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# Beginning Blender

Open Source 3D Modeling, Animation,  
and Game Design

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your own 3D design and animation projects*

Lance Flavell

Apress®

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Open Source 3D Modeling, Animation,  
and Game Design



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## **Beginning Blender: Open Source 3D Modeling, Animation, and Game Design**

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*To Christal*

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# About the Author



**Lance Flavell** is a fully registered teacher from the Kapiti Coast of New Zealand, with a sideline interest as a 3D animator/freelance artist. At the time of writing this book, Lance is teaching a full-time workload as an IT tutor at the Paraparaumu College secondary school. Lance has a passion for open source programs and has run Linux as his primary operating system for the past decade. He has gained a few academic degrees over time, and is especially fond of having earned his animation diploma from the Media Design School of Auckland, New Zealand. Lance has contributed to online publications such as BlenderArt magazine and he is frequently involved in holiday programs teaching computer graphics, where he usually specializes in Blender. Lance can often be found in the BlenderArtists forums (<http://blenderartists.org/forum>) or at [www.nzcg.com](http://www.nzcg.com) under the username “Lancer”.

# About the Technical Reviewer

**Luca Bonavita** is an Italian engineer and special effects supervisor.

During his studies at the Politecnico of Turin, he worked as a freelance camera operator in broadcast television, and later on as a motion control specialist in the advertising and film industries.

As his job, he makes extensive use of Blender for designing visual effects (previsualization, animatics) and for sharing 3D data with motion control rigs on the set. He uses Blender for the postproduction of his project, at [www.mindrones.com](http://www.mindrones.com).

## Acknowledgements

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The book was written in a time of extreme business and stress, so I owe thanks to God for answering my prayers and finally allowing it to be completed.

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# Introduction

Welcome to the world of 3D! The fact that you are reading this book means that there is a good chance you are interested in 3D animation. You have heard that Blender is a freely available program capable of making such animations, so now you want to know how to use it, and fast! But then, it's dangerous for me to guess this scenario. Perhaps it's 3D games you're interested in making. Perhaps you're not into the animation side of things, but you want a good reference on how to get started on making your own 3D models. Maybe you've heard that Blender has some powerful video-editing capabilities. Well, Blender can do all these things and so much more.

When I started using Blender, I was soon overwhelmed with the many controls it has. Buttons just seemed to be arranged all over the place! When I pressed one button to see what it did, sometimes all the other controls around it would change, but I had no clue as to what the button I had just clicked was supposed to be doing.

What I needed was direction. I didn't want a manual explaining what every button does (I didn't have the patience), but a guide to explain just the few important options needed to get me started. I'm hoping that this is the kind of book I have written for you.

This book does not aim to be exhaustive, and yet it is not written to an overly simplified manner so as to insult your intelligence. 3D animation by its very nature is not simple. What you have with *Beginning Blender* is a book that covers a good range of the many different areas of Blender, with practical examples to get you fast-tracked into using those areas.

Whether you are wanting to learn 3D modeling, animation, game-making, or movie production, this book will get you started the area you want to go.

The following sections outline what we'll cover in each chapter.

## How This Book Is Organized

The first two chapters introduce Blender, with essential information that you really need to know before digging into the program.

Chapter 1 starts off with the background of Blender, explaining what Blender is and how it came to be, including some sample artwork from talented Blender users. I don't like "practical" books that turn into history lessons, although once you see what Blender can do, you're naturally going to get curious about how such a powerful program could possibly be free, so I decided the information was relevant. I have also included information on where you can get the latest versions of Blender and how you can install it on most common operating systems.

Chapter 2 contains key information to understanding Blender in terms of the user interface. It is important that you get a mindset for thinking in terms of 3D space. Everything you do in Blender will be affected by your understanding of the base concepts in this chapter, making it a must-read before any of the remaining sections of the book.

The remaining chapters of the book branch out into the different areas of Blender, before concluding with some resources you can look to for continuing your learning. The sections are progressive in terms of complexity, although I have made each chapter independent from the others, in order to cater for readers who like to skip a head and flip to a particular section of interest.

Chapter 3 contains information on basic modeling. Blender has many mesh modeling tools that can prove overwhelming to the beginner, so I have outlined the ones I believe are going to be the most important; and this chapter is designed to be a reference you will want to return to as you come to grips with the most essential tools. I have included instructions on how you can set up a mirror modifier for the times when you need to build anything symmetrical. Modeling is an art, making it a difficult task even for experienced Blender users, so I also included information on how you can use Blender's sculpting tools to make modeling as easy and as enjoyable as working with clay, including how you can integrate the different modeling techniques together.

Once you can make models, Chapters 4 and 5 are concerned with using lighting and texturing to make your work look good. In Chapter 4 you will learn how to set up a camera and lights to effectively display your model, and there is information on how you can design your own procedural textures to enhance the surface texture and the color of your models. Chapter 5 takes your texturing to the next level with UV-unwrapping techniques, showing you how to make very realistic textures created from photographic sources. The chapter then outlines normal mapping techniques, a valuable skill in games modeling, where you can use texturing to make low-detail models look as though they are highly detailed.

Chapter 6 returns to the earlier emphasis of modeling, this time outlining more unusual techniques than those presented in Chapter 2. The techniques presented here include lesser-used techniques, specifically for modeling with curved surfaces.

Chapters 7 and 8 look at animation. This is where your creations will be transformed from static models into moving, lifelike creatures. You will learn how keyframe-based animation is used in Blender and how you can set up your models so that they bend, and what you need to know in order to make them walk. Chapter 7 contains the basics of what you need to know to get started in animation, whereas Chapter 8 goes onto more advanced techniques, right up to how you can prepare the mouth shapes of characters for lip syncing animation.

Chapter 9 looks at how movies are can be made with Blender. You will learn how shots can be mixed in Blender's compositor, including greenscreen techniques. You will also learn how to use Blender's cutting room—the Video Sequence editor—in order to edit the shots of your own movies.

At the advanced end of the book, Chapter 10 looks at Blender's particle capabilities, which give you the power to generate special effects like water, hair, and smoke, while Chapter 11 explores how you can get started in making your own games, all completely within Blender!

Finally, Chapter 12 concludes the book by answering common problems users often face when they first use Blender. You will also be shown a range of resources you can use to continue to develop your skills, even after reading this book.

## A Note on Blender Versions

This book was written at a time when Blender was undergoing some massive changes. The official Blender version is currently 2.49b, although the Blender Foundation has been working hard on a complete bottom-up rewrite of the code, and Blender 2.49b will soon be superseded by the 2.5 release of Blender, which is currently available as an optional download to the 2.49b release. I started writing this book when Blender 2.5 alpha 2 was available. During the time of writing, this “cutting-edge” release progressed through Blender 2.53 beta and then 2.54 beta, which is available now. There are significant differences between Blender 2.49b and the developing 2.5 version of Blender. In order to future-proof this book as much as possible, I have avoided addressing issues specific to the 2.49b release. Instead, emphasis is on the 2.5 branch of Blender. It is likely that by the time you hold this book, yet another update of Blender will have been released; however, given that the Blender this book is based on is the next version in the making, much of what I have covered should remain relevant through the next few versions to come.

## Extras for This Book

This book contains many examples of many different things you can do in Blender. Various illustrations throughout the book show examples of what is being taught, taken as screenshots from my own computer while I was writing each section. I have tried to write the book in a way that makes the material directly applicable to your own work, although having access to example files can make understanding the exercises much easier. For this reason, you can download many of the example files used for my illustrations from the Source Code page on the Apress web site, at [www.apress.com](http://www.apress.com).

I very much hope that this book provides a key learning experience for people who will continue to enjoy Blender for a long time.

Please e-mail any feedback or suggestions to [blenderbook@orcon.net.nz](mailto:blenderbook@orcon.net.nz).

I would love to hear how this book has helped you, or how I could improve things in a future edition.

Lance Flavell

## CHAPTER 1



# History and Installation

First and foremost, Blender is a 3D modeling and animation studio package. If you are familiar with Autodesk Maya, Autodesk 3ds Max, NewTek LightWave, or other 3D modeling/animation applications, you'll have an idea of what Blender is like. If not, don't worry, you're in for a treat.

Think of animated cartoons, along the lines of those produced by DreamWorks, Pixar, and so forth. Think in terms of *Shrek*, *Toy Story*, *The Incredibles*, *Finding Nemo*, *Kung-Fu Panda*, *VeggieTales*, and so on. While those movies may not have actually used Blender (I'm throwing out random examples that most readers have heard of to give you an idea), they are in the genre of 3D animation that you would typically expect from Blender. Some clever computer graphics people spent time creating all the 3D characters in those movies, lovingly rigged them for animation, and rendered off the final film mix. To do this, they needed some pretty powerful computer programs known as *3D animation packages*. And that is the kind of program that Blender is.

Often, production pipelines require several powerful packages: one for modeling, another for texturing, others for animation and compositing. Fortunately, Blender is kind of a Swiss Army knife program in that it can do many of these tasks.

- Blender is a 3D modeler, which can make characters for movies.
- Blender has powerful texturing tools for painting the surface of the models.
- Blender has powerful rigging and animation functions. The models you create can then be made to move around and act.
- Blender has its own rendering engine and can be thought of as a complete lighting studio for a film. It also provides support for external renderers such as YafaRay and LuxRender.
- Unlike other 3D packages, Blender has its own compositing module, so movie “shots” can be mixed. Blender also has a unique video sequence editor, making it possible to cut and edit movie strips without having to rely on extra third-party applications for the final editing stage of production.
- Besides all of this it also has a full-blown game creation suite.

Now that you know what Blender is, the rest of the chapter will cover the following topics:

- A small sample of artwork made in Blender by experienced Blender users
- The history of how Blender originally came to be and how it has developed over the years
- How Blender has been used in real-life projects
- How to download and install Blender on your own machine

---

■ **Note** Blender is also an *open source* program. We'll see what that means later in the chapter.

---

## Sample Blender Artwork

While Blender may have a steep learning curve, this book is designed to introduce you to the program in a logical and relatively painless way. That said, Blender is a very big program, providing many hours of ongoing study even after you have a good understanding of the basics.

To start, Figure 1-1 shows some artwork made with Blender from people at the BlenderArtists forums ([www.blenderartists.org](http://www.blenderartists.org)).



**Figure 1-1.** From left to right, *Old Guy*, by Kamil (maqs) Makowski; *About Freedom of Speech*, by Enrico Cerica ([www.myline.be](http://www.myline.be)); *Maid San*, by FEDB; *Snake and Mouse*, by Anna Celarek ([www.ania.xibo.at](http://www.ania.xibo.at)); *Digital World*, by Fabian Fricke (<http://frigi.designdevil.de>); and *Mothbiter*, by Derek Watts



Visit the BlenderArtists galleries at <http://blenderartists.org/forum/forumdisplay.php?f=27> for more.

Blender has been used in the making of TV advertisements and also some high-quality short films. *Elephants Dream* and *Big Buck Bunny* (see Figure 1–2) are Open Movie projects where only open source software (discussed in the next section) was used (as a rule), making Blender the primary choice. A third Open Movie, *Sintel* (see Figure 1–3), is set to be released at the same time this book is published.

These open projects, which are the initiative of the Blender Foundation, were made in order to stress that Blender is valuable at a professional level; each movie focuses on a different aspect of Blender (e.g., *Big Buck Bunny* focuses on Blender's particle-based hair and fur features).



**Figure 1–2.** Movies from the Blender Foundation: *Elephants Dream* (left) and *Big Buck Bunny* (right). © 2006 and 2008, Blender Foundation / [www.elephantsdream.org](http://www.elephantsdream.org), [www.bigbuckbunny.org](http://www.bigbuckbunny.org)



**Figure 1–3.** Concept art and test model for *Sintel*. © copyright Blender Foundation | [durian.blender.org](http://durian.blender.org)

## Blender History Timeline

Figure 1–4 shows the history of development from which Blender was born. In a nutshell, Ton Roosendaal, the cofounder of animation studio NeoGeo, was in charge of its in-house software. However, the company hit financial problems, and in 2002, with investors beginning to pull assets, Ton took the radical measure of offering the Blender software as public domain, on the proviso that the community of Blender enthusiasts could raise 100,000 euros to relinquish the debts. Blender had obtained a loyal following, and the bid succeeded within a few weeks. As

promised, Blender was released as open source under the GNU General Public License (GPL), and Ton has since dedicated himself to ongoing development of the software. Blender has grown because of a strong following of users and developers who tirelessly work on improving the application and its uses.

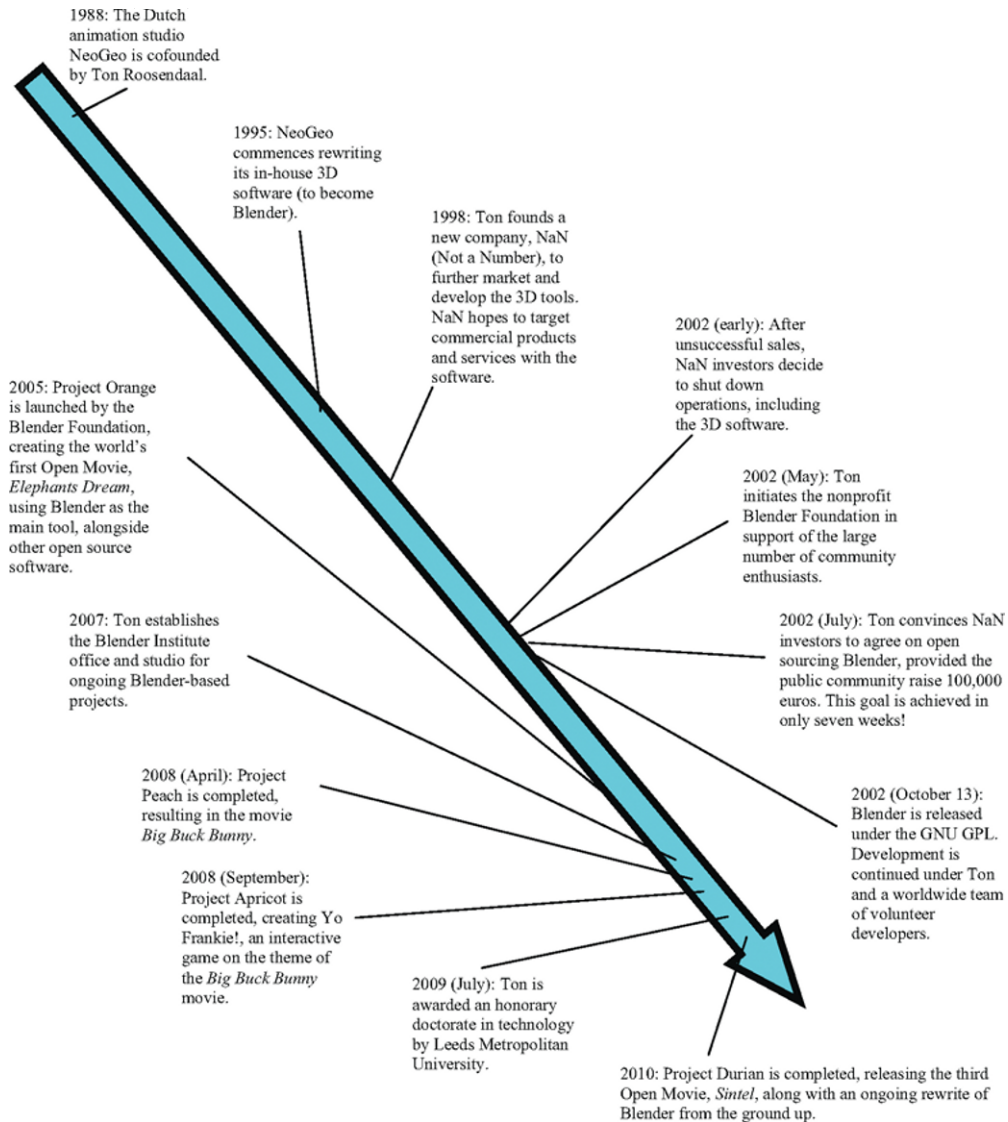


Figure 1–4. Blender history timeline

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■ **Note** For a more detailed breakdown of the timeline, see [www.blender.org/blenderorg/blender-foundation/history](http://www.blender.org/blenderorg/blender-foundation/history).

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Also of significant note is that, since 2007, the Blender developers have been hard at work on a complete bottom-up rewrite of the Blender code, with the goal of renewing the internal architecture and the user interface as well: this Blender series is called 2.5. You can find the development roadmap at [www.blender.org/development/current-projects/blender-25-project](http://www.blender.org/development/current-projects/blender-25-project).

What this means is there are currently *two* versions of Blender you can download:

- The current “stable” version, Blender 2.49b, which is the default download.
- The 2.5 release. This version, which is the new, rewritten Blender project, currently has some incomplete features, as it’s still under heavy development; however, it is certainly very usable. Instructions throughout this book are based on the 2.5 version, as it will soon supersede the 2.49b release.

At the time of this writing, the very latest available version is 2.54 beta (see Figure 1–5 for the current release timeline). Ultimately, when all the version 2.5 features have been implemented, Blender will work toward a grand 2.6 series. As with the previous open projects by the Blender Foundation, project Durian (the *Sintel* movie) is being made to demonstrate that Blender 2.5 works at a professional level.



**Figure 1–5.** The Blender 2.5 development roadmap (courtesy of [www.blender.org/development/current-projects/blender-25-project](http://www.blender.org/development/current-projects/blender-25-project))

As you can see from Figures 1–6 and 1–7, the newer 2.54 beta version of Blender looks quite different from the 2.49b version.



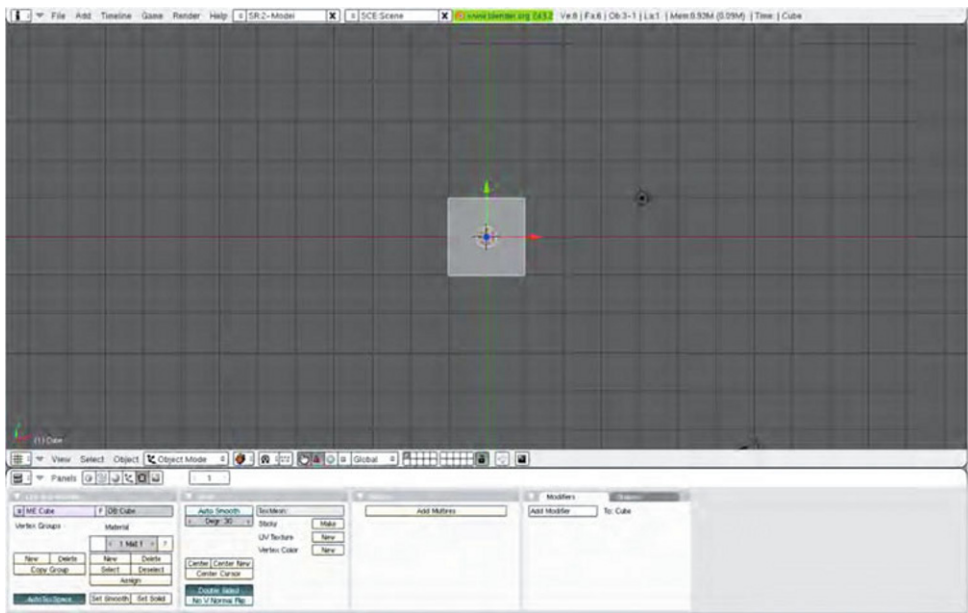


Figure 1–6. Blender 2.49b

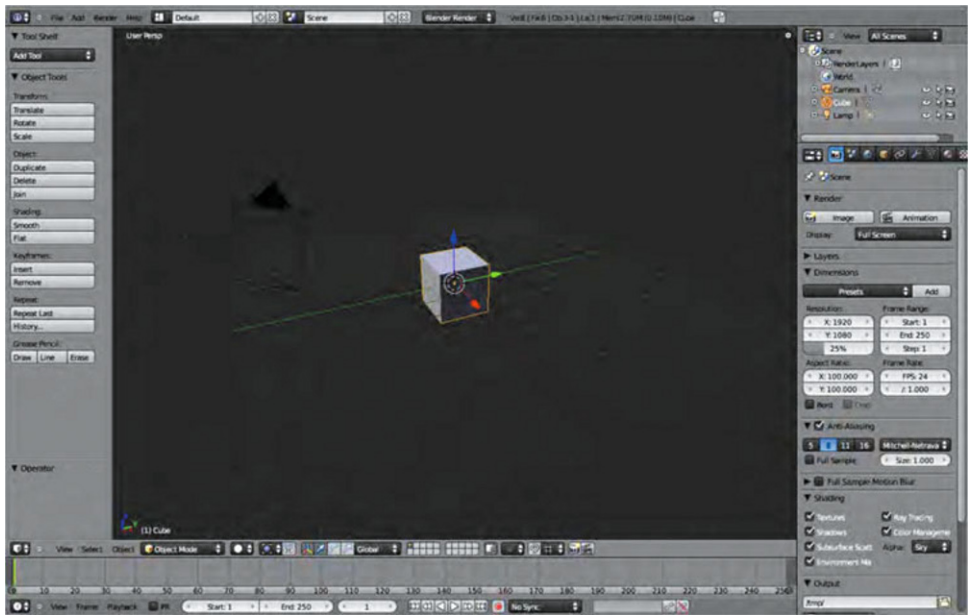


Figure 1–7. Blender 2.54 beta

Due to the free availability of Blender, many Blender artists are 3D graphics hobbyists and enthusiasts. However, Blender is increasingly being used by computer graphics industry professionals for commercial work. Some examples of this are shown in Figures 1–8 and 1–9.



*Figure 1–8. Studio 125 used Blender in its pipeline for its animated TV series Me and Jessie D.*



*Figure 1–9. ProMotion Studio (now Red Cartel) has been using Blender alongside 3ds Max for a number of years.*

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■ **Note** The music video for “All Nightmare Long” (directed by Robert Schober), a song from the legendary metal group Metallica, used Blender for some of its animations and 3D special effects. About the animation, Schober says, “Most of it was done in ZBrush and Maya, but the bomber and giant walking robots were done using Blender” (see [www.blendernation.com/blender-used-in-pipeline-for-metallica-video](http://www.blendernation.com/blender-used-in-pipeline-for-metallica-video)).

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There are many more people using Blender for their projects. See Appendix A for some examples, or look online at [www.blender.org/community/professionals](http://www.blender.org/community/professionals).

## About Open Source

In the history timeline shown previously, you can see that Blender has really made ripples by becoming public domain under the terms of the GNU GPL (see [www.gnu.org/licenses/gpl.html](http://www.gnu.org/licenses/gpl.html)).

When software is released as open source, it means that the software follows some very special copyright conditions, as dictated by whichever open source license is attached to the software. In the case of Blender, that license is the GPL (authored by Richard Stallman); this section will describe how the GPL makes Blender open source.

Essentially, open source works by acknowledging that the original author holds copyrights over the software, but that as the original owner, they give the rest of us permission to make copies on as many machines as we like. They give us full distribution rights to the software (we can give it away to our friends and we can also sell the product if we like). What we can’t do is add extra conditions when distributing the software. We can’t say to our friend, “I sold that to you so therefore you can’t give it away.” Once they have their copy, the GPL dictates that they have all the rights that we do.

What makes the GPL open source is how it affects the distribution of the program code. When released under the GPL, the conditions state that the uncompiled source code written to create the working program must also be freely available. If you are a developer (i.e., a programmer) and you see something you want to change, you can modify the code and build your own version of the program with the changes you want. This is different from the typical concept of copyright, where the original form of the program must be protected. It encourages programmers to get actively involved in contributing improvements to the software. The GPL has the restriction that your modified version should also be released as open source under the GPL (not all open source licenses require that the modified version be covered by the original license). Some like to call the freedoms given by the GPL “copyright reversed” or “copyleft” for this reason. It’s better than just making the software “free of charge,” because without the well-thought-out GPL, “free of charge” risks having conditions attached somewhere down the line.

This may sound wonderful (and it is), but what does it mean to you? How does it affect your using Blender for, say, commercial purposes? Some companies fear that by using open source, they may inadvertently lose the ability to keep a commercial ownership on any resulting work. To put their minds at ease, the sections that follow provide a summary of what is and is not included in Blender copyrights.

For a more detailed breakdown of the GPL terms of use regarding Blender, see the following:

- Appendix B, which covers the Blender terms of use (see also [www.blender.org/education-help/faq/gpl-for-artists](http://www.blender.org/education-help/faq/gpl-for-artists))
- Appendix C, which covers the GPL (see also <http://download.blender.org/release/GPL-license.txt>)

## Do I Owe Royalties If I Use Blender for Commercial Work or Otherwise?

You are free to use Blender for any purpose—from private renders in your own home to commercial movies. The Blender Foundation will not be asking for royalties on any of your own work.

## Does the GPL Apply to All the Work I Do with Blender?

No, work created with Blender is your sole property and can be licensed or sold under any conditions you prefer.

## If I Download Blender for Free, Can I Give It Away? Can I Sell It?

You can give it away to your friends. You can make multiple copies of Blender. You can install it on any number of machines you like. You can even sell Blender. However, you must include the GPL terms in the documentation, which give the receiver full permission to also distribute Blender as they please. In other words, if you distribute Blender to someone, you cannot then restrict them from selling, or even giving Blender away for free, regardless of whether you sold it to them or even gave it to them in the first place.

## What About Making Changes to Blender Source Code? Can I Market My Own Custom Version?

Certainly; being licensed under GPL, Blender allows you to look into its source code and change what you like. However, if you want to distribute your modified version, the GPL terms state that your revamped version must remain as free to distribute as the original versions. You must include full documentation of the code and the GPL license (see Appendix C), along with your revised version of Blender.

## Technical Caveats

There are a few extra technical caveats I have not mentioned. While games can be made using Blender, the games engine is actually a mini version of Blender, and thus must remain under the GPL even if the game itself is to be under commercial copyright. In such cases, it is best to keep the game file and the engine as separate (not embedded) files to avoid end user confusion about what may be freely distributed. Also, the Blender and Blender Foundation logos are registered trademarks and must be respected as such (see [www.blender.org/blenderorg/blender-foundation/logo](http://www.blender.org/blenderorg/blender-foundation/logo)).

## Installing Blender

Blender is a very complex program. It uses every key on the keyboard in about three different ways (e.g., holding down Shift, Alt, Ctrl, and so on can bring about different functions for each key), and it uses some uncommon keys, such as those found on the number pad (referred to in the keyboard combinations in this book as “numpad”). The interface relies heavily on the user having a mouse with a wheel that can be clicked as a third button. So, provided you have a computer with a good amount of RAM, a reasonable graphics card, and a three-button mouse with a wheel (this being the third button), you should be able to run Blender.

## Hardware

These days, there is a vast array of different computer specifications for any user, so it can be difficult to guarantee that any program will run on a given system. Generally speaking, though, the installation requirements for running Blender are as shown in Table 1–1 (see also [www.blender.org/features-gallery/requirements](http://www.blender.org/features-gallery/requirements)).

*Table 1–1. Blender Hardware Requirements*

Hardware	Minimum Performance	Medium Performance	Production Standard
CPU	300MHz	2GHz dual-core	64-bit quad-core
RAM	128MB	2GB	8GB
Monitor	1024×768-pixel display with 16-bit color	1920×1200-pixel display with 24-bit color	Two 1920×1200-pixel displays with 24-bit color
Mouse	Two-button mouse (with wheel acting as third button)	Two-button mouse (with wheel acting as third button)	Two-button mouse (with wheel acting as third button), plus tablet
Keyboard	Working number pad (optional but recommended)	Working number pad (optional but recommended)	Working number pad
Graphics card	Open GL graphics card with 16MB RAM	Open GL graphics card with 128 or 256MB RAM	Open GL graphics card with 768MB RAM, ATI FireGL, or Nvidia Quadro

You should have at least 20MB of hard drive space for the install, in addition to ample space for your amazing 3D creations, especially if you’re intending to go into animation; all those movie frames can add up! Bear in mind that professional production studios often far exceed these recommendations, eating terabytes of storage space (and then there’s the backups to think of as well!). That said, these recommendations should be sufficient to get you up and running.

## Operating Systems

Blender is available on a wide range of operating systems, including

- Windows
- Mac OS X
- Linux
- Irix
- Solaris

As mentioned earlier, there are currently two Blender versions available: the stable 2.49b release, which can be downloaded from [www.blender.org/download/get-blender](http://www.blender.org/download/get-blender), and the highly recommended 2.5 release, which is available from the main [www.blender.org](http://www.blender.org) page (follow the Blender 2.54 Beta link on the right). Note that different versions are available depending on your operating system and in some cases the type of processor you run (e.g., 32-bit vs. 64-bit versions).

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■ **Note** FreeBSD users can download a port from [www.freshports.org/graphics/blender](http://www.freshports.org/graphics/blender), after which they can follow directions given at [www.blender.org/development/release-logs/blender-254-beta](http://www.blender.org/development/release-logs/blender-254-beta) to see whether the 2.5 version is available. At the moment of writing, Blender is available to FreeBSD as a 2.49 release.

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### A NOTE ABOUT PYTHON

Blender 2.5 relies on Python 3.1, although it should be contained within the download. If menus are missing in the program, it could be that Python needs to be downloaded. Python is a freely available scripting language available from [www.python.org](http://www.python.org).

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Let's look at how to install Blender 2.5 on a Linux machine.

## Installation Example: Linux

Until the 2.5 release becomes the default, downloading Blender from the Download Now link on the main [www.blender.org](http://www.blender.org) page will lead you to a download of the current Blender 2.49b release.

If you would like the cutting-edge Blender 2.5 version, follow the Blender 2.54 Beta link (note that this may have been updated since publication). Depending on whether your machine is a 64- or 32-bit model, choose either Linux x86-64 or Linux x86-32.

Once you have the correct Blender package, you can either install it through your GUI window manager (e.g., Gnome, KDE, etc.) by double-clicking the file, or by using a command terminal.