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TAKE CONTROL OF

# YOUR M-SERIES MAC

*by* **GLENN FLEISHMAN**

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# Read Me First

Welcome to *Take Control of Your M-Series Mac*, version 1.3, published in March 2022 by alt concepts. This book was written by Glenn Fleishman and edited by Joe Kissell.

This book will help you configure and protect your Apple silicon M-series Mac. You will learn to manage new features and work with its advantages and constraints, while understanding the comprehensive changes across hardware and macOS from Intel Macs.

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## Updates and More

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## What's New in Version 1.3

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On March 8, 2022, Apple announced what they said was the last chip in its M1 series, the M1 Ultra. This followed the original M1, M1 Pro, and M1 Max. The M1 Ultra so far appears only in certain configuration of the new Mac Studio computer introduced at the same time. This book has been updated throughout to incorporate features of the M1 Ultra and specs for the Mac Studio.

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## What Was New in Version 1.2.1

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This version included fixes for a few typos. It also included the following changes:

- **Monterey support for multiple systems on a drive:** With the release of Monterey, I was able to confirm a reported feature: that you could install multiple copies of macOS on an external volume. This is now explained in [Can You Roll Back to an Earlier macOS?](#).
- **FileVault encryption on external boot drives:** I was unable to get this to work in Big Sur and others had the same problem. Either in Monterey or an interim release of Big Sur, Apple fixed whatever problem we were having. You can now enable FileVault encryption on external drives for security. See [Encrypt External Drives](#) and [Protect a Drive with FileVault](#).
- **Monterey virtualization:** While it doesn't affect many readers, Big Sur couldn't run as a self-contained virtual machine inside of Parallels or other software. Apple added the necessary elements to Monterey to allow it. This is now mentioned in [What Is Emulation?](#)
- **SuperDuper! compatibility:** [SuperDuper!](#), a macOS drive-cloning app, released its version 3.5 update on October 25—moments after we released version 1.2 of this book. That update was the first production release with macOS 11 Big Sur and M1 support, and also added macOS 12 Monterey compatibility.

- **Boot integrity:** An important insight about macOS Big Sur and later is that your Mac won't start up or, with an M-series chip, continue to operate if anything changes from the installed copy of macOS. I added an explanation of this in [Boot for Proof of Integrity](#).

# Introduction

Apple introduced the M1 system-on-a-chip in 2020, surprising even the most cynical users and reviewers with its remarkable advances in performance, battery life, and memory utilization. Then Apple blew people’s minds again with vastly more powerful M1 Pro and M1 Max (October 2021) and M1 Ultra (March 2022) versions of the chip.

M-series Macs sport a range of firmware and hardware changes that make them different in many ways from all Macs that come before them. This includes unique advantages, such as running iOS and iPadOS apps, and providing even stronger protections baked into hardware against attackers trying to take over your Mac.

*Take Control of Your M-Series Mac* digs into the important stuff that lets you take advantage of new features, while also performing routine tasks that have changed in large and small ways, such as backing up your Mac and protecting it.

That starts with understanding how the M-series chips work, what makes the series different from Intel processors, and how to migrate successfully from an Intel Mac. The book then moves into specifics: How do I back up an M-series Mac? Can I create a backup on an external drive that I can boot from? How do you manage the long battery life? What’s different when I restart in recovery mode?

The book also digs into system security, which covers the changes that Apple introduced for both Intel and M-series Macs in Big Sur, and which remained effectively stable in the Monterey release. You’ll learn the Apple silicon twist on all those macOS differences.

Finally, I explain the ins and outs of using iOS and iPadOS apps in macOS, and the early stages of running Windows within macOS on an M-series Mac.

When you finish reading this book, you will have a complete mastery of what makes an Apple silicon Mac tick and how to tune it and keep it running to your best advantage.

# M-Series Quick Start

This book both teaches you about how the M-series chips work and the differences they have from Intel processors, and offers insight into areas like battery life, backups, security, and recovery. You can read most of the book in any order.

## ***Start with background:***

- It's useful to understand how the M-series chips work and how Apple baked security right into the chip; see [How Apple Silicon Works](#) and [How Security Is Baked In](#).
- Learn about the extended battery life with M-series Macs and how to measure and manage it; see [Work with Extended Battery Life](#).

## ***Prepare for and recover from problems:***

- Understand how backups work in Big Sur with an M-series chip; see [Back Up Your M-Series Mac](#).
- Get to know recoveryOS, the new special boot option for reinstalling macOS, controlling security, and more; see [Understand recoveryOS](#).

## ***Dig into Security:***

- Figure out whether FileVault's extra protections work for you; see [Protect a Drive with FileVault](#).
- Learn about Big Sur's extra protections for system files; see [Protect a Drive with FileVault](#).
- Modify system security for specific purposes; see [Protect a Drive with FileVault](#).

## ***Run Something Different:***

- Most iOS and iPadOS apps can be installed and run on an M-series Mac; see [Launch iOS and iPadOS Apps on Your Mac](#).
- You can run a pre-release version of Windows that works on M-series processors today; see [Install and Use Windows](#).



# Learn M-Series Details

Apple’s M-series chips are profoundly different from the Intel generation they supersede. For those who have read up on the architecture of an iPhone or iPad, this series of Apple silicon processors will seem familiar; those who haven’t may feel at sea. In this chapter, I explain how a system on a chip (SoC) works, how Apple’s processors differ from Intel’s, and how Apple bakes security into silicon.

You don’t have to be a chip-head or a hardware expert to understand the details that follow, nor will there be a test at the end. The idea is to give you a sense of what’s new—and sometimes extraordinary—inside the chips, and how special features enable entirely new capabilities.

**Tip:** If you find chip-based technical detail not quite as interesting as I do, skip ahead to [How Security Is Baked In](#), which is more critical to understanding parts of the rest of the book.

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## How Apple Silicon Works


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A traditional CPU-based system wastes a lot of time and energy moving data between it and other chips across a circuit board. Every time memory is manipulated, a security coprocessor needs to perform encryption tasks, or graphics operations have to be offloaded to a GPU (graphics processing unit), there’s a huge amount of signaling and voltage that consumes power, delays actions, and generates heat.

A computer will often also have separate chips for each type of *controller*, a combination of firmware and processor that manages communication with hardware devices. That includes standards like Thunderbolt, USB, and PCIe that connect your computer to printers, displays, and drives. (PCIe is typically used to connect expansion cards in computers with slots.)

## Separate Controllers Allow Greater Throughput

Some controllers come in multiples to create separate data paths, or *buses*, for different ports or sets of ports. Each USB/Thunderbolt bus in M-series Macs can carry up to 40 Gbps in each direction simultaneously plus a certain amount of video data. The more buses, the more monitors that can be supported, more or less.

Apple provided two USB/Thunderbolt buses with its M1 chip. Based on this, I believe the M1 Pro and M1 Max have two and four buses, respectively. Apple doesn't publish this spec, but you can extract it: hold down Option, go to  > System Utility, and select Thunderbolt/USB4 or a similar entry in the left-hand list under Hardware. The M1 Ultra has a slightly more robust configuration of buses, but those aren't documented, either.

For reasons best known to Apple, the higher-end iMac models released at the end of April 2021 have four USB-C ports, but only two are Thunderbolt 3/USB 4—the other two are “plain” USB 3.1 Gen 2 (10 Gbps) versions that don't allow for video or networking. The Mac Studio model may explain it: it comes in an M1 Max version with a similar USB/Thunderbolt split, and an M1 Ultra flavor where all the USB-C ports support Thunderbolt 4. That indicates the chip includes an additional Thunderbolt bus compared to the other M1 chips.

A computer also needs radio chips for Bluetooth and Wi-Fi (and sometimes cellular), as well as storage chips packaged as solid-state drives (SSDs).

On an Intel-based Mac (or an AMD- or Intel-based computer of any kind), the processor is a generic model available to any manufacturer. The rest of the chips required to make up the computer are largely commodity items, sourced based on cost and features. Apple uniquely has often designed or had made to its spec some secondary chips to provide a specific set of features or meet certain performance criteria.

But taken altogether, every CPU-oriented computer is a Frankenstein, however nicely assembled and however well every part works together.

In contrast, a system on a chip combines most functions into a single hunk of silicon. It is more like an organism designed in the lab and produced from scratch, in which each part is designed to work with

# Migrate from an Intel Mac

Most of us aren't starting from scratch when we set up an M-series Mac. We have a previous computer with an Intel chip built in that has an operating system with a particular configuration, and software and files that go with it.

First, if you haven't yet purchased an M-series Mac or want the full details on hardware aspects, read [Pick the Right New Hardware](#). External displays are one of the key stumbling blocks when planning a purchase or (if you already own an Apple silicon Mac) when trying to figure out how to expand.

Then read [Run Old and New Code](#) and the rest of the chapter to understand how Mac apps written for Intel models can run on an M-series chip, and the limitations of that for now.

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## Pick the Right New Hardware

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Apple has successively released M1-based Macs to replace its line-up of Intel computers. As of March 2022, those new models include:

- **Laptops:** MacBook Air (M1), 13-inch MacBook Pro (M1), 14-inch MacBook Pro (M1 Pro or M1 Max), 16-inch MacBook pro (M1 Pro or M1 Max)
- **iMacs:** 24-inch iMac (M1)
- **Desktops:** Mac mini (M1), Mac Studio (M1 Max or M1 Ultra)

The only models not yet replaced are the now-discontinued 27-inch iMac and the Mac Pro. Apple's Mac Studio combined with the new 27-inch 5K Studio Display is, more or less, the 27-inch Intel iMac's replacement. During their March 2022 announcement of the M1 Ultra and Mac Studio, Apple said the Mac Pro is yet to come.

Each model is distinct to one degree or another.

## Processor, GPU, and Neural Engine

With the addition of pro-level chips to the M1 family, Apple provides a wide range of options for different categories of users' computational, production, and battery-life needs.

The model lines' pricing—noted here for U.S. purchasers—starts at levels similar to or better than what we've grown accustomed to with Intel models that had substantially lower performance:

- **M1 with an 8-core CPU/7-core GPU:** You can pay as little as \$999 for a MacBook Air or an iMac for \$1,299. At this price, you get 8 GB of RAM and a 256 GB SSD.
- **M1 with 8-core CPU/8-core GPU:** Most M1 models have this top level of GPU cores, and prices for an 8 GB model start at \$1,249 for a MacBook Air, \$1,299 for a 13-inch MacBook Pro, \$1,499 for an iMac, or \$699 for a Mac mini. All those models include a 256 GB SSD, except the MacBook Air, which comes with a 512 GB SSD. Higher-end iMacs come with extras beyond storage and memory, described below.
- **14-inch MacBook Pro with M1 Pro:** Apple's starting price is \$1,999 for a model with an 8-core CPU/14-core GPU, a 67-watt power adapter, 16 GB of RAM, and a 512 GB SSD. Bump up to \$2,499 for a 10-core CPU/16-core GPU, a 1 TB SSD, and the fast-charging 96-watt adapter.
- **14-inch MacBook Pro with M1 Max:** The \$1,999 base model can be bumped from an M1 Pro to a 10-core CPU/24-core GPU M1 Max and a required minimum 32 GB for an additional \$900 (\$2,899); the \$2,499 M1 Pro model costs \$600 more to upgrade it to 32 GB and the M1 Max processor.
- **16-inch MacBook Pro with M1 Pro:** Apple's base configuration pairs a 10-core CPU/16-core GPU M1 Pro with 16 GB of RAM and a 512 GB SSD for \$2,499.
- **16-inch MacBook Pro with M1 Max:** For \$3,499, get a 10-core CPU/32-core GPU M1 Max with 32 GB of RAM and a 1 TB SSD.

# Back Up Your M-Series Mac

With each system release in the last few years, Apple has layered on more protection for system files and software. These improvements have made it ever harder for any kind of hacker, local or remote, to mess around with macOS to grab your data, watch you while you work, or commit other mayhem. In fact, macOS is so restrictive that even when you're logged in to a running copy of macOS as the root user via the Terminal, you can't make any changes to system files!

Generally, that's good. But where it's bad—or at least tricky—is in creating a full backup of your system that you can use to start up your Mac as an external drive, and restore exactly after erasing your Mac or to a new system. The M series makes this *even harder* by having a unique combination of hardware features and requirements. I would argue this is not bad, even though it can be irritating.

In this chapter, you learn how macOS, starting in Big Sur, organizes its system and data files, and learn a strategy for making bootable backups—and whether you need one at all.

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## Learn About Drive Structure in macOS

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Apple plays a long game. In 2016, they started to preview APFS (Apple Filing System), a freshly conceived filesystem that was optimized for SSDs, allowed a better organization of data beyond partitions, and incorporated lessons learned since Mac OS Extended (or HFS Plus) replaced an even earlier filesystem, plain old HFS, back in 1998.

In APFS, you can still *partition* a physical drive, allowing you to divide up available storage into different pieces. But within a partition, you can have one or more *containers*, which can dynamically resize as needed for their contents, which can be one or more *volumes*. Each

volume has a *role*, which defines the kind of data they contain, like System, Data, Backup, Recovery, Preboot (a special volume handled at startup), and so on.

With the release of macOS 10.13 High Sierra in 2017, the macOS installer converted all SSD-based Macs to use APFS. The next year, 10.14 Mojave converted hard disk drive and Fusion drive Macs during an upgrade or installation.

But it wasn't until 10.15 Catalina that we saw the real picture, when Apple introduced the concept of *volume groups*. These are sets of separate volumes in an APFS container that can present to the Finder as a single, bound-together unit. A startup container has multiple invisible volumes plus a volume group with system and Data volumes inside. Links between the two volumes let you navigate through a single entity in the Finder as if you were navigating just one volume. Nifty, but complicated.

In previous versions of macOS, Apple relied on System Integrity Protection (SIP) to lock down system-file modifications (see [Control macOS's System Integrity](#)). With Catalina, Apple went further: all system files are placed on the system volume, including all the apps Apple built into macOS. This system volume set to be read-only. The operating system prohibits modifications. Your user data is on the Data volume, which can be read from and written to.

macOS 11 Big Sur went one step further to ensure the system can't be fiddled with, as I describe in complete detail in [Control macOS's System Integrity](#). During an installation or update of Big Sur or Monterey—on both Intel and M-series Macs—the installer creates a *Signed System Volume* by producing a cryptographic “seal” when installation is finished. If the seal can't be validated at startup, your Mac won't boot into macOS, and it tells you to reinstall the operating system.

macOS 12 Monterey, by contrast, is an ocean of stability. Substantive changes in system structure and integrity weren't announced, documented, or discovered during the public beta process. There's one improvement, however: you can install multiple distinct versions of macOS on a drive if you need to maintain older versions.

# Work with Extended Battery Life

There's a point while reading superlatives when your eyes rightly glaze over. I know I have a very low limit for it. Which is why I sometimes feel like a huckster and shill when people ask me about the battery life of an M1-series Mac laptop. It's ridiculous. It's absurd. I'm nearly embarrassed to talk about it, because it's *so dangned huge*. And that was before the release of the 14-inch and 16-inch MacBook Pros.

An M1-series chip consumes energy so efficiently that it can carry out processor-intensive tasks over a long period of time and consume what seems to be somewhere between one-third and one-half as much battery power as a comparable Intel laptop. Sometimes, even less.

And when you're performing more normal tasks, like reading articles in a web browser or using a word processor, or simply leaving your Mac active and not engaged in working on it, the battery seems to go on and on and on and on. I've taken my Mac off power and left it by accident, and several hours later come back and find that its charge remains nearly full.

I'd wager that some people could work for two full business days in a putative post-pandemic world of commuting or travel without plugging in. That's the kind of performance associated with an iPad.

Add to that the new fast-charging mode for 14-inch and 16-inch MacBook Pros, and you could potentially work for another full business day every time you can manage just 30 minutes of charging.

In this chapter, I detail how macOS charges and manages batteries, so you understand how best to keep your battery in fine fettle. I explain MagSafe 3 and the new fast-charging mode. And you'll learn to use macOS and third-party tools to keep on top of current time left and charging cycles to maximize battery life *and* longevity.



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## How Batteries Charge and Cycle

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Lithium-ion (Li-ion) batteries are a modern miracle that effectively made mobile devices feasible, as well as electric cars and much else. Unlike previous generations of batteries used in vehicles and electronics—odd bedfellows there—Li-ion batteries hold energy densely while discharging slowly when not in use. They also lack the dreaded “memory effect” found in older rechargeable batteries, when a battery that’s not fully discharged starts to get stuck at a maximum recharge limit that’s far below its actual maximum capability.

Developments a few years ago allowed manufacturers to move away from a battery-cell approach, in which Li-ion batteries were in a form factor similar to alkaline and nickel metal hydride (NimH) rechargeable ones. A “polymer” form of Li-ion allows them to be shaped in all sorts of ways. Apple used this effectively to fill in all the empty spots in an iPhone with battery, and to create the equivalent of layered shingles of batteries to fill the insides of laptops.

The real limit with Li-ion batteries is carefully charging them to the safest full capacity. Overcharging one of these batteries or battery packs can lead to excessive heating, which can cause a fire.

**Warning!** If you ever see a bulgy part of a device where its battery is, immediately stop charging the device, and if possible put it in a metal bucket on a concrete floor where there’s air circulation. Bulging typically happens when internal safeguards in the lithium-ion cells have been damaged or it’s been overcharged, and a runaway reaction can occur that can result in a dangerous fire. [This Macworld column](#) I wrote has additional safety and disposal advice as does [this Battery University article](#).

This is why “100%” isn’t really 100% when it comes to Li-ion charging. Even with a fresh device, the “100%” charge is 100% of what the battery maker and the device maker decide is the safest amount to charge a given battery. There’s always additional capacity that’s left in reserve to avoid overheating.



# Understand recoveryOS

Apple's separate recovery operating system (recoveryOS) has been a vital part of troubleshooting your Mac since it first appeared about a decade ago. It's also where you go when you need to make changes to certain low-level and security settings that can't be modified while macOS is running.

## The Many Names Used with Recovery on an M-Series Mac

Apple seems to be in a transition point about what it calls this special boot mode on a Mac. The best we can figure it at Take Control Books is that there are three terms in use:

- ✦ *Recovery mode* is the generic term for a recovery boot process in macOS, iOS, iPadOS, and all Apple operating systems.
- ✦ *macOS Recovery* used to be the term that referred to restarting into Mac recovery mode. If you start up an Intel Mac by holding down  $\mathbb{R}$ -R, the app that appears has a header labeled macOS Recovery, in fact. macOS Recovery is used in some of Apple's user-facing manuals and documentation online.
- ✦ *recoveryOS*, a term we first saw in the Apple Platform Security document (aimed at security researchers and system administrators) and in some IT-focused guides, refers to the special limited-purpose operating system that runs recovery mode on a Mac. On an M-series Mac, when you restart in recoveryOS, there's no header label. It's only when you click Options and authenticate that the main recovery "app" appears and is still labeled macOS Recovery—this is just confusing and may change. (And you might be prompted at the login window, if you delay entering your password for a while, to restart in... "Recovery OS.")
- ✦ Recovery Assistant is a hidden assistant that aids with fixing a Mac when its system volume loses its integrity in a way I describe how to fix in [Reinstall with the Personalization Error](#).



Since we're only talking about M-series Macs in this book, I have chosen to use the term recoveryOS for the general state of booting in recovery mode, because it's the most consistent available name.

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# Restart in recoveryOS

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To enter recoveryOS on your M-series Mac:

1. Choose Apple  > Shut Down.
2. When you see your Mac has powered down, hold down the power button until you see a prompt that says “Loading startup options.”
3. A set of one or more drives appears along with a gear icon labeled Options. (It may take tens of seconds for all drives to appear.) To continue with Options, you select Options, click Continue, select an account, enter its password, and click Continue.
4. A screen appears on which you can click to select from among four tasks or choose other options from the Utilities or Apple  menu.

I describe how all these options in step 3 and 4 work across the rest of this section.

## M-Series Macs Have Fewer Boot Modes

Intel Macs have a variety of keyboard shortcuts and buttons you can press to trigger starting up in [several different modes](#), like internet recoveryOS, diagnostics, Safe mode, Single User Mode, and others.

[M-series Macs have just four](#): macOS, recoveryOS, fallback recoveryOS (described below), and safe mode (described next).

## Start Up in Safe Mode

In safe mode, macOS won't load any kernel extensions (*kexts*) you've added. This can solve startup problems related to buggy extensions. You won't need it often.

To boot in safe mode, restart in recoveryOS as above. In Step 3, hold down the Shift key when your startup drive appears, click Continue in Safe Mode, and release the Shift key. Your Mac restarts in safe mode. Restart again to boot up normally.

# Manage System Security

Apple has built in a number of excellent protections in recent years against a combination of physical intrusion, in which someone can sit down in front of your Mac and attempt to break in, and system integrity, in which system files have been increasingly immutable.

In this chapter, I explain three major elements of system security that are different on an M-series Mac and that you may find yourself needing to work with or around.

**Note:** For a full dive into macOS security for Intel and M-series Macs, read my book [Take Control of Securing Your Mac](#).

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## Protect a Drive with FileVault

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The current version of FileVault was developed for Mac OS X 10.7 Lion way back in 2011, where it combined two separate features: software-based full-disk encryption (often called FDE) with a special startup and login mode that worked with a fully encrypted disk. (Apple later added dedicated silicon to Macs to accelerate encryption.)

With the introduction of the T2 Security Chip in Intel Macs, Apple separated FDE from the FileVault login mode. On T2-equipped Macs and M-series Macs, which have a Secure Enclave, the internal drive is always encrypted. FDE is always on and can't be disabled.

Intel Macs still require a special startup mode in recoveryOS, but M-series Macs no longer do: they boot into macOS directly.

So what's the difference with an M-series Mac between FileVault enabled and disabled? Here's the distinction:

- With FileVault *disabled*, the startup process automatically retrieves the volume's security key in a process mediated by the Secure Enclave. The Data volume is decrypted even before an account

password is successfully entered. That leaves an inch of room for an attacker to try gain access, difficult as it might be.

- With FileVault *enabled*, a Mac with Apple silicon boots from the System volume; the Data volume remains fully encrypted. Once the password for a user account is successfully entered, macOS can retrieve the encryption key that protects the Data volume, and unlock it for use.

**Note:** If the SSD drive were removed from a Mac—which in modern Macs is nearly infeasible—the decryption information would remain in the Secure Enclave that’s left behind. But taking the whole computer still leaves the problem of breaking into the Secure Enclave, which has proven so far highly resistant to attack.

## How macOS Manages FDE

While FDE is not a feature of FileVault as such with an M-series Mac, since encryption is always enabled, FileVault does mediate how a Mac’s startup drive becomes available after it starts up or restarts.

Full-disk encryption puts a layer between the operating system and a storage drive that automatically decrypts all information coming off the drive and encrypts it as it’s written. This means all information whenever it’s stored on the drive—when it’s *at rest*—is fully encrypted. This includes when the Mac is in use and when it’s powered down.

Only while a Mac is active is stored information vulnerable to interception, as macOS must hold the encryption key in memory to allow it to encrypt and decrypt data on the fly. This allows macOS to treat an encrypted volume as if it were effectively not encrypted at all while in use, including letting you share the volume over a network; back it up to an external drive, a networked volume, or an internet service; and use sync services like Dropbox, iCloud Drive, and OneDrive.

Whenever any Mac with FileVault enabled is shut down—whether an M-series model or a pre-T2 Intel Mac—its startup drive is an inaccessible vault, with no more information accessible than a lump of solid metal. The key material necessary to decrypt its data can’t be accessed.

# Launch iOS and iPadOS Apps on Your Mac

One of the most surreal things you can do on an M-series Mac is install and launch apps designed for iOS and iPadOS. Because the M-series Mac has a compatible ARM-based processor, mobile apps can run across those three platforms. (macOS apps can't run in iOS or iPadOS...yet?)

Not every iOS and iPadOS app can run, but most can. Touch-based actions have to be mapped to ones that can be performed with a mouse, trackpad, or keyboard, too. But it's a surprisingly seamless process.

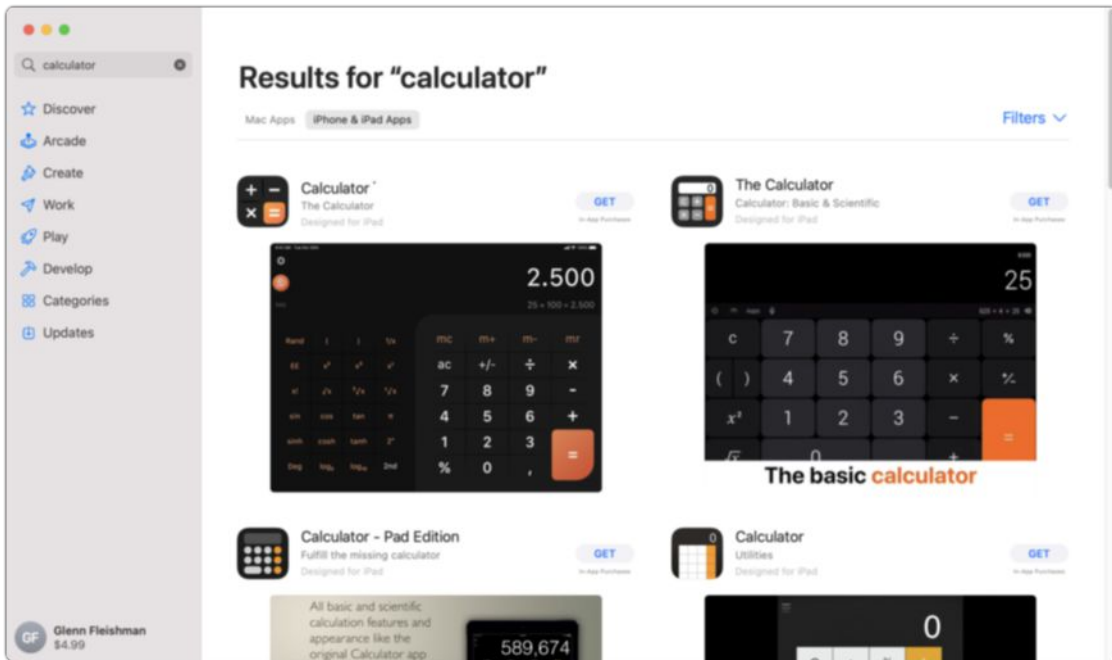
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## Find and Install Mobile Apps

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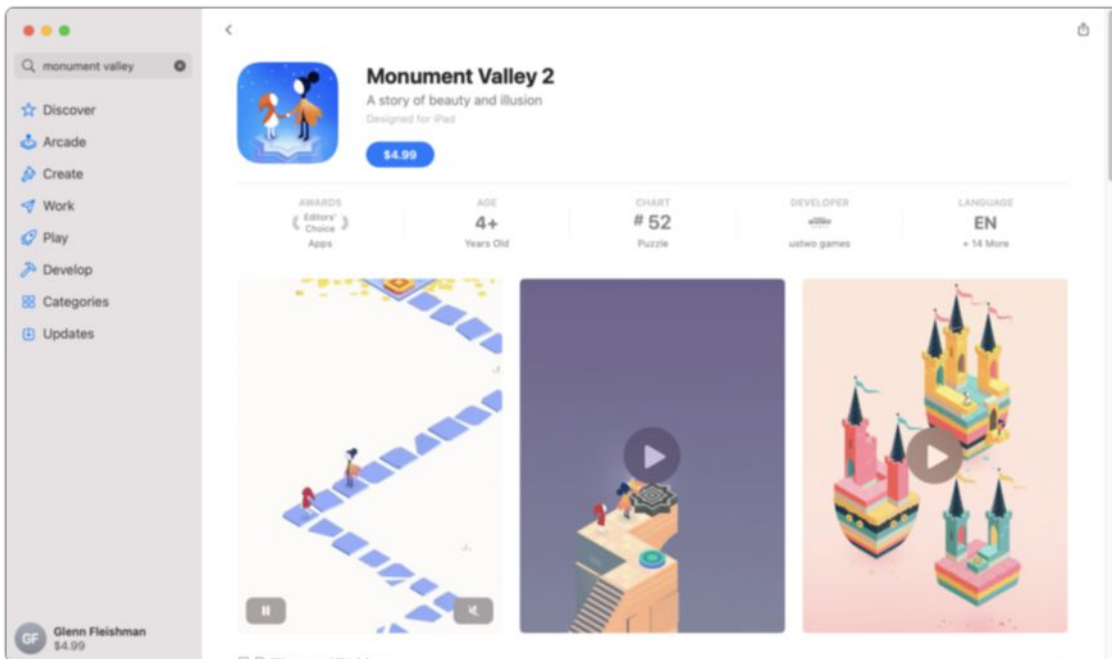
The Mac App Store now offers both macOS apps that developers have made available for download, sale, or subscription through Apple, and iOS and iPadOS apps.

Unfortunately, you can't browse through categories to find mobile apps. You have to either follow a direct link to an iOS or iPadOS app or search by keywords or by name. For instance, search for "calculator" and you will see two items under "Results for 'calculator'": Mac Apps and iPhone & iPad Apps. Click the latter link, and the results are all mobile apps (**Figure 21**).



**Figure 21:** The App Store lets you select iPhone & iPad Apps in search results.

All apps will show either “Designed for iPhone” or “Designed for iPad.” Apps designed for both appear to show only the iPad label, though. Obtaining an app and downloading it is just the same as with any Mac app in the App Store or in the iOS and iPadOS App Stores (**Figure 22**).



**Figure 22:** Just click the price, confirm the purchase, and the game is downloaded to your Mac.

# Install and Use Windows

A popular use of high-performance Macs has been to run Windows. At times, the fastest machine that could run Windows was in fact a Mac. Apple even made this an authorized function way back in 2006, by adding Boot Camp, a utility that manages installing Windows and starting up your Mac into it.

With the first M-series Macs, that went out the window. There's no Boot Camp, and no production release of Windows for M1 Macs.

**Note:** Emulators that could pretend to be an Intel processor don't yet exist for Apple silicon, either. As noted in [Run Old and New Code](#), the only way to run Intel-based operating systems on a Mac is to have an Intel Mac.

That could change, however. Apple's head of software engineering, Craig Federighi, [told Ars Technica back in November 2020](#) that Microsoft could opt to license ARM-based Windows for Mac users. We've heard nothing more concrete since!

As of March 2022, there is one simple way to run a limited version of Windows on an M1 Mac: Parallels Desktop for macOS starting with version 16.5, which added native M1 support.

Start by obtaining the version of Windows 11 that works with ARM installations. It's in beta, so you can't simply purchase or download it. However, Microsoft makes it extremely easy to set up a free developer account and download it.

Here's how to get the Windows 11 for ARM beta:

1. Start with [the Windows Insider Preview Downloads page](#) for "Windows 11 on ARM Insider Preview." You will be prompted to login in. If you don't have an Outlook.com or Live.com account, follow the steps offered to create one.



2. Return to the downloads page, if you aren't automatically redirected. You should be prompted to agree to Windows Insider terms. Make sure you read what you're agreeing to and then check the boxes offered.

**Note:** Editor Joe Kissell found himself stuck at step 2. He wasn't able to agree to terms and proceed. Instead, he had to register separately for a Windows Insider account and complete the process from within an existing running copy of Windows. I didn't encounter this.

3. Click "Windows Client ARM64 Insider Preview - Build *xyz*"; a build number appears in lieu of *xyz*, and will change over time. The download is roughly 9 GB and will be named something like [Windows11\\_InsiderPreview\\_Client\\_ARM64\\_en-us\\_\\_22454.VHDX](#).

Set the file aside until you've completed one or both of the next two emulator installations.

**Note:** After you complete an installation with an emulator, follow the instructions in Windows 11 when prompted to log in to the account associated with your Windows Insider membership. You will also get instructions on enabling optional diagnostics, which is required to download incremental updates to Windows 10 in the beta program.

Now purchase [Parallels Desktop for macOS](#) version 17, which costs \$79.99 per year for a new license or \$49.99 per year if you're upgrading from a previous version or adding a license to run the software on an additional Mac.

**Tip:** Parallels often offers small to huge discounts off an initial 1-year license. Search the internet for deals.

After installing Parallels Desktop and entering the activation code provided on purchase, follow these steps:

1. Launch Parallels Desktop from the Applications folder.
2. Navigate to the Windows 11 Client ARM64 installer file or click Find Manually and drag and drop it into the window.



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## About the Author

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Glenn has written oodles of books since the 1990s. Most recently, those include *Take Control of Securing Your Mac*, *Take Control of Zoom*, *Take Control of iOS & iPadOS Privacy and Security*, and *Six Centuries of Type & Printing*. Glenn writes for the *Economist*, *Increment*, *Macworld*, and TidBITS on topics as varied as the longest-running metal foundry in America, the unique nature of sheriffs in America, and how syndicated cartoons were distributed to newspapers in the 1920s.

(Photo credit: Lynn D. Warner)

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## About the Publisher

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alt concepts, publisher of Take Control Books, is operated by [Joe Kissell](#) and [Morgen Jahnke](#), who acquired the ebook series from TidBITS Publishing Inc.'s owners, Adam and Tonya Engst, in 2017. Joe brings his decades of experience as author of more than 60 books on tech topics (including many popular Take Control titles) to his role as Publisher. Morgen's professional background is in development work for nonprofit organizations, and she employs those skills as Director of Marketing and Publicity. Joe and Morgen live in Saskatoon, Saskatchewan, Canada, with their two children and their cat.

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