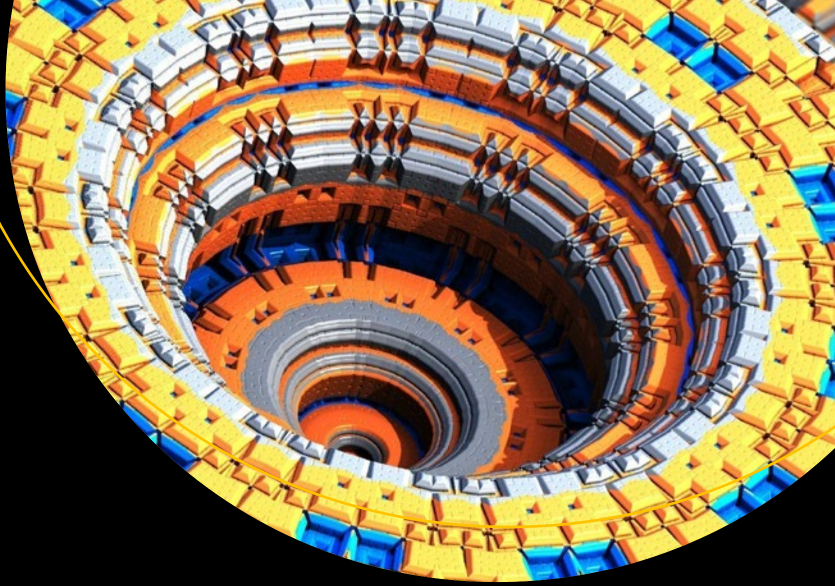

Basic Math for Game Development with Unity 3D

A Beginner's Guide to Mathematical Foundations

Second Edition

Kelvin Sung
Gregory Smith

Apress®

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To my wife, Clover, and our girls, Jean and Ruth, for completing my life.

—Kelvin Sung

To my wife and our little one, thank you for making
my life better each and every day.

—Gregory Smith

Table of Contents

About the Authors

Kelvin Sung is Professor with the Computing and Software Systems Division at the University of Washington Bothell (UWB). He received his Ph.D. in Computer Science from the University of Illinois at Urbana-Champaign. Kelvin's background is in computer graphics, hardware, and machine architecture. He came to UWB from Alias|Wavefront (now part of Autodesk), where he played a key role in designing and implementing the Maya Renderer, an Academy Award–winning image generation system. At UWB, funded by Microsoft Research and the National Science Foundation, Kelvin's work focuses on the intersection of video game mechanics, solutions to real-world problems, and mobile technologies. Together with his students and colleagues, Kelvin has co-authored six books: one in computer graphics and the others in 2D game engines with Apress.

Gregory Smith is a software engineer at Virtual Heroes, a company that focuses on creating training and simulation software in Unreal Engine. He received his undergraduate degree in Computer Science from Northwest Nazarene University in 2018 and earned a Master of Computer Science and Software Engineering degree from the University of Washington Bothell in 2020. Gregory also owns his own game company, Plus 2 Studios, which he works on in his spare time.

Acknowledgments

This book and the projects it relates to stem from the results of the authors' attempts to understand how to engage learners in exploring knowledge related to interactive computer graphics, introductory programming, and video games. Past funding for related projects includes support from the National Science Foundation for the projects "Essential Concepts for Building Interactive Computer Graphics Applications" (Award Number, CCLI-EMD, NSF, DUE-0442420) and "Game-Themed CS1/2: Empowering the Faculty" (Award Number DUE-1140410). Projects supported by Microsoft Research and Microsoft Research Connections include "XNA Based Game-Themed Programming Assignments for CS1/2" (Award Number 15871) and "A Traditional Game-Themed CS1 Class" (Award Number 16531). All of these past projects have laid the foundation for our perspectives and presentation of the materials in this book. We would also like to thank NSF officers Suzanne Westbrook, Jane Prey, Valerie Bar, and Paul Tymann for their invaluable discussions and encouragements, as well as Donald Brinkman and Kent Foster as they continue to be our best advocate and supporters at Microsoft. Lastly, we remember and continue to miss Steve Cunningham, John Nordlinger, and Lee Dirks for their early recognition of our vision and ideas.

A thank you must also go out to our students, whose honest, even when brutal, feedbacks and suggestions from CSS385: Introduction to Game Development, CSS451: 3D Computer Graphics, CSS452: Game Engine Development, and CSS551: Advanced 3D Computer Graphics at the University of Washington Bothell inspired us to explore the approach to present these materials based on an accessible game engine. They have tested, retested, contributed to, and assisted in the formation and organization of the contents of this book. The second author of this book is an alumnus of CSS551.

It must also be mentioned that the teaching brown bag hosted by Yusuf Pisan offered the opportunity for the discussions with Yusuf, Johnny Lin, Lesley Kalmin, and Mike Stiber on the topics of linear algebra applications which sparked the initial idea for this book. A sincere thank you goes to Yusuf for his enthusiasm and energy in organizing us and, of course, for the delicious-looking Tim Tam; one day, I will try them.

We also want to thank Spandana Chatterjee for believing in our ideas, her patience, and continual efficient and effective support. Nirmal Selvaraj organized everything and ensured proper progress was ongoing.

Lastly, a thank you must go to Peter Shirley, our technical reviewer, whose frank and precise comments made this a much easier to understand book.

The vehicle models used are free assets, UAA - City Props - Vehicles, downloaded from the Unity Asset Store under the Unity-EULA. The cone shape that represents the arrow heads for the axis frames and vectors in all examples is created based on the utilities developed and shared by Wolfram Kresse available at https://wiki.unity3d.com/index.php/CreateCone. The cosine function plot from Figure 5-5 is based on a screenshot taken from www.desmos.com/calculator/nqfu5lxaij.

Introduction

Welcome to *Basic Math for Game Development with Unity 3D*. Because you have picked up this book, you are probably interested in finding out more about the mathematics involved in game development or, maybe, in the details of fascinating applications like Unity. This can be the perfect book to begin with your exploration.

This book uses interactive examples in Unity to present each mathematical concept discussed, taking you on a hands-on journey of learning. The coverage of each topic always follows a pattern. First, the concept and its relevancy in video game functionality are described. Second, the mathematics, with a focus on applicability in game development and interactive computer graphics, are derived. Finally, an implementation of the concept and derived mathematics are demonstrated as an example in Unity.

Through interacting with these examples, you will have the opportunity to explore the implications and limitations of each concept. Additionally, you can examine the effects of manipulating the various related parameters. Lastly, and very importantly, you can study the accompanied source code and understand the details of the implementations.

In Chapter 2, you will begin by reviewing simple number intervals in the Cartesian Coordinate System. Chapters 3 and 4 let you examine and learn about vectors and the rules of their operations to formally relate positions in 3D space. Chapters 5 and 6 study the vector dot and cross products to relate vectors and the space that defines them. Chapter 7 leads you to work in multiple coordinate spaces simultaneously to address compound issues such as describing motions inside a navigating spaceship. Chapter 8 introduces quaternions and the rotation operator and Chapter 9 concludes with the basic math involved in game development. Throughout this book, you will learn the mathematical and implementation details of bounding boxes; bounding spheres; motion controls; ray castings; projecting points to lines and planes; computing intersections between fast-traveling objects; projecting objects onto 2D planes to create shadows; computing reflections; working in multiple coordinate spaces; rotations to align vectors; and much more!

Who Should Read This Book

This book is targeted toward video game enthusiasts and hobbyists who have some background in basic object-oriented programming. For example, if you are a student who has taken an introductory programming course, or are a self-taught programming enthusiast, you will be able to follow the concepts and code presented in this book with little trouble. If you do not have any programming background in general, it is suggested that you first become comfortable with the C# programming language before tackling the content provided in this book.

Besides a basic understanding of object-oriented programming, you will also need to be familiar with the Cartesian Coordinate System, basic algebra, and knowledge in trigonometry. Experience and working knowledge with Unity are not required.

Code Samples

Every chapter in this book includes examples that let you interactively experiment with and learn the new materials. You can download the source code for all the projects from the following page: `www.apress.com/`.

CHAPTER 1

Introduction and Learning Environment

After completing this chapter, you will be able to

- Know the details of what this book is about
- Understand the style that this book uses to present concepts
- Install Unity and an Integrated Development Environment (IDE) for developing programming code
- Access the accompanying source code and run the example projects
- Understand the Unity terminology used throughout this book
- Begin to appreciate the intricate details of math for game development

Introduction

When you think of math in a video game, you may picture health bars, attack stats, experience points, and other game mechanics. You may not consider the underlying math that enables the in-game physics world, such as calculating gravity, movements, or enemy chasing behaviors. Additionally, you may not consider physical interaction in a mathematical manner, such as collisions between different objects and the reflections of these objects after they collide. These underlying mathematical computations are critical to implementing a successful video game. When creating a game, whether you intend on using a game engine or you intend on performing the computations yourself, understanding the details and knowing how the underlying mathematics work and when to use them to create what you want, where you want, is vital.

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Traditionally, math is taught without any application contexts. Typically, theories are developed based on abstract symbols, formulas are derived to support these theories, and then numbers are used to verify the formulas. You are tested on whether you can generate the correct solution based on how the formulas are applied. It is believed that learning math in this manner has the benefit of granting learners the ability to understand the concepts being taught at the pure abstraction level. Then, once understood, the application of these concepts to different disciplinary contexts becomes straightforward. For many learners, this assumption is certainly true. However, for other types of learners, it can be difficult to appreciate the intricate details in the abstract without concrete examples or applications to build off. This fact is recognized by educators and often story problems are introduced after a basic understanding is established to help learners gain insights and appreciate the formulas. This learning approach is taken on and exploited in the context of linear algebra and video games.

This book takes you on the journey of learning linear algebra, a branch of mathematics that is the foundation of interactive graphical applications, like video games. While the underlying theories can be abstract and complicated, the application of these theories in graphical object interactions is relatively straightforward. For this reason, this book approaches linear algebra topics in a concrete manner, based around game-like examples that you can interact with. Through this book, you will learn a flavor of linear algebra that is directly applicable to video games and interactive computer graphics as a whole.

Every math concept presented in this book is accompanied with concrete examples that you can interact with and are relevant to video game development. It is the intent of this book that you will learn and know how to apply the concepts in solving the problems you are likely to encounter during game development. A direct consequence of this focused approach is that readers may find it challenging to apply the knowledge gained throughout this book to other disciplines, like machine learning or computer vision. For example, the dot product, which will be covered in Chapter 5, can be used to calculate intersection positions, and it can also be used in machine learning algorithms as a data reduction tool; however, this book will only focus on the video game applications of the dot product. If you are looking for general knowledge in linear algebra, you should consider a more traditional textbook. Such a book is likely to cover concepts at levels that are suitable for applications for multiple problem spaces. If you are interested in solving problems specific to interacting graphical objects, especially for game development, then this is the perfect book for you.

After the introduction to the game engine and terminologies in this chapter, Chapter 2 reviews the Cartesian Coordinate System and number intervals leading to the exploration of one of the most widely used tools in game development—bounding boxes. Chapter 3 continues bounding volume exploration by examining bounding spheres while also beginning the investigation of relationships between positions. Chapter 4 introduces vectors to formalize the relationships between positions in 3D space and applies vector concepts in controlling and manipulating object motions under external effects like wind or current flow. Chapter 5 presents the vector dot products to relate vectors, represents line segments based on vectors, and demonstrates the application of these concepts in computing distances between objects and motion paths when approximating potential collisions. Chapter 6 discusses the vector cross product, derives the space that defines vectors, defines vector plane equation, and illustrates the application of these concepts in computing intersections and reflections of moving objects and 2D planes. Chapter 7 examines the axis frame, or the derived space that contains vectors, analyzes the representation of vectors in different axis frames, and explains how to work with movements in axis frames that are dynamically changing, such as object motions in a navigating spaceship. Chapter 8 introduces the quaternion as a tool for rotating vectors, analyzes the relevant properties of quaternions, and demonstrates the alignments of 3D spaces based on quaternions. Finally, Chapter 9 summarizes all of the concepts presented in an aggregated example.

Choice of Unity Engine

Unity is the choice of platform for presenting the mathematical concepts covered in this book for three reasons. First, Unity provides elaborate utilities and efficient support for its user to implement and visualize solutions based on mathematical formulas. Its application programming interface (API) implements the basic and many advanced linear algebra functionalities, while the Entity-Component-System (ECS) game object architecture allows straightforward user scripting. These qualities give Unity a close pairing of math concepts to your programming code, assisting in the visualization of the mathematical solution that you are trying to understand. This close pairing cannot be understated and is the backbone of this book.

The second reason for choosing Unity is that, being a game engine, the system allows for a high degree of intractability with the solution as well as the ability to visualize that solution. For example, in addition to being able to examine the results of a ray and 2D plane intersection computation in real time, you will also be able to manipulate the ray and the 2D plane to observe the effects on the intersection. The ability to interact, manipulate, and examine the application of mathematical concepts in real time will give you a greater understanding and appreciation for that concept. Third and finally, Unity is chosen because there is no better way to learn math concepts for video games than through a popular game engine!

While this book is meant for readers who may be interested in building a video game in Unity, the focus of this book is on the math concepts and their implementations and not on how to use Unity. This book teaches the basic mathematical concepts that are relevant to video game development using Unity as a teaching instrument. This book does not teach how to use the math provided by Unity in building video games. You should focus on understanding the math rather than the Unity-specific functionality. For example, a position in 3D space in Unity is located at `transform.localPosition`; you should focus on working with that position and not be concerned about the `Unity.Transform` class. Ultimately, you should be able to take what you have learned in this book and apply to developing games in any game engine.

Note Unity Technologies is the name of the company; the game engine is most often referred to as Unity, though it is sometimes called Unity 3D. For simplicity, this book refers to the entire game engine system as Unity.

Setting Up Your Development Environment

There are two main applications that you will work with when using Unity. The first is the game engine editor, which will be referred to as Unity or Unity Editor throughout this book. The Unity Editor can be thought of as the graphical interface to the Unity game engine. The second application you will need is a script editing Integrated Development Environment (IDE). Microsoft's Visual Studio Community 2019 is the IDE of choice for developing the C# script examples in this book. This software will be referred to as the Script Editor, or the IDE, throughout the rest of this book.

To begin your download and installation of Unity and Visual Studio Community 2019, go to `https://store.unity.com/download?ref=personal`, accept the terms, and then download Unity Hub.

Note If you ever find yourself stuck at a certain point in this book, whether on installing Unity or just using it, there is a plethora of tutorials online, many of which were referenced in the development of this book and will be listed at the end of this chapter.

Notes on Installing Unity

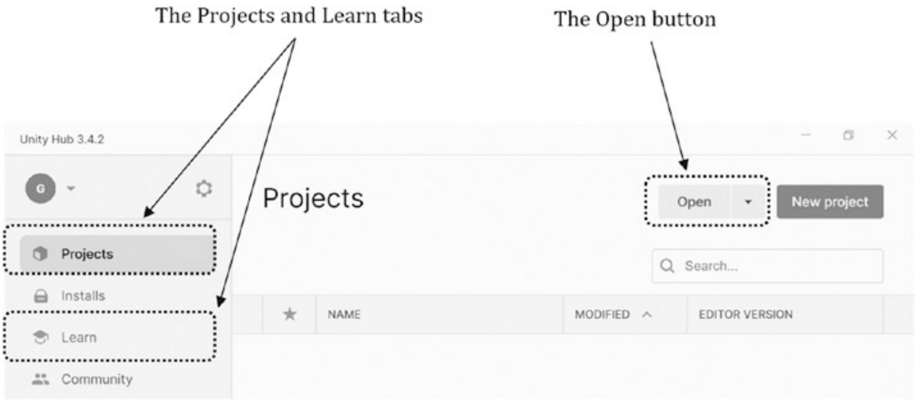
This book is based on Unity in its most basic form. Unless you know what to specify when installing features or desire extra features, it is suggested you follow the default settings. Please begin downloading, installing, and launching the Unity Hub if you haven't already. When Unity Hub is up and running, navigate to the **Installs** tab on the left side, and select the **Install Editor** button in the top right. From here, you will be prompted with a list of different Unity versions. The version that this book uses is 2021.3.25f1. If you do not see this version in the selected list, you can go to this link `https://unity3d.com/get-unity/download/archive` and find it there to download. It should be noted that while this book is based on Unity 2021.3.25f1, any version at or newer than this version should suffice but is not guaranteed.

After selecting your Unity version, you will be prompted with options to install extra features. As mentioned previously, this textbook only requires the default options. These options, if you are running on Windows 10 or 11, should only be the suggested IDE, "Microsoft Visual Studio Community 2019." If you already have Visual Studio 2019 installed, then you may uncheck that option. Once you have selected all the features you want, begin the install process and then move onto the next section to begin familiarizing yourself with the source code used throughout this book.

Unity Editor Environment

It should be noted, again, that in this book Unity is used as a tool for learning math concepts for game development and not as a game building editor. This means many Unity-specific and game building–related information that do not pertain to the concept at hand will simply be skipped. For example, this book does not discuss how to create or save Scenes or how to build a final executable game. If these are subjects of interests, you should consider research through the many online tutorials or for example refer to the **Learn** tab of the Unity Hub. It should also be noted that all examples throughout this book will be run and interacted with through the editor and not as games. This will become clearer as the first example is discussed.

Now that you have Unity and the IDE installed and ready to go, you can refer to the GitHub repository located at `https://github.com/Apress/Basic-Math-for-Game-Development-with-Unity-3D`. After downloading the repository, open Unity Hub and add the `Chapter-1Introduction` project. Directions on how to do this can be seen in Figure 1-1.


The Projects and Learn tabs

The Open button

Figure 1-1. *Opening `Chapter-1-Introduction` (the Intro to Unity Project) from Unity Hub*

As Figure 1-1 shows, to add a project, navigate to the **Projects** tab and then select the **Open** button. From here, navigate to where you downloaded the source code to this book. You will notice that the file structure is organized according to chapters. The first example you should open using the **Open** button is `Chapter-1-Introduction`. Note that after a project is opened, you need to click the newly opened project to launch it.

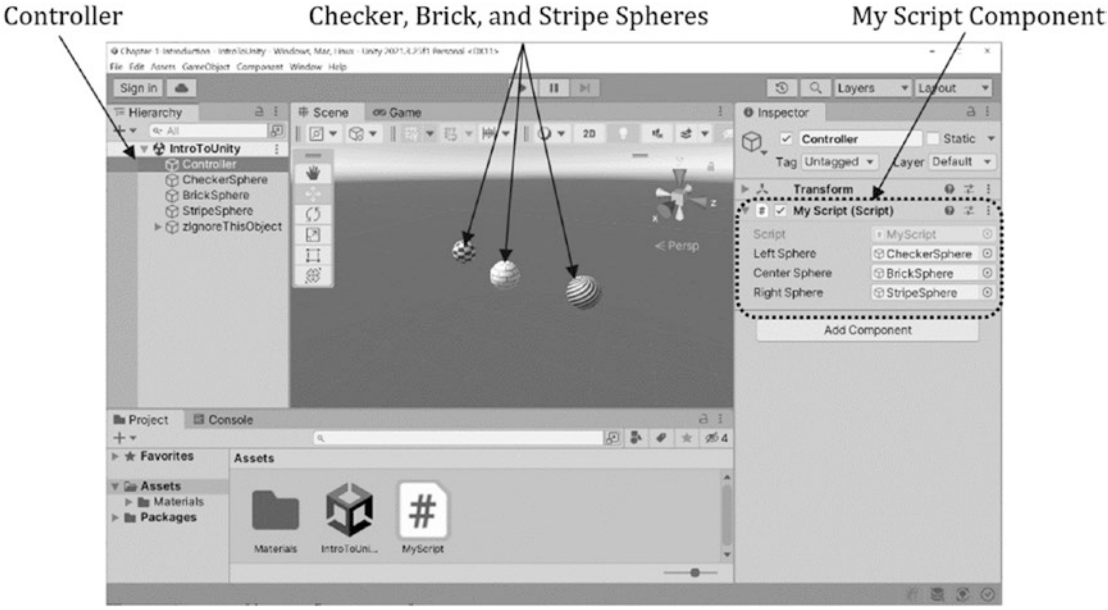
Figure 1-1 also establishes where the **Learn** tab is located. Here you can view and select Unity sponsored tutorials. The "Foundational Tutorial" category contains tutorials that will be very helpful to those who have never used Unity before as it contains tutorials such as "Welcome to Unity Essentials" and "Explore the Unity Editor." At the end of this chapter, there are some additional suggestions as to which tutorials to follow if you are new to Unity or just need a refresher.

Opening the Intro to Unity Project

To open a project from Unity Hub, simply click it. The first time you try to open any projects from this book, you will encounter the following two steps:

- Unity will invite you to select the version to use; you can simply select the version you just installed.
- Unity will display an information dialog box titled, "`Opening Project in Non-Matching Editor Installation`," you can simply click the `Continue` button.

The first time opening a project will take a while for Unity to copy the support library and perform system configuration. Once you open `Chapter1-Introduction`, you should be confronted with a window similar to the screenshot in Figure 1-2. If you do not see a screen similar to that of Figure 1-2, make sure the `IntroToUnity` scene is open and not an `Untitled` scene. To open the `IntroToUnity` scene, find it in Asset folder under the Project Tab and double-click to open it.



☑ Controller

☑ My Script (Script)

Script	MyScript
Left Sphere	CheckerSphere
Center Sphere	BrickSphere
Right Sphere	StripeSphere

Figure 1-2. *Running the IntroToUnity scene in the Chapter-1Introduction project*

Figure 1-2 shows a very simple scene. There is the `Controller` game object and three different spheres. Each sphere is named after the design pattern placed upon it: `CheckerSphere`, `BrickSphere`, and `StripeSphere`. In this screenshot, the `Controller` object is selected so you can observe the `MyScript` component on the right. The `Controller` object and the `MyScript` component are present in every example in this book and will be described in detail. The purpose of this example is to familiarize you with how examples are organized and to establish terminologies that will be used throughout the book.

Working with the Unity Editor

Figure 1-2 is an example of what the Unity Editor looks like and is one of the two editors you will be working in. The other editor, the Script Editor, or IDE, will be discussed later. Figure 1-3 illustrates the various functionalities of the Unity Editor.

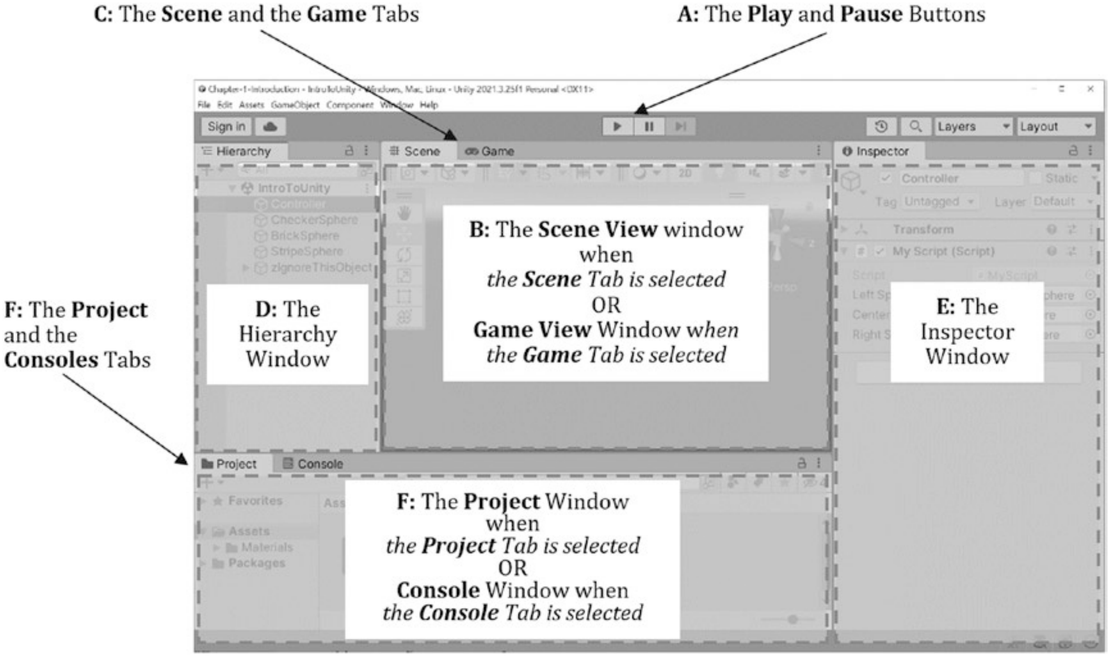

C: The Scene and the Game Tabs
A: The Play and Pause Buttons
Sign in
Layers
Layout
Hierarchy
Scene
Game
Inspector
IntroToUnity
Controller
CheckerSphere
BrickSphere
StripeSphere
zIgnoreThisObject
Tag Untagged
Layer Default
Transform
My Script (Script)
B: The Scene View window when the Scene Tab is selected OR Game View Window when the Game Tab is selected
F: The Project and the Consoles Tabs
D: The Hierarchy Window
E: The Inspector Window
Project
Console
Favorites
Assets
Materials
Packages
F: The Project Window when the Project Tab is selected OR Console Window when the Console Tab is selected

Figure 1-3. *The Unity Editor Environment*

Figure 1-3 overlays the editor in Figure 1-2 with labels identifying the different windows presented by the Unity Editor and establishes the terminologies that will be used from here on:

- A: The Play and Pause buttons: In the top-center area, you can see the Play and Pause buttons. These buttons control the running (or playing) of the game. Feel free to click the Play button, give the system a few seconds to load, and then observe the movements of the spheres in the scene. If you click the Play button again, the game will stop running. You will learn more about and work with these buttons later.
- B: The Scene View window: The main 3D window in the top-left region of the Unity Editor is the main area for performing interactive editing. In Figure 1-2, this window is displaying the Scene View of the game.
- C: The Scene and the Game View tabs: Above the Editor Window (B), you can spot the Scene and Game tabs. If you select the Game tab, then Unity will switch to the Game View which is what a player will see in an actual game. An example of the Scene View next to the Game View can be seen in Figure 1-4.

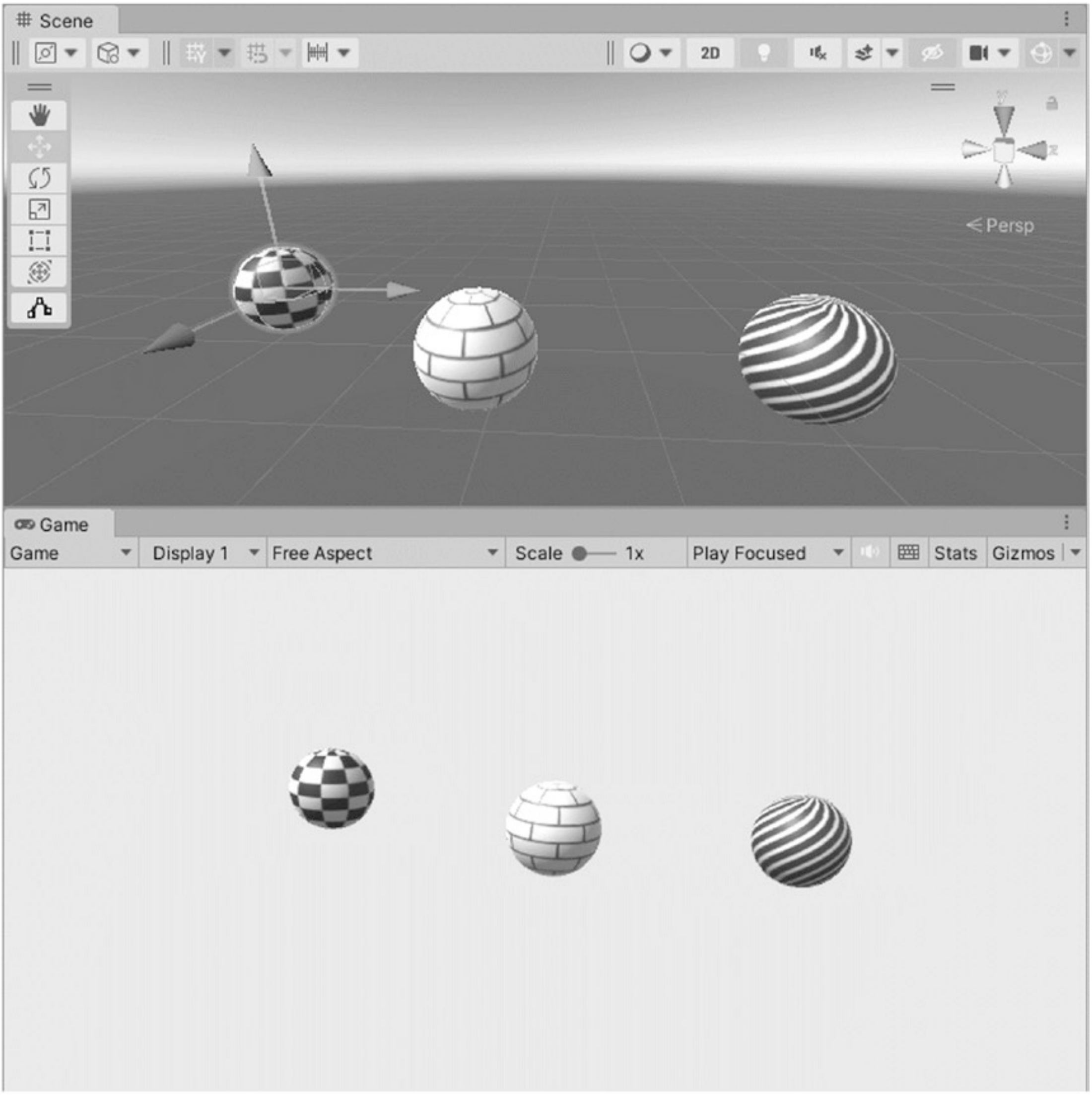


Figure 1-4. The Scene View (top) and the Game View (bottom)

Note Please pay attention to the differences between the Scene and Game Views. The Scene View is meant for the game designer to set up a game scene, while the Game View is what a player of the game would observe while playing the game. While both views can be invaluable tools for examining the intricate details of the mathematical concepts, you will be working exclusively with the Scene View.

Note To help distinguish between the Scene and the Game Views, as depicted in Figure 1-4, in all the examples for this book, the Scene View has a skybox-like background, while the Game View window has a constant, light blue backdrop. Once again, you will be working exclusively with the Scene View, the view with the skybox-like background.

EXERCISE

Working with the Scene View Window

Left-click and drag the Scene View tab to see that you can configure and place the Scene View window at different configuration locations throughout the Unity Editor or even outside as an independent window. This is the case for most of the Unity tabs, including the Game View window. Figure 1-4 shows the Scene View and Game View windows as two separate windows that can be examined simultaneously.

Figure 1-5 is a close-up view of the Hierarchy Window, which is labeled as D in Figure 1-3.

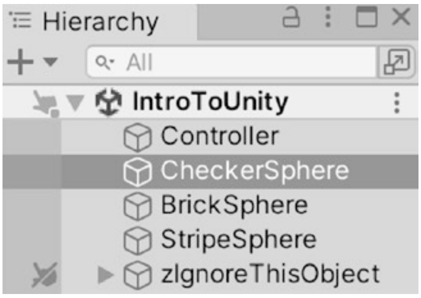


Figure 1-5. The Hierarchy Window

Note The crossed-out finger icon next to the last object, `zIgnoreThisObject`, disables click-select functionality in the editor window. In all examples, objects that are not meant to be interacted will have the crossed-out icon next to them.

- D: The Hierarchy window: In the Unity Editor, this window (Figure 1-5) is typically anchored to the left of the Scene View and above the Project/Console Windows (F). The Hierarchy Window displays every object and its parental relationship to other objects in the scene. Just like the Scene View and Game View, the Hierarchy Window can be moved and placed wherever you desire. You should observe the different objects within the Hierarchy Window. There is the `Controller`, which will be discussed later, but for now know that it contains the script that supports your interaction with the scene; the `CheckerSphere`, which is the checkered sphere; as well as the `BrickSphere` and `StripeSphere`, which also correspond to their object's descriptions. Finally, there is the `zIgnoreThisObject` object; this last object supports the setup of the game environment for the learning of math concepts specific to each example. You will never need to interact with this object, and therefore this book will ignore this object as its details can be distracting. You are, of course, more than welcome to examine and explore this object, and any others, at your leisure.

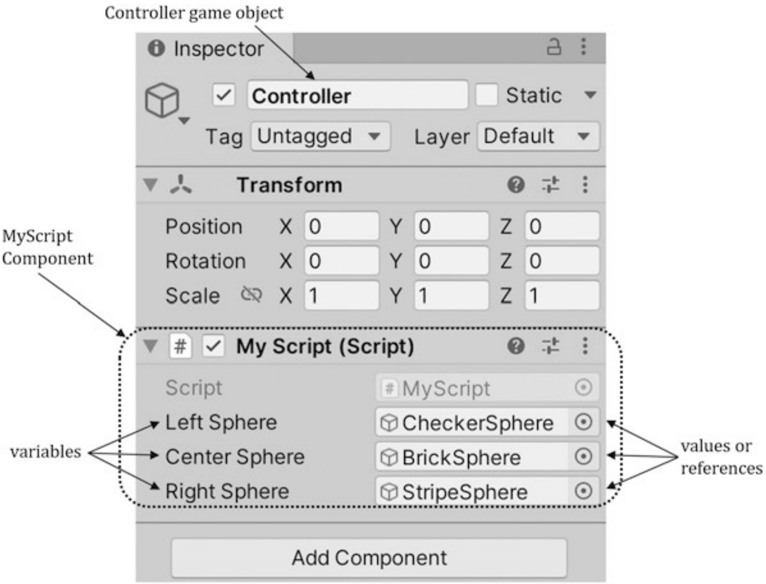
Note Try clicking the different objects in the Hierarchy Window and observe how the Scene View highlights the object you have selected while the Game View does not. This simple feature underscores how the Scene View is meant for scene edits while the Game View is not.

EXERCISE

Observe Differences Between the Scene View and Game View

Select different spheres in the Hierarchy Window and switch between the Scene and Game Views to observe the differences between these two views. You should notice that the selected sphere is highlighted in the Scene View and not in the Game View. It is essential to differentiate between these two views when you manipulate the scene in examining concepts. Once again, and very importantly, all examples in this book work exclusively with the Scene View.

Figure 1-6 is a close-up view of the Inspector Window, which is labeled as E in Figure 1-3.



Controller game object

MyScript Component

variables

values or references

Inspector

☑ Controller □ Static

Tag Untagged Layer Default

Transform

Position X 0 Y 0 Z 0

Rotation X 0 Y 0 Z 0

Scale X 1 Y 1 Z 1

☑ My Script (Script)

Script MyScript

Left Sphere CheckerSphere

Center Sphere BrickSphere

Right Sphere StripeSphere

***Figure 1-6.** Inspector Window with the `Controller` object selected in the Hierarchy Window*

- E: The Inspector Window: The Inspector Window (Figure 1-6) displays the details of the selected object for the user to inspect and manipulate. The Inspector Window is typically located on the right of the Scene View. Just like all other windows described, it can be placed wherever you want. The selected object being displayed in Figure 1-6 is the `Controller`. Notice that there are two components attached to this object: `Transform` and `MyScript`. Figure 1-6 shows that you can expand and compress each of the components to examine or hide their details. In this case, the `Transform` and `MyScript` components are expanded. The `MyScript` component is the custom script developed for this book. Note that on the left side of the `MyScript` component are the names of the public variables defined in the script: `Left Sphere`, `Center Sphere`, and `Right Sphere`. Directly across from these variable names, you can see their values or the objects that the corresponding variables reference: `CheckerSphere`, `BrickSphere`, and `StripeSphere`. These aspects of the `MyScript` component will be explained in more detail in the next section.

- F: The Project and the Console windows and tabs: The Project Window displays the file structure of your project. This is where scripts, prefabs, materials, and everything else that will be loaded into your game are located. The Console Window is where Unity will output debug messages, warnings, and errors, all of which can be very helpful in debugging your code if something goes wrong. The Project Tab and Console Tab allow you to switch between these two windows just like the Game View and Scene View tabs do. These windows can also be moved around and placed wherever you decide.

Figure 1-3 shows the default layout used by this book. In the rest of this book, the corresponding windows will be referenced by their name as depicted in Figure 1-3. If you accidentally close one of these windows, they can be reopened by going to the Window drop-down menu at the top of the Unity Editor and then selecting the General option. There you will see a list of all of the windows that have been discussed.

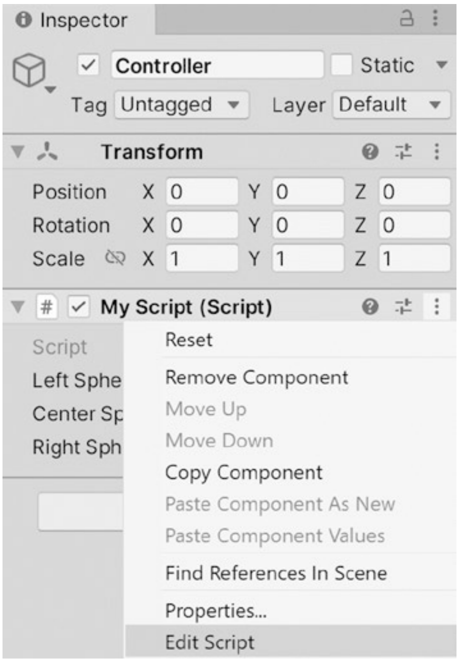
Note In later chapters, there will be folders added to the Project Window such as Editor, Resources, and so on. These folders will include utilities that the book uses to create the examples. You are more than welcome to explore these. However, please keep in mind that the content in these folders will not be relevant to learning the mathematical concepts presented. For example, the Resources folder is a special folder that Unity searches for object blueprints known as prefabs. Knowing about these prefabs is irrelevant to learning the math concepts and therefore will not be covered.

Working with MyScript

In general, a Unity script is a component with code that can be attached to any game object. This script can then modify the behavior of that object or the entire game. All scripts presented in this book are written in C#.

Throughout this book, in each example you will only have to work with one script. This script will have `MyScript` be part of its name, for example, `EX_2_1_MyScript`, and will always be attached to the `Controller` object. It is important to note that the `Controller` object in all of the examples is empty (it does not contain anything visible) and does not perform any function other than to present the MyScript script for your interactions. The MyScript script always implements and demonstrates the concept being studied.

Figure 1-7 shows how you can open and edit MyScript.



Inspector

☑ Controller □ Static

Tag Untagged Layer Default

Transform

Position X 0 Y 0 Z 0

Rotation X 0 Y 0 Z 0

Scale X 1 Y 1 Z 1

☑ My Script (Script)

Figure 1-7. Invoking the Script Editor

There are two ways to open and edit scripts in Unity. The first method is depicted in Figure 1-7. To open and examine the source code of MyScript, select Controller in the Hierarchy Window, and then in the Inspector Window with the mouse pointer over the MyScript component, left-click the Settings button (the three-dots icon in the top right of the MyScript component) or right-click the name of the MyScript component ("My Script (Script)"). Both of these actions will trigger the pop-up menu as depicted in Figure 1-7. From there, select the "Edit Script" option at the very bottom. The second way to open and edit a script is by double-clicking the script icon in the Project Window. In all of the examples, MyScript is located in the Assets/ folder. Once you open MyScript, you should see a pop-up window showing the progress of Unity invoking the IDE.

After your Script Editor has loaded, you should see a screen similar to that of Figure 1-8, which shows the MyScript's code using Visual Studio under the light theme.