Beginning XNA 2.0 Game Programming

From Novice to Professional

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Foreword

It's hard to believe the runaway popularity XNA has achieved in the short period of time since it was released in late 2006. At that time, I got together with a couple friends to check out (with some trepidation, I must confess) whether games really could be written in managed code. We were very excited, and everyone wanted to know if you could get the same benefits from writing games using managed code as you do when creating standard Windows programs. We knew people in the game programming community were worried about managed code's execution speed, and many people simply didn't believe a "real" game could be created using XNA. As time passed, though, more and more people began to realize the truth: there are a great number of benefits to using managed code, and the performance concerns are exaggerated.

You haven't experienced the full potential of the Xbox 360 or, indeed, Windows until you've created your own homegrown games for these innovative systems—and with the XNA Framework, the only limit is your imagination! From an educational perspective, due to its simplicity, XNA is also a great choice for anyone wanting to learn or teach the C# programming language. Game development offers an excellent common ground for collaboration between computer science students and their counterparts in other disciplines such music, the arts, and design. In fact, XNA has become such an important technology for Microsoft that the company has decided to create a new game development category in 2008 for the famous Imagine Cup (`http://www.imaginecup.com`), Microsoft's largest student contest.

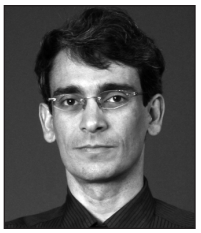
With the release of the XNA Framework 2.0, I have again become excited about the future of game development. And when I see a book like this, which explains the basics of game programming and XNA in a clear and simple style, I get even more excited, and I hope you will be as well. Whether you've never tried to write a game before, or you are simply looking for advice on the best way to do things in XNA, I think you'll be happy with what you find: after reading this book you'll be able to apply your newfound knowledge to write your own XNA cross-platform games.

I'm waiting to see what the ever-growing community of XNA game developers will create next. It's exciting to think that we'll probably see games that break all the rules of the current gaming genres, because with a vibrant community comes innovation, and with innovation comes truly unique ideas.

I look forward to the games of the future—I hope you'll be the person writing them!

Amintas Lopes Neto
Academic Relations Manager, Microsoft Brazil

About the Authors



ALEXANDRE LOBÃO is a passionate man. His first passion was reading, starting with large books—Mark Twain, Érico Veríssimo, Jules Verne, Monteiro Lobato, Alexandre Dumas, and others—when he was seven. When he was twelve, he discovered his two next passions: playing and creating games (by that time on his first Apple computer), and writing.

Many years later—he's about forty now—these passions flourish. Now he is a teacher of academic game development courses, has written four books on the topic, and has participated in some Brazilian game development contests both as a contestant and as a judge. He has also written short stories, children's books, and young adult books, and in 2008 he released his first romance, *The Name of the Eagle*, currently only available in Portuguese. And, of course, he still loves to read, from Ken Follett to Paulo Coelho.

His ultimate passions—starting in 1995 and still burning now—are his wife, Waléria, and his kids, Natália and Rafael.

Alexandre believes that lives need passion to be lived entirely, and hopes that this book helps light this passion in readers' hearts. You can find his work at `http://www.AlexandreLobao.com`.

BRUNO EVANGELISTA is a game developer with a passion for computer graphics. Bruno started programming when he was ten—his father taught him how to write programs in BASIC—and he always dreamed of creating games instead of just playing them.

Bruno was a graphics programmer at VirsaT, where he worked on the Peixis game, (winner of the JogosBR 2006—the Brazilian national contest of complete games); having previously worked as a software engineer at Olympya. He has also worked on some projects and game demos developed with C++, C#, and Java using DirectX, OpenGL, and XNA.

Besides his professional experience, Bruno has hosted courses and tutorials about XNA, OpenGL, and shader development at conferences and universities, such as the Brazilian Symposium on Computer Graphics and Image Processing (SIBGRAPI), Brazilian Symposia on Games and Digital Entertainment (SBGAMES), Gamefest Brazil, Federal University of Minas Gerais (UFMG), and others.

Today, 22-year-old Bruno is an avid XNA developer who has taken second and third place, respectively, in the 2006 and 2007 XNA Challenge Brazil competitions.

Bruno received his Bachelor of Science degree in computer science from PUC-MG in 2006 and is currently a Master of Science student in computer science at UFMG. He lives in Belo Horizonte, Brazil. You can find his work at `http://www.BrunoEvangelista.com`.

JOSÉ ANTONIO LEAL DE FARIAS has been a game programmer since he acquired his first computer in 1985, when he tried to draw aliens on an 80 × 25 pixel screen. After obtaining a degree in Computer Science, he established one of the first game companies in Brazil in 1997, called Hardcode Entertainment. He has worked on many diverse gaming projects in Europe and the US. In 2004 he received the Most Valuable Professional award from Microsoft for his contributions to the Brazilian coding community. In 2006 he established the Sharp Games community, devoted to studying and spreading advice about the XNA platform. You can find the portal for Sharp Games at `http://www.sharpgames.net`.

About the Technical Reviewer

FABIO CLAUDIO FERRACCHIATI is a senior consultant and a senior analyst/developer using Microsoft technologies. He works for Brain Force (`http://www.brainforce.com`) in its Italian branch (`http://www.brainforce.it`). He is a Microsoft Certified Solution Developer for .NET, a Microsoft Certified Application Developer for .NET, a Microsoft Certified Professional, and a prolific author and technical reviewer. Over the past ten years he's written articles for Italian and international magazines and coauthored more than ten books on a variety of computer topics. You can read his LINQ blog at `http://www.ferracchiati.com`.

Acknowledgments

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Alexandre Lobão

I would like to thank God for his countless blessings and for giving me the opportunity to work on this great book; my parents Kathia and Gledson, who always motivated me to do my best; my stepfather Claudio, my stepmother Celida, and my brothers for all their support; and a special thanks to my girlfriend Helenice for all these great years together.

Also a special thanks to Alessandro Silva, a great friend and game developer who studied with me during my university years; Carlos Augusto, who contributed some assets for the XNA TPS game; and Francisco Ardisson, who helped translate some parts of the book.

In this long journey I had a few mentors and guides who helped me to get here and who I cannot forget to mention: Theldo Franqueira, Marcelo Nery, Fabio Policarpo, Rosilane Mota, Luiz Chaimowicz, Renato Ferreira, Esteban Clua, Fabio Tirelo, and Harlen Batagelo. Thank you for all I have learned from you!

Bruno Evangelista

First, I'd like to thank all the Sharp Games community for the encouragement and suggestions they provided me, and especially my friends Shinji and Amintas Neto for everything they've done for XNA in Brazil.

I also need to say thanks to Microsoft; to its MVP program; to Leonardo Tolomelli, my MVP lead; and to all other MVPs in Brazil who always are a source of inspiration for me.

Also a special thanks to my wife Cecir for having enormous love and patience with me when this book was being planned and written; to my four-year-old son Leonardo for his critical sense of what is a good game; and to my parents for continuing to love a son who read books on assembly language when the other boys read *Spiderman* comics.

José Antonio Leal de Farias

Introduction

According to the point-of-sale information compiled by NPD Group (`http://www.NPD.com`), a leading US marketing information provider, computer and video game sales totaled more than seven billion dollars in each of the last three years.

The video game software industry is accountable for more than six billion dollars of this total. If we include portable and console hardware, software, and accessory sales, in 2006 the video game industry generated revenue of close to twelve and a half billion dollars, exceeding the previous record of around two billion dollars. By the time we completed this book—early 2008—no statistics were available yet for 2007, but there's no expectation of lower figures.

With Microsoft XNA, for the first time ever a nonprofessional game developer can create single and multiplayer games that can run on both PCs and the Xbox 360 console.

These figures alone might be reason enough to interest someone in learning XNA and becoming a game developer, trying to get a share of a market that's more profitable than the Hollywood movie-making one.

Although, let's be fair and not hide the facts. Unfortunately, there are few openings in this area: about one game programming job per every thousand "real life" programming jobs. Worse than that, on average, the game industry pays its programmers less than other industries do.

After digesting these facts, if you still think that working as a game developer might be cool and rewarding, then this book is for you! We also have some good news: with Microsoft's promise to open its LIVE market, allowing anyone to sell its games to other LIVE members, there may be a potential ten-million-user market (January 2008 figures) for your homemade games soon!

This book has the goal of introducing you to XNA, the new cross-platform game programming framework from Microsoft, and also presenting you with basic concepts from the game programming industry, showing how these concepts map to the XNA world. The samples in this book, which include some complete games, will give you the knowledge you need to create your own simple games.

That said, this book won't present you with hardcore math and physics or dig into advanced programming concepts, which are indeed needed if you really want to become a professional hardcore game developer. Instead, this book is a first step into this industry, presenting an overview of most of the things you have to know, giving you the ability to create a roadmap for further studies in this area.

More than that, this book intends to be fun! One of the most interesting things you'll see in the game programming industry is the unmatched passion of the people who work in it. If there's one goal for this book, it's to light this passion in novices' hearts with simple explanations and, especially, with cool game examples, so this fire can keep burning in the years to come.

After all, this is a book written with such passion!

What Is XNA?

XNA is a play on words. It stands for "It's Not an Acronym." Microsoft's world is so full of acronyms that it decided to create a name that looks like an acronym, but isn't, just for fun.

But XNA is much more than that. The innovative concept of bringing to the average Joe the power to create his own games for the Xbox 360 is a great technological innovation, which comes with many efforts from Microsoft to establish an active community for game creators (joining both the Windows and Xbox 360 game programming communities) and also to establish programs in the academic area to support institutions that wish to create courses using retail Xbox 360 consoles.

These efforts become obvious when we notice that Microsoft XNA Game Studio 2.0 can be downloaded at no charge from Microsoft's site, at `http://www.microsoft.com/XNA`. Microsoft also offers free game content, including video tutorials, starter kits (ready-made games, which can be freely customized), samples, and other support content at the XNA Creator's Club: `http://creators.XNA.com`.

The last step in making Microsoft LIVE known as the "YouTube for games" is the ability to upload the games you created to Xbox LIVE and distribute (or even sell) your games to anyone in the world with a LIVE connection. No wonder the nonprofessional game programmer community is so excited, with XNA Game Studio launching and the frequent updates with new content on the XNA Creator's Club site!

The greatest secret behind XNA's success is that it's easy—much easier than any console programming application programming interface (API), and also easier than any Windows game programming API, because of the abstraction it provides for details that you need to worry about in other APIs. XNA uses the same integrated development environment (IDE)—XNA Game Studio Express—and the same framework for developing games both for Windows and Xbox 360 platforms, which ensures a high degree of compatibility. However, there are differences in the lower layer. The Xbox 360 console runs a compact version of the .NET Framework, so you must be careful: not all functions available in Windows will run on the Xbox 360.

We'll address all this in more detail as we progress through the book, but you can always find the latest information about XNA architecture at Microsoft's XNA site and at the XNA Creator's Club site.

Who This Book Is For

This book is targeted to anyone who wants to start developing games, both for the Windows and Xbox 360 platforms. It can be used as a first step on a long road toward a game development career, or can simply be used by those who have a great idea for a simple game—the next Tetris—and always wanted to have the basic knowledge, straight and simple, of how to create games.

Briefly, this book is targeted to those who want to have fun by creating or modifying simple games, sharing them with friends, and playing them on Windows, Xbox 360, or both.

How This Book Is Structured

This book is organized so you can start learning generic game programming concepts, such as common gaming terminology and math, see how these concepts are implemented in XNA, and then apply these concepts to real, simple games. We believe that this organization improves your learning, so you'll be ready to create your own XNA games after finishing the book.

Chapter 1, "Game Planning and Programming Basics"

In this chapter, you'll learn important game planning concepts that will help you create great games, and also some general game programming concepts and how these concepts map to XNA. You'll also create your first XNA program.

Chapter 2, "2-D Graphics, Audio, and Input Basics"

In this chapter you'll familiarize yourself with some fundamental concepts related to 2-D game programming, along with some samples that will make you easily understand how the XNA Framework implements these concepts. You'll also discover how to use sound and the Xbox 360 controller in your applications.

Chapter 3, "Creating Your First 2-D Game"

This chapter is where the real fun begins! You'll find out how to put together the ideas you saw in the last chapters to create a complete game, Rock Rain. Besides tips on how to improve this simple but addictive game, you'll learn details you need to pay attention to when moving games to the Xbox 360.

Chapter 4, "Improving Your First 2-D Game"

You're still in the 2-D programming world; in this chapter you'll explore other concepts such as creating menus, moving through game screens, managing players' scores, and more.

Chapter 5, "Basics of Game Networking"

In this chapter you'll learn about one of the most exciting features of XNA 2.0: the ability to create network-enabled games, allowing you to connect different machines, directly or through LIVE.

Chapter 6, "Rock Rain Live!"

Getting back to your 2-D game, you'll now learn how to create a multiplayer version, including a new opening scene that allows players to create or join a match on other machines.

Chapter 7, "3-D Game Programming Basics"

Expanding the concepts you learned in the previous chapters, this chapter will introduce you to the fundamentals of 3-D game programming. You'll learn how to create a 3-D scene, load and manipulate 3-D objects, move the camera, and everything else you need to know to start digging into virtual 3-D worlds.

Chapter 8, "Rendering Pipeline, Shaders, and Effects"

Getting deeper into the 3-D world, you'll learn more details about the Content Pipeline and the use of effects and shaders in XNA, paving the way to create your first 3-D game.

Chapter 9, "Lights, Camera, Transformations!"

In this chapter, you'll create the base objects used in any 3-D game, which will help you manage lights and cameras, and apply transformations to your 3-D objects.

Chapter 10, "Generating a Terrain"

Every 3-D game that uses a landscape needs a terrain, and in this chapter we'll present the steps for creating, adjusting, and drawing the terrain, and also how to calculate object collisions with the terrain.

Chapter 11, "Skeletal Animation"

XNA 2.0 doesn't offer default support to read and play animations created by the modelers along with the 3-D models. In this chapter you'll learn how to create a custom model processor to read and play animation data.

Chapter 12, "Creating a Third-Person Shooter Game"

In this chapter you put it all together, using the knowledge from the last few chapters to create a simple 3-D third-person shooter.

Chapter 13, "Closing Words"

As we said, this book is fun, and includes a lot of information about game programming, but it's only a first step. In these last few pages, the authors present the advice they always give to their students when finishing a game programming course.

Prerequisites

Before you continue to the first chapter, be sure to download and install the latest version of XNA, which is easy to find in the Downloads section at `http://www.microsoft.com/XNA`. We also recommend that you download the DirectX Software Development Kit (SDK), which comes with some content you can use when learning XNA. Don't forget, also, to download and install the XNA Starter Kits and samples at `http://creators.XNA.com`. All these tools and samples are free to download and use.

If you don't have a copy of Microsoft Visual Studio, you must also download a free copy of Microsoft Visual C# Express, whose download link can also be found at `http://www.microsoft.com/XNA`.

Book Code and Errata

Although you can maximize your learning by typing the book code while you're reading, sometimes you simply can't wait to see the code running. If you're in a hurry, look for the book name at the Apress site, `http://www.apress.com`: all the book code is available for downloading.

Please note that, especially in the later chapters, some repetitive parts of the code were omitted to help you focus on the most relevant parts. The complete code listings are available at `http://www.apress.com`.

Although Apress and the authors make their best efforts to ensure that there are no errors in the book code or text, sometimes a bug appears. You can always find the most recent code and any text or code errata at the Apress site, `http://www.apress.com`. All you have to do is to look for the book name.

Contacting the Authors

Alexandre Lobão is available from his personal web site, at `http://www.AlexandreLobao.com`, which includes all his works as an author, comics writer, and movie script writer.

Bruno Evangelista also maintains a personal web site, with his game programming projects, including downloadable content, at `http://www.BrunoEvangelista.com`.

José Leal is the head of a top Brazilian C# programming community, Sharp Games, available at `http://www.sharpgames.net`.