

<http://www.macwindows.com/winintelmac.html>

# How to Run Windows on Macs

## A Comparison of Available Solutions

By John Rizzo

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There's no need to be embarrassed -- there are lots of reasons to run Windows software on a Mac. You may need to run a Windows application or a game that isn't available on a Mac, or you may need access to a scanner or other peripheral that doesn't have drivers for the Mac. Or maybe you've sunk hundreds of dollars into Windows software that you want to run on your Mac. Or maybe you *prefer* Windows and want to run it on Apple's sleek Mac hardware all the time.

Fortunately, there are different solutions that satisfy different types of needs. These fall into three categories, each with different strong points. This report will help you determine which is the best for you. Here's the short version of what's on this page:

1. [Dual booting](#). Every Mac comes with software called Boot Camp that lets you install Windows and enable it to start up the Mac. You can choose to boot either from Windows or OS X, but you don't have access to both at the same time. Boot Camp is the fastest way to run Windows.
2. [Running Windows in a virtual machine](#). With this approach, you boot the Mac with OS X and run Windows in a virtualization application. Unlike Boot Camp, virtual machines let you switch between the Mac OS X and Windows environments without rebooting. Virtual machine software also supports more versions of Windows than does Boot Camp. The disadvantage to virtualization is that it takes more RAM memory and CPU utilization, leaving fewer of your Mac's resources for other applications. Most tools let you move files between the two operating systems and sharing peripherals and networking. The main products for doing this are [Parallels Desktop](#) and [VMware Fusion](#). Sun's [VirtualBox](#) is a free virtualizer that has some appeal.
3. [Running Windows apps directly in Mac OS X -- without Windows](#). CrossOver from [CodeWeavers](#) runs Windows applications directly in Mac OS X, without using Windows. Because you don't need to own a copy of Windows, CrossOver is the least expensive way to run Windows programs on a Mac. It's also fast. The trade off is that it doesn't run every Windows application.

This report provides a comparison of all of the options for running Windows on Intel Macs. The next section describes [dual-booting with Boot Camp](#), followed by the [choices of virtual machines](#). After that is a [description of Crossover](#) for running Windows software without Windows.

Which version Windows is best to run on you Mac? It's more complicated than you think. See [Choosing the right Windows 8 for your Mac](#)

## Booting into Windows: the dual-boot Mac and Boot Camp

Although Macs and Windows PCs both are powered by Intel processors, you can't just stick a Windows installation disc into a Mac and expect it to install. Apple's Boot Camp gives Windows what it needs to start up a Mac. Boot Camp will also create a separate partition on your hard disk for Windows.

You can boot the Mac into Windows by holding the Option key down while restarting. You then select the Windows Partition or the Mac partition, which appear as hard drive icons. The Mac will boot from OS X or from Windows, depending on which one you choose. Unlike the virtualization products, Boot Camp does not give you access to OS X and Windows at the same time. You have to reboot back into Mac OS X to get access to your Mac software.



Choose to boot in Windows or OS X when you hold the Option key during startup.

You install Boot Camp and your copy of Windows with Boot Camp Assistant, located in the Applications>Utilities folder in Mac OS X. Directions are included once you launch the Assistant, where you can print them if you like. The Boot Camp Assistant "dynamically creates" the Windows partition for Windows, so it won't erase your Mac data. The Assistant then guides you through installing Windows, and downloading installing drivers in Windows to support the Mac keyboard and other hardware and peripherals from within Windows. Boot Camp does *not* provide Windows; you'll need to supply your own copy.

Apple has said that Boot Camp runs Windows "completely natively," which makes it faster than virtualization software for hardware-intensive tasks. Windows with Boot Camp also uses less of the Mac's processor and memory than with virtualization because it is only running one operating system at a time. (This can also be said of [CrossOver](#).) Boot Camp tends to be more compatible with gaming software than virtualization software.

Lion and Mountain Lion 10.8.2 and earlier came with the current version, Boot Camp 4, which supports only Windows 7. Earlier versions of Boot Camp also support Windows XP Service Pack 2 and Windows Vista. Boot Camp 4 does not support Windows 8, but you can install Windows 8 and have it will run relatively well, though the Windows drivers for graphics are outdated. Apple added [support of Windows 8 with Boot Camp 5](#) in the OS X 10.8.3 update. Windows 8 is only supported on more recent Mac models. (See a list [here](#).)

[Apple released the first Boot Camp](#) on April 5, 2006. Boot Camp versions 1.0 - 1.4 were officially beta (prerelease) versions. They ran only on Mac OS X 10.4 Tiger, and are also the *only* versions of Boot Camp to run on Tiger. More recently, Lion came with Boot Camp 4, which Apple still offers for older Macs. Mountain Lion 10.8.3 and later come with Boot Camp 5.

You can download Boot Camp from the Boot Camp Assistant, which you will find on your Mac in the Utilities folder (inside of Applications). You can also [download Boot Camp from Apple's support site](#).

## Boot Camp 5

**Pros:** Best performance and compatibility with Windows applications; uses less RAM and processor power than virtual machines; Comes with the Mac, so the only cost is that of Windows

**Cons:** Can't access Mac and Windows applications at the same time; A limited number of operating systems supported: Version 5 supports only Windows 7 and Windows 8; Win 8 doesn't run on all Macs

## System Requirements

- Boot Camp 5 runs on the following Macs:
  - MacBook Air, Mid 2011 or newer
  - MacBook Pro, Mid 2010 except for the 13" inch model, or newer
  - Mac Pro, Early 2009 or newer
  - Mac Mini, Mid 2011 or newer
  - iMac, 27-inch, Mid 2010 or Mid 2011 or newer (the 21" Mid 2010 does not support Windows 8)
- Older Mac models support Boot Camp 4. For a complete list, see Apple's [Boot Camp System Requirements](#) page.
- USB keyboard and mouse, or a built-in keyboard and trackpad
- 8 GB USB storage device, or external drive formatted as MS-DOS (FAT) to install the downloaded drivers

### Related Articles:

- [Boot Camp 5 Tips and Reports](#)
- [Boot Camp 4 Tips and Reports](#)
- [Boot Camp 3 Tips and Reports](#)
- [The most reliable Windows PC is a Mac, study concludes](#)
- [Apple Releases Boot Camp 5 for Boot Macs with Windows 8](#)

## Running Windows in a Virtual Machine

A *virtual machine* is a simulated PC that runs in software on your Mac. It contains an operating system (such as Windows), called the *guest OS*; the copy of OS X that boots your Mac is called the *host OS*. With virtual machine software, your Mac can run several guest operating systems, including as Windows 7, Windows 8, and Linux, all at the same time, within OS X (as in the screen shot below).

The trade off with virtualization is the burden of running two operating systems at the same time -- the OS X host OS and the Windows guest OS. This means using a lot of processor power and system memory used and performance that is not as fast as booting from Windows with Boot Camp. Virtualization can also cause slow the performance of Mac applications when virtual machines are running.

You can run Windows in full-screen mode, as you might experience with Boot Camp, or have Windows displayed in a OS X window. You can also hide the Windows desktop so that only the Windows applications are displayed. With any of these views, you still have access to all your Mac apps. Windows applications appear in the Mac's Dock and in LaunchPad (OS X 10.7 and later), letting you launch Windows applications and switch between them without using the Windows interface.

You can move files between the different operating systems and drag and drop files between Mac OS X and Windows. You can also copy and paste between Windows and Mac applications, and set Mac applications to launch when double clicking on a particular type of Windows file. For instance, you can open all your Word files in Word for Mac, even when you double click a .doc file inside of Windows.

Virtualization software supports more versions of Windows than does Boot Camp, which currently only supports Windows 7 and 8. Virtualization also supports Linux and Unix operating systems as guest OS's. An added bonus is that you can also run OS X or OS X Server on one Mac in a virtual machine, which can be useful for testing a new version of OS X before rolling it out. The versions of OS X that run in a virtual machine on a Mac are OS X 10.5 Leopard Server, OS X 10.6 Snow Leopard Server, OS X 10.7 Lion client and Lion Server, and OS X 10.8 Mountain Lion Server and Mountain Lion client.

Virtualization products let you take "snapshots" of a virtual machine, which saves the state of an operating system, including which Windows applications are open, as well as the current settings and configurations. If you ever mess up the system in your virtual machine, or it gets infected with a virus, you can revert to a previously saved snapshot.

You also don't need to shut down Windows when you're finished using it. When you quit the virtualization application or close the virtual machine, the software will ask you if you want to "suspend" the virtual machine. The next time you launch it, Windows will appear exactly as you left it, without having to go through Windows' startup process.

There are three virtual machine products for running Windows on Macs, which all support the features I've just described: [Parallels Desktop](#), [VMware Fusion](#), and Oracle's [VirtualBox](#). Parallels Desktop and VMware Fusion are close to each other in terms of features, but Parallels tends to run Windows faster, particularly in graphics. A third virtual machine product, [VirtualBox](#), is free for personal use, but is in a class behind Parallels and VMware.

The next sections describe the current state of virtualization packages for Intel-based Macs.

- [Parallels Desktop](#)
- [VMware Fusion](#)
- [VirtualBox](#)

After that, I describe [CrossOver](#), which is not a virtualization application at all, but is something else entirely.

## Parallels Desktop 9

The day after Apple announced Boot Camp in 2006, Parallels surprised Apple-watchers by releasing a beta of [Parallels Desktop](#). Since then, Parallels Desktop has been the leader of the virtualization approach to running Windows on a Mac. The company claims Parallels Desktop can run “nearly any x86-compatible OS,” including Windows 3.1-through Windows 8.1, several versions of Windows Server, as well as most Linux distributions, FreeBSD, Solaris, and others.



Parallels Desktop 8 running Windows 8 and Windows 7 virtual machines

Although Boot Camp is still the fastest way to run Windows on a Mac, Parallels Desktop 9 is the fastest of the three virtualization products for the Mac. ([Crossover](#) can sometimes be faster, however.) Parallels is also faster in suspending and resuming a guest OS.

Parallels Desktop is also faster at 2D and 3D graphics than VMware Fusion and VirtualBox. Graphics-intensive PC games run smoother in Parallels Desktop 9 than in VMware Fusion 6, and with higher frame rates. Parallels also supports DirectX 10, while VMware Fusion 6 still only supports the earlier DirectX 9.0c, which means that some newer games won't run at all in VMware Fusion.

Both Parallels and VMware have their own unique Mac integration interface goodies. Parallels Desktop Version 8 added an IE button to the OS X (Mountain Lion and later) Safari toolbar. Clicking this button in Safari launches Internet Explorer in Windows (and Parallels if not already open) to the web page you were just viewing in Safari. You can also drag and drop files from the Mac Finder into Outlook for Windows to attach to an email, something you can't do in VMware Fusion. Parallels does a better job integrating with Launchpad in Lion and Mountain Lion. You have the option of choosing which Windows apps you want to appear in Launchpad. VMware Fusion only lets you turn Launchpad integration on or off, adding some Windows apps you don't want, and sometimes not including some that you do want.

While you're installing Windows 8, [Parallels Desktop 9](#) gives you an option for adding a Start menu, which is glaringly missing from Microsoft's latest OS.

One unique feature released in Parallels Desktop 9 is shared access to cloud storage. This includes Dropbox, Google Drive, iCloud and SkyDrive. This feature prevents duplicate files and cache from being stored in OS X and Windows, and synchronizes files on the Mac host and Windows guest.

Although [Parallels Desktop 9](#) wins in performance and edges out VMware Fusion 5 when it comes to user interface. But Fusion also has some things going for it, and may be better for some users, as I describe next.

## Parallels Desktop 9

**Pros:** The fastest virtual machine product for running the Windows OS on a Mac, particularly for graphics; Some nice Mac and Mountain Lion integration features; Shared access to popular cloud storage

**Cons:** Not as good integration with OS X Launch Pad as Parallels; Slower than Boot Camp; like all virtual machine programs, takes more RAM and CPU than Boot Camp or CodeWeavers CrossOver

### Requirements:

- Mac OS X Snow Leopard 10.6.8 or later

### Related:

- [Parallels Desktop 9 brings cloud integration, boosts speed, adds Windows 8 features](#)
- [Parallels Desktop Tips and Reports](#)

## VMware Fusion 6

[VMware Fusion 6](#) is a close competitor to [Parallels Desktop 9](#), though not as fast as Parallels, has some useful interface features not found in Parallels Desktop.

Although Parallels may do Launch Pad better, VMware Fusion has a better integration with Mission Control. Each open Windows application appears separately, just like Mac apps do. In Parallels Desktop, the Windows apps are combined into a single Parallels icon. VMware Fusion 6 also lets you place Windows 8 Metro apps in the OS X Dock.



In VMware Fusion, Windows applications appear in the Mission Control view of Lion and Mountain Lion

In full screen mode, Fusion presents a small bar when you mouse over the center of the top edge of the screen. This bar presents options that let you do anything Fusion allows, including change to single window or Unity modes, suspend the virtual machine, take a snapshot, or a number of other tasks. In Parallels Desktop, you only have one choice when in full screen mode: to exit the mode into single mode.

Fusion does a better job with its virtual machine library, the window listing all the installed virtual machines. Fusion's library lets you turn on and suspend multiple virtual machines and access their settings, all in one spot. In Parallels Desktop, clicking on a virtual machine in the list opens its window, covering the library window.

VMware Fusion 6 beefed up hardware support for virtual machines for beefy Macs. You can now assign up to 64 GB of RAM memory, 16 virtual CPUs, and 8 TB virtual disks, if you need it. You'd need a Mac Pro to max these out.

Although this is an article about Windows, but it's worth noting that with Linux/Unix virtual machines, Fusion lets you drag and drop files between Linux and Windows virtual machines and the OS X host. (Parallels does this only for Windows.) If you want to run Lion or Mountain Lion as a guest OS, it is easier to install Lion in a virtual machine in VMware Fusion than in Parallels Desktop. However, OS X guests doesn't support drag and dropping of files in either package.

VMware is also the biggest name in virtualization, and its VMDK file format for virtual machines is a standard. Which means that VMware Fusion can run virtual machines created by VMware's virtualization software for Windows and Unix. This is an important benefit in a PC shops using VMware, where the same virtual machines can be distributed to Mac and Windows users.

VMware.com also offers a huge number of free and paid "virtual appliances," which are VMDK virtual machines preconfigured with various Linux and Unix builds, both servers and clients. Parallels can import VMDK virtual machines, but the results aren't always successful.

VMware also offers a Pro version that adds some enterprise features, such as the ability to create control policies that restrict access to resources or peripherals. Administrators can also create "restricted" virtual machines that expire at a set date and time.

[VMware Fusion 6](#) also costs less than Parallels Desktop 9. You can try both for free in time-limited demos.

## VMware Fusion 6

### System Requirements:

Mac OS X 10.7.0 Lion or later; OS X 10.7.5 or later recommended

**Pros:** Superior integration with OS X Mission Control; Uses the standard VMDK format for virtual machines, giving you access to free Linux virtual appliances; Best way to run OS X Server in a virtual machine; Costs less than Parallels Desktop

**Cons:** Not as fast as Parallels Desktop (or Boot Camp), particularly with graphics; Not as good integration with Launch Pad as Parallels; Like all virtual machine programs, takes more RAM and CPU than Boot Camp or CodeWeavers CrossOver; Doesn't work in Snow Leopard

### Related:

- [VMware Fusion 6 updates for new OS's, enterprise features](#)
- [VMware Fusion Tips and Reports](#)

## VirtualBox

[Oracle's VirtualBox for Mac OS X](#) is free software based on GPL open-source code. Oracle got VirtualBox when it acquired Sun, which purchased VirtualBox from a German company called Innotek. Like [Parallels Desktop](#) and [VMware Fusion](#), VirtualBox can run Windows 7, supports USB, and can be scripted from the command line. VirtualBox also supports VMDK virtual machine format used by VMware, although importing a virtual machine can be challenging. VirtualBox uses VMware's VMDK format for compatibility with virtual appliances.

VirtualBox can run Windows in a virtual machine without crashing and without glitches. But overall, VirtualBox it lags behind Parallels Desktop and VMware Fusion, and is in a class below. In VirtualBox, it is not as easy to install and set up virtual machines as in the other two. The interface isn't as polished as VMware and Parallels, and is not as integrated with Mac OS X. "Seamless" mode, which hides the Windows (or Linux) desktop, is not quite seamless -- it retains the Windows (or Linux) taskbar at the bottom of the screen. Windows applications don't get individual icons in the Dock or in the Application Switcher, as they do with Parallels and VMware. VirtualBox is slower than Parallels Desktop and VMware Fusion.

Oracle also offers a \$50 Enterprise Edition for commercial use, which is about the same price as the superior [VMware Fusion 6](#). If price is your number-one concern, CrossOver CodeWeavers (see below) will be cheaper than VirtualBox, which requires a Windows license.

## VirtualBox

**Pros:** It's free for personal use, though you still need to own a copy of Windows; Uses a standard format for virtual machines that is used by VMware products

**Cons:** The slowest of all solutions for running Windows applications on a Mac; interface is not as polished as other solutions; has less integration with OS X

## System Requirements

- Mac OS X 10.6 Snow Leopard or later

**Related:**

[VirtualBox Tips and Reports](#)

## Running Windows Apps in OS X without Windows with CrossOver 13

After dual-booting and virtualization, there's a third way to run Windows applications on a Mac that doesn't use the Windows operating system at all. [CodeWeavers' CrossOver 13](#) is neither a virtualization environment or a dual boot enabler. CrossOver adds code (called Wine) to OS X that enables several thousand Windows applications to run directly in OS X.

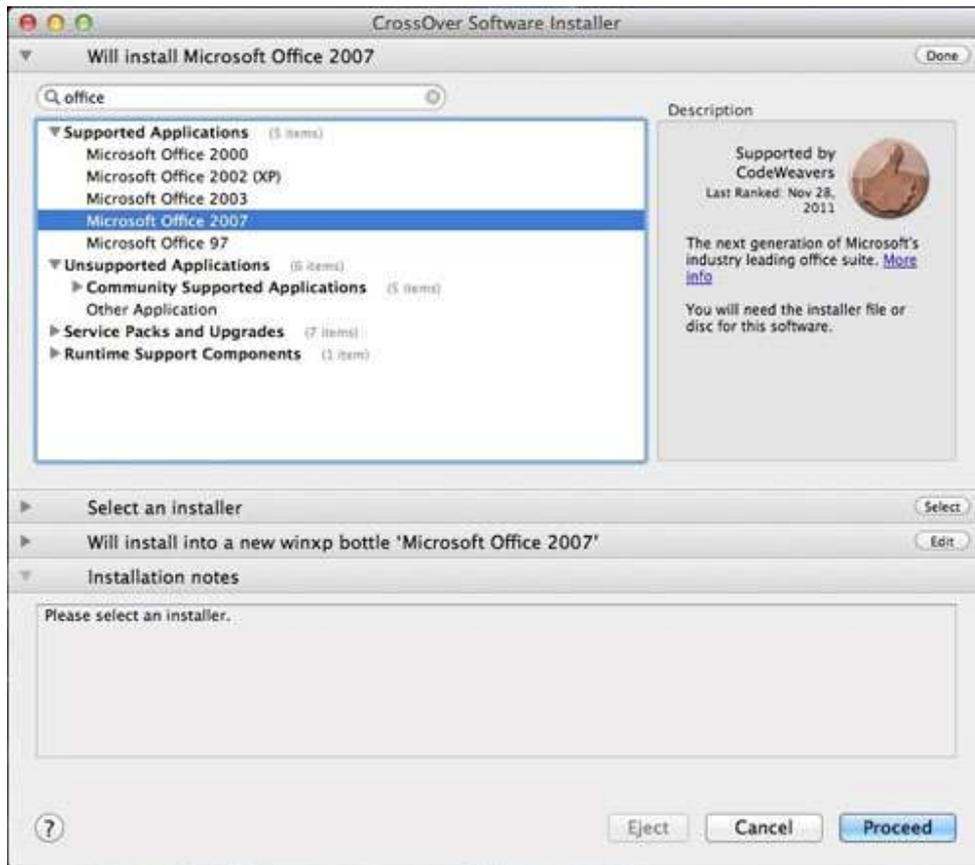
Because CrossOver doesn't have the overhead of running a second operating system (Windows), it uses less memory and CPU bandwidth than do Parallels or VMware. CrossOver enables Windows applications directly access Mac hardware. That lack of Windows also means that CrossOver uses much less of your Mac's CPU and RAM memory than Parallels or VMware Fusion, so that you don't get the slow down of Mac applications that you can sometimes see with the virtualization products. CrossOver uses the Intel Mac's native graphics acceleration, and performance is good for games and other tasks. And unlike the virtualization products, there is no need to wait to suspend or resume a guest OS, because there is no guest OS.

With CrossOver, each Windows application document runs in a window along with your Mac apps. There is no Windows desktop or start menu, and Windows apps can minimize in the Mac OS X Dock. Users can launch Windows applications installed with CrossOver from the Finder or from a Dock menu or a Programs menu in the OS X menu bar. CrossOver also provides a Windows Run Command window for running Windows command-line programs.

[CrossOver 12.5](#) added more OS X integration features. Windows apps act like Mac applications in Expose and Spaces, and there is better integration with the OS X Dock. Windows apps have their Tray icons appear in the Mac menu bar, and there is support for the Mac standard Command-tab switching in full-screen mode.

Because CrossOver doesn't require the user to own a copy of Windows, the total cost is lower than any virtualization solution and even lower than Apple's Boot Camp solution.

The trade off is that CrossOver won't run all Windows applications. Codeweavers.com has a database of 10,000 or so Windows apps that you can consult. There are about 2000 Windows apps listed at the "gold," the highest level of compatibility. There are also silver and bronze levels which run with varying levels of compatibility. Gold apps include business applications such as Microsoft software such as Office, Internet Explorer and ActiveX, Outlook, Access, as well as Quicken. Many gold apps are PC games. You can also check for supported Windows apps from within the CrossOver Software Installer.



### Installing a Windows application on a Mac with CrossOver

Installing Windows applications can in many cases be accomplished with a single click. CrossOver will recognize the DVD installer disc of a supported Windows application and offer to install it. You can also install an application from an installer (.exe) file by selecting it from a list in CrossOver. Installing unsupported applications is a little more complicated. The CodeWeavers web site has a tutorial on how to do it.

[CrossOver](#) is a good way to go if you have a small number of Windows applications to run on a Mac, or even just one, such as Internet Explorer with ActiveX or a PC game. It's simple and cheap. You can test CrossOver for free with your app to see if it works well. If it doesn't, you can move on to Parallels Desktop, VMware Fusion, or Boot Camp.

## CrossOver 13

**Pro:** Fast performance, particularly gaming graphics; The least expensive way to run Windows apps on a Mac, the only solution where Windows is not required; uses less CPU and RAM resources than virtualization; unlike Boot Camp, runs Mac and

Windows applications at the same time.

**Con:** Does not run all Windows applications