Community Experience Distilled

Unity 3.x Scripting

Write efficient, reusable scripts to build custom characters, game environments, and control enemy AI in your Unity game

Volodymyr Gerasimov Devon Kraczla

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About the Authors

Volodymyr Gerasimov is a level designer and scripter. His major passion is creating modifications for popular games, and developing small, indie projects, with scripting as a main tool. He learned various scripting and programming languages at The Art Institute of Vancouver. Introduced to Unity in 2010, he created and worked on a number of projects, indie games, and prototypes. He has worked as Lead Level Designer and Scripter, on the hack-and-slash action game, *Splik and Blitz: Baked in Blood*, and has also worked on a couple of indie projects for iOS and PC. His latest, finished project is the puzzle platformer game, *Red Rolling Hood*. Currently, he is working at Best Way, as Producer of an action role-playing game.

I would like to thank all my friends and teachers who shared their experience with me. They surrounded me with an aura of creativity and art, which kept my passion burning, and my work going. I would also like to thank all who will open this book, and be able to learn something, create, and share.

Devon Kraczla is an independent game developer. Having an artistic background, Devon came to the gaming industry to explore new ways to surprise people with his creations. Over the last couple of years, having graduated from The Art Institute of Vancouver, Devon has developed multiple, independent projects, both solo and with other enthusiasts, and has worked on the award-winning *Battlefield 3*, as a member of the motion capture team at EA Canada. In his games, Devon focuses on simple and engaging game mechanics, covered with a unique art style that makes his games appealing for hardcore and casual audiences alike. Currently, Devon is working on a new project along with a large group of passionate developers.

I would like to thank my teachers and peers of The Art Institute of Vancouver, for helping me pursue the endeavors that I sought after. I would also like to thank my friends and family, outside of my school life, who helped keep me sane, well, as sane as I can be, and for being there when it mattered most. Prost!

About the Reviewer

Jeff Mundee is a game designer and instructor from New Brunswick, USA, who moved to Vancouver, Canada, a decade ago to produce video games. Since then he has worked on many game projects in various roles, from Motion Capture Specialist at Electronic Arts, to Game Designer for Activision, and all sorts of independent productions in between. He is currently working on a Unity-based game with Holy Mountain Games. He also teaches classes at The Art Institute of Vancouver, about game production using Unity, among other subjects.

I would like to thank Vlad and Devon for being leaders in a strong graduating class, by taking the initiative to master Unity. I know they will both go on to make great games.

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Preface

If you are an enthusiastic gamer who is ready to seriously get into game development, this book will give you a great head start for your journey. We will guide you through the step-by-step process of creating your first playable game prototype, which you will be able to further extend into a full-scale game. This book contains examples of the most important features that can be found in games, and much more; it will help you to understand Unity better, and increase your programming skills.

What this book covers

Chapter 1, *Diving into Scripting*, will teach you how to set up the project and take advantage of built-in character controllers. We will talk about dynamic objects and their collision, as well as investigate creating a moving platform and explosions.

Chapter 2, *Custom Character Controller*, will show you how to create your own character controllers, camera rigs, and animation systems.

Chapter 3, *Action Game Essentials*, will introduce programming of basic gameplay features, such as shooting, picking up items, and opening treasure boxes, as well as soft bodies and tethering.

Chapter 4, *Drag-and-Drop Inventory*, will give you an example on how to create your own inventory and character customization with the help of Unity GUI.

Chapter 5, *Dynamic GUI*, will take you step by step, through the creation of the HUD and targeting system.

Chapter 6, *Game Master Controller*, will teach you how to design and program systems to run and manage your game.

Chapter 7, Introduction to AI Pathfinding and Behaviors, will give you a sneak peek of AI programming, and talk about the basic theory behind it.

Appendix, Object-oriented Programming in Unity, will cover some basics of programming that will help you to continue learning.

What you need for this book

You need to be comfortable in an editor's environment, and have a very basic knowledge of Unity's JavaScripts, or any other object-oriented programming language.

Who this book is for

This book is for passionate game developers, students who are preparing to make their first project, or people who think they are ready to learn something new.

Conventions

In this book, you will find a number of styles of text that distinguish between different kinds of information. Here are some examples of these styles, and an explanation of their meaning.

Code words in text are shown as follows: "After the `Start` function, we will create the `MoveButton` function."

A block of code is set as follows:

```
function Update(){
if( tnt != null ){
    If(trigObj.getComponent("Button").ReturnButtonStatus()){
         BOOM();
     }
    }
}
```

New terms and **important words** are shown in bold. Words that you see on the screen, in menus or dialog boxes for example, appear in the text like this: "To gain access to the package data, open **Unity** and go to **Assets | Import Package | Custom Package...**, as shown in the following screenshot".

[Warnings or important notes appear in a box like this.]

[Tips and tricks appear like this.]

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You can contact us at `questions@packtpub.com` if you are having a problem with any aspect of the book, and we will do our best to address it.

1
Diving into Scripting

Welcome to advanced Unity scripting! In this book, we will cover interesting information about scripting in Unity's built-in scripting language—JavaScript for Unity. We believe that this book, and included material, has the fundamentals needed to create a game that you always dreamed of creating.

In order to start working with this book, you need to have a basic understanding of what Unity3D is; navigate freely inside Unity, and have basic knowledge of JavaScript and **object-oriented programming** (**OOP**) in general.

In this chapter, we will:

- Set up a project and a third-person Character Controller
- Talk about dynamic objects and collision detection
- Create moving platform and explosion box

Downloading and installing assets for this book

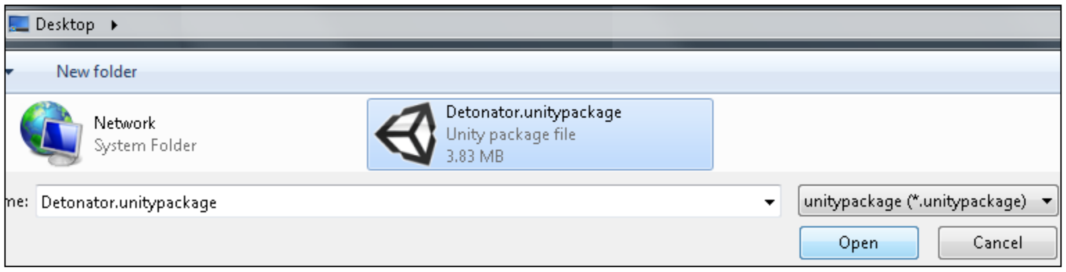
In Unity3D, there is the ability to download pre-made packages or import assets. These packages/assets can be of 3D models in the form of raw art assets, game objects, prefabs, particles, scripts, animations, sounds, and so on. Packages are identified by having a `.package` extension.

In order for the reader to be able to follow along with the examples in the book, get the greatest amount of experience, and practice out scripting in Unity, pre-made packages have been made available for the reader's convenience.

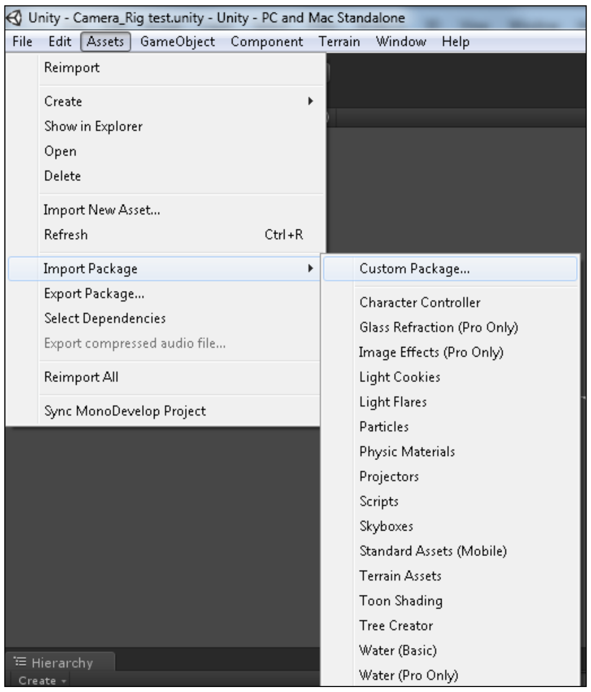
Downloading the example code

You can download the example code files for all Packt books you have purchased from your account at `http://www.packtpub.com`. If you purchased this book elsewhere, you can visit `http://www.packtpub.com/support` and register to have the files e-mailed directly to you.

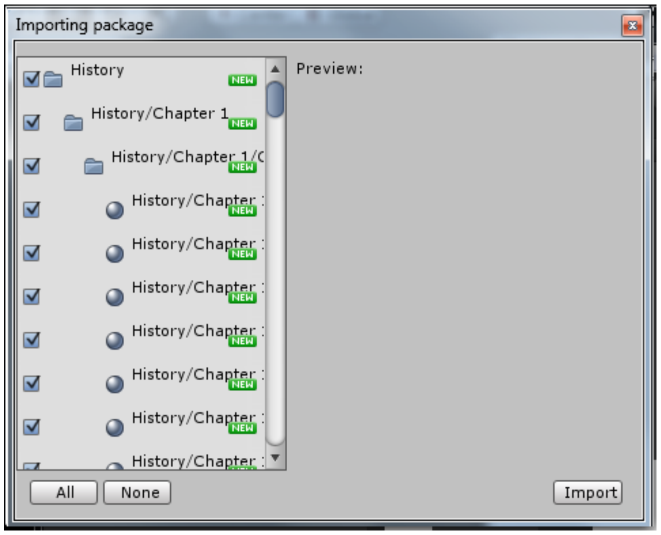
These packages are available for download on the book's website underneath the **Packages** heading. There is only one package here and it is called **Unity_Scripting.unitypackage**. The downloaded file will be a ZIP file.



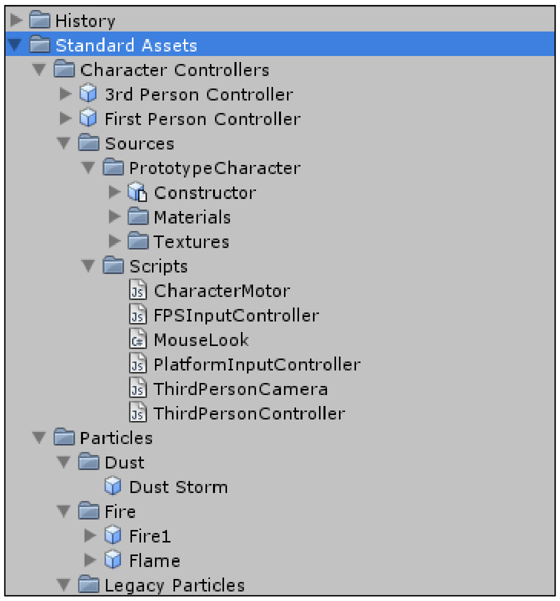
Extract the data and put the package where you would like it to be in your Unity project. To gain access to the package data, open **Unity** and go to **Assets** | **Import Package** | **Custom Package...**, as shown in the following screenshot:



Search for the location of your project and open your package. A small interface comes up showing a list of all the assets on the left-hand side and a prompt asking if you would like to install all assets. Click on **All**, as shown in the following screenshot:



This will open up the **Unity_Scripting** package. The default path for the downloaded assets is **Standard Assets** in the Unity project. If a `Standard Assets` folder does not exist, it will create one and download your package into it.



Congratulations, you have now downloaded and successfully installed the assets required for this book. Now, let's start building!

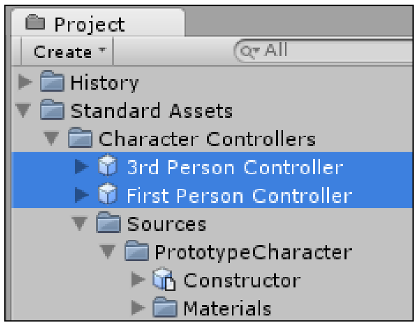
Getting started with the game

From now on, we will start to script our own game and dive into uncharted depths of JavaScript. The first chapter is dedicated to creating a simple platform game. We will learn to use the built-in functionality of Unity to set up our character, and use the Character Controller component to make that character move and be controlled with our commands. Later in the chapter, we will get into creating a playground for our character. We will also get into teaching him to move boxes around, script moving platforms, create custom triggers, and make huge explosions.

Available Character Controllers

Now, let's get into the fun part and set up a controllable character. Let's open the project that comes with the book and start coding.

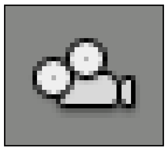
There are two kinds of Character Controllers that are available with a Pro version of Unity3D—**3rd Person Controller** and **First Person Controller**. Default Character Controllers can be found in **Project** view | **Standard Assets** | **Character Controllers**, as shown in the following screenshot. To use any of those Character Controllers, just drag-and-drop them on a scene using the left mouse button. Now, we can click **Play** and start the game, and see our character following orders when we press control buttons.



Now, let's take a look at what these Character Controllers consist of.

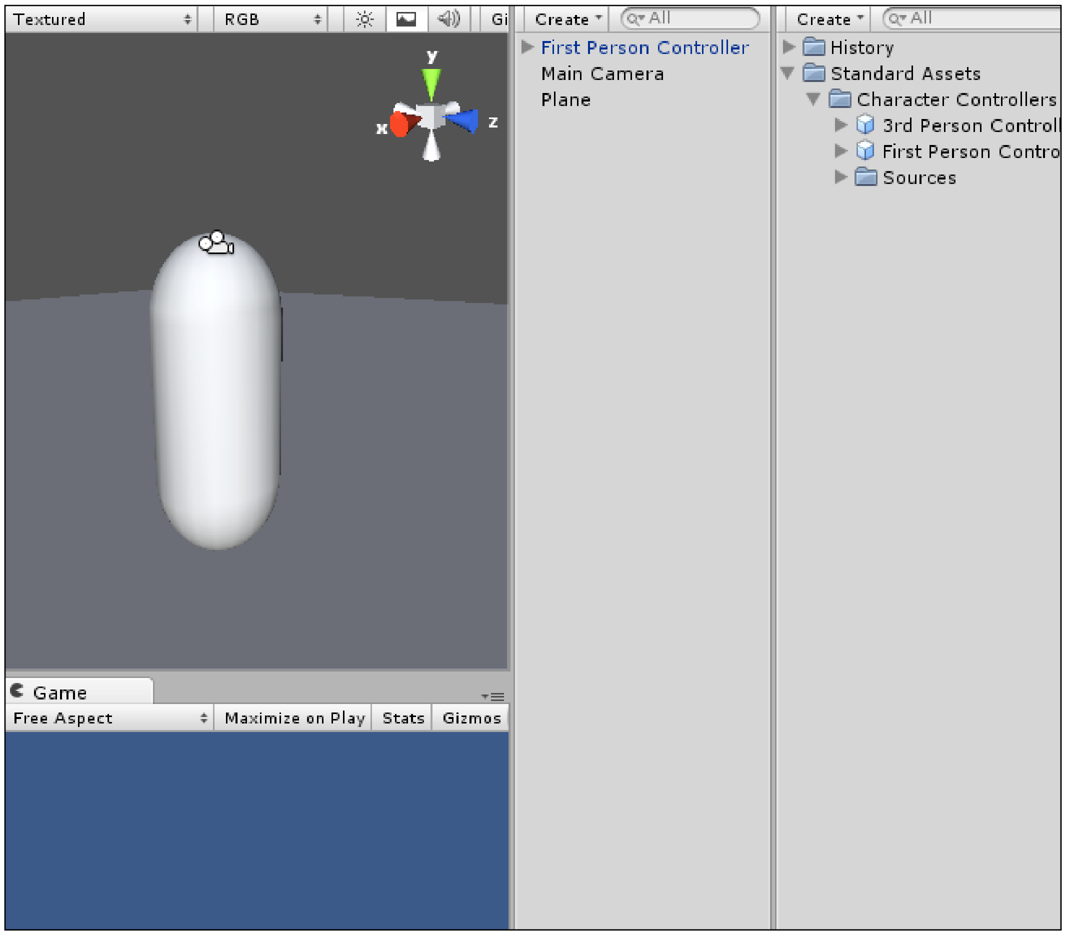
Character Controller is a default physics component that does all the necessary collision calculations for us but, at the same time, doesn't follow rules of physics and isn't affected by external forces. However, that doesn't mean that it can't push Rigidbodies if scripted. In general, if we are trying to create a controllable humanoid and don't wish bothering with tons of code, Character Controller will be our best choice. If we are planning to create a character that is being influenced by external forces (like physics) or interacting with objects that are influenced by physics, we will see Character Controller becoming our worst enemy that will break game functionality for no reason. Supplementary to Character Controller are pure physics objects—Rigidbodies. They allow us to create almost anything that is physics related and consist of many hard edges that we will go around in future chapters.

From now on, we will look into both Character Controllers separately and start with First Person Controller. By dragging **First Person Controller** prefab on the screen, we will see a simple cylinder with a camera icon above it. Let's take a look at what's inside:



- **Character Controller**: This is attached to the cylinder with the camera icon above it, at the very top of the list. To attach the Character Controller to the object, select the object, go to **Component** at the top of the screen, and click on **Physics | Character Controller**.
- **Mouse Look (Script)**: This handles the camera rotation based on mouse manipulations. This script is written in C# and is beyond this book's scope, but it has a fair amount of description inside, which can be used to tweak mouse controls. To attach a script, go to **Component | Camera Control | Mouse Look**.
- **Character Motor (Script)**: This is a script that is responsible for registering all the inputs and controlling **Movement**, **Jumping**, **Sliding**, and so on. It is available at **Component | Character | Character Motor**. Some of the functionality can be tweaked from the **Inspector** view, but most of it has been purposely hidden and is accessible only through scripts.

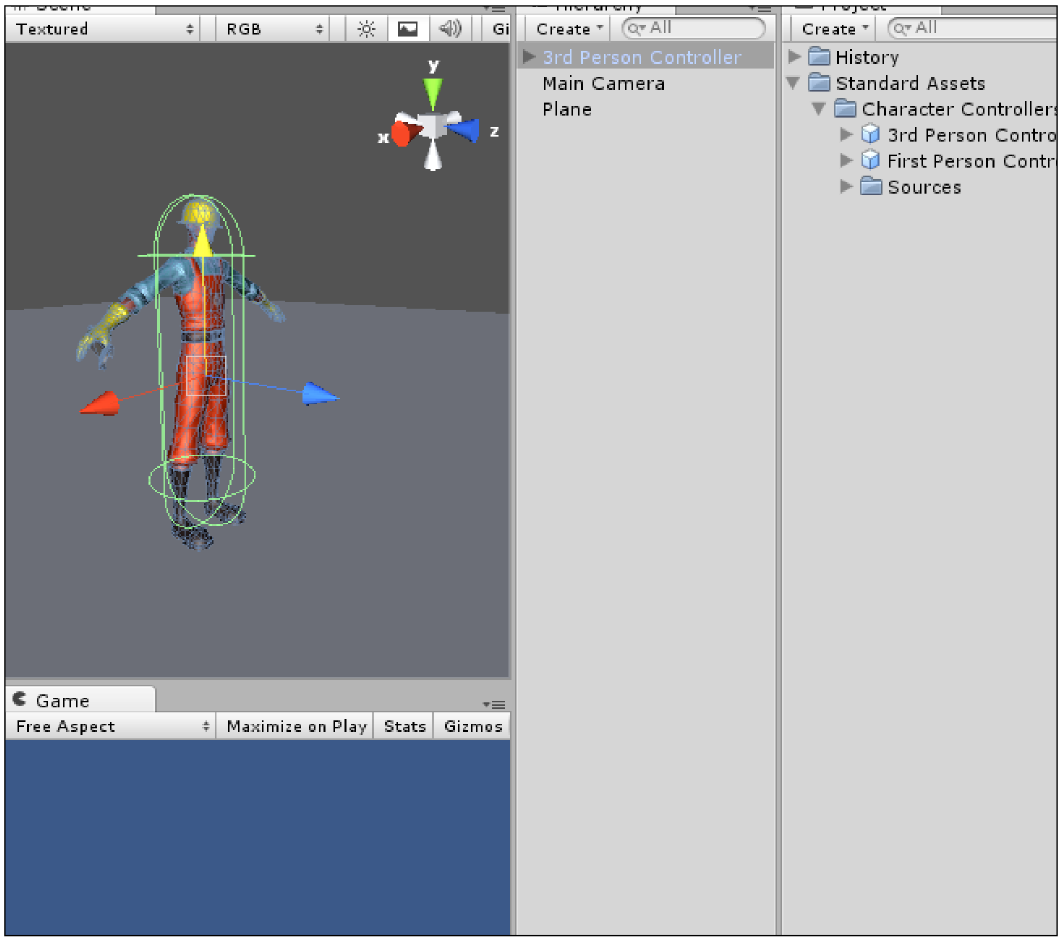
- **FPSInput Controller (Script)**: This works together with **Character Motor (Script)**. Its main purpose is to control the functionality of previous scripts (**Component** | **Character** | **FPSInput Controller**).



Now that we are done with the **First Person Controller**, lets switch to **3rd Person Controller**. There are few things that make it stand apart. They are as follows:

- **Animation**: Unlike First Person Camera, we are expecting to visually observe our character and watch it playing various types of animations. This is what **Animation** does; we simply attach it to the object (**Component** | **Miscellaneous** | **Animation**) and add baked animations to the animation array. The rest is done through code and will be covered in future chapters.

- **Third Person Controller (Script)** and **Third Person Camera (Script)**: They are self-explanatory. The first one controls character, registers inputs from the keyboard, handles animation synchronization, and so on. The latter one adjusts the camera according to character position and actions. Both scripts can be found in **Component** | **Scripts**.
- **Character Motor (Script)**: This is a script that is responsible for registering all the inputs and controlling **Movement**, **Jumping**, **Sliding**, and so on. It is available at **Component** | **Character** | **Character Motor**. Some of the functionality can be tweaked from the **Inspector** view, but most of it has been purposely hidden and is accessible only through scripts.
- **FPSInput Controller (Script)**: It works together with **Character Motor (Script)**. Its main purpose is to control the functionality of previous scripts (**Component** | **Character** | **FPSInput Controller**).



Interactive objects

So, you want to interact with objects in the environment now? Interactive objects are usually the objects, which the player has to interact with in order to continue their progression through a level and/or environment. In deciding which interactive items to include as examples, we have chosen to pick objects that show a variety of player interactions. The following is an overview of the type of interactive objects, which will be covered in this chapter:

- Buttons/plunger
- Explosion box
- Moving boxes
- Platform

The list of interactive items can be quite extensive but luckily, once you have thought of the logic behind one, scripting another becomes easier. For a better understanding of the preceding interactive objects, we can split them into two categories—**Triggers** and **Triggered Objects**. TNT plunger, targets, buttons, levers, and volumes fall under the **Triggers** category, whereas TNT box, triggered door, item required/event door, breakable door, and raft fall under **Triggered Objects**. For more information on other interactive items such as pickups, treasure chests, and weapons, see *Chapter 3*, *Action Game Essentials*. All assets for this chapter can be found in the **History | Resources | Chapter 1** folder.

Triggers

As stated previously, these objects are used to trigger events in the environment. Through interacting with them, doors can be opened, non-interactive events can be triggered, and enemies can be spawned. These are only a couple of examples of the infinite number of tasks that can be done by interacting with a trigger. Here is a breakdown of the mentioned triggers. Due to the limited number of pages, we will dive right into the description and breakdown of code for each project.

Buttons

In our case, a button will be described as an object, which the character directly has to interact with in order for it to be triggered. What we will write is a base script, which when used triggers an event. This script, once written, will be used to open a door and explode a box of TNT.

Base button script

So let's script a button. Go grab the **Button** prefab from the **Chapter 1 prefabs** folder and drag it into the **Hierarchy** view. Once that is done, there will be two game objects in the prefab asset. In **buttonTrigger**, there is a default script on the asset called **Button**.

In the `Start` function of this script, we want to get the initial position of the button.

Declare a variable for initial position, make its type a `Vector3` and default it to `Vector3.zero`. To get the position, have the variable equal to `transform.localPosition` in the `Start` function:

```
var initPos : Vector3;
function Start(){
     initPos = transform.localPosition;
}
```

After the `Start` function, we will create the `MoveButton` function.

Activating platform status

This next function will move the button to the move position and set the activated status for the platform.

Create a `private` variable for the button pressed, set its type as `Boolean` and default it to `false`. Inside the `MoveButton` function, create an `if` statement. Have the `if` statement check to see if the button pressed variable is equal to `false`. Inside the `if` statement, we want to send the activation information to triggered object.

To send the information to the appropriate platform in the level, we will have to create a new variable called `Platform`, or something along those lines, with the type of `gameObject` and defaulted to `null`. In the `MoveButton` function, we need to call the `Activated` function in the `platform` script (this script will be created later in this chapter). The following is an example of what it could look like:

```
Platform.GetComponent( platform ).Activated();
```

Now, we need to move the button to give visual indication to the player that the button has been pressed. To get the move position, create another variable for move position, set its type as a `float` and default its value to `0.1` (this value can be adjusted later in the inspector).

```
var movePos : float = 0.1;
```

To move the button from its current position to the new position, we will take the local Z position of the button, subtract the move position value and apply it to the current local position of the button (we will use the **Z** axis for the example due to the world having Z as depth and the button being mounted on a wall).

The last thing to add to this `if` statement before we close it is to turn the button pressed variable `true`. That's it for this script. We just need to add the collision check function to the built-in `Character Controller` script and we will have functionality.

Inside of this function, we will do a name check to identify what object the character has collided with. In order to get the name information from the collided object, we have to access the name component, which is a property of `gameObject`. We will then compare this to one that we want, which in this case is `Button`:

```
function OnControllerColliderHit ( Hit : ControllerColliderHit){
     if ( Hit.gameObject.name == "Button" ){
     }
}
```

If the name matches what we want, we need to access the `MoveButton` function in the `Button` script. To do this, use `GetComponent` to grab the `Button` script and access the desired function. The following statement shows roughly what it should look like:

```
Hit.gameObject.GetComponent("Button").MoveButton();
```

Then in the `if` statement for the detonator plunger, we want to access the `GetPressed` function in the `Button` script.

You have finished writing the base `Button` script. The following is a sample of what that script could look like:

```
var initPos : Vector3;
var movePos : float = 0.1;
var Platform : Transform = null;
var isPressed : Boolean = false;
function Start(){
     initPos = transform.position;
}
function MoveButton(){
    if(!isPressed){
     Platform.GetComponent( platform ).Activated();
     transform.position.z = transform.position.z - movePos;
    isPressed = true;
    }
}
```

Remember that this is a base script and much, much more functionality can be scripted into it.

Explosion box

It's time to make things explode. Let's script a little bit of explosion box. When the player applies pressure to a detonator box, it triggers the explosion box, and the explosion box explodes! There are just six steps to achieve that, as follows:

1. Prepare objects.
2. Write `Update` function.
3. Write `BOOM` function.
4. Download and install **Detonator** package.
5. Write functionality for button pressing.
6. Preparation.

In this section, we will handle the entire preparation of available resources.

[Grab the **Detonator_Box** prefab out of the `Chapter 1 prefabs` folder and drag it into the **Hierarchy** view.]

If you open the `gameObject` of the detonator box, you will see that it is made up of two pieces—**Detonator_Box** and **Explosion Box**. We want to drag the **Button** script, made in the last example, to the inspector of the **Detonator_Plunger** asset located underneath the **Detonator_Box** group. As the plunger is essentially a button, and the base `Button` script is generic, it can be used for many purposes, such as triggering the explosion box to explode. This script will be the master control for the explosion box as well as the detonator box. It will determine the explosion created when the explosion box explodes, what object is used as the trigger, and the object triggered. You will notice that the prefab parent of **Detonator_Box** has the **TNT** script in its **Inspector** menu.

The Update function

The next function that we will write is the `Update` function. In this function, we will do a check for getting the trigger object's pressed status.

First, we have to create a couple of variables—the first one for a trigger and the second one for the explosion box. We want the trigger variable to be of `Transform` type and defaulted to `null` and the `tnt` variable to be of a `Transform` type as well and defaulted to `null`. Create an `Update` function. We will have an `if` statement to make sure that the `tnt` variable has an object associated with it.

To do the trigger check, we will have to write an `if` statement that gets the `Button` script component from the trigger object. To do this, we will have to declare a new variable, make it `public` and call it something along the lines of `trigObj`. We should declare its type as `gameObject`, and default it to `null`.

The value we need for this statement is the return function located in the `Button` script. To access this, we get the script component of the trigger object using `GetComponent`. We then declare the script by the name that we wish to access and then the name of the function which has the value to check. The following is an example.

```
function Update(){
if( tnt != null ){
    If(trigObj.getComponent("Button").ReturnButtonStatus()){
         BOOM();
     }
    }
}
```

As you can see, we have added the `BOOM` function in the name of the next function, which we will be writing.

The BOOM function

The `BOOM` function will create an explosion at the location of the explosion box and destroy the explosion box game object from the **Hierarchy** view. Before we do anything, let's declare two more variables. The first variable is `explosion` and the second one is `collidedObj`. Make sure that explosion is `public`, its type declaration is `Transform`, and it is defaulted to `null`. The `collidedObj` variable should be `private`, and the type declaration should be as a `Collider` array.

In the `BOOM` function, we want to create a collision sphere that will detect all colliders within a given area from a given point. To accomplish this, we will use the `Physics.OverlapSphere` function. Have the `collidedObj` variable equal to the `Physics` function with the parameters of the `tnt` variables—`position` for position and the size of the collision sphere set to `1`. The following is an example of how it should look:

```
collidedObj = Physics.OverlapSphere(tnt.transform.position, 1);
```

After this, we need to go through the `collidedObj` array and for each object in that array, create an explosion at its position and then destroy the object. To do this use a `for` loop to loop through the array. Call Unity's built-in creation function—`Instantiate` inside of the loop.

The `Instantiate` parameters are the explosion variables, `Obj` in the `collidedObj` array position and then a rotation. The rotation of the current `gameObject` will perform `transform.rotation`. The following is a sample:

```
for (var obj in collidedObj)    {
    Instantiate(explosion, obj.transform.position, transform.
rotation);
}
```

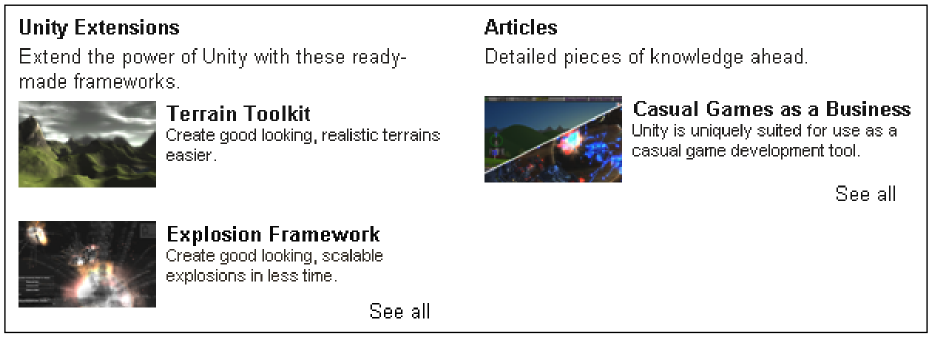
Lastly, we will destroy the `gameObject` in the array. To do that, after the instantiation code, type the following line:

```
 destroy(obj.gameObject);
```

Downloading the Detonator package

Now, return to the **Inspector** of **Detonator_Box**. Under the **TNT** script, you will see the variables that were `public`. These variables are, for example, trigger, explosion, and TNT.

In the trigger variable, drag your detonator trigger into it. For the explosion variable, we are going to do something different. For the explosion, we will utilize the **Detonator** package that can be downloaded off of Unity's website. You can find it in the **Support | Resources** section at `http://unity3d.com/support/resources/`.


Unity Extensions
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Terrain Toolkit
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Explosion Framework
Create good looking, scalable explosions in less time.
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Articles
Detailed pieces of knowledge ahead.
Casual Games as a Business
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