Andrew Marcus

The Designer's Guide to the Buttons

A History of Interfaces from Early Computers to Virtual Reality. In Search of a Universal Design System

New York, 2026

Andrew Marcus

The Designer's Guide to the Buttons: A History of Interfaces from Early Computers to Virtual Reality. In Search of a Universal Design System

This book is a comprehensive guide to the creation and evolution of computer interfaces. Unlike conventional collections of rules and standards, it is built as a historical narrative that reveals the causal relationships behind modern interface solutions. By tracing how interfaces evolved, it helps readers understand the principles that govern them, not merely memorize ready-made patterns.

The book is divided into three parts. The first part covers desktop interfaces from Xerox Alto and Apple Lisa to modern macOS and Windows. The second part focuses on mobile devices—from Apple Newton to the iPhone and Android. The third part explores the future of interfaces: interaction in virtual and augmented reality, illustrated through Meta Quest and Apple Vision Pro.

The edition features hundreds of illustrations, diagrams, and screenshots, as well as examples from 180 popular applications. Thanks to its clear, sequential structure, the book will be useful to both new and experienced designers.

About the Book

This book is intended for a wide audience interested in UX/UI, product or interface design, digital technology, and the history of computing. It is valuable to both newcomers and experienced professionals.

Beginning designers will find it especially engaging to trace how familiar elements of interface—buttons, text fields, checkboxes, and dropdown menus—originated from their physical-world counterparts: electric bells, radio dials, paper ballots, and various mechanical devices. It's not merely a historical excursion but an invitation to see everyday things from a new perspective.

For professionals, the book offers a reason to reflect deeply on the nature of interface decisions. It helps answer questions that seem simple yet often prove challenging: Why is a component built the way it is? Should a button brighten or darken on hover? What is the best way to highlight a selected item in a list: by a check mark or with a color? What's the difference between a dropdown list and a dropdown menu? How to align form fields for the best clarity?

The book analyzes 180 interfaces from popular applications, both desktop and mobile. Hundreds of illustrations showcase classic and contemporary products alike: Google Docs, Notion, Airbnb, Uber, Microsoft Word, WhatsApp, Telegram, and many others. Designers often struggle to find solid, real-world examples of interface components; this book solves that problem by building visual literacy through direct comparison.

This book is not just a history of interface design—it is also a practical manual for creating a modern design system. Each chapter focuses on a single component and examines it in depth: from its very archaic origins to its modern anatomy and a universal matrix of states, styles, and variations.

Several features make the book unique.

First, it includes 35 QR codes linking to popular articles, video tutorials, and supplementary materials, turning it into a truly interactive encyclopedia. You no longer need to google for a new term or search for a live example of the interface in action. Just scan the code with your phone!

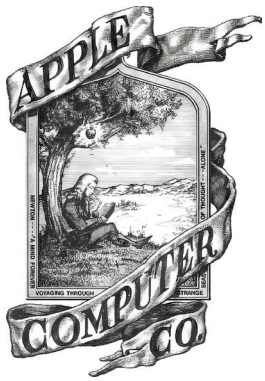
Second, all the design principles described in here are consolidated into a real, working design system, published on the Figma Community and used in large-scale international projects the author has worked on.

Third, the structure of the book allows complex sections—such as component matrices—to be skipped without losing comprehension, letting you simply enjoy the story and visuals.

Finally, it is the only book in the world with an intermission.

Contents

Before the Common Era | *Common Era*



1911
Founding of IBM

1968
First Mouse

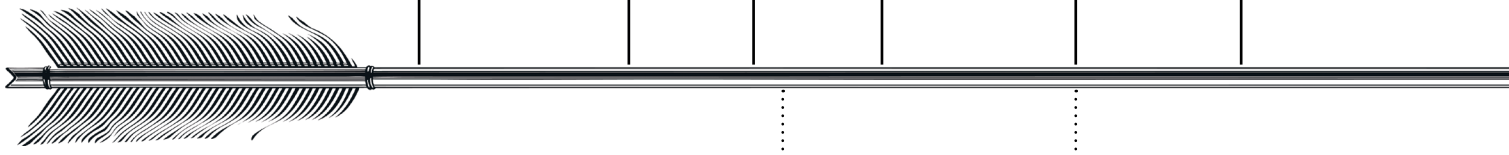
1973
Xerox Alto Release

1976
Birth of Apple

1985
Fall of the Empire

Release of Windows 1.0

1993
Launch of Newton



Prehistoric Period | *Ancient Era* | *Middle*

Charles Babbage
1791…1871

Alan Turing
1912…1954

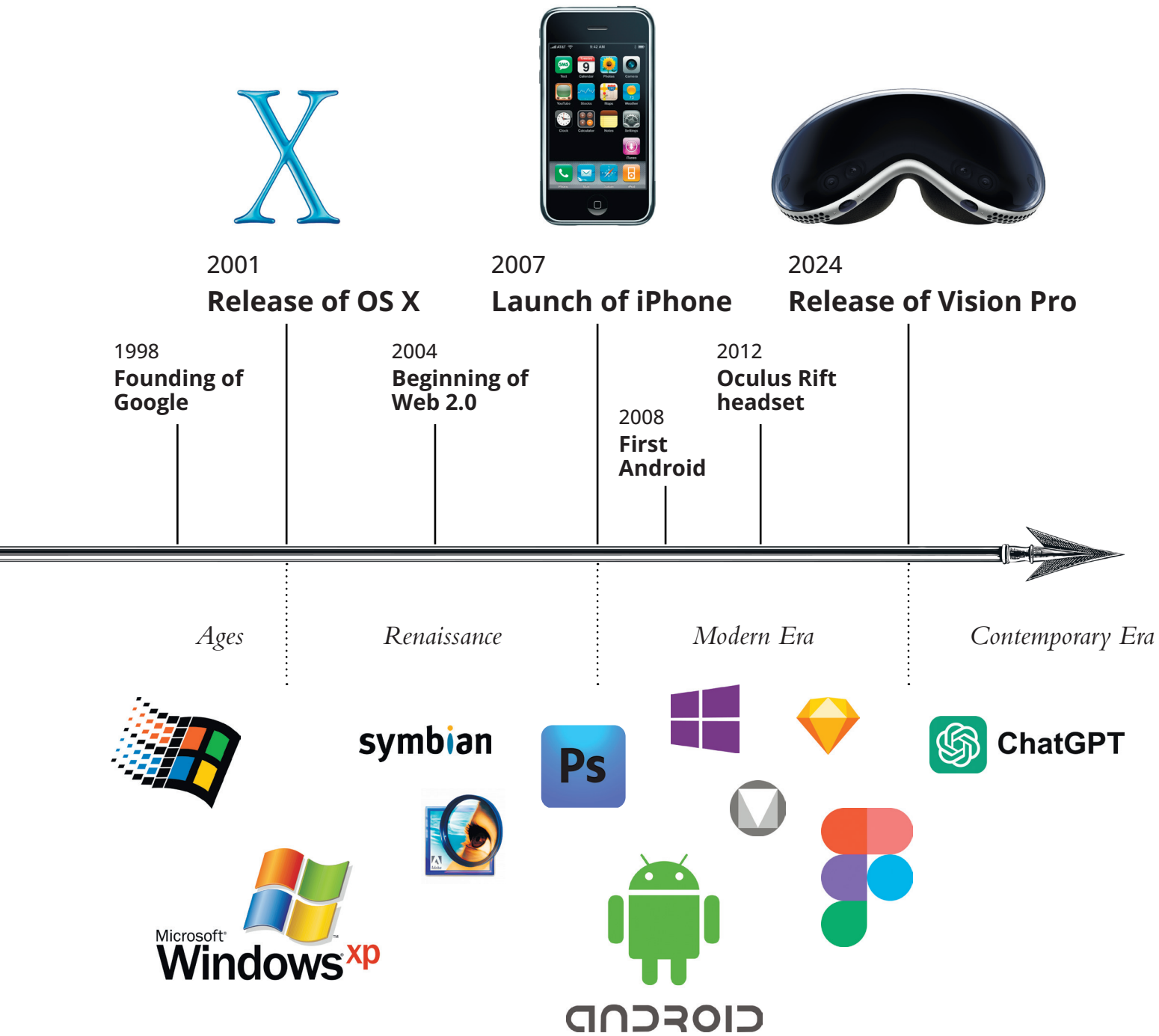
Jeff Raskin
1943…2005

XEROX PARC

MICROSOFT

commodore 64

Common Era


2001
Release of OS X
2007
Launch of iPhone
2024
Release of Vision Pro
1998
Founding of Google
2004
Beginning of Web 2.0
2008
First Android
2012
Oculus Rift headset
Ages
Renaissance
Modern Era
Contemporary Era
symbian
Ps
ChatGPT
Microsoft Windows xp
ANDROID

Part one

Desktop Interfaces

The Invention of the Button

Doorbell, 19th century

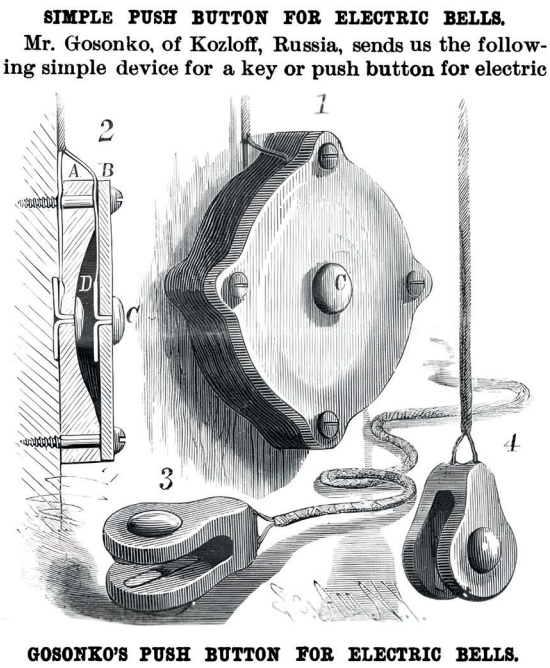
We know about the appearance of the first electric button roughly as little as we know about the invention of the wheel—even though the button was created in 19th-century Europe, and the wheel appeared around year -3500 in Mesopotamia.

Rachel Plotnick, in her book *Power Button*, writes that buttons emerged "no later than 1880" and were used to close an electrical circuit. And although people had already been using Morse code for almost fifty years by then, the device's little gizmo was technically a lever, not a button—so Plotnick is probably right.

The earliest buttons were made mostly of bronze and framed with wide panels packed with decorative details, as was the case with just about any object from the Victorian era. They were primarily used for doorbells and calling hotel staffs. You can still find such bells in some European cities today, or buy a modern reproduction on eBay.

Curiously, at first, buttons—like electricity itself—provoked genuine fear. People in the 19th century were far more terrified of electricity than we are today of "artificial intelligence." It's easy to understand why. After all, I have never heard of a ChatGPT chair, but the electric chair was already in use back then for executions.

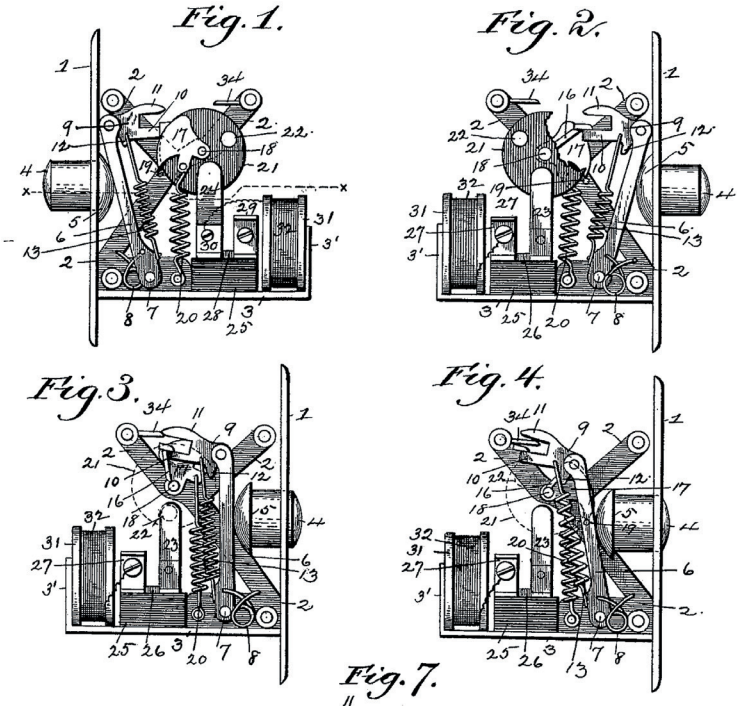
As for the buttons themselves, even though they quickly became popular, many educated people in the late 19th century worried that if everything was simply "left to run its course," buttons would destroy the younger generation's ability to navigate the world. People would get so used to buttons, they warned, that they'd forget how to do anything with their hands. And although few doubted the usefulness of the new invention, it was nonetheless believed that a person should first study the principles of electrical circuits in detail, then the inner workings of the buttons themselves, and only then start pressing them.



SIMPLE PUSH BUTTON FOR ELECTRIC BELLS.

Mr. Gosonko, of Kozloff, Russia, sends us the following simple device for a key or push button for electric

GOSONKO'S PUSH BUTTON FOR ELECTRIC BELLS.



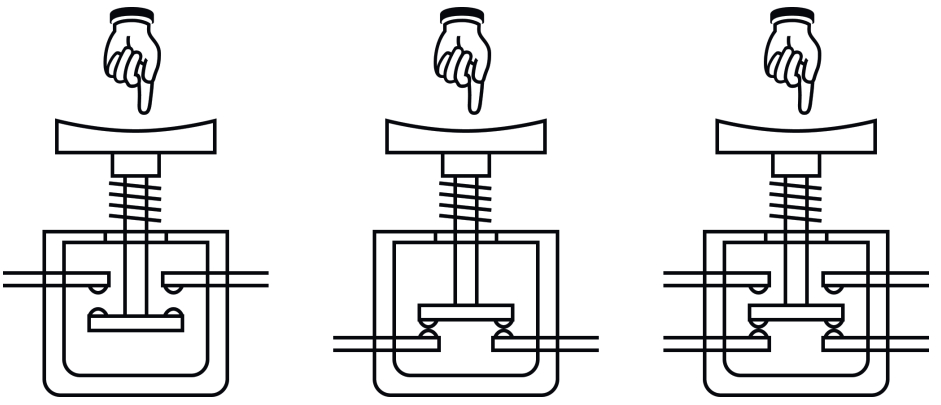
▲

Left: a drawing of Mr. Gosonko's button from Kozlov, Scientific American, № 26, 1885

Right: a drawing of American engineer McLaughlin's button, U.S. Patent № 521.808, 1894

Let us, too, take a careful look at how a button actually works.

Its most complicated part lies not in the press itself, but in the mechanism that returns it to its original position. Over the years, inventors proposed all kinds of ways to "unpress" a button. The simplest was to use a spring or mount the button on a flexible rubber membrane, as suggested in 1885 by a certain Mr. Gosonko from the town of Kozlov, who sent his invention to *Scientific American*. Other designs were far more intricate—like the doorbell button patented in 1894 by the American engineer McLaughlin, which consisted of thirty-three individual parts.



Different buttons use different mechanisms, but the underlying principle is the same

However different their mechanisms might be, all buttons—whether made of three parts or thirty-three—worked in essentially the same way: they simply closed an electrical circuit by connecting two wires. Once the circuit was closed, current flowed through it, activating the bell. Simple as that.

Once the passion for doorbells had been satisfied, by the end of the 19th century, buttons began to be used for all sorts of new purposes. They started appearing in all kinds of devices of the era. In 1888, Kodak launched a famous

advertising campaign for its new button-operated cameras, whose slogan declared: "You press the button, we do the rest." Another company, Eveready, received a patent in 1899 and released the first battery-powered flashlights with a button switch, using batteries of its own manufacture, today known under the Energizer brand.

Kodak advertisement for its button-operated cameras, 1888

Buttons very soon conquered more serious uses. By the late 19th century, American homes were rapidly replacing bulky wall-mounted levers with modern and compact electric light switches. Around the same time, buttons began appearing in elevators, which had previously been controlled by levers and powered by hydraulic or steam systems. A little later, in the 1910s, cars began to be started with buttons. Twenty years after that, buttons found their way into radios. By the 1950s, cars were experiencing a boom in button-filled dashboards, and by the 1960s, buttons had taken over virtually all consumer electronics: televisions, telephones, washing machines, tape players, arcade machines, and even airplanes.

The triumphant march of electric buttons around the world met almost no resistance—right up until the mid-1970s. Only one last bastion stood in the way of their global domination, a small dark cloud in an otherwise perfectly clear sky: a recent invention, the latest sensation in electrical fashion—the personal computer. Yet just short of the podium, something unexpected happened: buttons collided with a force they could not overcome, and from that moment began their slow but steady decline.

On March 1, 1973, the Xerox PARC research center introduced the first graphical user interface.

Calculator in early iOS imitated the Braun ET66 as part of skeuomorphism

Skeuomorph Attacks!

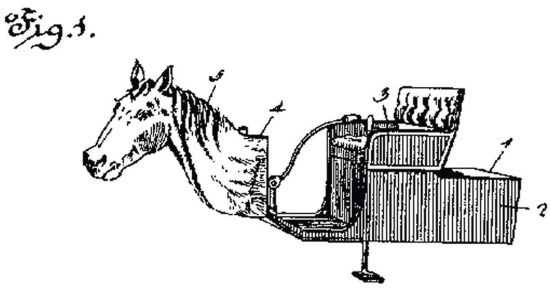
Decades have passed since then, and one thing is clear today: the number of real, physical buttons around us has dropped dramatically. Sure, computers still use more than a hundred buttons on a keyboard, but that hardly compares with the number of virtual buttons we press on a screen every day. Buttons never managed to conquer the personal computer. Instead, the computer swallowed the buttons, sending their souls to a virtual heaven known as the graphical user interface.

What's interesting is that today we barely notice the substitution. Yet on-screen buttons are nothing like the real ones. A virtual button offers no physical feedback whatsoever. While a real button can be felt and pressed with your eyes closed—you can sense its springy travel or hear a click—a virtual button can only be pressed while looking at the screen, and you can't feel it at all.

Still, on-screen buttons try their best to behave like the real ones. They have shadows, highlights, depth, and sometimes even sound—especially when the designer is dealing with a stubborn client. And while designers often overdo the decoration, all these visual tricks didn't appear by chance.

As early as the late 19th century, inventors realized that the brave new world of buttons and electricity was too strange for people accustomed to riding horses and dining by candlelight. Lamps, electric doorbells—all of this frightened people because it was unfamiliar. To make new devices less intimidating, inventors tried to give them the shapes of familiar objects. Electric chandeliers, for example, were designed to look like ornate candle candelabras, and light bulbs were sometimes shaped like flames.

Often, this kind of imitation really did help people adapt to the new world, but sometimes it went too far. The most famous example is the legendary Horsey Horseless. In an effort to make automobiles less frightening for horses and villagers, one American inventor came up with the idea of attaching to the car a full-size horse's head. Luckily, the invention never went beyond the patent stage; otherwise, instead of gleaming hoods, Henry Ford's cars might have been outfitted with massive bronze horse heads.



Left: drawing from Patent № 30551 for a horse-headed automobile

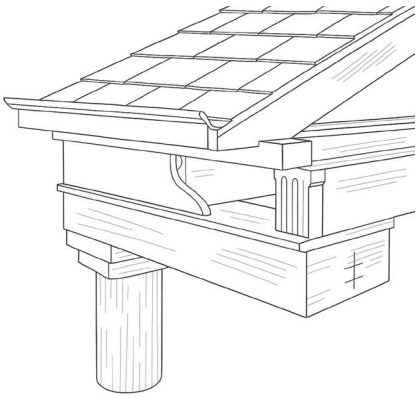
Right: illustration from Historical Motor Scrapbook

You have probably already guessed what this is about. This kind of imitation—when the design of a new invention mimics that of an older one—is what we call *skeuomorphism*. And while the word itself is unfamiliar to most people, the phenomenon is known to anyone who has ever held a phone.

When people talk about skeuomorphism, they usually mean the design of early versions of OS X and iOS, where every interface element was styled after a real-world object. In the Notes app, for example, the notepad was drawn as sheets of paper stitched together with a decorative coil; the camera simulated the narrowing of a mechanical aperture when taking a photo; and every button carried a stack of shadows, a gradient, and a texture.

These are indeed good examples of skeuomorphism, but in reality, it isn't limited to the interface of an early iPhone. In fact, it is *any* imitation whatsoever in which a new object mimics an older one in order to preserve familiarity.

And although the word appeared in the late 19th century, the phenomenon itself has been with us for thousands of years. The triglyph, for instance—the pattern of three vertical bars running along the entablature of ancient Greek temples—has no architectural function at all. It just imitates much older wooden temples, where the pattern appeared simply because the ends of wooden beams stuck out that way.



Triglyph in ancient Greek temples—a skeuomorphic element imitating the beams of older wooden temples

The graphical user interface introduced by Xerox PARC in 1973 became a monumental turning point in the history of technology. This leap was far more astonishing than the transition from wooden temples to stone ones, or from flaming candles to electric lightbulbs. Perhaps that is why almost every element of the graphical interface is—or at least once was—a skeuomorph, mimicking some object from the real world.

The engineers at Xerox brought to life something that had existed only in imagination and a couple of Hollywood movies. The graphical interface was so unlike anything people had seen before that it *had* to imitate the real world for an ordinary person to understand it.

The book you are holding in your hands tells the story of the inner logic of the graphical interface, uncovering the deepest mechanisms that make it work. This book is a kind of reverse engineering for the world of design. Step by step, as we reconstruct the history of each element—button, checkbox, dropdown list and so on—we will come to understand why they look and behave exactly the way they do, and not otherwise. Like the first users of electric buttons, we are simply obliged to understand the inner workings of virtual ones.

I am convinced that a truly complex, coherent, and extensible interface can be designed only by someone who thoroughly understands its underlying logic. And that logic can be grasped only by bringing up from the bottom of history the original problems and their solutions that made modern interfaces what they are today.

Ancient Buttons

We begin with buttons, the simplest element of the interface.

Their Ancient Era began in 1973 with the release of the Xerox Alto, the first personal computer with a graphical user interface. Along with it came the first

interface button, marking the end of the prehistoric age of physical buttons. It looked as simple as possible: a short English label enclosed in a checkered frame.

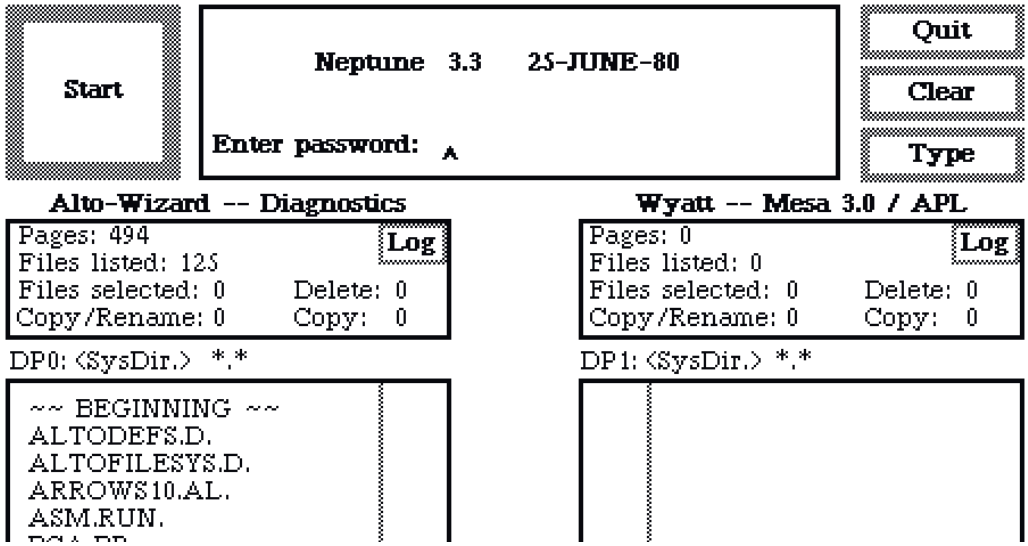
Obviously, the designers modeled the virtual button after real, physical ones, which were often rectangular. But the idea of placing the label inside the button—that was something new. In the real world, text is rarely put directly on a button, since simple paint wears off quickly under a finger. That's why physical buttons are usually labeled below or beside the control. Just imagine what an interface would look like if the buttons were round, with labels sitting off to the side. Fortunately, such design appears only in video games and simulators. Then again, checkboxes and radio buttons actually look exactly like that—but more on that later.

Despite their primitiveness, ancient buttons followed one of the core rules of interface design from the very beginning: since a button performs *an action,* its label should be *a verb.*

Let's look at one of the first file managers in history, the Neptune app for the Xerox Alto. It was the ancient analogue of Windows Explorer, though its two-column layout makes it look more like Norton Commander. We not concerned with file operations right now; what is interesting is the top control bar, which contains several buttons: *Start, Quit, Clear,* and *Type.* Their meaning is easy to guess from the name alone, and even if you remove the outline, the verb label still makes it clear that this spot can be pressed and an action will occur.

Buttons in game interfaces and stylized UIs can be round, with labels beside

Top: elevator in France
Bottom: Fallout menu

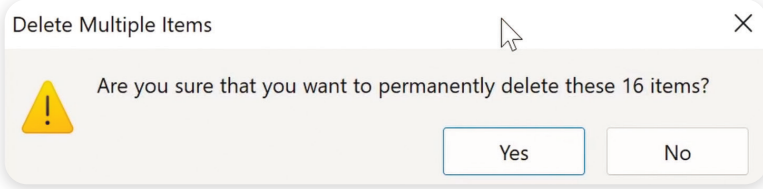


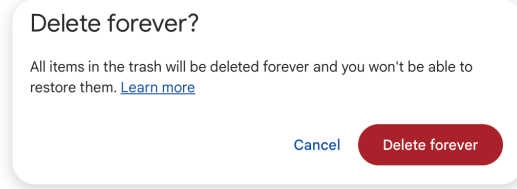
Neptune 3.3 file manager for Xerox Alto computers

Although this rule was established back in 1973, designers still often forget about it today, which can seriously degrade the interface. For example, when choosing between *Yes* and *No* in a file-deletion dialog, the user is forced to read a long and often useless block of text. Meanwhile, choosing between *Delete* and *Cancel* would be obvious without any explanation.

Windows: the trash cleanup dialog forces to read the message; Google Drive makes the choice obvious

▼



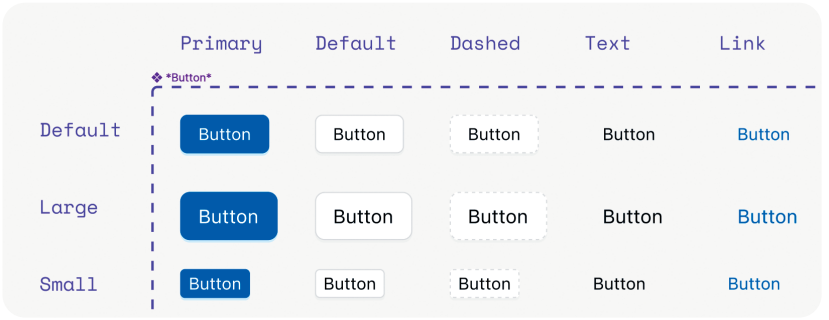


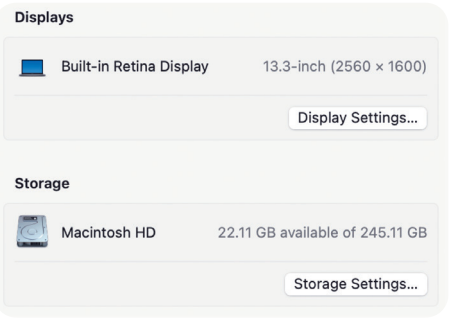
On the other hand, web designers sometimes go to the opposite extreme and use verbs in hyperlinks, even though a hyperlink should be *a noun,* since it is simply a gateway to another page and doesn't perform any action.

Some designers might think that only beginners make mistakes like this, but in Figma you can find dozens of professional design systems where links aren't treated as a separate component. Instead, they're just one of the button styles, usually labeled as "Link".

Left: Ant Design system, an example of mixing a button and a hyperlink

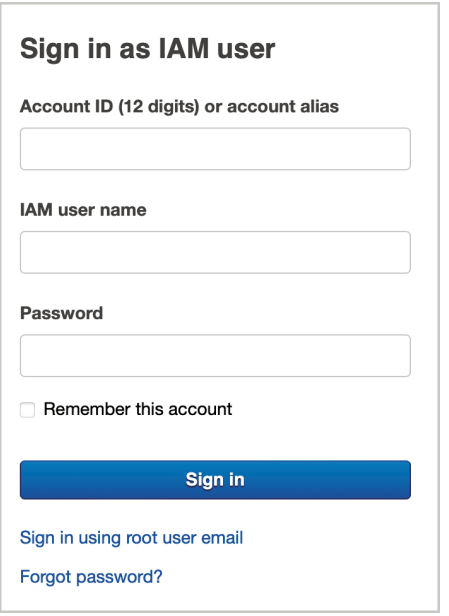
Right: when a button leads to another screen, a noun with an ellipsis is used instead of a verb

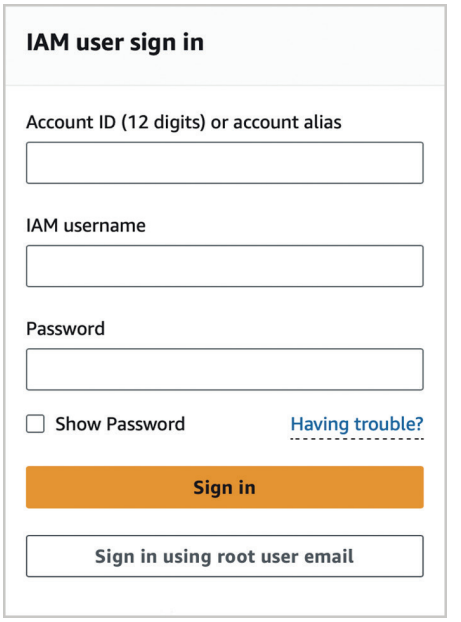




This reflects a systemic misunderstanding of subtle logical distinctions that, once ignored, can snowball into serious mistakes in complex interfaces. For example, links and buttons cannot be merged into a single component, if only because links have a different set of states: in addition to *Hover* and *Pressed,* they can also be *Visited.* But details like these are routinely ignored today.

Old vs. new Amazon AWS sign-in dialog. Designers can't decide whether *Sign in using root user email* should be a link or button





Button States

It seems this is the first time I've used the term *state.* Physical buttons have two positions: the default one and the pressed one, in which the button stays

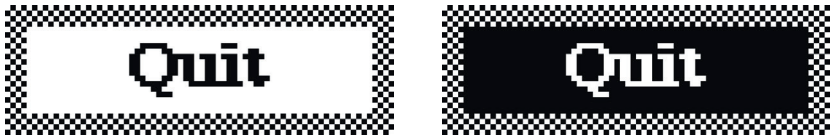
for a fraction of a second, sinking into the panel and then springing back to its original place. Virtual buttons cannot be pressed with a finger; they have nowhere to sink and no pressed position. And, in fact, we don't really press on-screen buttons. We press the mouse button, and the "pressing" of the on-screen button is nothing more than an illusion.

When we press the mouse button, we get tactile feedback in the form of a click. If, at that moment, we focus on the on-screen button and forget the mouse exists, our perception creates the illusion of pressing the button on the screen. The same effect allows a person to operate a bicycle or a car without thinking: we don't consciously feel the handlebars or the pedals, as if we merge with the mechanism into a single whole.

This idyll is disturbed by only one flaw: the on-screen button still doesn't get actually pressed, and while a person does receive tactile and auditory feedback from a mouse click, that feedback is not reinforced visually. Therefore, to make the illusion fully work, the button must visibly react to being pressed.

Incredibly, those very ancient designers who introduced the world to the first graphical interface took care of this subtle detail right from the start: when an interface button was pressed in the Xerox Alto, its background turned black for a split second. This technique was nothing more than an imitation of the shadow cast by a physical button when you press it with your finger.

It would be incorrect to call such an imitation a position, which is why we use another term today: *the state* of a button. Thus, we can say that buttons in the Xerox Alto interface had two states that later entered designers' vocabulary under familiar names: *Default* and *Pressed*.



Xerox Alto button: Default and Pressed states

The black color was chosen to imitate a pressed state simply because there were no other options: at the time, all displays were monochrome. Later, as displays began to support shades of gray, the idea was developed further, and designers started to imitate lighting in greater detail.

The Ancient Era was in full bloom when Apple was born on April 1, 1976, marking the beginning of a new epoch. Contrary to the common stereotype, the company's early computers couldn't work with graphics at all and relied on a text-based interface. Apple's first computer with a graphical interface was the Lisa, introduced only in 1983—just a year before the release of the Macintosh, the subsequent fall of the Empire, and the decline of the Ancient Era.

However, the Middle Ages that followed were not as dark as some historians claim. Even though the interfaces of the Medieval period look outdated today, they were well-refined for their time. For example, designers of Mac OS and Windows learned to give buttons volume using two simple tricks: they added a dark border to the bottom and right edges, and a light border to the top and left edges. This was meant to show that the button protruded slightly toward the viewer from the surface, with light falling on it from the upper-left corner. When pressed, the light border turned dark, and in Mac OS, the background darkened as well.

Early Mac OS and Windows simulated top-left lighting by adding light and dark shading to button edges

These primitive button shadows were the first step toward fully developed skeuomorphism, which early designers struggled to achieve due to technical limitations. In the late 1990s, rapid advances in computer graphics began—advances that continued throughout the 2000s and pulled the graphical interface along with them.

Primary and Secondary Buttons

The Middle Ages saw plenty of inventions, though none could truly be called revolutionary. From 1984 to 2001, the computer industry seemed to be gathering strength, preparing to unleash its full potential in the Renaissance, which began with the release of Mac OS X.

Apple's new operating system introduced the glossy Aqua interface, built on OpenGL graphics. Its striking look became the system's main attraction. During the presentation, Steve Jobs said that one of the goals was to design something so appealing that users would want to lick the screen. And the new buttons really were beautiful. They resembled droplets of water glistening in the sun, hence the name Aqua.

Steve Jobs at the Mac OS X presentation, Jan 5, 2000

"One of the design goals was that when you saw it, you wanted to lick it"

There was another detail almost no one noticed. In the same presentation, Jobs drew attention to a new kind of button. On one of the screens, to the right of the familiar gray *Cancel* button, there was a blue *Apply* button that gently shifted its color, as if imitating a neon glow. Steve explained that the blue button was the primary button—the one you could activate with the Return key.

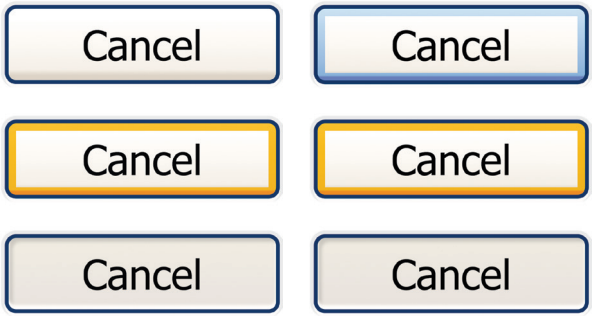
This was the first time interface elements were divided into multiple types according to their importance. Until then, all buttons were identical dull gray rectangles, but now one of them—the primary one—could be blue. This made it immediately clear which action was the main or recommended one.

This separation of buttons into two types quickly became a staple of interface design. Today, it's hard to find an interface without these two types. Design systems typically call them *Primary* and *Secondary,* and often include additional types as well, which we'll examine later.

Secondary and Primary buttons in OS X 10.0

At the same time, Microsoft also decided to rethink its interface and, in that same year of 2001, released Windows XP. This system, too, introduced a distinction between primary and secondary buttons. Both types had a white background, but the primary button received a supplementary blue outline. In addition, the system brought its own innovation to interface design by adding

a third state for buttons. Now, a button not only darkened when pressed but also displayed an orange highlight when the mouse hovered over it.



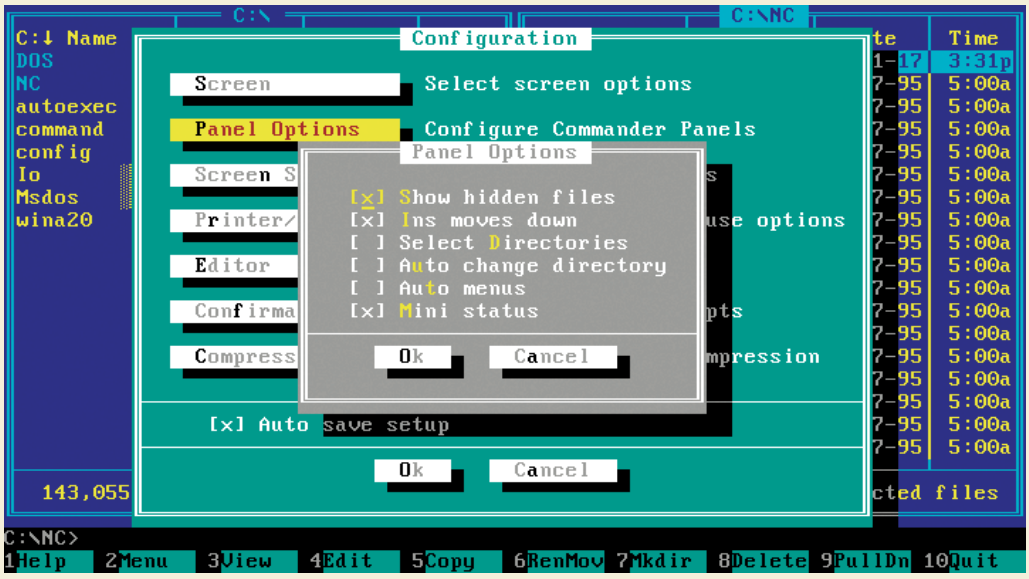
Windows XP buttons

Left: Secondary buttons
Right: Primary buttons

Top to bottom: Default, Hover, Pressed states

Interestingly, the third state—what we now call *Hover*—never made its way into Mac OS. The system still uses only two states: default and pressed. Perhaps Apple's designers have a point: after all, there is no such thing as "hovering" in the physical world, so why add it to virtual buttons?

Nevertheless, most modern interfaces do use a hover state, and I see no reason not to. A slight color change when the cursor hovers over a button adds a bit of charm to the interface, and the brief darkening at the moment of pressing creates a sense of depth, polish, and responsiveness.



Text Strikes Back

In parallel with the progress of the graphical interface, a strange mutant was evolving—the text interface. It combined elements of the command line with those of a full-fledged interface, drawing flat buttons, checkboxes, and even dropdown menus using special characters and solid-color fills. The most famous example of such an interface was Norton Commander, a file manager that gained worldwide popularity in the 1990s. It was often used by professionals accustomed to typing commands on the keyboard who didn't find graphical interfaces particularly convenient.

The aesthetic–usability effect

This effect is so important that it can even compensate for logical flaws. For example, Facebook's interface—despite being quite inconvenient—still appears friendly and visually appealing. This is known as *the aesthetic-usability effect*. Some experiments have shown that, between two otherwise equivalent interfaces, the one that looks more attractive tends to feel more usable.

So what exactly is a hover state? In searching for an analogy in the physical world, I arrived at two interesting metaphors.

Imagine you're looking for the right button on a control panel in a poorly lit room. You're using a small flashlight with a narrow beam, pointing it at them one by one, and the button illuminated by the flashlight becomes brighter. This might well be the effect the designers of Windows XP were trying to imitate.

However, some design systems do the opposite, slightly darkening the button on hover. And that approach is justified, too. Imagine bringing your finger close to the button you're about to press. In that case, the finger casts a shadow on the button, making it a bit darker.

Which approach to choose is up to the designer. I have always liked the odd flashlight analogy and used to make buttons slightly brighter on hover, but while writing this book, I had to reconsider that approach. It turned out to be logically incorrect: buttons without fill simply can't be made brighter—they're already completely white.

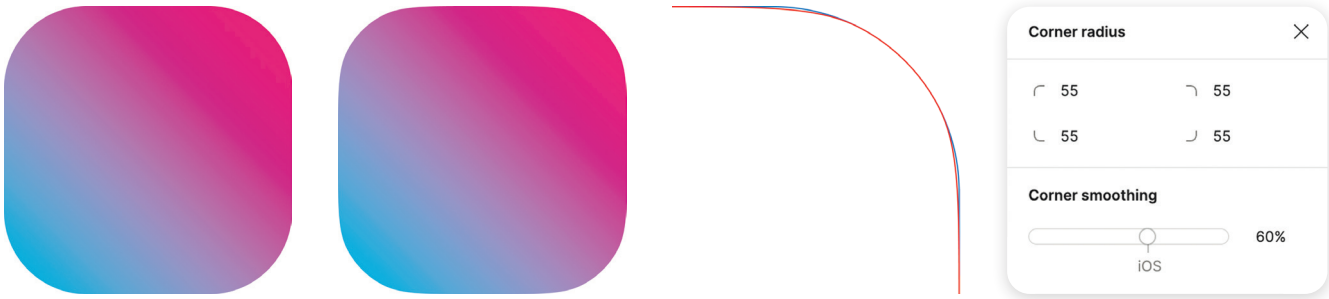
Enter Photoshop

Skeuomorphism evolved rapidly throughout the 2000s. Designers of that era seemed to compete to see who could stack the most shadows, gradients, textures, and animations onto their buttons without triggering an epileptic seizure in the user. A typical button of the time usually included: a drop shadow at the bottom, a glossy highlight at the top and a glow underneath it, a gradient fill, an outline, a texture or noise layer, and some additional effects applied to the label.

A leather-styled button from graphicsfuel.com—a typical example of peak skeuomorphism, 2012

The height of refinement was the contour shadow, a secret feature hidden in Photoshop. Instead of a standard linear shadow, you could create one that faded along a Bézier curve. A contour shadow was seen as the same kind of meticulous detail that a superelliptical border radius represents in iOS today. And, just like superellipses, it wasn't supported by any browser. However, this wasn't a problem back then, buttons were made using images.

Squircles use superelliptical corners (2) and hard to distinguish from rounded squares (1) yet a key part of iOS style. Figure 3 shows comparison; Figure 4 is the setting in Figma



1 2 3 4

The peak of skeuomorphism came in the late 2000s, beginning in 2007 with the release of the iPhone, the first phone operated with fingers. Many designers still remember the interfaces of the early iOS versions with a certain warmth: every app had its own unique design, polished down to the smallest detail. Notes looked like a real notepad; the camera showed a closing-aperture animation when taking a photo; and the books in the reading app sat on a wooden bookshelf.

Superellipse and squircle

Calendar app on iPad running iOS 6—the last version of the system to use skeuomorphism

Curiously, throughout all those years, designers continued drawing interfaces in Photoshop—a photo-editing tool completely unsuited for the job.

The first proper tool for interface design was Sketch, released in 2010, which gained some popularity by the end of the decade but never truly won designers'

hearts. Most likely, Sketch arrived too early. At the time, skeuomorphism was still popular, yet Sketch worked only with vector graphics. On top of that, the app was available only for Mac OS.

So designers, while fully aware of Sketch's advantages, moved to it slowly and hesitantly, secretly launching Photoshop to add a texture or a dotted outline here and there. It would be several more years before the blessed Figma appeared, and almost a decade before it gained all the functionality designers needed.

Salvation came unexpectedly: skeuomorphism was killed by Apple itself.

UI Kits and Design Systems

The era of skeuomorphism also saw the rise of UI kits—collections of interface elements created in a consistent visual style.

Here's how they worked. Suppose a designer needed to create the interface of an app, say a book reader. After preparing the initial concept, the next step was choosing an appropriate visual style and drawing the full interface, with all the details, fonts, colors, textures, and decorative elements.

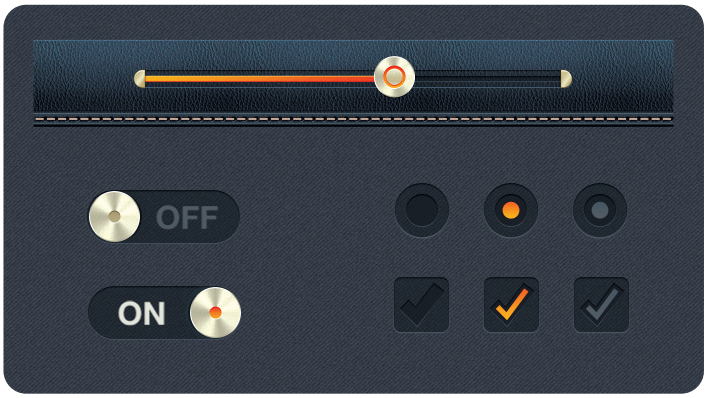
This part was always the hardest. There's a reason creative people talk about the "fear of the blank page." It happened like this: you opened Photoshop, stared at the white canvas, and had no idea where to begin. Even to draw the simplest button, you had to know at least what color it should be and what font the label should use. But to understand that, you first had to imagine the entire interface as a whole and only then zoom back down to the level of a single button.

UI kits were invented to solve exactly this problem. A designer would go to Dribbble or Envato, download a ready-made set of buttons—for example, in a wooden style (since books sit on wooden shelves)—then find a matching texture and font, draw the missing elements, and gradually assemble all the app's screens.

Although UI kits were a useful source of inspiration, they were not very helpful for designing complex interfaces, where, in addition to the visual layer (UI), you also needed a deep understanding of the underlying logic (UX).

UI kits were far too primitive for large-scale tasks. Typically, they included a couple of simple buttons, a radio button, a checkbox, a toggle, and a range or a slider. That was enough to design a simple reading app, but nowhere near enough for designing a large application like Microsoft Excel.

Most UI kits were visually appealing but contained very few components and weren't suitable for complex interfaces



There was another problem: skeuomorphism. Although many buttons really did look so delicious you almost wanted to lick the screen, this kind of styling seriously held design back.

A large project's interface consists of dozens of components, each with multiple styles and states. Take a simple button, for example. It can be filled or outlined, or rendered as plain text. You can add an icon to the left or right of the label, and you often need buttons in several colors: white, blue, or red (for destructive actions). And each of these variations may have at least four states: default, hovered, pressed, and disabled. Even the simplest button is extremely difficult to draw in all these styles, variants, and states when working in a skeuomorphic style. That's not to mention the dozens of other components! This is precisely why, in 2013, Apple killed skeuomorphism. By sacrificing visual beauty, the company paved the way for design systems—the next step in the evolution of interface design.

A design system can be viewed as an advanced form of a UI kit, containing dozens of components with numerous states, styles, and types. Components can be elementary—such as a button, checkbox, or input field—or composite, such as a calendar, form, or control panel. Composite components are built from elementary ones: a control panel, for instance, is nothing more than a row of buttons and other components arranged horizontally. This principle, known as atomic design, was introduced in 2013 by designer Brad Frost. A proper design system also includes a color library (for both light and dark themes), as well as typographic styles for headings and labels.

Atomic design

This book is dedicated to the search for a universal design system. After studying the history of user interface in detail and analyzing dozens of existing systems, I noticed that all of them are built on a set of universal principles. At the same time, every design system violates these principles in some way. Many chapters of this book are devoted to examining these principles and dissecting the mistakes found in today's design systems.

Photoshop Exits. Enter Figma

The era of skeuomorphism came to an end in 2013, when Jony Ive, Apple's design chief, introduced the flat iOS 7, followed year later by the flat Mac OS Yosemite. The design of these systems came to be called "flat" because of the complete absence of shadows, gradients, and textures: Ive removed even the faintest hints of skeuomorphism.

Users met the new interface with hostility. The early versions of flat design looked dull compared to the bright, lively interface of the old iOS. But over time, the design was polished, and it became quite appealing. Ive himself explained the demise of the old style with two reasons. First, he argued that skeuomorphism had been useful only in the early years of smartphones, when users were still getting used to the new technology. Second, he believed that unnecessary details distracted the eye, putting the style of apps above their function.

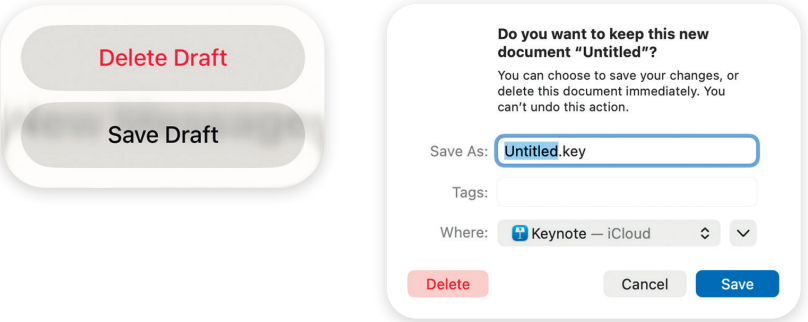
Despite all the missteps and the wave of criticism, Mr. Ive turned out to be largely right—and remarkably farsighted. Importantly, the end of skeuomorphism opened the way for the brilliant design tool Figma, which replaced Sketch and has since become beloved by all designers. But even more importantly, flat design paved the way for design systems, which by then had been nearly impractical

outside large corporations. As a result, the mid-2010s saw a kind of Cambrian explosion in interface design, producing an entire swarm of new buttons, radios, checkboxes, and dropdowns.

One of the first new buttons to appear in the flat Mac OS was the danger button. In fact, it had already existed in the early versions of iOS, but it didn't make its way to desktop until a decade later. The danger button is highlighted in red and typically performs a destructive action, such as deleting a file.

Following the danger button, appeared many variations of this component: outlined, borderless with hover feedback, borderless without hover feedback, and even plain text versions. One by one, we will examine all these styles and include them in our design system.

Danger buttons in modern iOS and macOS



Beyond purely stylistic changes, one of the major advances after the fall of skeuomorphism was the emergence of auxiliary elements, typically placed along the edges of components. A modern button consists not only of a base and a label; it may also include an icon to the left or right of the text, as well as a small supplementary label, often used as a counter.

It's not that none of this existed during the skeuomorphic era. Of course, there were danger buttons and buttons with icons. But creating an entire set of buttons with dozens of combinations was simply impossible. First, Photoshop couldn't work with component libraries: if you needed to update the design of a button across ten different pages, you had to open each file separately and replace the layers manually. Second, even if you solved that problem, maintaining a design system in the skeuomorphic style—with all its shadows, textures, and highlights—would have been extremely time-consuming.

Sketch was a significant step forward: it allowed designers to work more closely with libraries and component properties. But the true revolution came with Figma, which expanded this toolkit to an unprecedented level.

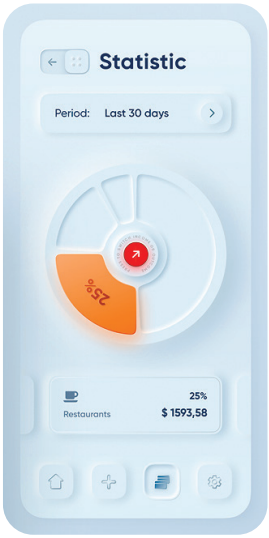
Neomorphism

The nostalgia for skeuomorphism lingered among designers for a long time. Many of us, even after recognizing the advantages of flat interfaces, could not fully accept the disappearance of shadows and gradients and therefore sought a compromise between the two incompatible styles. The most successful attempt was made by designer Alexander Plyuto, who introduced a visual language later called *neomorphism*.

The style emerged in 2019, when Plyuto presented a concept for a banking app on Dribbble. The unusual interface employed a soft color palette, elegant milky shadows, and a gentle glow in the upper-left corner of components. Its aesthetics resonated so strongly with the community that the concept went instantly viral. Over the following years, neomorphic interfaces proliferated at an incredible rate, winning the hearts—and portfolios—of designers, and many began predicting a bright future for the style.

At first, it seemed that neomorphism might take over the world, yet it soon became clear that the style was too demanding for large-scale adoption. Alas, it required a meticulous approach to color and an exceptionally delicate treatment of lighting. Beyond purely technical difficulty, neomorphism also proved to be incompatible with most corporate brand systems. Its aesthetics depended on a very specific palette and fell apart the moment one introduced even a slightly different shade.

Although many applications were eventually released in a neomorphic style, most of them were created by enthusiasts. Large companies tried to adopt the trend, but their efforts rarely went beyond tentative experiments in advertisements and design concepts. Unfortunately, neomorphism turned out to be not only too complex but also too beautiful: using an app turned into admiring the interface. Within a couple of years, the hype faded and soon disappeared entirely. Attempts to revive skeuomorphism, however, did not end.



The first neomorphic design, 2019

Liquid Glass

The solution came, quite literally, from another dimension. A new wave of realism in interfaces was sparked by the Vision Pro—an AR headset—and, at the time of writing this book, that wave is only beginning to grow into a tsunami.

Augmented reality opened the door to spatial interfaces, in which virtual elements integrate seamlessly into the physical world. Such an interface does not lie on a two-dimensional screen but exists directly in front of the user's eyes, occupying actual space. A browser window can now hang on a wall, and a 3D model can stand on a table among ordinary objects. For virtual elements to truly settle into the real world, they must behave accordingly: refract light, exhibit highlights, cast shadows, respond to viewing angles, and so on.

Liquid glass was inspired by Vision Pro, yet it still uses a simpler effect

Apple's designers concluded that the best material for these tasks would be something resembling glass. Indeed, a glassy button appears natural, is easily noticeable thanks to light refraction and edge highlights, and yet doesn't block what's behind. This idea led to a new design language inspired by liquid glass.

Interestingly, although liquid glass originated in augmented reality, the Vision Pro headset itself uses a much simpler version of the effect than the one found in iOS 26. Perhaps we will see it in future iterations of the headset, and the puzzle will finally come together.

Immediately after the June 9, 2025 presentation, the public noted that glassy interfaces had existed before. In fact, the first operating system to use a glass effect was Windows Vista, released in 2007. Its style was called *Aero Glass.* Window titles, the Start button menu, and some applications, such as the media player, were made semi-transparent with a slight background blur. macOS also featured a glass effect long before it was replaced by liquid glass. It appeared in the Launchpad menus, the Dock, dropdown menus, and sidebar panels. The macOS version used much stronger background blur, referred to as *frosted glass,* or simply *blur.*

Glass effects: Aero Glass in Windows Vista, frosted glass in macOS 15, and liquid glass in iOS 26

Of course, liquid glass resembles all other glasses only at first glance. In reality, it is far more refined. Technologically, it is superb. Engineers even achieved dispersion along the edges of glass components, causing them to shimmer with color, and implemented a perfectly calibrated geometry of light distortion. This is not just a simple filter but genuine graphics card work and use of shaders, almost as in video games.

This complexity, however, is also the core problem of liquid glass. Unlike ordinary blur, such an effect cannot be produced without GPU rendering. On the web, it relies on WebGL, which is resource-intensive and poorly compatible with HTML. It will likely take quite some time before developers' favorite libraries—React and Vue—learn to simulate it. This means that iOS design will enter a state of real chaos: only native apps will be able to use liquid glass, while thousands of popular web apps will be stuck with outdated interfaces. The gap between platforms may become outright insurmountable, especially if Android introduces its own fancy-schmancy effect.

Liquid glass effects include magnification, dispersion, distortion, and surface tension

The third part of this book is devoted to augmented reality, examining the interfaces of AR headsets and glasses. As for liquid glass, this effect is primarily visual, and while the book does touch on visuals, its main focus lies on the internal logic and evolution of interfaces. Fortunately, a button remains a button even if we teach it to refract light and to wobble in response to a finger's glide.

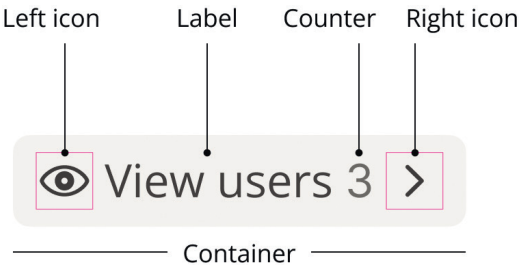
The Anatomy of a Button

IT IS TIME TO MOVE FROM THEORY TO PRACTICE. Let's take a scalpel in our right hand and a pair of tweezers in our left, and dissect a button to understand its anatomical structure.

Through the entire body of the button—the part we'll call *container*—runs its backbone: *the label*. Typically, the button's width adjusts to the length of its label; the label itself never wraps to a second line and is kept as short as possible.

To the left of the label is an icon—a pictogram chosen to illustrate the action the button performs. There may also be an icon on the right of the label, such as a › right-pointing chevron, which is often used for a *Next* button. Finally, a small secondary label sometimes wedges itself in between the main label and the right-side icon—a small bit of text I've come to call *a counter.*

How to create a button in Figma: component properties



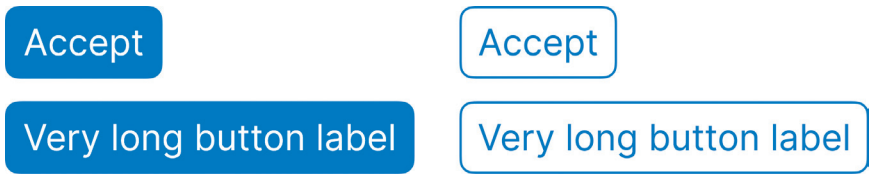
Naturally, you don't have to use all of these elements. The point is to create a universal button component in which these elements exist as optional parts. In design systems, such options are implemented as *component properties* that the designer can turn on or off as needed.

Container

ALTHOUGH SOME BUTTONS consist of text only, most have a colored background that visually separates them from their surroundings. This background—often called the body, base, or container—is usually a rounded rectangle. However, in Figma, the container is never created with the Rectangle tool. Instead, it's built as a *Frame* using *Auto Layout,* with all button elements—its label, icons, and the counter—placed inside it.

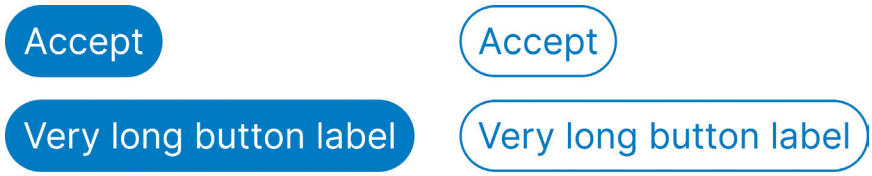
Because the width of a button must automatically adapt to the length of its label, you don't set a fixed pixel width. Instead, the container is given the *Hug contents* property. As for visual styling, the two most common container types are *Fill* (a solid background) and *Outline* (a border with a stroke).

Examples of simple Fill and Outline buttons. The button's width automatically adjusts to the length of its label

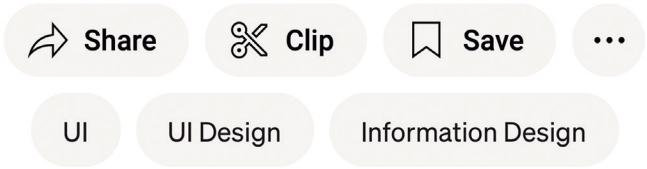


Perhaps the most debated parameter of the container shape is the degree of corner rounding. Until Snow Leopard, Mac OS used heavily rounded buttons shaped almost like pills or capsules. Apple then abandoned this approach and switched to rectangular buttons with rounded corners—only to come back to circular buttons in macOS Tahoe. If we wish, we can easily create a pill-shaped button in Figma by setting the corner radius to its maximum. Such a form works well for stylistic purposes, but in general it should be avoided: today, pill shapes are associated primarily with tags and badges.

Buttons with full-round corners aka *pill buttons*; this shape is better for tags than for buttons



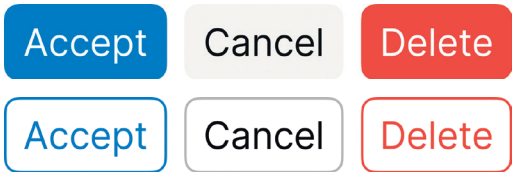
YouTube's pill buttons (top) resemble Medium's tags (bottom) and are distinguished mainly by their icons and size



The background color of a button can be anything. Most interfaces use three colors: blue for primary buttons, gray for secondary buttons, and red for danger buttons. In design systems, the button's color is rarely set directly. Instead, it's tied to the button's type and controlled by a *Type* property, which usually has three values: *Primary, Secondary,* and *Danger.*

Note that it's not just the background color that changes, but the label color as well. Obviously, black text is hard to read on a blue background, so primary and danger buttons with a filled background use white labels instead.

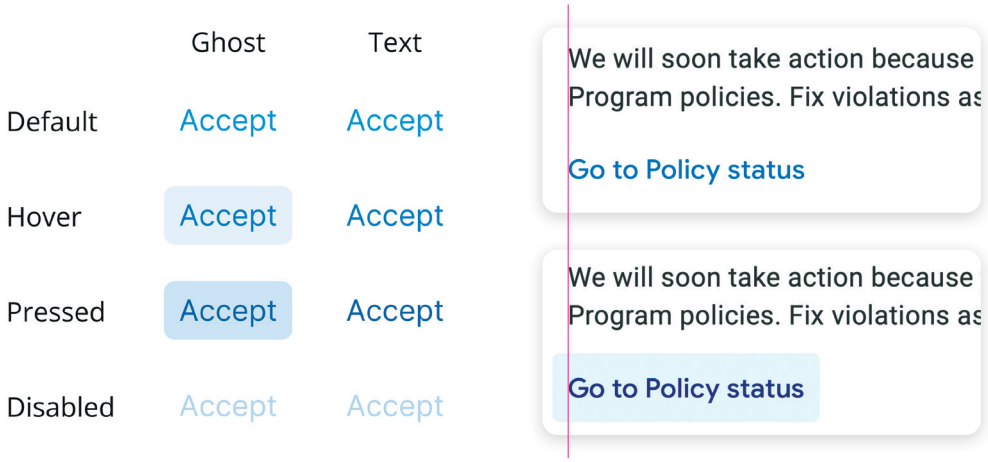
Button color is defined by its type: Primary is usually blue, Secondary is gray, and Danger is red



Two styles—Fill and Outline—aren't enough for complex interfaces, so most design systems include two more.

One of them is called *Ghost*. Sometimes this style is described as an empty, transparent, or invisible button. Of course, such buttons are perfectly visible; they just have no fill or outline, leaving only the label and icons. Still, a Ghost button lights up with a light background both on hover and on press. At that moment,

it becomes clear that the button does have a container and internal padding, but its color is by default transparent.

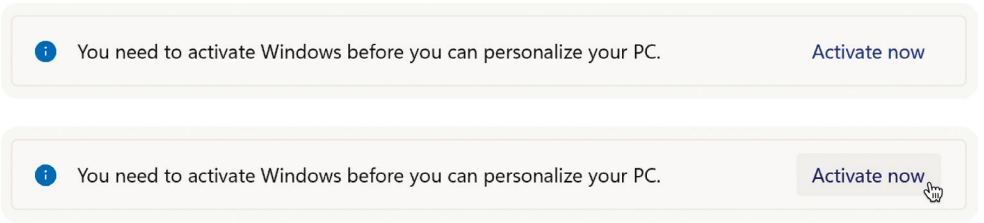


Left: Ghost buttons have a container and highlight on hover and press; text buttons have no container or padding

Right: An example of proper alignment for a Ghost button in Google Play Console. The button shifts left so that the label and text edges align

The second additional style is called *Text*. Unlike a Ghost button, a Text button does not light up with a background on hover or press. Only the label color changes, which makes it similar to a hyperlink. This is the style designers often—and incorrectly—label as *Link*. A Text button has no container and no internal padding.

Ghost buttons are common in Google products and other large platforms. They are often used in navigation and toolbars, as well as for secondary actions on sign-in screens.



Ghost buttons have a container and internal padding, which become visible through the highlight on hover

Text buttons are used for the same purposes. Often, a secondary action is so unimportant that you want to draw as little attention to it as possible. In such cases, a Text button is the perfect choice. It also has no internal padding, which helps save valuable space.

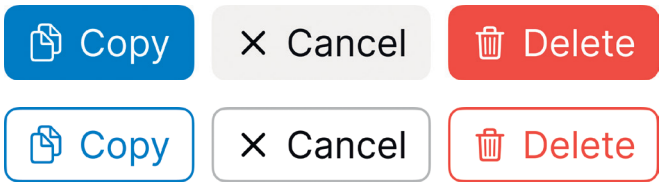
Text buttons have no container, are compact and unobtrusive

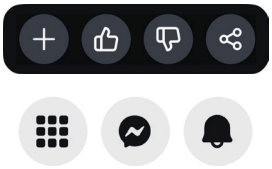
Left Icon

An icon is often placed to the left of a button's label. Its purpose is mostly decorative. As it supports the label and draws attention, it shouldn't appear on every button. Typically, an icon is added to the button you want to emphasize.

If several buttons appear in a row, icons are often added to each to prevent the row from looking like a line of plain text.

An icon to the left of the label helps the button stand out from the others





Round icon-only buttons in Amazon Prime Video and Facebook

Now that we've added an icon to the button, nothing stops us from removing the label entirely and ending up with an icon-only button. Such a button should be used with caution. The icon must be understandable to the user without a label or tooltip—something that's not easy to achieve.

The list of truly unambiguous icons is very short, containing no more than a dozen pictograms. For instance, an icon of a trash bin is clearly understood as *Delete,* and a gear will most likely open settings. However, a simple symbol such as × cross can mean anything: *Close, Delete, Hide,* or *Cancel*. The same issue applies to an icon of two stacked files: without context, it's impossible to tell whether it copies the selected file to the clipboard or creates a duplicate.

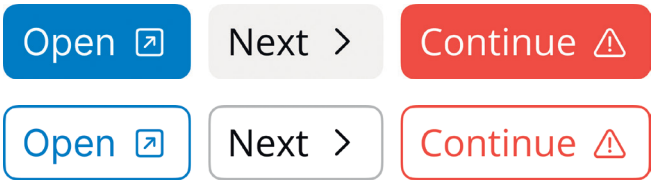
Use icon-only buttons with caution, as even the simplest pictograms can be interpreted differently

If we now fully round the corners of a square icon button—just as we did earlier with a rectangular one—we get a neat circular button. Unlike pill-shaped buttons, which are easy to confuse with tags or badges, circular icon buttons are a solid design choice and are used quite often, for example, by Google.

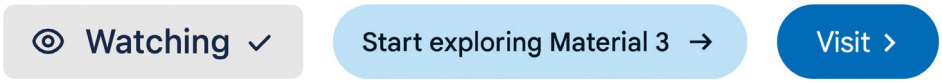
Right Icon

An icon doesn't have to be on the left side of the label—it can appear on the right as well. Most often, this is a › right-facing chevron, which pairs nicely with a gray button labeled *Next*. For variety, let's experiment with a different icon here, such as the arrow for opening a link in a new window. I haven't seen similar examples for a red button, but we can easily imagine a *Continue* button with an ⚠ exclamation mark icon.

An icon on the right helps clarify the button's label



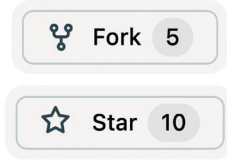
The difference between a left and right icon is subtle. An icon on the left reinforces the label. For example, if a button says *Download*, the cloud icon goes on the left because it depicts the download action itself, acting as an illustration. An icon on the right, however, *clarifies* the label. This is easy to see with a button labeled *Open*: the arrow-in-a-square icon doesn't illustrate the very act of opening—it clarifies that the link will open in a new window.



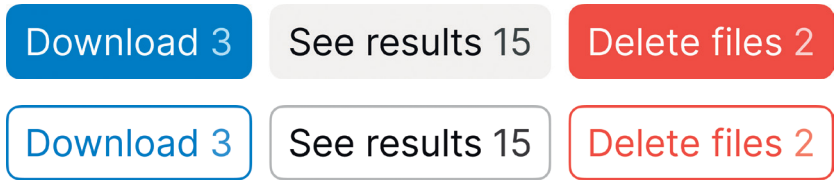
Buttons with right icons: Trello, Google Material Design, Google Images

Counter

The final element of a button is the counter. This small secondary label sits between the label and the right icon. I call it a counter because many buttons genuinely count things. For example, a *Download files* button may show how many files will be downloaded; a *Delete* button with a counter helps indicate how many items will be removed; and so on.



GitHub's *Fork* and *Star* buttons show how many users have already performed the action



Of course, the counter can be used for other purposes as well. In the following chapters, we'll see that this small secondary label can serve more than just counting.

Button States

From our historical overview, we learned that buttons react to user actions: they highlight on hover and darken on press, mimicking the physical world. To account for this behavior, every component is created in several states. In Figma, this is done using *Variants*—different versions of the same component.

A component's states are implemented as a property, usually named *State,* that can be switched just like types and styles. The default state is called *Default,* and the hovered state is called *Hover.* Designers often call the pressed state *Active,* but that's inaccurate: a simple button doesn't activate; it gets pressed for a fraction of a second, which is why I prefer the term *Pressed*.

The fourth state is *Disabled,* used for inactive buttons. Strictly speaking, it isn't a state in the same sense. We call a state the button's reaction to user actions, but a disabled button is disabled not by user interaction, but by the developer.

Debates over the usefulness of the disabled state have been ongoing since its emergence in the 1980s. At first glance, disabling a button seems pointless: if it shouldn't be used, why not just hide it? The problem is that a button may be

Component variants in Figma

needed in general but undesirable in certain cases. For example, a *Delete* button may be available only for user files, not for system ones. If the button is always hidden, a new user who clicks through a few files and never sees a delete option may conclude that files simply cannot be deleted at all. To avoid this confusion, buttons are usually shown but made semi-transparent and unpressable.

There is also a third approach. Its supporters argue that a button should always be visible and clickable, and the system should show an error when the action isn't allowed. A typical example is a form where the *Submit* button becomes available only after all fields are filled in. In this case, it's indeed better to allow the user to click the button even when the form is incomplete—and then highlight the empty fields in red. But this approach clearly wouldn't work for something like a browser's *Forward* button, so it's not universal.

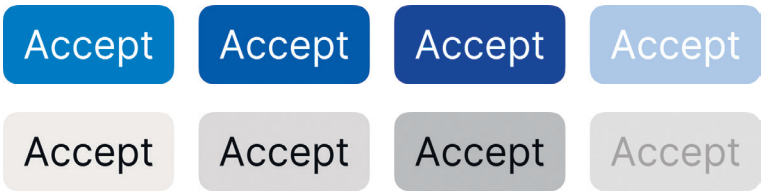
UX questions: hide or disable?

The choice between the two main options—disabling or hiding a button—comes down to this: if the action is unavailable temporarily or in a specific situation, the button should be disabled. If the action is permanently unavailable due to a constant restriction, the button shouldn't be shown at all. For example, if a user has turned on *Do not disturb* mode, that's a temporary condition, so the call button beside their name should appear disabled. If, however, calls are forbidden by the system administrator, that's a permanent restriction, and the button shouldn't be shown at all.

Even the → *Forward* button in browsers can be either disabled (Chrome) or simply hidden (Edge)

So we have four button states: *Default, Hover, Pressed,* and *Disabled*. As agreed, the button will become slightly darker on hover and significantly darker on press. For the disabled state, we'll use a semi-transparent background and text.

Button states, from left to right: Default, Hover, Pressed, Disabled



Focus Mode

Designers almost always mistakenly include a fifth state in a design system called *Focus.* It's used for a button that currently has keyboard focus. Such a button gets an additional outline: in macOS, it appears as a thick blue border, and in Windows as a thin dotted border. This state indicates that the button can be pressed from the keyboard.

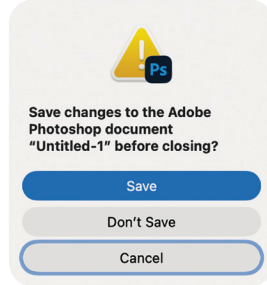
Let's be honest: this isn't a particularly important feature of modern design. Triggering buttons from the keyboard was popular in the 1990s, when something was always breaking in Windows 98, and a wireless mouse could stop working

after a driver update. In such cases, you had to roll back the driver while navigating through system settings purely with the keyboard.

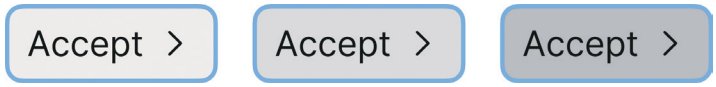
Today, such situations are extremely rare. For example, in macOS, keyboard navigation across buttons is disabled by default and only works for text fields. And even if you enable it, the behavior is odd: a focused button is triggered only with the *Space bar,* while *Return* always triggers the blue Primary button—even when that button isn't in focus.

It seems that designers long ago gave up on this state, and not without reason. First, almost no one actually uses keyboard navigation anymore. Unless you're designing a system-level, fault-tolerant interface, you can safely omit this state for components other than text fields. As for users with limited hand mobility, most of them use touchscreens or accessibility plugins. Second, if keyboard navigation is enabled, the operating system will add a focus outline automatically, assuming, of course, that the element is properly marked up as a button.

There's another problem: focus isn't actually a state—it's *a mode.* The difference is that states are mutually exclusive: a button can only be in one state at any given time. But a button in any of these state—Default, Hover, or Pressed—can still be in focus at the same time.



Operating systems today don't pay much attention to keyboard navigation. Here, pressing Return triggers the *Save* button, even though the *Don't Save* button is in focus



Focused buttons can be in any state, which means *Focus* is a *mode*

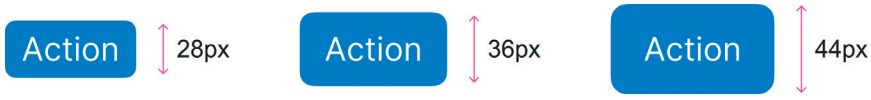
This is one example of the logical confusion that has taken root in many designers' minds, including professionals. In every design system I'm aware of, *Focus* is implemented as a state alongside *Hover* and *Pressed*, even though it would be more accurate to treat it as a separate property.

For all the reasons mentioned above, we'll include the focus mode in our design system only for compatibility and won't spend much time on it. It will be implemented as a layer with a blue outline and controlled by a separate binary property with a toggle.

Sizes

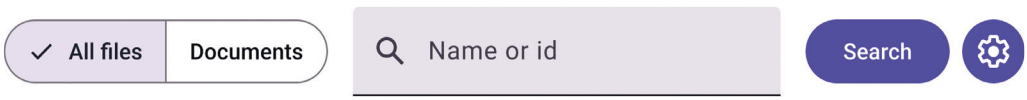
Many design systems, including Windows and macOS, use only a single component size. Others, such as Bootstrap and Ant Design, use three: *Small, Medium,* and *Large.* Since a component's width usually adapts to its contents, when we talk about sizes here, we mean only height. Unlike width, height is set as a specific value in pixels using the *Fixed* property in Figma.

I haven't found any consistent logic for choosing button sizes that could serve as a general rule. Every design system uses its own values, and all of them are arbitrary. Based on my own taste and experience, the most reasonable sizes are 28, 36, and 44 pixels.



You may choose different sizes if you like. The important thing is that all components share the same height, since they may appear in a single row. This rule seems obvious, yet it's often broken. For example, in Material Design, the text field is 56 pixels tall, while the button and other components are only 40 pixels tall. As a result, the text field sticks out of an otherwise neat row of buttons in a toolbar.

The Material Design text field has greater height than other components



When building our design system, we'll avoid making such obvious mistakes. We'll also apply visual compensation: larger buttons require larger internal padding and a stronger corner radius in order to look balanced.

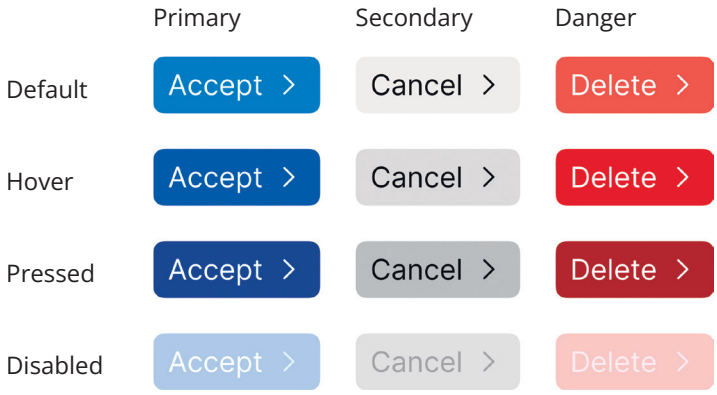
Component Matrix: Bringing It All Together

So, we have discussed all the parameters of a button. Now our task is to bring them together and define the button as a component with a set of properties.

It's important to understand the following. This entire set of types, styles, sizes, and states produces a huge number of combinations—144 variants of the same button, to be exact. Such a large number of variants can't be represented as a simple list, which is why design systems store components as tables where styles and states are labeled vertically, and sizes and types are labeled horizontally.

To start, we'll try this approach with a single size and a single style. If we list the button states vertically and the types horizontally, we get a 3×4 table with 12 buttons.

The combinations of component properties form a table in which the columns correspond to types, styles, and variants; and the rows correspond to states



I like to refer to such a table as a matrix of variants and states, or simply as a *component matrix*.

The example above shows the simplest case: a matrix for a single button size. To construct the full matrix of all combinations, we replicate this table, placing three copies horizontally and four vertically. For clarity, we group the buttons by color. Horizontally, we label the groups by size; vertically, by style. The result is a large component matrix consisting of 144 button variants.


Primary
Secondary
Danger
Small
Medium
Large
Fill
Outline
Ghost
Text
Default
Hover
Pressed
Disabled
Action 3

This is exactly what a component looks like in a professional design system. Buttons, text fields, dropdowns, and other components can have as many styles and types as needed; they may even treat focus mode as a state or have other minor mistakes. But the key distinction between a professional design system and an amateur one is the *completeness of combinations,* which can be achieved only by representing the components as a matrix.

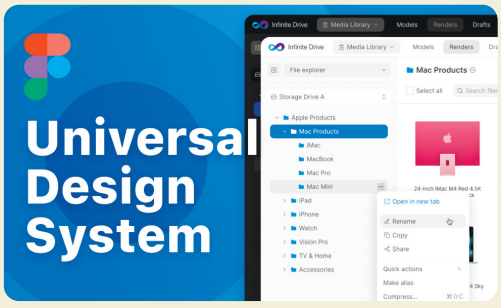
I have seen many design systems that ignore this rule and present components linearly. Even though large corporate products are built on top of them, working with such systems is often extremely difficult. You could never find a button in the exact style you needed, so you had to detach the component and make edits manually. An incomplete design system is like a cheap screwdriver set: it works fine for standard screws, but the moment you need to take apart a laptop, the Torx bit is always missing.

I firmly believe that a good designer, like a good engineer, should always have a complete set of tools and never remove a screw with manicure scissors.

Universal
Design System

Congratulations, dear reader. We've just created our first component—the universal button *(Latin: Buttonis universalis).*

Take a look at the spread where all possible button variations barely fit on a single page. I've shown the full version without any shortcuts, even though modern Figma lets you use binary properties to show and hide layers inside a component without creating separate variants. The feature is extremely useful, but it obscures the component's underlying logic and beauty. What designer would give up such elegance?



Universal Design System

A design system inspired by this book is available on Figma Community. You can use it not only as a supplemental material, but also as a foundation for your own projects.

Toggle Button

Alongside the ordinary button *(Latin: Buttonis vulgaris),* the interface of the first personal computer, the Xerox Alto, also featured a subspecies: the toggle button, in the physical world also known to engineers as a latching button.

Every designer is undoubtedly familiar with such a button. You'll find it in old elevators, where the floor buttons didn't merely press but stayed pushed in until the elevator reached the selected floor. Another example is found on all sorts of appliances whose buttons turn a device on or switch its operating mode; they also sometimes appear on washing machines, kitchen range hoods, desk lamps, and oscilloscopes.

It's important not to confuse a toggle button with a group of mutually exclusive buttons used in tape decks and audio players. A toggle button works on its own, while a button in a group not only presses itself but also pops out all the other buttons in the group.

The button panel of a radio receiver shouldn't be confused with a toggle button

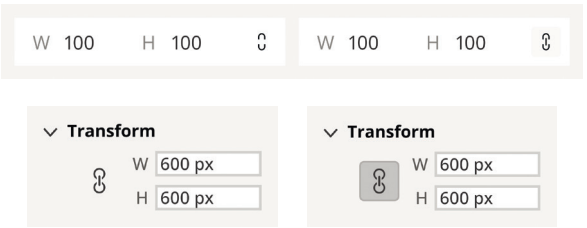
Toggle buttons aren't very popular in the physical world because of their complex mechanism. Inside such a button is a tiny latch that, on the first press, catches onto a small ridge and holds the button in the pressed position; on the second press, it slips off the ridge and releases the button. Over time, this latch loosens, and the button starts sticking in one of its positions.

For this reason, modern elevators (and not just elevators) don't use true toggle buttons. Instead, they use regular buttons that simulate toggling through illumination. Rather than physically staying pressed in, the button lights up with an internal LED and stays lit until the elevator reaches the selected floor. The same trick is used in modern media players and other devices.

Elevators and household appliances abandoned latching buttons (left) and switched to regular LED-lit buttons (right)

Fortunately, we're designing only virtual buttons, which don't wear out. You can press our buttons as many times as you like!

The most common example of an interface toggle button is the button for constraining proportions that can be found in any graphics editor. It's usually placed beside the width and height text fields and uses a 🔗 link icon. On the first press, the icon either changes (the link breaks) or the button gets a darker background, indicating it's pressed in. On the second press, the button pops back out and returns to its original state.



Toggle buttons are used for locking proportions in graphics editors

Unfortunately, virtual toggle buttons are just as troublesome as their physical counterparts—and not because of wear and tear. The real problem is that, at a glance, it's impossible to understand how such a button behaves. Every interface implements it differently, and designers have no shared agreement on how a toggle button should work.

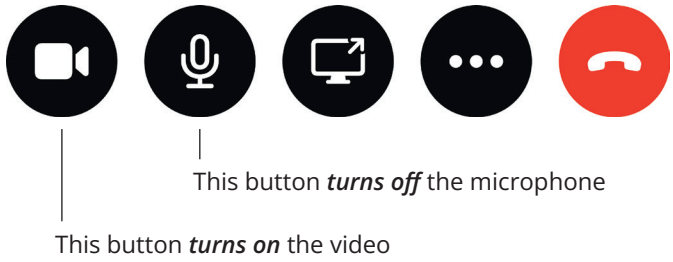
Toggle buttons cause the most confusion when they control audio or video

in calling apps. Try guessing without a tooltip: which of the two buttons on the right turns the microphone on and which turns it off?

If an icon appears on a regular button, it represents the action that will be performed when the button gets pressed. For instance, a downward-facing handset icon means "hang up." But with a toggle button, things get far more complicated. An icon of a crossed-out mic may represent not an action but *the state* of the microphone. In that case, pressing the button won't turn off the microphone—it will *turn it on*.

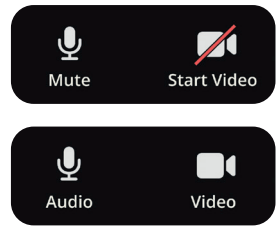
That would be fine if toggle buttons always worked that way. But they don't. The best-known counterexample is the ▶ *Play* button: when pressed, it performs exactly the action shown—starts playback—and then turns into a ⏸ *Pause* button.

If this still feels like a minor issue, let's look at a real case. The screenshot shows the call controls in the dearly departed Skype for Business, designed by a Microsoft designer who preferred to remain anonymous. The video icon on this panel represents an action: pressing it *turns on* the camera. Yet an identical toggle button with the mic icon right next to it *turns off* the microphone.



Hall of Fame: the Skype for Business (macOS) call panel, unknown designer

Designers at Zoom didn't fare much better than their colleagues at Microsoft. They correctly noted that a toggle button should display not an action but the system's current state. But then they decided to add labels to their buttons—and, of course, labeled them incorrectly. For a long time, Zoom's interface featured a crossed-out camera icon that was labeled *Start Video*. Today, it has been replaced with the label *Video*, which is meaningless, as it merely duplicates the already obvious pictogram.



Call controls in Zoom

Before: the icon contradicts its label

After: the labeling issue is resolved, but labels on obvious icons serve no purpose

Strictly speaking, a toggle button is used for compactness, and adding a label to it is already a sign of a flawed interface. But if a toggle button must be labeled, the label should reflect a status, not an action—otherwise it will inevitably contradict the icon.

I'm convinced that a toggle button works best when the icon stays the same. All the trouble comes from designers trying to argue with the laws of nature: in the physical world, toggle buttons don't change their markings when pressed—they latch! If the toggle buttons in the earlier examples simply changed their background color—that is, if they imitated the shadow of a real-world pressed button—there would be no ambiguity. Unfortunately, such techniques fell out of fashion with the death of skeuomorphism.

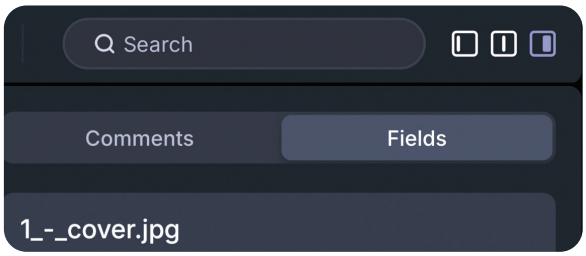
Using shadows to simulate a pressed-in button clearly communicates the state of the camera and microphone

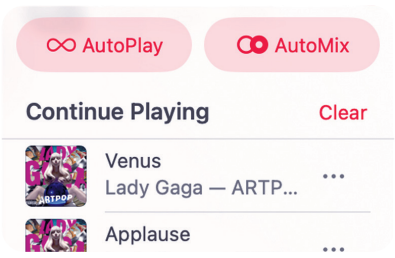
Classic toolbars for text styling in Microsoft Word and Google Docs follow this old principle. The icons for bold, italic, and underlined text don't change when pressed; only the color does. You'll agree that skeuomorphism as a way to help people learn computers no longer seems like "a silly thing for beginners."

Why, then, do we use apps like Zoom and the now-defunct Skype every day without noticing the inconsistency? It's a well-known phenomenon. The way we read intefrace cues is similar to how the human brain reads text—correcting it on the fly and overlooking mistakes. For example, most readers didn't notice the typo in the word "interface" right above—but that doesn't mean the typo isn't there. Users understand the state of the mic or camera from context: perhaps the laptop's indicator light is on, or they simply remember turning the microphone off.

Left: Frame.io highlights the ◨ toggle button for opening the panel with a violet tint

Right: Apple Music app highlights the ∞ button with both the background and text color



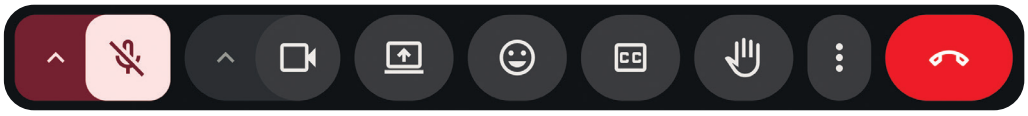


Shadows are not the only way to solve the problem. A proper toggle button only requires three conditions:

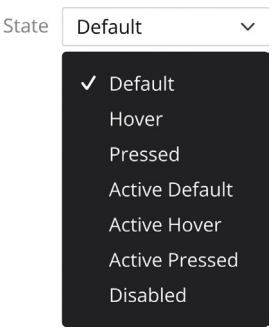
1. The icon must represent a state of the system rather than an action (with rare exceptions, such as the *Play* button);
2. The on and off states must be visually distinct;
3. Adjacent buttons must behave consistently.

Of all the calling apps I'm familiar with, only Google Meet satisfies all three conditions, although it somewhat riskily mixes toggle buttons with regular ones.

Google Meet call panel. The two toggle buttons represent system state; other buttons—actions



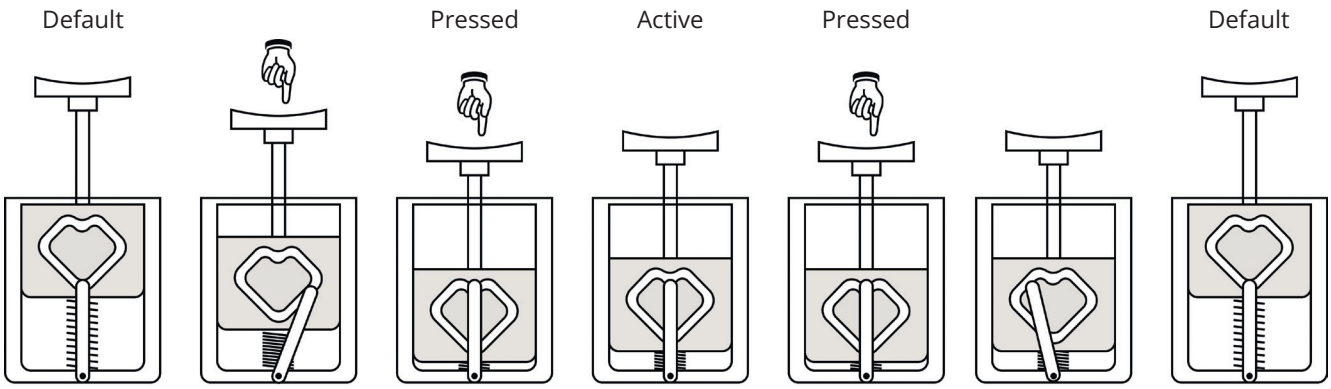
Component Matrix



A TOGGLE BUTTON WORKS almost like a regular button, but it has a different set of states. It can remain pressed for a long time rather than just a split second, and a user can move the cursor far away from it, returning later to "unpress" it. Because of this, a toggle button has not one but two hovered states—the second one for hovering over a pressed button.

Strictly speaking, a toggle button has two versions of *every state*. The thing is that the differences between them are almost imperceptible. In the physical world, a latching button doesn't stay fully pressed after you push it. At the

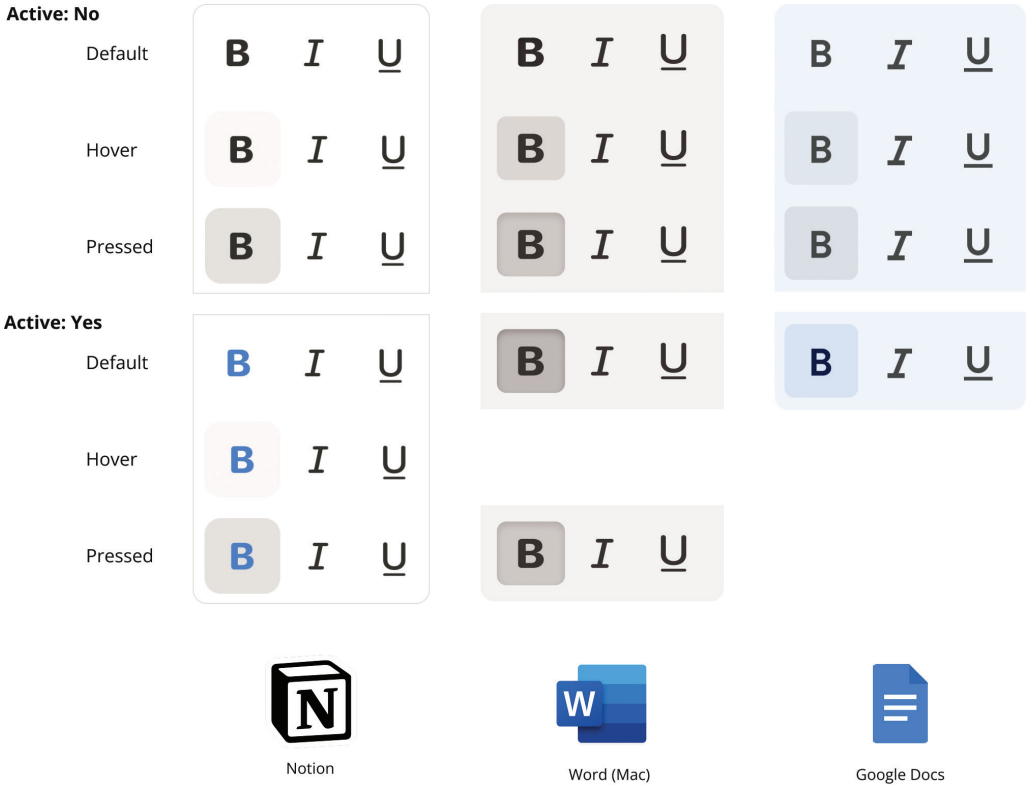
moment of pressing, your finger pushes it all the way down; then it rebounds slightly and remains in that position. To "unpress" the button, your finger must push it down to the bottom again, after which it springs back to its original state.



▲ One of the mechanisms behind a latching button. The scheme in the center shows the *Active* state, while the surrounding ones show the *Pressed* state, where the button is pushed-in even deeper

If we approach interface design formally, we would need to create a twin for every state of our button. A toggle button can be in the plain *Hover* state or in the *Active Hover* state—and the same applies to all other states except *Disabled*.

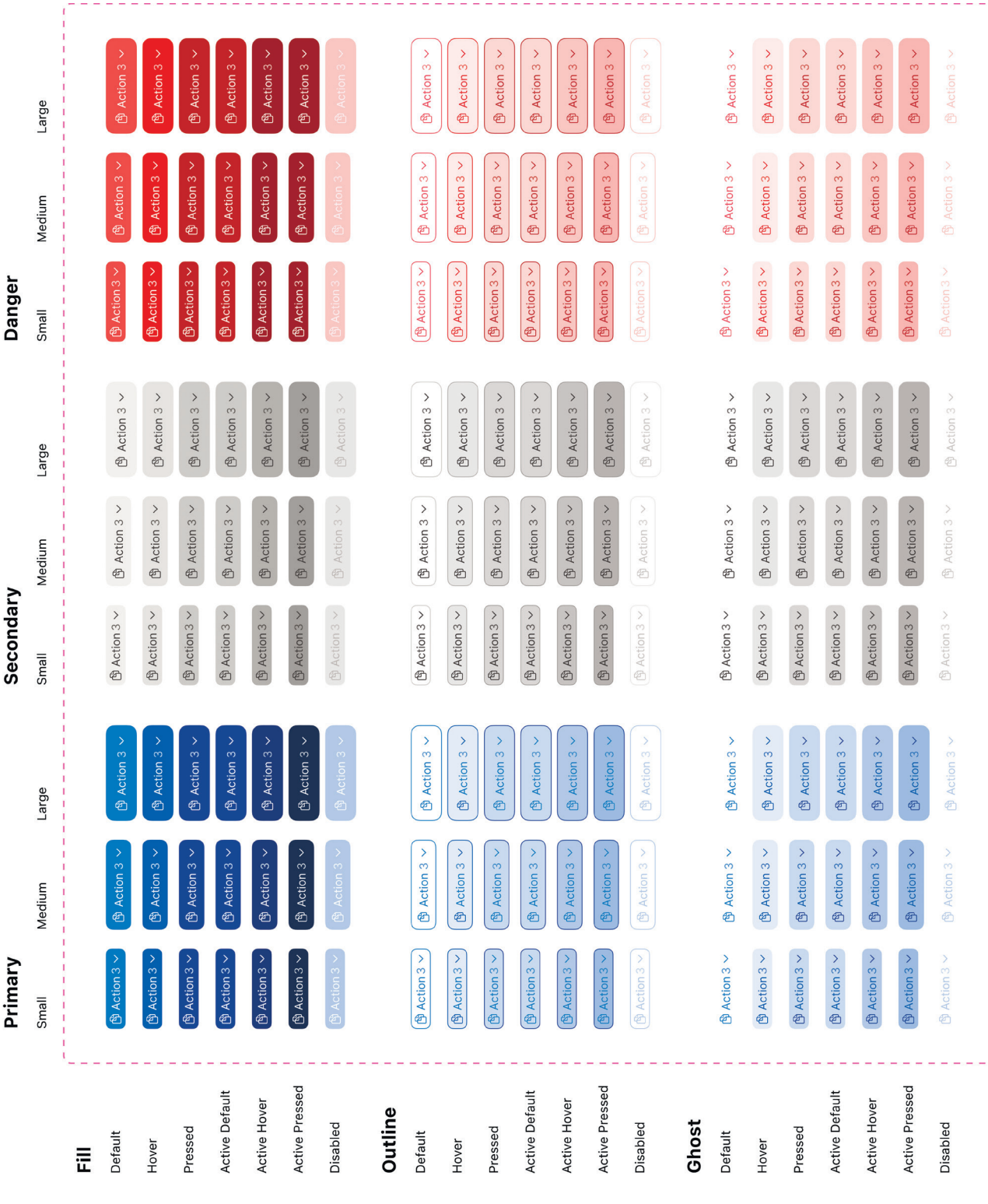
Today, almost all design systems ignore this formality, and just a handful of apps showcase the full spectrum of states of toggle buttons. One such example comes from Notion, a project-management software. Its designers put in the work and carefully defined every state of their toggle buttons. On the other hand, Microsoft Word supports all states except one: its pressed toggle button doesn't react to hover. Google Docs goes even further and supports only four states: its toggle buttons, once pressed, show no signs of interaction.



The set of states of a toggle button may vary across apps, depending on level of attention to detail in the design

The decision about the number of supported states for a toggle button should be made by the designer, depending on the task. If you're building a polished, text-focused service like Notion, you'll likely need to define every state. On the other hand, if your interface has only a single toggle button, you can easily fake it by using a regular one.

Since this book follows a formal, logic-driven approach, our design system will support every possible state. The matrix for a toggle button is largely similar to that of a regular button, except for three additional states, so only part of it is shown here.

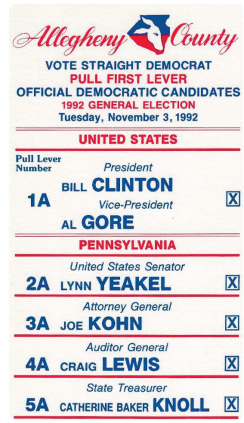


Checkbox

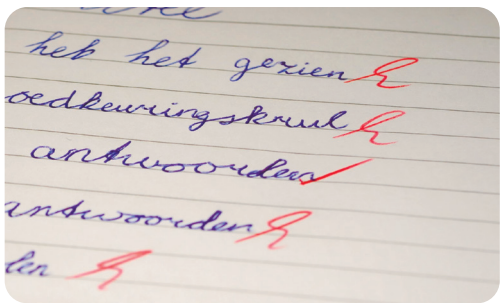
The ✓ check mark is familiar to anyone who's ever filled out a ballot: every time we vote, we mark a little check inside the box next to a candidate's name. Another everyday example is the classic checklist—a to-do or a shopping list where completed tasks or purchased items are marked with a check.

Surprisingly, even such a simple and universal symbol has its own curious history. For instance, most readers know that some people use a ✕ cross symbol instead of a check mark, even though it looks more like a strikeout of an item. Far fewer people know that in some countries, the meaning is reversed: check mark means a wrong answer, while cross indicates a correct one.

The most well-known example is Finland. In Finnish, the word for "wrong" is *väärin*. Its first letter, v, resembles a check mark, which is why Finnish schools traditionally use a check to mark an *incorrect* answer. A correct answer, on the other hand, is marked with an odd symbol ⅋ known as the commercial minus. In neighboring Sweden, the check mark once also meant a wrong answer, while correct answers were marked with the letter R, from the Swedish *rätt,* meaning "correct." Of course, this is largely archaic today, and thanks to globalization, the check mark is now understood in both countries.



Ballots traditionally used a cross, while the check mark became popular only with the rise of personal computers



Left: In the Netherlands, the mark for "correct" takes the form of a curl called the *flourish of approval*

Right: The symbols for "entrance" and "no entrance" on doors in North Korea

In Japan and Korea, however, traditional symbols are still popular. For example, in the Japanese version of the Sony PlayStation controller, the ✕ cross icon is used for the *Cancel* button, while the ○ circle icon is used for the *Confirm* button—but in European countries they are inverted! As for the check mark, in Japan, similarly to Finland, it traditionally means "wrong," although, of course, Japanese users fully understand it when it's used in the Western sense.

While working on this book, I specifically checked whether the familiar checkbox is replaced by a circle or any other symbol in some localized versions of Windows. It is not. Computer checkboxes use the check mark in every language. Still, I managed to find a wonderful example of attention to detail: in the Japanese version of Photoshop, the *Cancel* and *Apply* buttons, which are shown during photo cropping, change their icons from the ⃠ crossed-out circle and the ✓ check mark to the ✕ cross and the ○ circle, respectively.

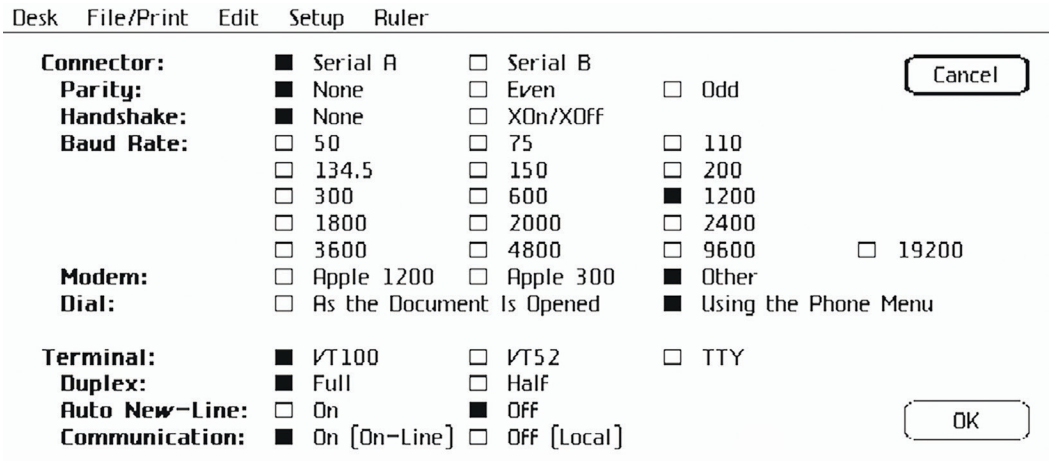
In the Japanese version of Photoshop, the *Cancel* and *Apply* buttons use other symbols

What does the check mean: yes or no?

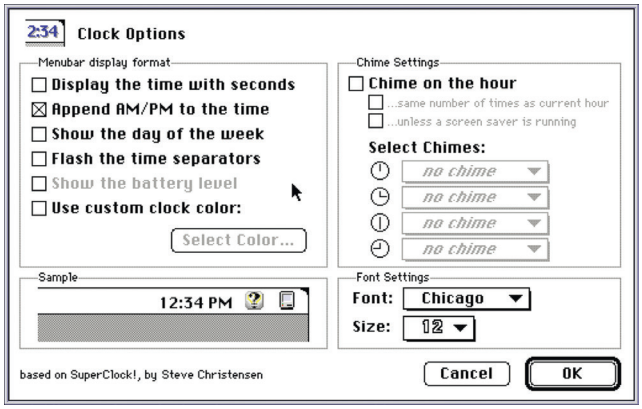
In fact, the check mark is fairly new and there's no point looking for its origins in Ancient Rome. Yes, it most likely comes from the first letter V of the Latin word *veritas*—truth. However, it became widely known only after the mass adoption of computers; earlier generations, when filling out forms, mostly drew a cross.

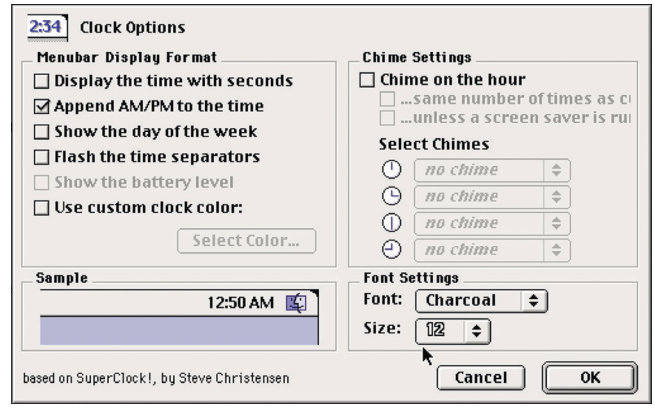
It's no surprise, then, that the first computer checkboxes also used a cross rather than a check mark, and this is yet another example of skeuomorphism. It's worth noting that the very earliest checkboxes used a filled square—but probably only because early computers had trouble drawing anything more meaningful, and this phase didn't last long.

Before checks and crosses, checkboxes used a filled square (Apple Lisa)



Checkboxes with a cross symbol were used in Mac OS systems up to version 8, released in 1997. This time, "the engine of progress" was Microsoft, abandoning crossed checkboxes two years earlier than Apple with the release of Windows 95.

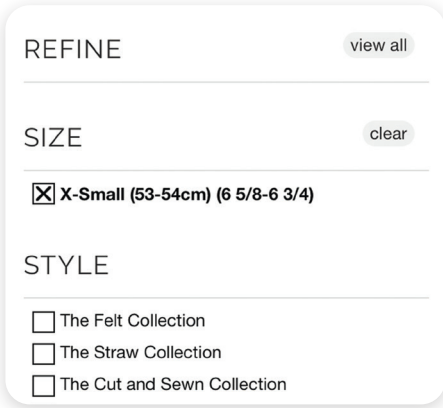


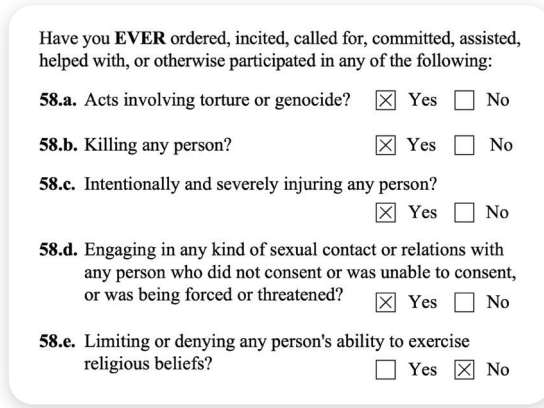


▲
Clock settings in Mac OS 7.5 and Mac OS 8: crosses in checkboxes were replaced with checks

Still, this is only a historical note. The era of crossed checkboxes is over, and they no longer appear in any modern interface.

With considerable effort, however, I did manage to find one example. Some PDF files can contain not only text and images but also fillable forms. And for some unbelievable reason, all applications designed to fill out such forms still use a cross to mark a checkbox! Perhaps it's an attempt to mimic the look of classic paper questionnaires.



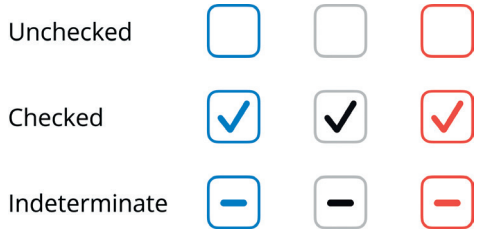


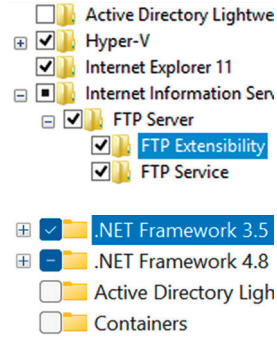
Left: The JJ Hat Center site uses crossed checkboxes as a stylistic choice

Right: A U.S. immigration form not only asks strange questions but suggests using a strange symbol for answers

Statuses

When a designer talks about checkboxes and radio buttons, the word *state* may refer not only to hovered and pressed states, but also to checked and unchecked states. To avoid confusion, I propose using the term *status* to indicate whether a checkbox is checked.



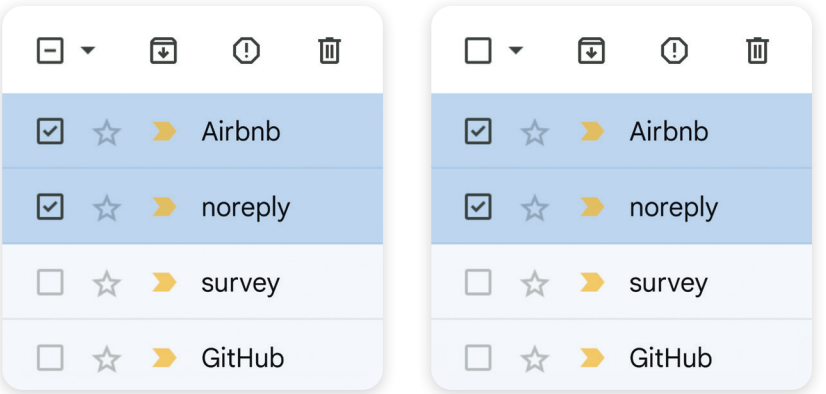


Starting with Windows 11, Microsoft finally got rid of the square used to indicate a checkbox's third state

Many designers know that a checkbox can not only be checked or unchecked but can also be in an *indeterminate status.* In this case, instead of a check, it is marked with a — dash or a ■ filled square. To my knowledge, the square was previously used only by Microsoft, but in Windows 11, it was replaced with a dash as well. Other systems have always used the dash, so we will use this symbol too.

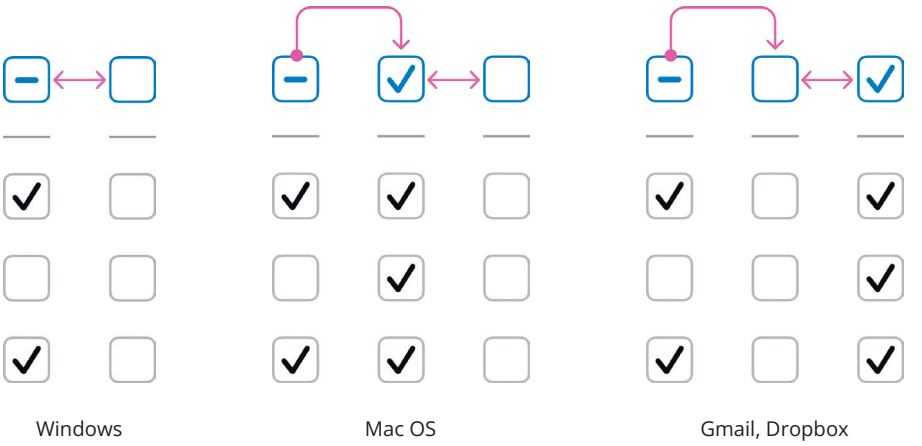
The indeterminate status—often called simply *the third state*—is used when a checkbox has nested checkboxes and only some of them are checked. This is a rare case, mostly encountered in email clients and file managers. However, even here it is possible to get by with only two statuses: if not all nested checkboxes are checked, the parent checkbox can simply remain empty.

In the Gmail interface, the indeterminate checkbox can be replaced with an unchecked one without loss of meaning

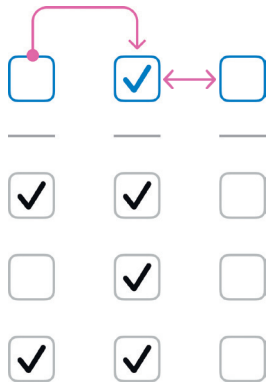


Aside from the fact that a dash inside a checkbox is far from obvious to many users, the way it works also creates numerous problems. What is supposed to happen when a user clicks such a checkbox? Every system answers this question differently. Windows clears all nested checkboxes and remembers their previous state, so they are restored on the next click. On macOS, however, the first click checks all nested checkboxes, and the second click clears them. Gmail, Dropbox, and other web services do the exact opposite.

Each system reacts differently when a third-status checkbox is clicked

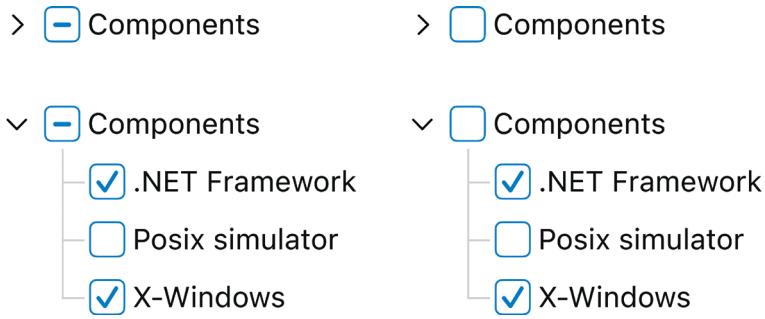


If you eliminate the third status, this not only removes any confusion about the unclear symbol but also simplifies the multiselect scenario. It's obvious that clicking an empty checkbox should check all nested checkboxes, and clicking it again should clear them.



The behavior of a checkbox list becomes clear once the third status is removed

Sadly, such substitution isn't always possible. There are cases where the third status is necessary—mostly in tree lists and filters. Unlike the previous examples, nested checkboxes in a tree list are not visible when the parent is collapsed. If the parent checkbox appears empty even though it contains checked nested checkboxes, this is a serious usability issue that can easily mislead the user.



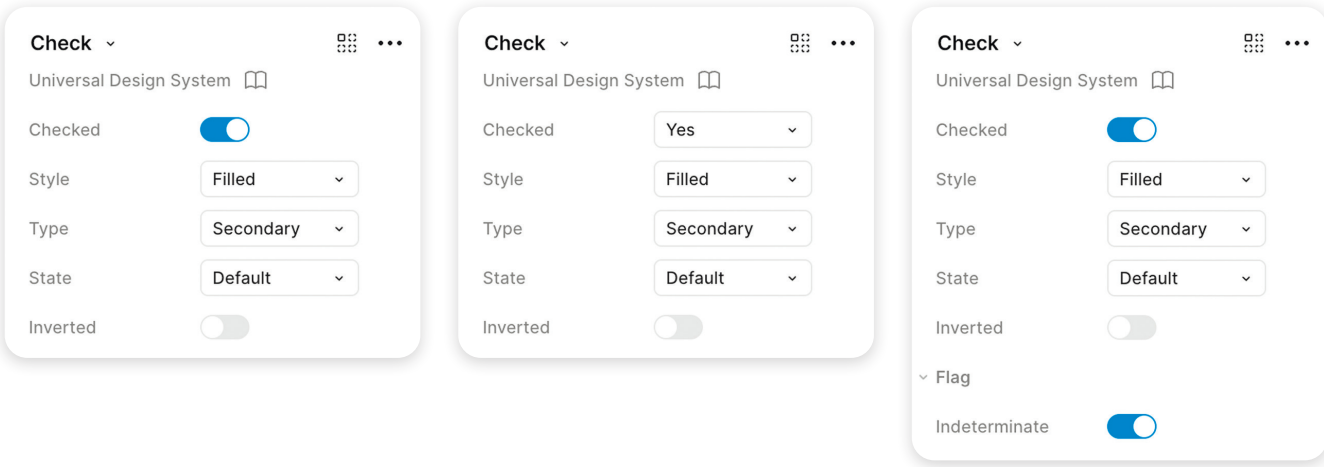
In tree lists, nodes can be collapsed, and nested checkboxes become invisible, so the third status cannot be replaced

Tree lists are used rather rarely, and most designers are unlikely to ever deal with them. Still, the third status cannot simply be removed from a design system. That is why, in most design systems, a checkbox has three states, so the *Checked* property takes three values instead of two: *Yes, No,* and *Indeterminate.* As a result, a convenient binary toggle in Figma becomes an awkward dropdown list, with one of the items most designers will use only once in their lifetimes.

The *Checked* property in a three-status checkbox has to be implemented as a dropdown list (1) instead of a convenient toggle (2)

The solution is to make the flag a nested component inside the check (3)

▼



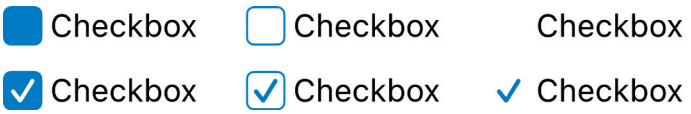
Nested properties in Figma

I've found a good way to avoid this complexity. The check mark itself can be implemented as a separate auxiliary component, called *Flag*, that takes the *Indeterminate* property, and then used as the basis for the checkbox. Now the check's *Checked* property can be toggled with one click, while the third status appears as a separate toggle at the end of the property list.

Styles

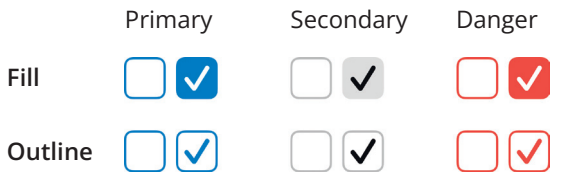
I SPENT A GREAT DEAL OF TIME searching for a universal approach to checkbox styling. Unlike a button, a checkbox seems to have no body of its own. In most cases, it's drawn as a square with a stroke, with a label placed to the right. This means a checkbox can't really use the Fill or Ghost style, and can only have one size. When I tried to build a component matrix for a checkbox similar to that of a button, I ended up with complete chaos.

An attempt to apply the Fill and Ghost styles to a checkbox



If in the Fill style an empty checkbox was still at least somewhat recognizable, in the Ghost style it became simply invisible. For this reason, the check has to be implemented in only two styles: Fill and Outline, with the former differing from the latter only when it is checked.

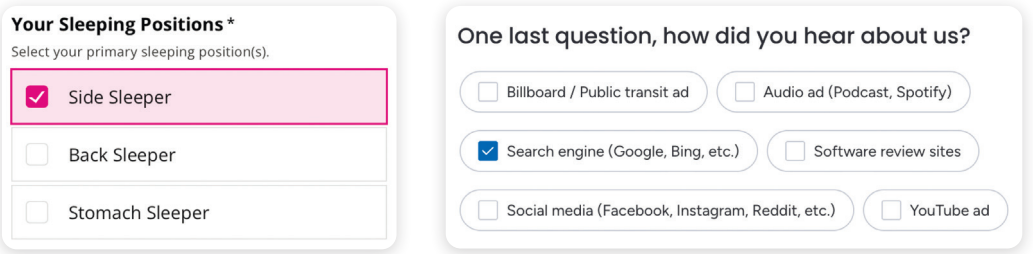
The Fill and Outline styles differ only when the check is checked



Nothing more could be squeezed out of the stubborn component. However, during my research, I came across checkboxes placed inside a container. These are sometimes used in forms or filters and look very friendly.

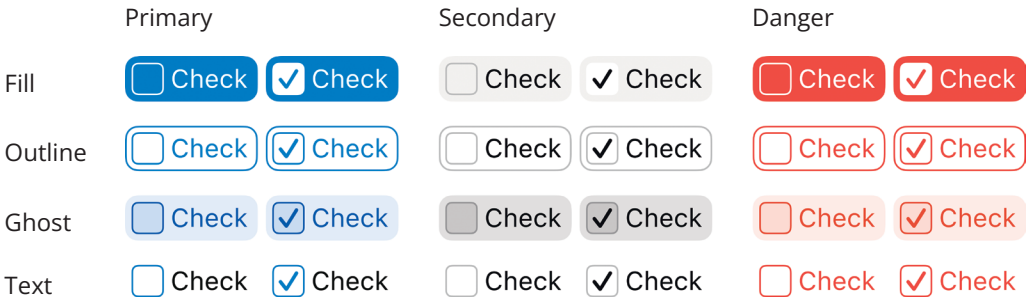
Checkboxes in a container are especially common in forms and filters

Left: naplab.com
Right: monday.com



It was this container that made it possible to apply all the remaining styles and to design the checkbox in three different sizes. The result was a component matrix fully equivalent to the button's, producing 144 checkbox variations to

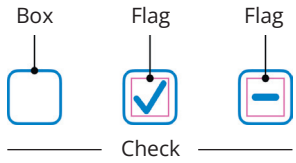
cover every possible use case! In this matrix, the original textual checkbox occupies just one row and constitutes the Text style.

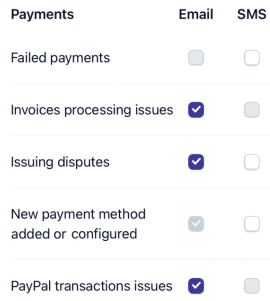


All styles can be applied to the checkbox container. The Ghost style is shown in the Hover state for clarity

Anatomy

As you may have already guessed, a checkbox—even in its plain, text form—is not a simple component. It consists of two parts: *the check* and *the label,* where the check is a small box containing the flag. The corners of the box's stroke are usually slightly rounded—typically between 4 and 8 pixels.





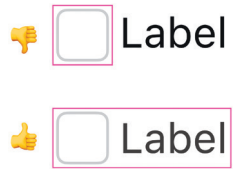
A rare case where a checkbox can exist without a label (Stripe notification settings)

A standalone check is extremely rare, and it's usually unjustified. How is the user supposed to know what it's for? A check must have a label; only then does it become a proper *checkbox*.

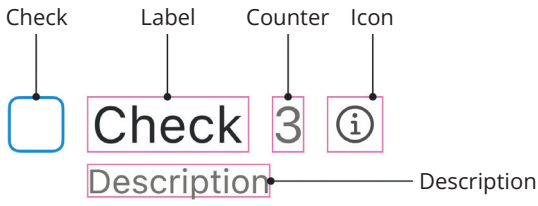
But the label alone isn't enough to cover every scenario. It's a good idea to add a counter on the right, just as we did earlier with the button. It's easy to imagine where this might be useful. For example, in a *Select all* checkbox used to select files, it might show how many files will be selected.

It also makes sense to include an icon to the right of the label. This icon usually displays a symbol of ⓘ information, and hovering over it shows a tooltip. Although tooltips are not great from a usability standpoint, they are still useful in certain cases: sometimes it is hard to compose such a label that is both short and easy to understand at the same time.

Finally, it can be helpful to add an explanatory text below the label. This element, which I call a *description,* is almost never used in buttons, but it's very common in checkboxes for additional clarification. It can also serve as a better alternative to a tooltip.



A checkbox should be clickable across the entire width of its label, not just on the check. This can be achieved by using a *<label>* tag with the *for* attribute.



The anatomical structure of a checkbox with a container is no different; only one new element is added—the container itself. It can have a fill, a stroke, or stay empty. In the latter case, the container becomes visible only on hover.

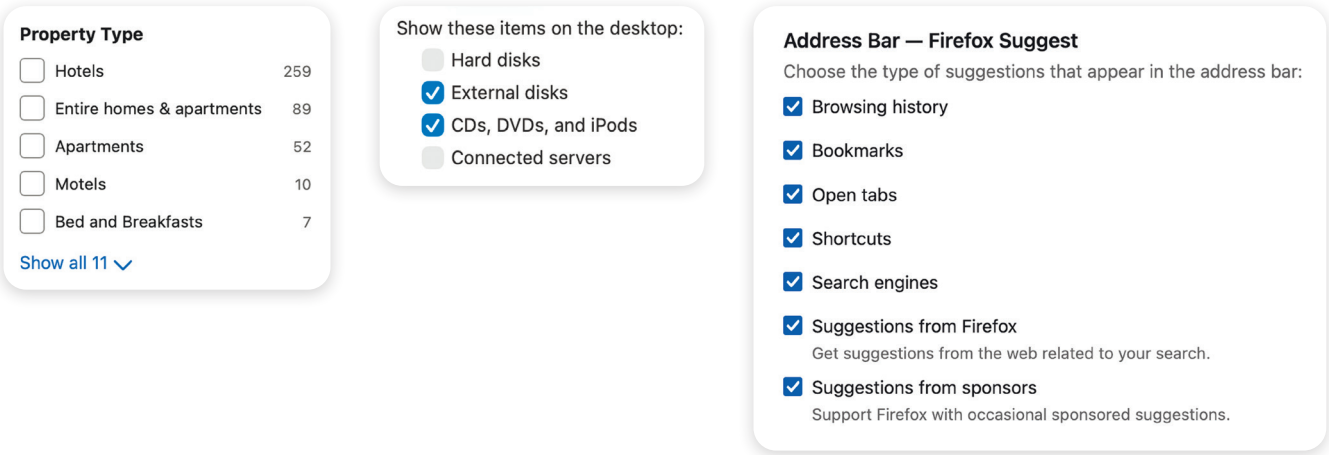
As mentioned earlier, the simplest textual checkbox without a container is merely one variation of the checkbox that uses the Text style. This is the one used in most interfaces, including operating systems. You can think of it as having no container at all or as having a container with zero padding.

One way or another, checkboxes often appear in groups. If a designer chooses to use a textual checkbox without a container, the spacing between checkboxes in a group must be set manually. If the container includes padding, the spacing can be set to zero. Both approaches work, and the designer may choose either one.

Left: Booking.com right-aligns its counters

Center: The left padding in Finder's settings creates contrast with the header

Right: The large padding in Firefox is used for descriptions

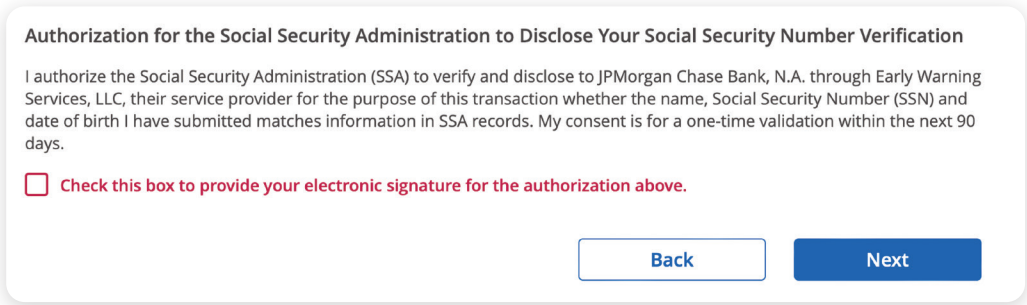


Component Matrix

A CHECKBOX HAS THE SAME STATES as a button: *Default, Hover, Pressed,* and *Disabled*. Designers often simplify checkboxes and omit the Hover and Pressed states. The reasoning is that a checkbox is a fairly small component, and the change between these states will be barely noticeable to most users—thus, they can be skipped to save time on design.

I believe that such small details are, in fact, easily picked up at a glance and give the interface a subtle sense of refinement. For this reason, our design system will include all four checkbox states. Moreover, we will design them for both statuses: checked and unchecked. Eight species in total.

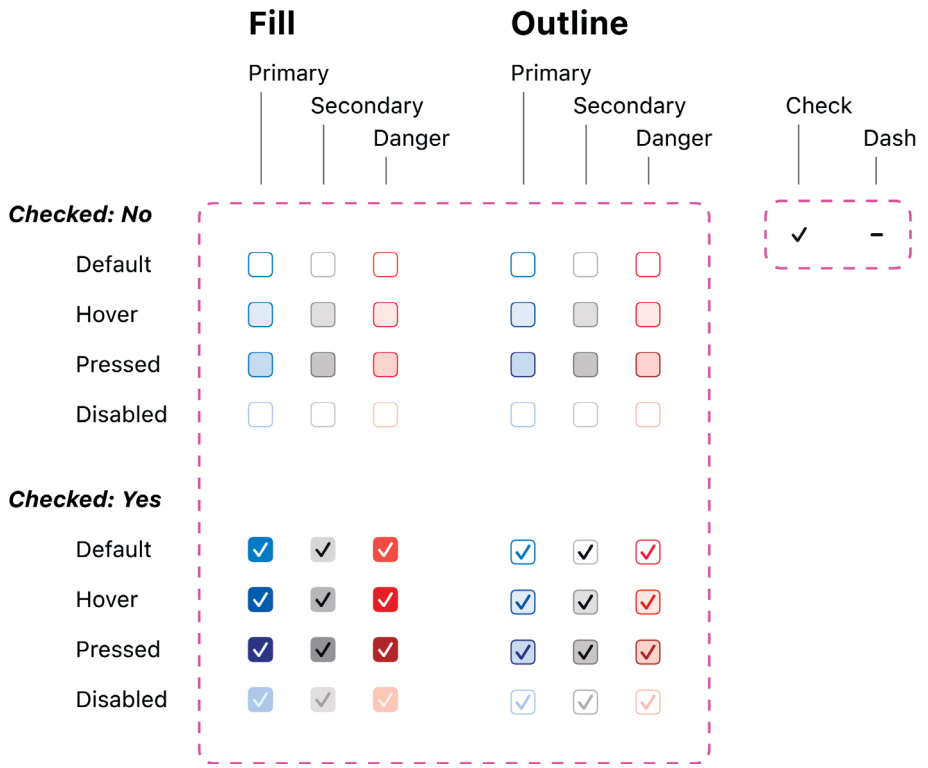
Our checkbox will have three types, just like a button: *Primary, Secondary,* and *Danger*. However, unlike a button, a red checkbox is not used to warn about a dangerous action; rather, it indicates that an error has already occurred. For example, if the "I accept the terms" checkbox is left unchecked before pressing *Submit,* it turns red.



Unlike a button, a Danger checkbox is used not for warning, but when an error has occurred

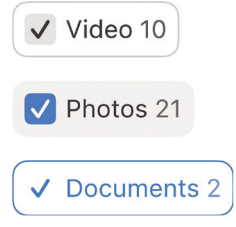
Regarding styles, as we established earlier, the check can have only two: *Fill* and *Outline*, and they differ only when it's checked.

Now we can compose a matrix for the check with six columns and eight rows. Remember that we decided to make the flag a separate component, which allows the check's *Checked* property to accept only two values—*Yes* or *No*. This lets it be implemented as a convenient toggle instead of a bulky dropdown list.

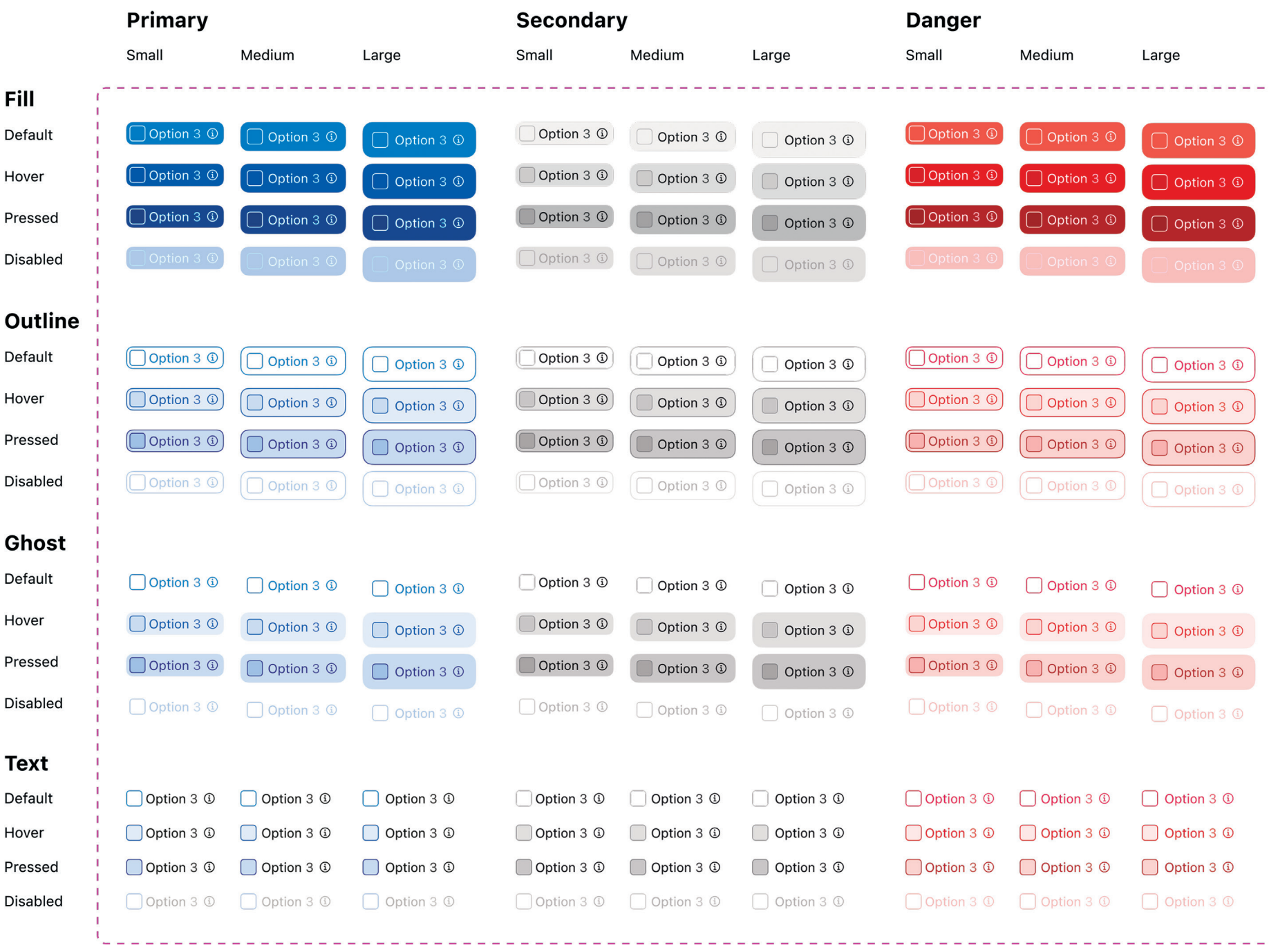


Left: check matrix
Right: flag component

Finally, we can compose a checkbox matrix, fully equivalent to the matrix of a button. The check becomes part of the checkbox and controls its status. The types, styles, states, and sizes become attributes of the checkbox itself. Note that white flags are used inside colored checks. I'll skip the details of how to create them to avoid tiring the reader: it's simply another style with a white fill, intended for use on colored backgrounds.



To conclude this chapter, it's worth noting that we could have created even more combinations of checkboxes. In our matrix, the check uses the same style as the container. However, if we break this rule and override the check's style, we can produce checkboxes in virtually any color combination!


Primary
Secondary
Danger
Small
Medium
Large
Fill
Outline
Ghost
Text
Default
Hover
Pressed
Disabled
Option 3