clothes were our ancestors wearing 180,000 years ago?

These questions and phrasings carry within them the implicit separation of practicality (tools and clothing) and art (painting, sculpture, and music). But does this separation, this contrast, this asserted dichotomy actually mean anything or is it just labeling?

There is a tendency in modern thinking to regard the utility of things as distinct from and in opposition to their beauty. Utility is artistically depicted as stern, hard, and earthy, while beauty is seen as airy and abstract, nebulous, and unimportant.

But if one asks whether clothes should feel good to wear, food taste good to eat, teachings be illuminating and memorable, houses be restful to live in, tools fit well in hands,

and so on, we find no clear boundary between beauty and utility. Far from being opposed, people want beauty in their utility and utility in their beauty. Indeed, for humans, the two concepts are so inherently entangled as to only be separable in theory, never in practice.

This can also be seen by starting from the other side. If we look closely at those aspects of human life that most people would explicitly identify as arts, drawing, painting, sculpture, music, song, and dance for example, we find that each of these has its own practical benefits.

Images and sculptures can aid memory and can present people, places, and things that are distant in a way that makes them imaginable. Music and dance give rhythm to actions, making it easier for people to work in coordination.

And then there are stories. Stories can bring the past to the present and can open up possible ways to consider the future. They can carry minds to distant places and show ways of action as yet unconsidered.

And, of course, all of these can be enjoyed, and people's lives are made better when they enjoy what they are doing. Enjoyment gives energy to humans in action. Enjoyment can bring the mind's attention to what it is doing. It can spur inventiveness and a willingness to return again and again to new variations of old possibilities. And enjoyment can be shared, creating social spaces that people like returning to.

Beautiful and useful are in a real sense different measurements of the same human actions.

Were this an art history book, we could follow the complex braided pathways of artmaking from those earliest artifacts through the diversity of human cultures until we reached the present day. Then we might dabble in predictions for the future so that future art historians could have a good laugh about how in error we were.

But this book has a different goal. We are trying to illuminate computer programming as an art. So, we are going to chart a more abstract course that looks at aspects of arts that are germane to that purpose. We will focus not on particular periods and practices but on art methods that have evolved into many art forms. We will see how computer programming fits in with them and how their perspectives and practices can help illuminate and improve the practices of programming.

---

## **Art as Illuminating Abstraction**

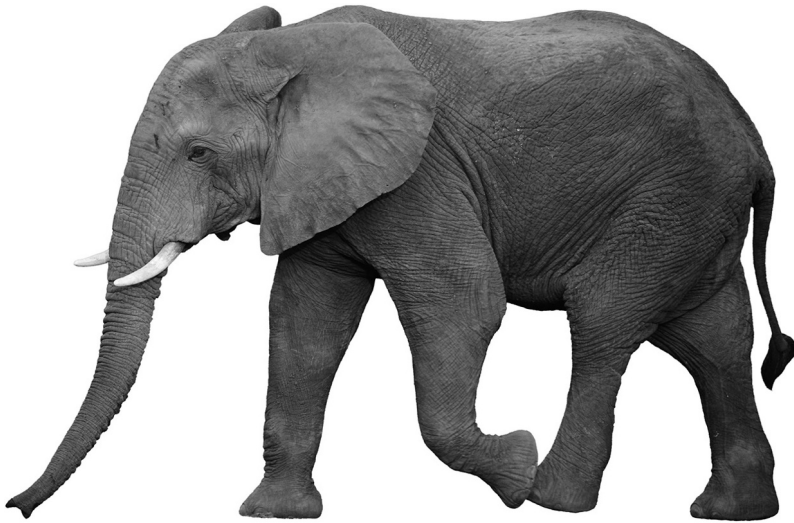
The real world is a complex, information-dense space. Human minds operate in this environment by abstracting what is around them and working upon the abstractions.

This process of taking experience in from the outside world and formulating a mental object by combining what is perceived with what the perceiver knows and understands, this personalized act of making sense by abstraction and composition is the most basic artistic action. All art begins and ends with the interplay between reality and human mind that we call abstraction.

We will discuss this in depth in Section II, where we will make the process of abstraction more concrete and practical.

For now, let's look at the benefits and drawbacks of abstraction and how they lead to art as humans understand and practice it.

Abstraction allows the mind to focus in on certain aspects of the piece of reality being abstracted. It does so by only considering those aspects and ignoring all others, or at least trying to ignore all other aspects. This, as we will examine later, is not as easy as it sounds.



**FIGURE 1.1**  
Elephant photograph.

Abstraction produces a simplified and emphasized object of mind. Each art has methods that help the artist determine what aspects to abstract as well as how to simplify the aspects and how to emphasize them. Different arts abstract different aspects in different ways because each art emphasizes different aspects of reality and so abstracts in ways that are useful for its particular emphasis.

Abstracted mental objects can illuminate real-world objects and any other mental objects that the perceiver connects with the abstracted objects.

Here is a photograph of an elephant (Figure 1.1).

This picture already ignores nearly everything about elephants as a species: their environments, life cycles, evolutionary forebears, etc. It also ignores most of this elephant as an individual being, giving us nothing about its life and experience, how it ended up where it is, what it smells and sounds like, how it perceives and thinks, and so on.

What the picture does is present for human eyes an image of a large creature with a few emphasized features (including trunk and tusks) made using the art and technology of digital photography.

Here are a bunch of images of statues, drawings, and paintings that depict elephants using those arts, each with their own emphasis (Figure 1.2).

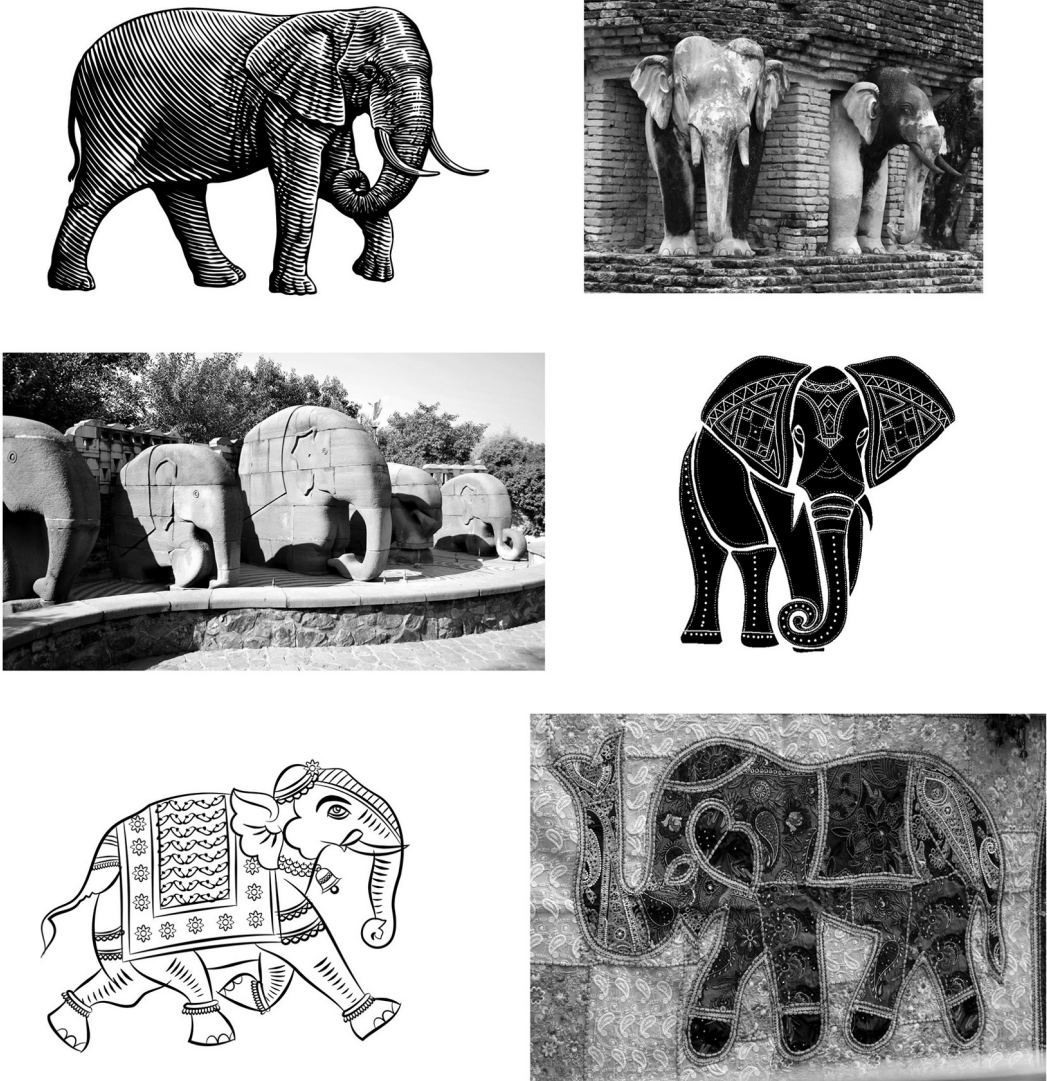
The above paragraphs in which elephants are discussed are themselves an abstraction of elephants into the art of writing. Each of these artworks reveals and emphasizes different aspects of elephantness.

All of the writing above presumes that you who read this know what an elephant is (even if you've never seen one in real life) and likely have various associations with the term elephant from whatever other elephant-containing art you've perceived.

If by some bizarre circumstance this book happens to survive to a time where the reader has no idea of what an elephant is, this whole section will be a bit more confusing and any readers from that time will not know what to make of this example.

Abstraction as seen from the artist's perspective is a matter of making something accessible to human perception and contemplation. It makes it possible for the human mind to consider, play with, enjoy, and learn from what is presented.

But abstraction is also a vital tool in science and mathematics, a tool used to make other tools.



**FIGURE 1.2**  
Collage of pictures of elephant art.

---

## Mathematics, Abstraction, and Tool Making

Mathematical abstraction involves creating numbers, shapes, spaces, and functions that correspond in a useful fashion to real-world properties, objects, extents, and processes. For an extremely elaborated discussion of this, see the author's cowritten work *X Marks The Spot*.<sup>1</sup>

The purposes of mathematical abstraction are twofold: to explore the implications of the abstract object and to make tools that will carry those implications into the reality that the objects are abstracted from.

Math is much more conscious of the act of abstraction than most arts are. From a mathematical perspective, we know that if we are looking only at the mass of an object, we are ignoring all the internal structure and shape of it, as well as other properties like charge and whether it's alive or not and how awkward sudden mass-to-mass interactions would be on a social scale.

Abstracting objects as mass alone gives us many implications to study when coupled with theories of force and gravity.

From these implications, we can and have made tools to measure and study the universe and tools to alter the world around us. Mathematical abstraction lets us put handles on the universe, pick it up, turn it around, shape it, and put it back down with new configurations.

Mathematically, abstraction is done to make it easier to make use of and understand what is being abstracted. Artistically, abstraction is done to make things easier to perceive, display, and understand.

These two abstractions, artistic and mathematical, are not separate processes. They are elaborations of the human mind's tendency to abstract in order to make it easier to perceive, make use of, display, and understand.

Refining abstraction so that it does all four of these is the province of a process that, in English at least, has a name with both artistic and mathematical meaning: Modeling.

---

## **Modeling and Representation**

Modeling is the process of assembling multiple abstractions from some aspects of reality in such a way as to create a representative construct that reveals those aspects of reality and aspects closely connected to them.

This is usually done by using hypothesized relationships between those aspects, taking measurements of those aspects, deducing other aspects using those relationships, and depicting them in an illuminating fashion. Therefore, both of the illustrations below depict acts of modeling (Figures 1.3 and 1.4).

A model relies on four things to be usable.

1. Accurate formulations of relationships between quantities.
2. The ability to accurately measure some of the quantities discussed.
3. The ability to use the formulations and the measurements to determine other aspects.
4. The ability to accurately reveal the results of step 3 to people who need the results.

You may notice that there are some very fuzzy terms in the above summary like relationship, formulation, accuracy, ability, determine, and reveal.

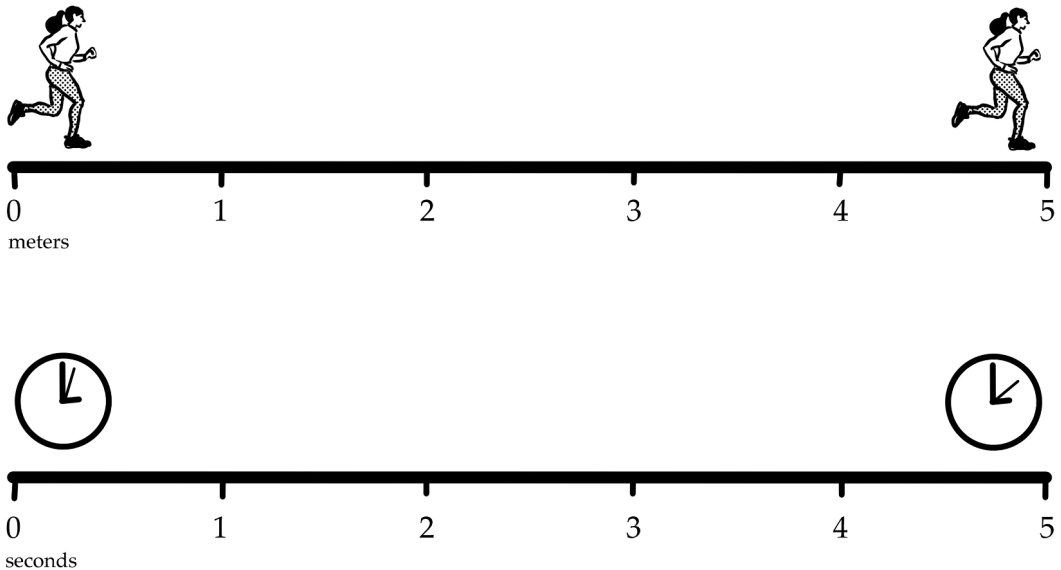
These concepts are deliberately broad. Their breadth and fuzziness let us generate models for a vast space of possible things in an evolving space of arts for an ocean of purposes that has always revealed itself to be deeper than we thought we were modeling.

So, let's focus in on the art this book is about and look at programming relative to this general description of modeling.

Programming is very good at step 3, using a combination of formulations (functions) and measurements (data) to produce new quantities.



**FIGURE 1.3**  
Measurement of object and drawing from those measurements.



$$\text{speed} = \text{distance} / \text{time} = 5 \text{ meters} / 5 \text{ seconds} = 1 \text{ meter} / \text{second}$$

**FIGURE 1.4**  
Measurement of physical quantities for motion, list equations of motion, plug values into equations, and produce calculated quantities for motion.

It needs other arts and sciences to provide the relationships from which functions are coded (step 1), other tools to provide the measured data that will be processed (step 2), and specialized devices to display the results in human-comprehensible fashions (step 4). There will be more about all of that throughout this book.

There's one more little term that we let slide by, a term that covers messy and complex stuff: Reality.

There are vast numbers of books of people trying to define reality. We're not going to deal with that. We're working on the assumption that there is a real world that we are part of. We also assume that our observations of the real world have some correlation with what's actually going on out there. If you're interested in a more elaborated discussion of this that still does not try to define reality, see my coauthored book *Three Steps to the Universe*.<sup>2</sup>

It is important to note that a model need not be accurate to reality. A model only has to be internally consistent and capable of taking in measured input and creating revelatory output to qualify. This allows one to model unreal worlds (see all SFF, most video games, surrealist art, and many discarded theories of reality). It also allows us to deliberately inaccurately model the real world (see any map that depicts a spherical planet on a flat surface).

There are two further steps that we can add to the definition of the model. They aren't as necessary as the first four steps are, but they are vital both to the scientific method and to representational art.

Step 5: Check the results of steps 3 and 4 against what you are modeling, that is, see if what you produced does in fact look like/sound like/move like/feel like/taste like what it's supposed to be like.

Step 6: Change the model if it doesn't fit step 5 to the standards you need it to. Those standards might be the accuracy of measurement or clarity of illumination for the audience you are showing the model to or the ability to use the model in order to advance some mental or physical work you are doing.

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## Reality Augmented by Art

Let's look closely at step 4 in modeling. "The ability to accurately reveal the results of step 3 to people who need the results."

What happens to someone who receives an artistic revelation? What happens to the world they are perceiving once they have been given the results of a model of aspects of that world?

This question is easy to answer because you are experiencing it right now. You are looking at a book or a display device or listening to a recording or touching braille writing and your mind is generating meaning and understanding from what you are perceiving. But you can only do that because you have learned the language you are reading this in and are projecting meaning onto the writing or sounds.

Humans do this all the time. We live in an augmented reality in which we mingle our knowledge with what we perceive and create a view of the world that is humanized by perceiving objects and processes relative to our human lives.

Human minds evolved to generate this personalized AR environment. It makes the world around us meaningful, useful, and, in various ways, beautiful. Our sapience is the kind of sapience that generates augmented reality.

But the process as evolved generates many false positives. We give meaning to the not meaningful and adjust our perceptions so that what we perceive fits the models we are using to augment our perceptions.

We can hear random sounds and think they are human speech. We can look at patterns of craters or rock shapes and think they are human faces. These false positives are one of the things that make art possible. Because we can project recognition onto things, it is possible to deliberately create things that people will project recognition on to. Here are a variety of things that humans will recognize as human (Figure 1.5).

Human perception and memory use a wide variety of clues and complex neurological processing methods (that at the moment are only beginning to be understood) to generate the augmented realities we each live in.

We won't be looking into neurology itself, interesting though that subject is, but we will be looking in depth at many of the practicalities of this process and how understanding it can help with all artistic endeavors both from the perspective of artists and audiences.

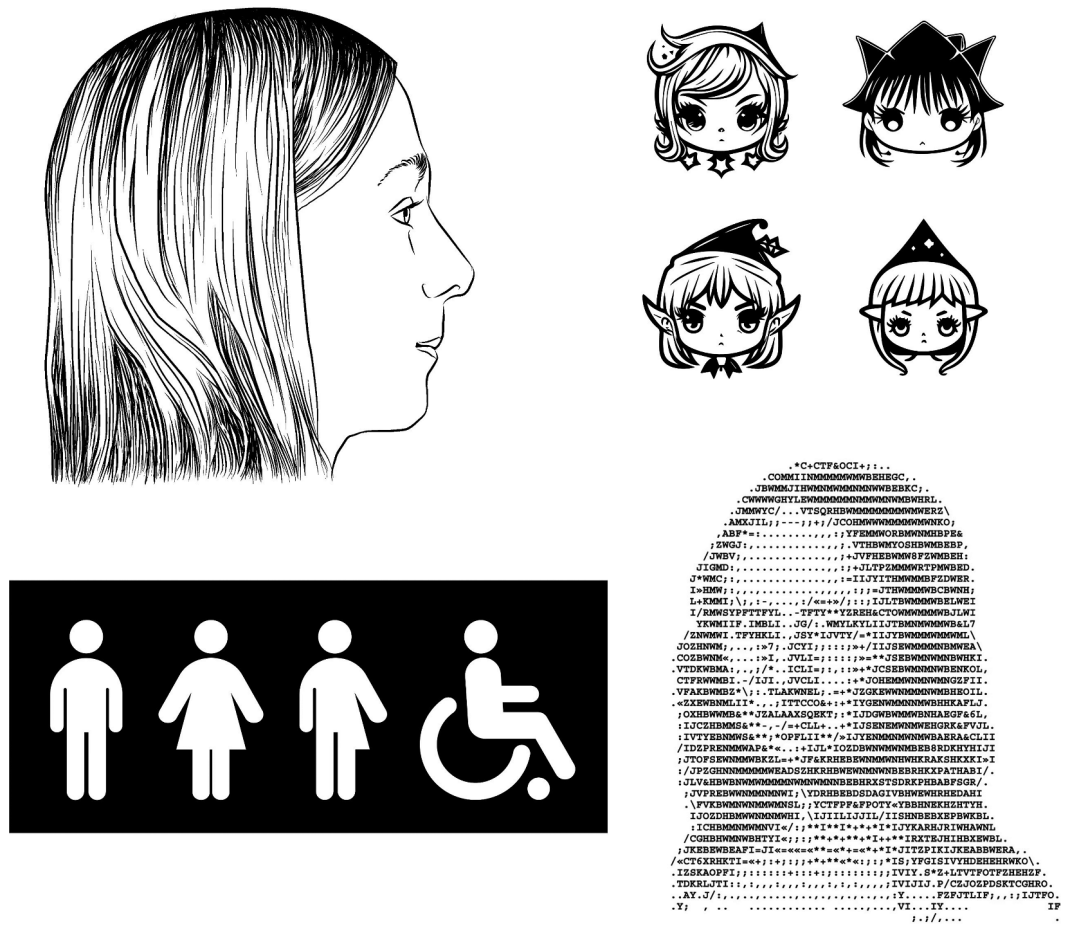


FIGURE 1.5 Collage of humans drawn in a wide variety of styles.

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## Composition and Contrast

Art relies on our abilities to recognize and project recognition on what we are perceiving. Before there can be recognition, there must be some aggregate of perception information that a person can recognize. As we will discuss in Chapter 7, we live in an information-dense world. We are constantly flooded with the possible-to-recognize.

How in an ever-evolving chaotic welter of possible information do we find what we're perceiving? And how do artists use their art to create easily recognizable bundles of information?

Our minds put things together out of information and separate out what information we are focusing on from the rest of what's happening. This leads to two principles that all arts rely on:

Composition: Putting together.

Contrast: Separating out by.

Each art has its own techniques of composition and contrast. A large part of learning an art is developing one's own ability to employ these two.

Composition and contrast are not really separable/contrasting concepts. They are a paired awareness. When we perceive things, we both put them together and take them apart. Both synthesis and analysis are always happening in our minds to craft our awareness. As we will discuss in depth later, the ability to perceive an art is also an art, the art of audiencing.

There are several forms of composition and contrast that are worth analyzing separately because they recur and are basic to many arts.

We'll start with something that is both composition and contrast:

Apposition, which is putting things next to each other.

Because human memory and perception are associative, we will tend to compare and contrast things placed next to each other. This is the most basic way in which computer and human thought are qualitatively different. Two things near each other in a human mind affect each other. Two things adjacent in computer memory have no effect on each other. We'll be dealing with this in depth in Chapters 8 and 9.

Common forms of composition include:

**Shared Properties:** A group of things seen as sharing a common property are often treated as the same so the mind can easily compose them into a commonality. This one has to be used carefully because it is common to treat sharing one property as sharing many. For example, raspberries are red, tasty, and nutritious. Cadmium red paint is red and, therefore, a mind might think that it should be tasty and nutritious. This is also a common composition in prejudices. This form of composition shows how the false positive character of human perception can lead one to major errors, but is still useful for putting together a plate of food or a painted forest.

**Blending:** Blending composes materials in such a way that they produce a new material. It is a vital process in cooking, paint mixing, pottery, metallurgy, creation of colors on a screen, and coining of words.

**Structuring:** Structuring is the process of connecting objects in such a way as to make a new object that differs qualitatively from the components that make it up. It is related to blending in that it can make new materials (e.g., hydrogen and oxygen structured to make water). It is also used to make clothes out of fabrics and buildings out of wood, stone, glass, etc. Structuring by its nature creates and relies on an infrastructure/underlying connection that may be hidden from direct perception. Structuring is the most common composition method used in programming. We'll be looking at this in depth in Chapter 5, and referring to it pretty much throughout the entire book.

**Metaphor:** Metaphor is something of an extension of shared characteristics that deliberately draws upon aspects of one thing to illuminate another thing. Lips red as roses, lips red as flame, and lips red as cherries. All of these are metaphors that import different associations with them. Metaphors work best when they associate not only surface characteristics but infrastructural/hidden characteristics as well. The kenning "whale road" used in *Beowulf* to refer to the ocean carries the idea of the ocean as a means of travel. The kenning "widow maker" for the ocean carries the idea of its dangers. Both metaphors illuminate the hidden aspects of the ocean that a prospective mariner should be aware of. The ability to switch from one metaphor to another or to blend them together (Hamlet's "To take arms against a sea of troubles") is invaluable in illuminating multiple aspects of what one is talking about.

**Persistence:** This one is a little subtle. Human awareness composes in time. We watch things move and change and form connections between them. We associate the thing we saw ten seconds ago with the object we are seeing now and think of it as the same object even if it's moving farther away from us. Persistence is one of the phenomena out of which we build our ideas of time. We will delve more deeply into persistence and its relationship to programming in Chapter 2, the next chapter. Note that the idea of a next chapter, or a next anything, arises from our concepts of persistence.

#### Common forms of contrast:

**Perceivable difference:** This is the most basic. If things register differently in our senses, then we can distinguish them. Different tastes, colors, notes, volume levels, textures, temperatures, etc. all create contrasts that can be employed to create art. But our senses are only so good. Our ideas of differences are often learned or varied by previous exposure (i.e., persistence).

The idea of the color blue covers a broad and fuzzy region of colors and different people will classify something in the aqua region as blue or green. Whether something feels cold or warm depends on what temperatures we are currently acclimated to and to our inner bodily processes. There's a common experiment with three containers of water – one hot, one cold, and one lukewarm. How the warm one feels to a hand depends on whether that hand was in the cold or hot container before going into the warm one.

Perceivable differences can be elaborated and tuned by cultural attitudes and personal experiences. We'll examine this in a broader context later in this chapter.

**Separation in space:** This is one of the most obvious. Two things that are at different positions will look distinct to us. Visual art relies as much on spatial separation as it does on spatial apposition. This has a few tricky elements in that differences in position can produce the illusion of difference (or sameness) in size.

The fact that the sun and the moon have similar apparent sizes to the Earth is an artifact of their actual size and actual distances. That artifact led to millennia of direct association between them, creating an artistic pairing that does not correspond to the distinct realities of star and lump of rock. On the other hand, both objects form a neat pairing to create time measurers, the sun to measure days and parts of days and the moon to measure months and parts of months. Their apparent commonality of size and shininess made it easier for humans to make tools out of their apparent orbiting. A lot of utility can be created by putting together things that only look like they fit together.

**Separation in time:** This one is more complex than separation in space. Our experience of time is not symmetric. We can't go back to a time we've been at before. We accumulate experience in one direction. And though our memories are not organized chronologically, the experiences that generated them happen in the local chronology we call personal experience. So having A before B is not the same as having B before A.

Making art that relies on separation in time (such as writing a book or composing music or teaching a class) requires an awareness of what is likely to happen if someone experiences B before A versus A before B. There can be a temptation to overload or underload parts of the experience, to go too much into detail when a thing is introduced. But often it is wiser to introduce an idea, then let it sit and be mentally digested, and close with a suggestion that more will be dealt with later in Chapters 2 and 3.

**Separation in environment:** The circumstances under which we experience things have radically different effects on how much we enjoy them and what we get out of them. Experiencing something for the first time in an enjoyable context can create associations of that thing with enjoyability. Experiencing it again under miserable circumstances can help remove some of the misery or replace the enjoyable associations. Environment and context are high-density forms of apposition. The tailoring of an environment and its experience is an aspect of art common to architecture, clothing, furniture, music, dining, and well, pretty much everything.

Separation in environment is also, along with separations in space and time, a vital consideration in the making of art. How, when, and where will you work upon what you are making? This will affect the quality of your work and the inspirations and distresses you will feel while working. This too we will discuss a great deal more in many places to follow.

**Separation in status:** This one is largely social. Objects, actions, and people are accorded statuses in societies, cultures, and subcultures. How someone has been taught to think about those statuses can affect how they perceive the things associated with that status. People internalize these early on and are often surprised when not everyone shares their separations. They are often also surprised that their own views evolve over time.

**Separation in meaning:** This is a process of distinguishing what underlying or overarching understanding is being depicted in the art. There are terms and ideas that cover qualitatively different subjects. The word "nature," for example, might mean physics, or inherent qualities, or inborn characteristics, or romantic woodlands or violent storms. Distinguishing which nature one is referring to requires clarity and illumination of art. A technical field will usually develop a technical vocabulary to make such distinctions; but outside the field, a fair amount of work is often needed to make clear what one is talking about.

Distinction in properties: This is when objects have differences in properties that are not necessarily perceivable nor inherently meaningful. The actual as opposed to the perceived sizes of the sun and moon are distinctions in properties. That one is a star and shines by fusion and the other is a big rock that shines by reflected light is both a distinction in properties and meaning.

Distinctions in properties are relative to what one is doing with the objects under examination. The biological differences between fruits, vegetables, and herbs are distinctions in properties. The culinary differences are distinctions in different properties with the same names.

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## Art Is Personal and Cultural but Never Universal

While the creation and enjoyment/utilization of art are shared characteristics of all of humanity, and the underlying methods of that creation are also shared, individual works of art are always local to their makers and their time, place, and culture of origin. They are also individual in who likes them and how they are liked.

*De gustibus non est disputandum* is a Latin maxim that roughly translates as there is no arguing about taste.

There's also the French saying *chacun a son gout*: Each to their own taste.

There are similar expressions in many other languages. These ideas are usually said as a way of ending the discussion of taste or ironically starting arguments wherein people object to the sayings and try to claim that there are objectively good and bad tastes.

We're not going to do either. Instead, we're going to examine what this personal quality of art means on practical, personal, and cultural levels.

The neurology of taste is being studied and examined now and as usual we're not going to dig into it. We're also not going to go too far into the psychology.

Our approach will instead be to illuminate what the late Sir Terry Pratchett, author of the Discworld novels, called a "substitution," a thing that is true that hardly anyone believes is true. The individuality of taste is true, but most people believe that there is right taste and wrong taste and that those who have wrong taste are either in need of education or are somehow mentally or morally wrong.

There is a practical reason why this basic fact is so often disbelieved. When most people see someone liking what they like or disliking what they dislike, a composition is created in the mind of the observer. They likely feel a fellowship and understanding of that person. They feel a mental proximity, a drawing closer to them and perhaps a space of possibilities to share with them.

If, on the other hand, people see someone else enjoying something those people could never enjoy or not enjoying something they do enjoy, then a contrast is created that creates a mental distance, a separation between them.

But why would the composition create art in the observer's mind, but the contrast not create art? Why is there a problem here?

The difficulty lies in what to do next after observing the other person's liking or disliking. What memory does the observer form from the fact of the contrast.

As I laid it out above, one form creates closeness and another creates alienation because the contrast is treated as an uncrossable chasm of tastes. But by adding one step to the process of awareness, one further augmentation to reality and the chasm can be bridged.

Composition: I like grapes. They like grapes. I can get and serve grapes to both of us.

Contrast: I like grapes. They like pineapples. Added step: In a situation where I would eat grapes, I should serve them pineapples. I will get and serve both grapes and pineapples.

The new step can be abstracted into the general principle: What is A for me is B for them. Therefore, in circumstances where I would like A, they would like B.

This means remembering particular tastes and interests of the other people one is interacting with. Because of the ways humans form memories of each other, this can be highly efficient. For most people, the better they know other people the clearer and more efficient their memories of those people become.

This approach works well on an individual case-by-case basis when the person one is dealing with knows what their own tastes are. But how do people determine what they personally like and dislike? This is generally done through a process of experimentation, trying things, and seeing how one feels about them.

All experimental methods require a test for outcomes. Generally, things done that are to one's tastes feel good in the doing and leave one feeling happier and generally more energized. Things that are against one's tastes are unpleasant in the doing and leave one feeling less happy and either drained or numb.

Unfortunately, people can be bad about experimental protocols, and other people can interfere with results and recording of results. Furthermore, as we will deal with in detail later, human memory is not great for data recording. There are a number of things that can interfere with the process and cause one to be bad about performing the experiments and remembering the results.

Here are a few such problems that can interfere with the memories one forms of one's direct experiences. There are many others, but these should give a sense of the space of them.

One more bite: Any enjoyable activity will eventually become too much. If the person testing something does not pay attention to when they've reached their limits, they might keep going and enter the unenjoyable zone. They might then keep going even further, trying to recover the initial enjoyable feeling, and end up with a memory of the experience being overall unenjoyable.

Shame: An action that was enjoyable might be something that is treated as socially unacceptable and the person doing it might therefore associate shame with the action and not realize that they actually liked it.

Should dos: The opposite effect of shame, doing something unenjoyable that one is told one should do and should enjoy the doing. This can produce false memories as well, wherein the person overlays a claim of enjoyment over the fact of non-enjoyment.

The above experimentation applies not only to the art one is trying as an audience member but also to what art one is trying to make. One can try to make too much of one kind of art (e.g., writing too many stories with the same plot) or be ashamed that one is doing a socially unapproved art, or feel that one's skills should be better spent on something socially favored, etc.

Shifting from the individual taste to a larger-scale social perspective on what arts to practice and which to audience, a number of questions emerge. What arts are available for someone to experiment with? What art does an individual have access to and when in their lives do they have access to it? What can they try and when can they try it?

The answers depend on when and where people grow up and live their lives, what art is available within their culture, and what would they need to do to have opportunities to sample it? This is automatically entangled with the question of what art/art making will the person inevitably be exposed to because of the time, place, and culture of their upbringing. This can be complicated by what art/art making is being deliberately taught and how is it being taught. A person can think that they do not like/are no good at doing a particular art if the teaching methods do not work for how they learn.

Children are exposed to a huge amount of art in their first years. The languages spoken around them and the clothing, furnishings, and architecture of their homes and larger environments are ambient to their existence. The nearby terrain and how it is described and traversed are part of their journeys and everyday routines.

There are also the music, songs, and dances they hear and take part in, and of course, there is the food they are fed on. Childhood is being the audience to a vast panoply of arts.

As for arts a child learns to practice, they will likely learn how to speak, read, and write. Depending on culture they may learn to sing or play music, to draw, to play particular games and/or sports, to watch videos, and to see views of distant and nearby places. They will play with particular toys and learn to use specific hardware and software. They may be told stories of their families, peoples, perhaps religion or religions, and so on. They may make friends and learn to converse and inquire and come to see other people and points of view. They will be taught practices meant to guide them toward adulthood and given ideas of what their grown-up life might be like.

They may, depending on where they live and who is nearby, have a monocultural or multicultural childhood. They may be part of a subculture or minority within a majority culture. They may have little or much access to publicly available art in the form of parks and museums, theaters, and so on. They may learn one or more than one language. They may live in one or many places, may travel, or never go far from their place of origin. All of these shape their individual experiences.

Childhood is art dense and experimentation happens at high speeds and at all times. No wonder children get exhausted.

Children learn very rapidly, so rapidly that they often don't notice that they are learning anything at all. They absorb culture and formalize it and their relationship to it in their minds without realizing that anything strange or amazing is happening.

As people grow older, they obtain more ability to determine which art they will interact with and start shaping their own personal experimentations. But all of that will be done within the context of one or more cultures they are dwelling in or visiting. Their personal experience of art and art making will always be entangled with the environments of those arts and the ability to access them.

Substitutionally, people absorb a great deal of art and art making and formulate complicated views of all of that without much sense of the processes they have been through or the results they recorded. Their likes and dislikes are not simple.

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## **Normalization, Fashions, and Aesthetic Theories**

One aspect of human thinking is the ability to acclimate to current environmental and social conditions. Acclimation is useful to humans because it lets us go from environment to environment or experience the changes of seasons with relative ease. It's a form of relativity, wherein we implicitly reset a center point for current conditions.