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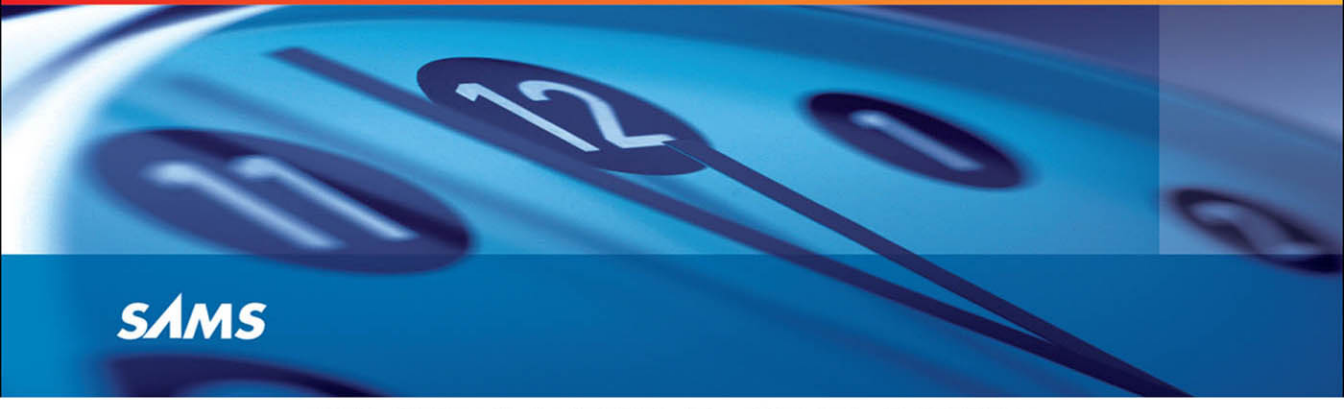
Unreal® Engine 4 Game Development in 24 Hours



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Sams **Teach Yourself**

Unreal® Engine 4 Game Development in 24 Hours

SAMS 800 East 96th Street, Indianapolis, Indiana, 46240 USA

Sams Teach Yourself Unreal® Engine 4 Game Development in 24 Hours

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Companion Files: To gain access to project files and downloads, go to the book's companion website at www.sty-ue4.com.

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Preface

Unreal Engine 4 is a powerful game engine used by many professional and indie game developers. When using a tool such as Unreal Engine for the first time, figuring out where to begin can be a daunting task. This books provides a starting point by introducing you to the interface, workflow, and many of the editors and tools Unreal Engine 4 has to offer. It will help you get a strong foundation you can later build on, and it will spark your interest to explore Unreal Engine and game design further. Each chapter is designed to get you up and running quickly in key areas.

Who Should Read This Book

If you want to learn to make games, applications, or interactive experiences but don't know where to begin, this book and Unreal Engine are for you. This book is for anyone interested in understanding the fundamentals of Unreal Engine. Whether you are new to game development, a hobbyist, or a student learning to become a professional, you will find something useful in these pages.

How This Book Is Organized and What It Covers

Following the *Sam's Teach Yourself* approach, this book is organized into 24 chapters that should take approximately 1 hour each to work through:

- **Hour 1, "Introducing Unreal Engine 4":** This hour gets you up and running by showing you how to download and install Unreal Engine 4 and introduces you to the Editor interface.
- **Hour 2, "Understanding the Gameplay Framework":** This hour introduces you to the concept of the Gameplay Framework, a key component of every project created in UE4.
- **Hour 3, "Coordinates, Transforms, Units, and Organization":** This hour helps you understand how the measurement, control, and organizational systems work in UE4.
- **Hour 4, "Working with Static Mesh Actors":** In this hour, you learn how to import 3D models and use the Static Mesh Editor.

- **Hour 5, "Applying Lighting and Rendering":** In this hour, you learn how to place lights in a level and how to change their properties.
- **Hour 6, "Using Materials":** This hour teaches you how to use textures and materials in UE4.
- **Hour 7, "Using Audio System Elements":** In this hour, you learn to import audio files, create Sound Cue assets, and place Ambient Sound Actors into a level.
- **Hour 8, "Creating Landscapes and Foliage":** In this hour, you learn to work with UE4's landscape system to create your own landscapes and how to use the foliage system.
- **Hour 9, "World Building":** In this hour, you apply what you learned in the previous hours and create a level.
- **Hour 10, "Crafting Effects with Particle Systems":** In this hour, you learn the fundamental controls of Cascade, which you can use to craft dynamic particle effects.
- **Hour 11, "Using Skeletal Mesh Actors":** In this hour, you learn about the Persona Editor and the different asset types needed to bring characters and creatures to life.
- **Hour 12, "Matinee and Cinematics":** In this hour, you learn to use the Matinee Editor and animate cameras and meshes.
- **Hour 13, "Learning to Work with Physics ":** In this hour, you learn to make Actors simulate physics to respond to the world around them, and you also learn how to constrain them.
- **Hour 14, "Introducing Blueprint Visual Scripting System":** In this hour, you are introduced to basic scripting concepts and learn to use the Level Blueprint Editor.
- **Hour 15, "Working with Level Blueprints":** In this hour, you learn about Blueprint event sequences and create a collision event that responds to the player's actions.
- **Hour 16, "Working with Blueprint Classes":** In this hour, you learn how to create a Blueprint class, use Timeline, and create a simple Pickup Actor.
- **Hour 17, "Using Editable Variables and the Construction Script":** In this hour, you learn to use the Construction Script and editable variables to make modifiable Actors.
- **Hour 18, "Making Key Input Events and Spawning Actors":** In this hour, you learn to make a keyboard input event that spawns an Actor during gameplay.
- **Hour 19, "Making an Action Encounter":** In this hour, you use an existing Game mode and Blueprint classes to design and create your own first- or third-person action-based obstacle course.

- **Hour 20, "Creating an Arcade Shooter: Input System and Pawns":** In this hour, you begin work on a 1990s arcade-style space shooter. You learn about the input system and user-controlled Actors called Pawns.
- **Hour 21, "Creating an Arcade Shooter: Obstacles and Pickups":** In this hour, you continue working on the arcade shooter game, creating asteroid obstacles and health pickups, and you learn how to utilize Blueprint class inheritance.
- **Hour 22, "Working with UMG":** In this hour, you learn to use the Unreal Motion Graphics UI designer and make a start menu.
- **Hour 23, "Making an Executable":** In this hour, you learn the quick path to preparing a project for deployment to other devices.
- **Hour 24, "Working with Mobile":** In this hour, you learn optimization guidelines and techniques for working with mobile devices and some simple ways to utilize touch and motion sensors.

We hope you enjoy this book and benefit from it. Good luck on your journey with the UE4 game engine!

Companion Files: To gain access to project files and downloads, go to the book's companion website at www.sty-ue4.com.

About the Authors

Aram Cookson is a professor in the Interactive Design and Game Development (ITGM) department at the Savannah College of Art and Design (SCAD). He has a B.F.A in Sculpture and an M.F.A. in Computer Art. After finishing his M.F.A., he went on to help start the ITGM program and served as the graduate coordinator for 9 years. Over the past 15 years, Aram has developed and taught a range of game art and design courses in classrooms and online, utilizing the Unreal Engine technology.

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Clinton Crumpler is currently a senior environment artist at Microsoft Studio's The Coalition, located in Vancouver, British Columbia. Previously an artist at Bethesda's Battlecry Studios, KIXEYE, Army Game Studio, and various other independent studios, Clinton's primary focus areas are environment art, shader development, and art direction. Clinton has released multiple video tutorials in collaboration with Digital Tutors, with a focus on game art development for Unreal Engine. He completed an M.F.A. in Interactive and Game Design and a B.F.A. in Animation at Savannah College of Art and Design (SCAD) in Savannah, Georgia. Prior to attending SCAD, he received a B.F.A. in Graphic Design at Longwood University, located in Farmville, Virginia. More information and his digital works are available at www.clintoncrumpler.com.

Dedication

Tricia, Naia, and Elle: I love you all. —Aram

To Grandpa Bob: Thank you for the constant support through my education and career. Without your contributions to my future, I would not be where I am today, and I am ever grateful. —Ryan

To Amanda: Thanks for driving me across the desert while I wrote. —Clinton

Acknowledgments

To my family: Thank you for being so understanding and patient, and for giving me the time to get this done.

Mom and Dad: Thank you for buying my first computer (TRS-80).

Luis: Thank you for thinking of me. You were an awesome department chair.

To Laura, Sheri, Olivia, and all the reviewers: Thank you for all your efforts.

Epic Games: Thank you for developing, and continuing to develop, such amazing technology and games.

—Aram

A big thank you to Samantha for tolerating and accommodating my weekends being entirely consumed at a keyboard. Your patience and support through this process have been invaluable.

—Ryan

Big thanks go out to my best friend, Brian, for always helping me become a better writer and editing my works and always increasing my confidence through brotherly support.

Thanks to Amanda and her family for supporting me while I wrote this during our move cross-country. Your understanding and help are always appreciated.

—Clinton

We Want to Hear from You!

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HOUR 20

Creating an Arcade Shooter: Input Systems and Pawns

What You'll Learn in This Hour:

- Identifying requirements with a design summary
- Creating a new project
- Making a custom Game Mode
- Creating a custom Pawn and Player Controller
- Controlling a Pawn's movement
- Setting up a fixed camera

When making a new video game, you almost always have the player take control of something in the game world. This can mean a full character or a simple object. What is important is that the player does something, like press a key or pull a trigger, and something in the game responds. In UE4, you use *Player Controllers* to interpret those physical actions and *Pawns* to act them out. This hour explores these concepts and helps you create your first game—a simple arcade shooter. You will learn how to determine requirements from a design brief, how to create and set up a new project, how to spawn and use a Pawn, and how to set up a game camera.

NOTE

Hour 20 Setup

In this hour, you begin to create a game from scratch. You will create a Blank project with Starter Content. In the Hour_20 folder (available on the book's companion website at www.sty-ue4.com), you will find the assets that you need to work with along with a version of the game called H20_AcradeShooter that you can use to compare your results.

Identifying Requirements with a Design Summary

No two games are exactly alike. It is important to focus on the fundamental elements you want to include in a game. In this hour, you will make a simple arcade shooter, similar to *Space Invaders* or *Asteroids*. Before you can create the game, you need to determine the requirements and features.

Your design in this case is simple: The player controls a spaceship that can move left or right and has to either dodge or destroy asteroids that are in the way.

Identifying Requirements

It is crucially important to take some time when starting a project to determine what types of interactions are necessary to make the design a reality. Understanding the requirements for a game helps you focus production. For the game you create in this hour, you can break down the design summary into the following component parts:

- The player controls a spaceship.
- The spaceship can move left or right.
- Asteroids are in the player's way, moving downward.
- The spaceship can shoot the asteroids to destroy them.

Breaking down the summary brings up some things you need to keep in mind. The design tells you that you will need an Actor in the game that the player can control; in UE4, these are called *Pawns*. The design also tells you that the movement of the spaceship is limited to one axis. This requirement means you need to set up input bindings for that one axis. Because you know the player is constrained, you can also assume that the camera is fixed and that the player does not control it. You also see what obstacles the player will face and that another type of input is needed to fire a projectile.

Creating a Game Project

The first thing you always need to do when creating a new game is create a new project in UE4. UE4 provides a lot of great starting content and templates for new projects. You can also create fantastic experiences from scratch by using the Blank Project template during project creation.

TIP

Setting Your Startup Level

You can change the default start level that the game and the Editor use by selecting **Project Settings > Maps & Modes**. Changing **Editor Default Map** to the map you are currently working on can speed up your process, and changing **Game Default Map** changes the map the game uses to start (when playing in Standalone).

In the following Try It Yourself, you create a new blank project and an empty map to use as a blank canvas to build your game-creation experience.

TRY IT YOURSELF ▼

Create a New Project and Default Level

Follow these steps to create a new blank project and replace the default level with a new empty level as the foundation for your arcade shooter:

1. Launch the UE4 Project Browser and go to the **New Project** tab, as shown in Figure 20.1.
2. Select the **Blank Project** template.
3. Target the project to **Desktop/Console**.
4. Set the Quality setting to **Maximum Quality**.
5. Set the folder location for your project to be stored.
6. Name the new project **ArcadeShooter**.
7. Click the **Create Project** button to create your new project.
8. When your new project loads, select **File > New Level** (or press **Ctrl+N**).
9. Choose the **Default** template from the New Level dialog.
10. Select **File > Save As** (or press **Ctrl+Shift+S**).
11. In the Save Level As dialog, right-click the **Content** directory and select **New Folder**. Rename the new folder **Maps**.
12. Make sure the **Maps** directory is selected and in the **Name** field, name the map **Level_0**.
13. Click **Save**.
14. In the Project Settings panel, click **Maps & Modes**.
15. Set both Game Default Map and Editor Startup Map to **Level_0**.

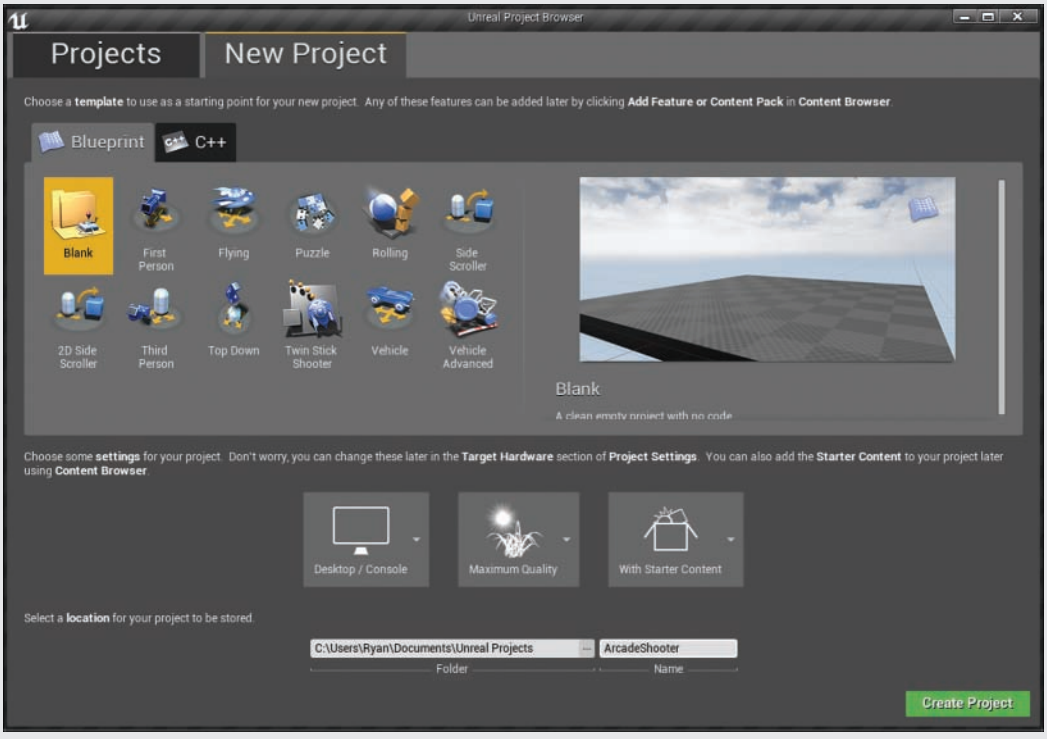


FIGURE 20.1
The New Project tab in the UE4 Project Browser.

TIP

The Maps Folder

While you can store level UAssets in any directory inside the Content directory, it is highly recommended that you store all levels in a directory named Maps. As long as your level is within a folder named Maps, it will show up in drop-down lists like the ones for the game default map. It will also make using the UE4 Front End executable for distribution and cooking slightly simpler by finding your levels automatically.

Now that you have created a basically empty level, you can move on to setting up the game's logic and systems.

Creating a Custom Game Mode

You need a place to store your game's logic and behaviors. In UE4, each level has its own Blueprint, which is one place to store game logic, but putting too much scripting in the Level Blueprint means a lot of copying and pasting down the road to transfer that logic to new levels and maps. Instead, UE4 has the concept of a Game Mode. Like Level Blueprints, Game Modes can store complex behaviors related to a game, but unlike with Level Blueprints, that behavior can be shared between multiple levels.

The Game Mode is responsible for defining the behavior of the game being played and enforcing rules. The Game Mode holds information about items a player begins the game with, what happens when the player dies or the game ends, game time limits, and scores.

Game modes are the glue between many of the different systems in a game. Game mode Blueprints hold the characters or Pawns you are using and also reference which HUD class to use, which spectator class to used, and the game state and player state classes that control the information necessary for multiplayer experiences.

At the most basic level, the Game Mode sets the rules of the current game—for example, how many players can join, how level transitions are handled, information about when the game is paused or active, and game-specific behaviors like win and loss conditions.

Creating a new Game Mode is easy. In the Content Browser, right-click and select **Blueprint Class** to open the **Pick Parent Class** window, which is where you can select **Game Mode**, as shown in Figure 20.2.

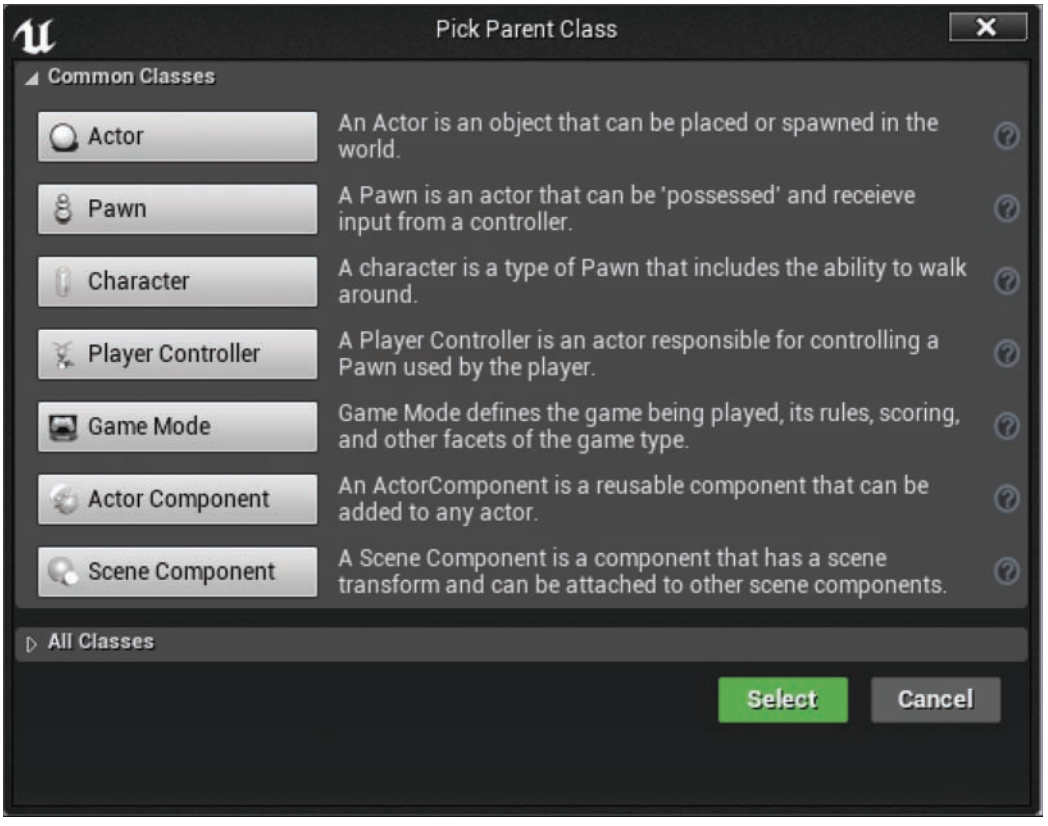


FIGURE 20.2
The Pick Parent Class window. This commonly used window offers several class options, including the Game Mode option you need now.

TRY IT YOURSELF

Create a New Game Mode Blueprint Class

Follow these steps to create a new Game Mode Blueprint class to store the game's logic:

1. In the Content Browser, right-click and select **Folder**.
2. Name this folder **Blueprints**.
3. Double-click the **Blueprints** folder to open into it.
4. In the Content Browser, right-click and select **Blueprint Class**.
5. In the Pick Parent Class window that appears, select **Game Mode**.
6. Name your new Game Mode **ArcadeShooter_GameMode**.
7. Select **File > Save All** (or press **Ctrl+S**).

Now that you have a new Game Mode, you need to tell UE4 to load it instead of the default Game Mode. You do this in the Project Settings panel.

TIP

Level Overrides

Sometimes it is necessary to use different Game Modes during different parts of a game. Each level can also override the Game Mode and class settings. To change these settings on a per-level basis, select **Window > World Settings** and find the Game Mode Override property. This property works exactly as it does in the Project Settings panel. Also, when you add a Game Mode Override setting, you can override other properties, such as those for Pawns or HUD classes, which can be especially useful when you're prototyping new features.

There is only ever one Game Mode present per level—either the default Game Mode set in the Project Settings panel or the Game Mode set on a per-level basis. In a multiplayer game, the Game Mode only ever runs on the server, and the results of the rules and state are sent (replicated) to each client.

TRY IT YOURSELF ▼

Set the New Default Game Mode

Follow these steps to use the Maps & Modes section of the Project Settings panel to set the default Game Mode for your game:

1. Select **Edit > Project Settings**.
2. In the Project Settings panel, click the **Maps & Modes** section.
3. In the Default Modes section, click the **Default GameMode** field to open the search box for all Game Modes.
4. Select your newly created **ArcadeShooter_GameMode** Game Mode.

Creating a Custom Pawn and Player Controller

In UE4, Actors that are controlled directly by players or artificial intelligence (AI) are called Pawns. These Pawns can be practically anything: dinosaurs, humans, monsters, vehicles, bouncy balls, spaceships, even animate food. Any player- or AI-controlled entity in a game is a Pawn. Some games may not have physical or visible representations of players, but Pawns are still used to represent the physical locations of players in the game world.

Pawns define the visible appearance of the controlled objects and also can control movement, physics, and abilities. It is often useful to think of them as the physical bodies of the player in the game world.

The non-physical representation of a player is a Controller. Controllers are the interface between a Pawn and the player or AI controlling it.

Controllers are Actors that can possess and control Pawns. Again, Controllers are non-physical and usually do not directly determine physical properties (e.g., appearance, movement, physics) of the possessed Pawn. Instead, they are more the representation of the *will* or *intent* of the player.

There is a one-to-one relationship between Controllers and Pawns—in other words, one Controller per Pawn and one Pawn per Controller. With this in mind, Pawns can be possessed (i.e., controlled) by AI through an AI Controller or by a player through a Player Controller.

The default Player Controller handles most behavior you need for your game, but you should create your own Pawn.

Inheriting from the Default Pawn

To create a Pawn, you can create a new Blueprint class. This time, however, you start with a class from the All Classes section of the Pick Parent Class window that has a few more features already premade for you. When you create a Blueprint class, you expand the **All Classes** to get access to all the classes in the project. As shown in Figure 20.3, you can look through this list for specific classes. In this case, you want to use the DefaultPawn class because it automatically sets up some of the behaviors that you are going to need in your game.

FIGURE 20.3
In the Pick Parent Class window, expand the All Classes subsection and search for the Pawn you want, such as DefaultPawn.

TIP

Class Inheritance

Inheriting from an existing class allows generalized behaviors to be shared with extreme ease. By inheriting from the DefaultPawn class, for example, you create a class that is a clone of several generalized behaviors but that has the ability to make specific changes. If improvements are made to the DefaultPawn class (or any of its parents), your Pawn will automatically receive those improvements as well.

Using inheritance throughout a project helps you avoid repetition and inconsistent work.

TRY IT YOURSELF ▼

Create Custom Pawn and Player Controller Classes

Follow these steps to create a new Blueprint class that inherits from the DefaultPawn class and create a new Blueprint class that inherits from the Player-Controller class:

1. In the Content Browser, navigate to the **Blueprints** folder.
2. Right-click in the Content Browser and select **Blueprint Class**.
3. In the Pick Parent Class window that appears, expand the All Classes category.
4. In the Search field, type **defaultPawn** and select the **DefaultPawn** class from the results. Click **Select** at the bottom of the window.
5. Rename the new Pawn Blueprint class **Hero_Spaceship**.
6. Right-click in the Content Browser and select **Blueprint Class**.
7. In the Pick Parent Class window that appears, expand the Common Classes category and select **Player Controller**.
8. Rename the new Player Controller Blueprint class **Hero_PC**.

You now have a new Pawn class, and you need to understand the different parts that make up the class. Double-click your new **Hero_Spaceship** class in the Content Browser to open it in the Blueprint Class Editor.

Look at the component hierarchy. By default, there are three components in a DefaultPawn class: CollisionComponent, MeshComponent, and MovementComponent (see Figure 20.4). These three components handle the major types of behaviors a Pawn is responsible for.

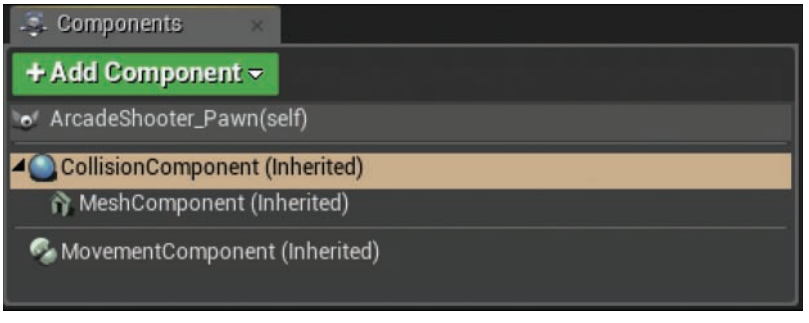


FIGURE 20.4
The component hierarchy in the Blueprint Class Editor for a DefaultPawn class.

`CollisionComponent` handles both physics collisions of the Pawn and trigger overlaps of the Pawn with volumes or Actors in the level. It represents the physical volume of the Pawn and can be shaped to fit the Pawn's simplified form. `CollisionComponent` does not show up in a game and is not part of the Pawn's visual representation.

`MeshComponent` controls the visuals in a game. Right now for your game, this `MeshComponent` class is a sphere, meaning that the visual representation of your Pawn is a sphere. You can replace or modify `MeshComponent` to make your Pawn look like anything you desire. You can add other types of components here to change the visuals, including Particle Emitters, Skeletal Meshes, 2d Sprites, and complex hierarchies of Static Meshes.

`MovementComponent` controls your Pawn's movement. Using `MovementComponent` is a convenient way of handling player movement. Complex tasks (such as checking for collision and handling velocity) are simplified through the convenient interface of `MovementComponent`.

Because you haven't changed it yet, your Pawn is currently just a simple sphere. You can change this by replacing MeshComponent completely or by changing its Static Mesh reference. In the next Try It Yourself, you will import the UFO mesh used by many of the UE4 content examples and then replace the current Pawn's mesh with it.

▼ TRY IT YOURSELF

Make the Spaceship Look Good

Your new Pawn is pretty drab as a sphere. Follow these steps to improve its looks:

1. In the root folder in the Content Browser, right-click and select **New Folder** to create a new folder.
2. Rename this new folder **Vehicles**.
3. Open the **Vehicles** folder and click the **Import** button.
4. In the Import dialog, navigate to the **Hour_20/RawAssets/Models** folder that comes with the book.
5. Select the **UFO.FBX** file and click **Open**.
6. In the FBX Import Options dialog that appears, leave all the settings at their defaults and click **Import All**.
7. In the Content Browser click **Save All** (or press **Ctrl+S**).
8. In the Content Browser, navigate to the **Blueprints** folder and double-click the **Hero_Spaceship** Blueprint class UAsset to open it in the Blueprint Class Editor.
9. If the Editor shows only the Class Defaults panel, then in the note beneath the panel title, click the **Open Full Blueprint Editor** link.

10. In the Components panel, select **MeshComponent**; in the Details panel, select the Static Mesh drop-down, type **UFO** in the search box, and select the **UFO UAsset** from the search results.
11. In the Details panel, set the transform's Scale property to **0.75, 0.75, 0.75** to fit the UFO's bulk inside the CollisionComponent's radius.
12. In the toolbar, click **Compile** and then click **Save**.

Controlling a Pawn's Movement

UE4 makes controlling a Pawn's movement very easy. Because you inherited your Pawn from the DefaultPawn class, all the heavy lifting has already been done. To see just how simple it is to control your Pawn's movement, you can test your work.

First, you need to tell the Game Mode to spawn the player using your new **Hero_Spaceship** Pawn by default. You set this in the class Defaults panel in the Game Mode's Blueprint Class Editor or in the Maps & Modes section of the Project Settings panel.

In the next Try It Yourself, you set the Hero_Spaceship Pawn class as the default Pawn class in **ArcadeShooter_GameMode**. You also set the Player Controller class to **Hero_PC**.

TRY IT YOURSELF

Set the DefaultPawn and PlayerController Classes

The Game Mode needs to know which Pawn and Player Controller you want to be spawned when the game starts. Follow these steps to set these things now:

1. In the Content Browser, navigate to the **Blueprints** folder and double-click the **ArcadeShooter_GameMode** Blueprint class UAsset.
2. In the class Defaults panel, in the Classes category, find the Default Pawn Class property and click its down arrow.
3. Select the **Hero_Spaceship** Blueprint class.
4. Also in the class Defaults panel, click the down arrow next to the Player Controller property and select the **Hero_PC** Blueprint class.
5. In the toolbar, click **Compile** and then click **Save**.

With Hero_Spaceship set up to be the Game Mode's default Pawn, you are ready to test your Pawn's movement. In the Level Editor toolbar, click **Play**, as shown in Figure 20.5. When the game starts, use the **arrow keys** or **WSAD** to move around. You can also use the mouse to look around. When you are done, press the **Esc** key to stop.

CAUTION

Using a Player Start

If things don't seem to be working, it may be because there is no Player Start Actor in the scene. If you don't see Player Start in your World Outliner panel, you can easily add a new one by going to **Modes** > **Basic** > **Player Start** and dragging it into the world. Remember to rotate the Player Start Actor to the direction in which you want your Pawn to come out looking!

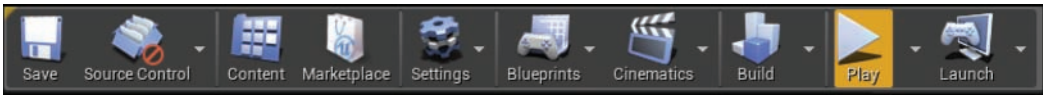
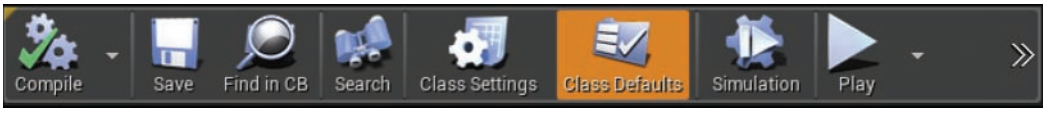


FIGURE 20.5
Click the Play button on the toolbar to instantly test your game while staying in the Editor.

Although your Pawn can move freely, a couple things don't seem to match your design brief. First, the camera is first person instead of top-down and fixed. Second, your Pawn is moving forward and backward as well as side to side. In this case, you want to pull back from all the features that UE4 has provided you and put in some logic to lock things down.

Disabling the Default Movement

The DefaultPawn class does a lot automatically, but in this case, you want to more manual control. Luckily, it's pretty simple to get that control. The DefaultPawn class's Defaults panel contains a property called Add Default Movement Bindings, which is selected by default. By unselecting this property, you can disable the DefaultPawn class's basic movement and overwrite its behavior and bindings with your own (see Figure 20.6).



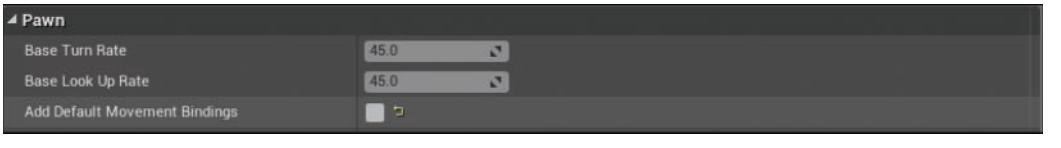


FIGURE 20.6
In the Class Defaults of the Pawn, disable the Add Default Movement Bindings check box.

TRY IT YOURSELF ▼

Disable Default Movement

In the game you are creating, the default Pawn is doing more than you need. Follow these steps to disable this behavior through the Hero_Spaceship Pawn's Blueprint class defaults:

1. In the Content Browser, navigate to the **Blueprints** folder and double-click the **Hero_Spaceship** Blueprint class.
2. In the Class Defaults panel, in the Pawn category, ensure that the **Add Default Movement Bindings** property's check box is unchecked to disable this feature.
3. In the toolbar, click **Compile** and then click **Save**.
4. Play again and notice that you can no longer move around. The camera is still in first person, but your spaceship is now locked where it was spawned.

Setting Up Input Action and Axis Mappings

A locked spaceship isn't exactly what you want. It looks like you quickly swung from too much freedom to none at all, and you need to add back some user control. One part of this is binding different keypresses to different actions. Taking an input—like a joystick movement, a keypress, or a trigger pull—and registering a specific action with that input is called *input binding*, and you do this at the Project level.

To set input binding, select **Settings > Project Settings** and then open the **Input** section of the Project Settings panel. At the top of this section are two lists in the Bindings section: Action Mappings and Axis Mappings. The difference between these two sections is subtle but important. *Action mappings* are for single keypress and release inputs. These are usually used for jumping, shooting, and other discrete events. *Axis mappings* are for continuous input, such as movement, turning, and camera control. Both types of mappings can be used simultaneously and picking the right type of binding for your actions will make creating complex and rich player interactions easier.

Axis mappings work slightly differently depending on the hardware generating an input. Some hardware (such as mice, joysticks, or gamepads) return input values to UE4 in a range from –1 to 1. UE4 can scale that value, depending on how much the user wants to let the input influence the game. Keyboards, however, separate up and down and left and right to different keys and don't provide a continuous range of input. A key is either pressed or it isn't, so when you're binding a key as an axis mapping, UE4 needs to be able to interpret that pressed key as a value on that same –1 to 1 scale.

For movement, you use axis mappings, and in your arcade shooter, you are limiting the player's movement to a single axis, so the player can move either left or right. In the next Try It Yourself, you set up the input bindings to support left and right movement for your Pawn.

TRY IT YOURSELF

Create the MoveRight Set of Mappings

In the following steps, you set up the game to be prepared for user input. Bind all the appropriate keys and the left gamepad thumbstick to left and right movement. Any bindings that will cause the user to move left instead of right should have a value of –1.0 set for their scale.

1. Select **Edit > Project Settings**.
2. In the Project Settings panel, select the **Input** category.
3. Under the Bindings category, find the Axis Mappings property, click the + icon beside it.
4. Expand the Axis Mappings field by clicking the arrow to the left of it, and rename the mapping **MoveRight**.
5. Click the arrow to the left of the MoveRight binding to expand the key binding list.
6. Click the + icon beside the MoveRight field four times to create five None mappings.
7. Click the down arrow next to each None field and replace each field to match Figure 20.7.
8. Ensure that each Scale property is set to match Figure 20.7.

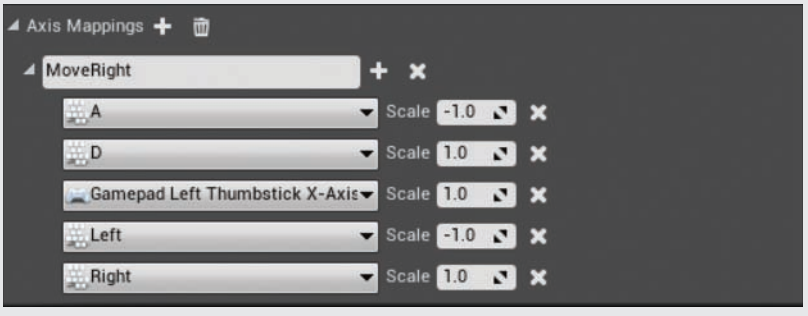


FIGURE 20.7
The Axis Mappings settings for MoveRight, which have three parts each: the name of the mapping, the key or axis that is being bound, and the amount positive or negative of the input that should be accumulated each second.

At the top of the Axis Mappings properties in the Project Settings panel is a field where you input the name for the action that is to be performed. You click the + symbol beside the action name to add a new binding. Each binding has two parts: the input that is being bound and a scale next to it that modulates the result.

You want the game to treat keypresses, like **A** and **D**, as a continuous axis. To do this, you need to have some of those keys be negative; in other words, when you press left, you want the axis to go down, and when you press right, you want the axis to go up.

For thumbstick axes (e.g., **Gamepad Left Thumbstick X-Axis**), the negative values are already calculated, so the scale should usually just be **1.0**.

In this example, the keys **A** and **D**, the **left arrow** and **right arrow** keys, and the **Gamepad Left Thumbstick** are all being bound to the **MoveRight** action. This brings up an important distinction: By using Action Mappings and Axis Mappings, you can bind multiple different input methods to the same event. This means less testing and duplication of Blueprint scripts in your project, and it means everything becomes more readable. Instead of having Blueprint scripts checking whether the **A** key is pressed, the Blueprint can just update movement when the MoveRight event is triggered.

But just creating an input binding doesn't make things move. Now you need to actually use the MoveRight action.

Using Input Events to Move a Pawn

You are now ready to set up movement again. You have a fancy input axis called MoveRight and a Pawn that is just itching to move again. First, you need to open the Blueprint Class Editor of your Pawn and go to the Event Graph. Here, you can begin to lay down behaviors that will fire when your MoveRight action is triggered.

In the Event Graph, right-clicking and searching for your action by name, **MoveRight**, brings up the InputAxis MoveRight event into the graph, as shown in Figure 20.8.

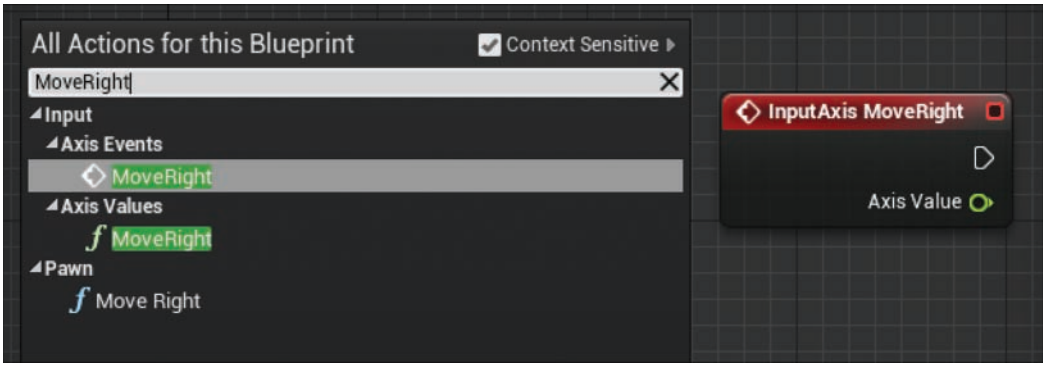


FIGURE 20.8
Axis mappings show up by name under Axis Events. There are also Axis Values functions and Pawn functions, but these functions are not what you are looking for in this case.

Once you have an axis event, you can query the axis value and convert it into movement. To do this you need a few more Blueprint nodes, starting with Add Movement Input. This function works with MovementComponent to interpret a value and a world space direction to move the Pawn in.

By hooking up the **InputAxis MoveRight** event's execution pin and the value that is returned in **Axis Value** to **Add Movement Input**, MovementComponent can take the player's inputs and move the Pawn in a world direction.

Since you want the spaceship to move left or right on input, you need to take the vector coming from the Pawn's right axis. You can get this vector by using the Get Actor Right Vector node and plugging its Return Value into the Add Movement Input's World Direction (see Figure 20.9).

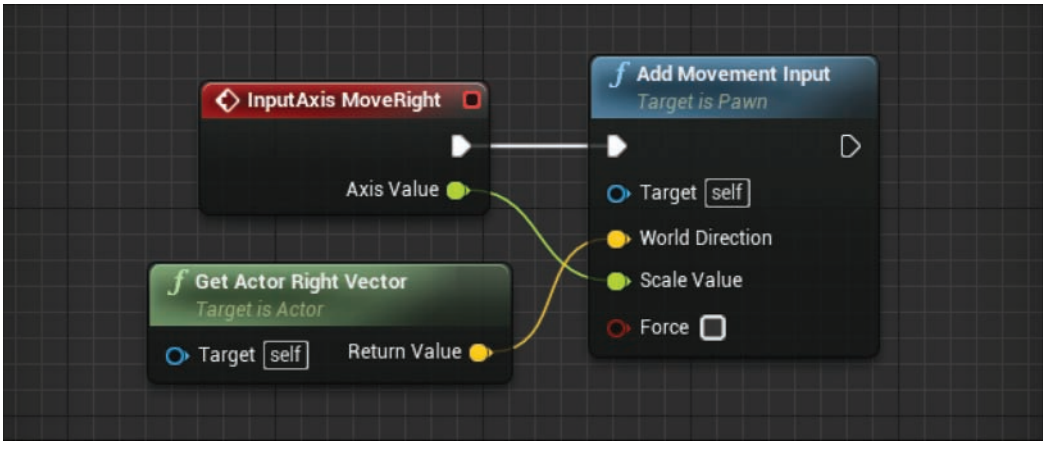


FIGURE 20.9
The finished graph of the Add Movement Input.

TRY IT YOURSELF

Hook Up the MoveRight Axis Mapping to the Pawn's Movement

With the MoveRight axis mapping, the Pawn needs to know how to interpret the values that come from the mapping. Follow these steps to hook up the simple graph required to tell the Pawn how to move on player input:

1. In the Content Browser, navigate to the **Blueprints** folder and double-click the **Hero_Spaceship** Pawn's Blueprint class to open the Blueprint Class Editor.
2. Right-click in an open space in the **Event Graph** and enter **moveright** in the search box.
3. Select **Axis Events > MoveRight** from the search results.
4. Click+drag from the InputAxis MoveRight event node's exec out pin and place an **Add Movement** input node.

5. Hook the InputAxis MoveRight event node's Axis Value output pin to the Add Movement Input node's Scale Value input pin.
6. Click+drag from the Add Movement Input node's World Direction input pin and place a **Get Actor Right Vector** node.
7. On the toolbar, click **Compile** and then click **Save**.
8. When this graph is all hooked up, test the game again. Pressing any of the input keys (A, D, left arrow, right arrow) or using a compatible gamepad's left thumbstick should move the camera either right or left.

TIP

Default Pawn Goodness

In your game, you use Add Movement Input, which takes a world direction. This powerful function can move the Pawn in any direction. The DefaultPawn class, however, gives you some convenience functions for this exact use case. Try replacing the Add Movement Input and Get Actor Right Vector with the DefaultPawn class's MoveRight function. This will have exactly the same result, but it keeps the graph a little bit cleaner, as shown in Figure 20.10.

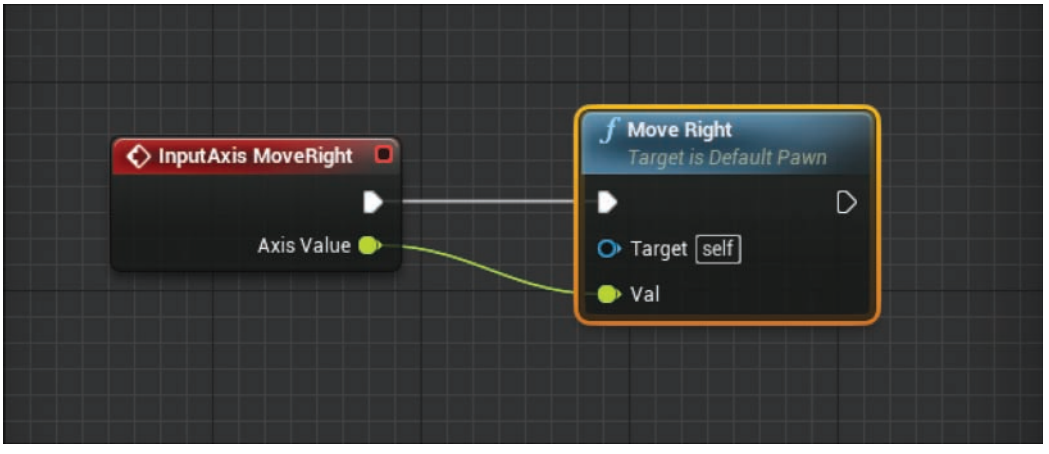


FIGURE 20.10
Alternative setup, showing the DefaultPawn class's MoveRight function instead of the Add Movement Input node.

Setting Up a Fixed Camera

Right now, your game has a camera that follows your Pawn around. This is the default, but for the game you want to make, it isn't quite right. Instead, you want a camera to stay fixed, looking down at the spaceship from above. You also don't want it to move when the Pawn does.

To solve this quandary, you can use Camera Actors and view targets and the built-in PlayerController class to set the view that a player sees. This setup could be done in the Level Blueprint, but it would then be more difficult to port your game logic to a new level. Instead, you are going to bundle this camera logic into a Game Mode. When the game begins, the Game Mode will spawn a camera for your game and then tell the PlayerController class to use that new camera.

In the next Try It Yourself, you use the BeginPlay event and the SPawn Actor from Class node to create a new camera and position it with a Make Transform node before setting it as the PlayerController class's view target.

▼ TRY IT YOURSELF

Create and Set a Fixed-Position Camera

Follow these steps to use the ArcadeShooter_GameMode to spawn a new camera and set it as the PlayerController class's view target:

1. In the Content Browser, navigate to the **Blueprints** folder and double-click the **ArcadeShooter_GameMode** Blueprint class to open the Blueprint Class Editor.
2. If the Editor shows only the Class Defaults panel, then in the note beneath the panel title, click the **Open Full Blueprint Editor** link.
3. In the EventGraph, locate the Event BeginPlay node, and if it doesn't exist, create it by right-clicking and searching for **begin play**.
4. Click+drag from the Event BeginPlay node's exec out pin and place a **SPawn Actor from Class** node.
5. On the SPawn Actor from Class node, click the down arrow in the Select Class field, and select **CameraActor**.
6. Click+drag from the SPawnActor CameraActor node's SPawn Transform property and place a **Make Transform** node.
7. Set the Make Transform node's Location property to **0.0, 0.0, 1000.0**.
8. Set the Make Transform node's Rotation property to **0.0, –90.0, 0.0**.
9. To the right of the SPawnActor CameraActor node place a new **Get Player Controller** node.
10. Click+drag from the Get Player Controller node's Return Value output pin and place a **Set View Target with Blend** node.
11. Hook the SPawnActor CameraActor node's Return Value output pin into the Set View Target with Blend node's New View Target input pin.
12. Hook the SPawnActor CameraActor node's Exec Out pin to the Set View Target with Blend node's exec in pin. Figure 20.11 shows the completed GameMode Event Graph.

13. On the toolbar, click **Compile** and then click **Save**.

14. Give the game another test run. At this point the camera should be looking straight down at your Pawn, which moves left or right when its input keys are pressed.

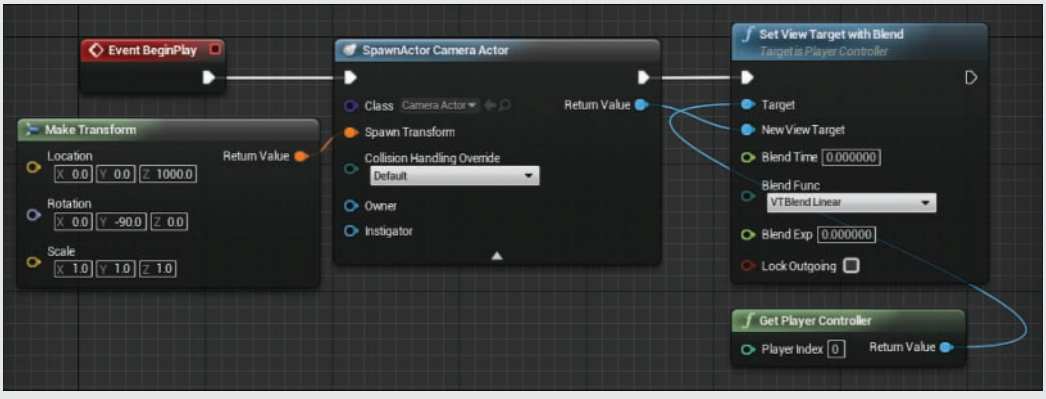


FIGURE 20.11
The finished Event Graph to set up a fixed camera in the Game Mode.

Summary

In this hour, you learned how to make a new UE4 project from scratch and how to get it set up with a custom level and a new Game Mode. You learned what Pawns and Player Controllers are and how to use them. You also learned how to disable the default movement of the DefaultPawn class and how to hook up your own movement and inputs through the Project Settings panel. Finally, you explored one way of setting up a fixed camera in a game.

Q&A

Q. Why should I put all the game logic in a Game Mode instead of in a Level Blueprint?

A. There is no requirement that game logic be put in one place or the other. Instead, it helps to think of the separation as a way to reduce repeated work later. All the logic that is shared between multiple levels should probably be put in a Game Mode or individual Actors, while level-specific logic (like triggers that cause doors to open or lights to turn on) should usually be put in Level Blueprints. You can choose to put everything in Level Blueprints, but if you decide to make a new level, you will have a harder time making sure everything works there and stays up to date than if you primarily use a Game Mode.

Q. Does a Pawn need to inherit from the default Pawn?

A. Not at all! DefaultPawn is just a convenience class, but all its features can be replicated with a bit of work. UE4 also comes with some other convenient Pawn classes, such as the Character class, which contains a Skeletal Mesh component and some logic dedicated to locomotion.

Q. Positioning a camera by inserting raw numbers is difficult. Do I have to spawn a camera this way?

A. No. Another option is to place a camera in a level and then reference it in level script when calling Set View Target with Blend. This brings the logic out of the Game Mode and makes it level specific, allowing easier artistic control of the camera.

Q. I don't like the speed at which my Pawn moves. Can I change it?

A. Absolutely. To change the Pawn's movement speed, open up the Pawn's Blueprint Class Editor and select MovementComponent. In the Details panel, set the three float values that control the Pawn's max speed, acceleration, and deceleration.

Q. Do I have to use only the single MeshComponent in the Hero_Spaceship Pawn Blueprint class?

A. No, you can use any number of components to define the visuals of a Pawn. If you are adding several components (or even if you are sticking with the single one), you might want to disable the physics simulation of your Static Mesh components. You can change the collision presets by clicking on the individual component and finding the **Collision Presets** property in the Details panel. Setting Collision Presets to **No Collision** ensures that it incurs the lowest physics cost possible. Make sure CollisionComponent has **Pawn Preset** and **Generate Overlap Events** enabled; if you don't do this, in the next hour nothing will work. Also, if you disable collision of any individual Static Mesh or visual components, make sure the CollisionComponent's sphere encapsulates your visuals.

Workshop

Now that you have finished the hour, see if you can answer the following questions.

Quiz

1. True or false: Pawns are Actors that players or AI control directly.
2. True or false: UE4 automatically knows which Game Mode to use by detecting it in the Content Browser.
3. True or false: Action bindings and axis bindings only work with fixed names such as MoveRight.
4. True or false: Axis bindings are for continuously pressed inputs like holding down a key or moving a joystick.

Answers

1. True. Any Actors in the scene that AI or players directly control are called Pawns.
2. False. The Game Mode must be set either in the Project Settings panel or the level's World Settings panel.
3. False. Any string can be put into the input binding's Name field and work. For example, you could replace MoveRight with Strafe.
4. True. Any time you need more input information than a simple on or off switch, an axis binding is what you should map your actions to.

Exercise

In this hour's exercise, practice setting up new input bindings to control your Pawn, modifying your Pawn, and customizing your level. Hook the left and right movement of your Pawn to your mouse input, and add walls or other affectations to your level. Then make the floors and walls invisible. The following steps should be done in the same Project and Level made for this hour.

1. Select **Project Settings** > **Input** and in the Move Right binding found, add a new axis.
2. Set the new axis to **Mouse X** and the Scale property to **1.0**.
3. Preview your game to see the mouse affect your Pawn's location.
4. Select the MovementComponent of your Pawn in the Pawn's Blueprint Class Editor.
5. Modify the **Max Speed** and **Acceleration** settings of MovementComponent to change how fast the Pawn moves.
6. Select the floor of your level and duplicate it several times by pressing **Ctrl+W**.
7. Position the duplicated floors to box out the left and right sides of your level and stop your Pawn from being able to leave the camera's view.
8. Select all the duplicate floors and enable the **Actor Hidden in Game property** in the Rendering category to make all the floors invisible while the game is running.

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