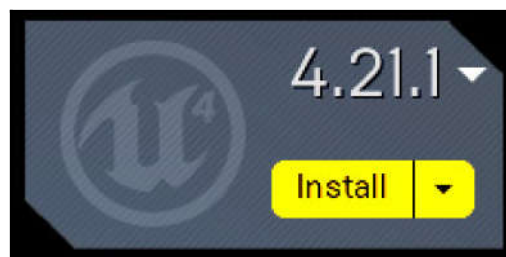
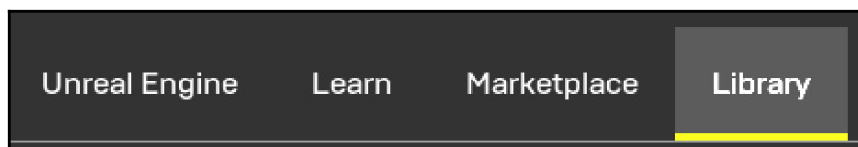
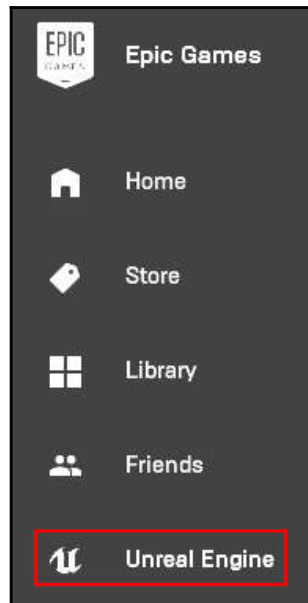


# Chapter 1: Introduction to Unreal Engine 4



**Projects** **New Project**

Choose a **template** to use as a starting point for your new project. Any of these features can be added later by clicking **Add Feature** or **Content Pack** in **Content Browser**.

Blueprint C++

Blank First Person Flying Handheld AR nDisplay Puzzle

Rolling Side Scroller 2D Side Scroller **Third Person** Top Down Twin Stick Shooter

**Third Person**

The third person template features a playable character where the camera is

Desktop / Console

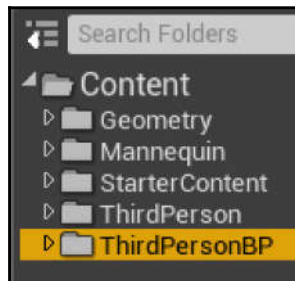
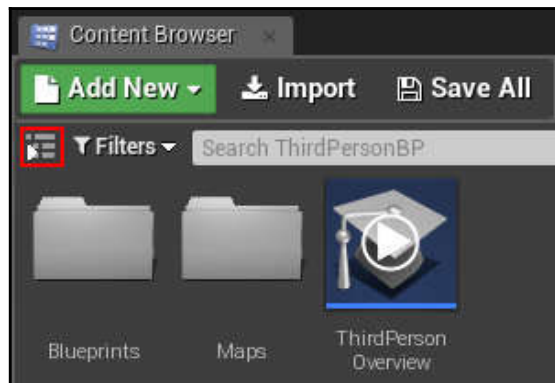
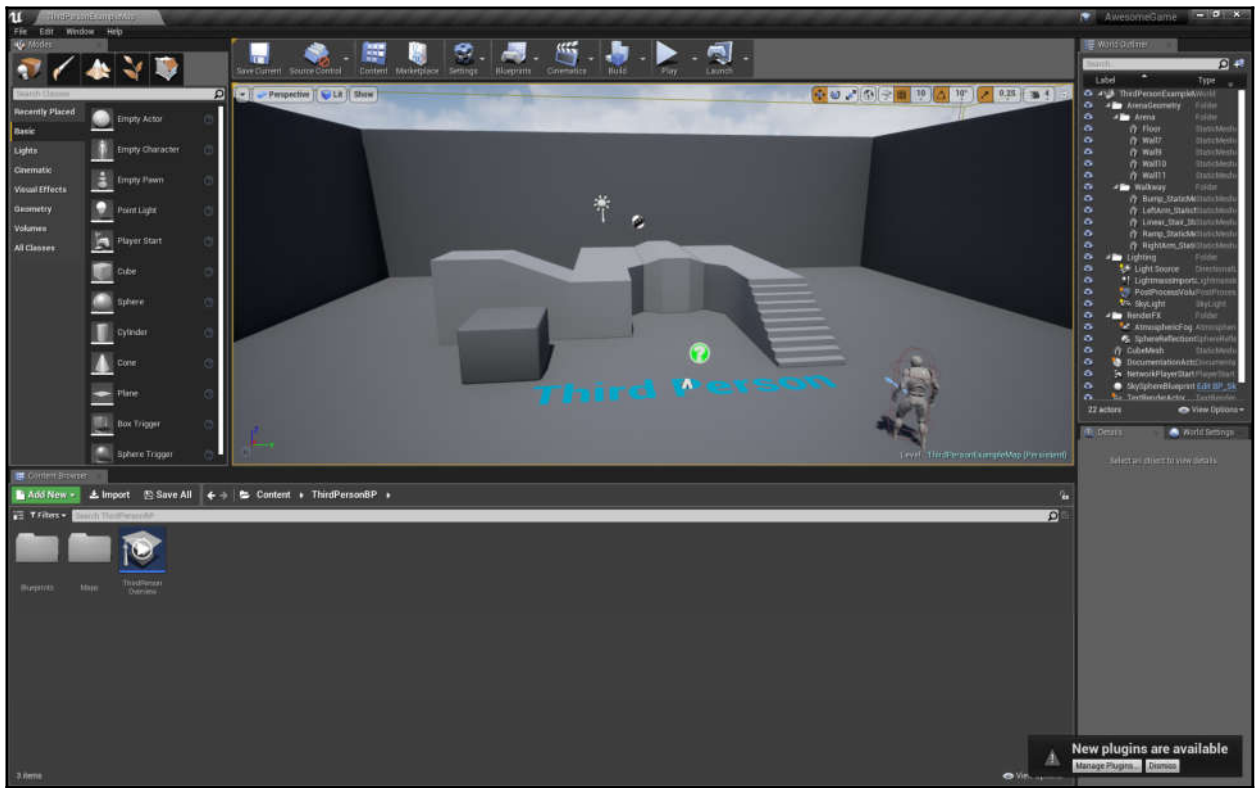
Maximum Quality

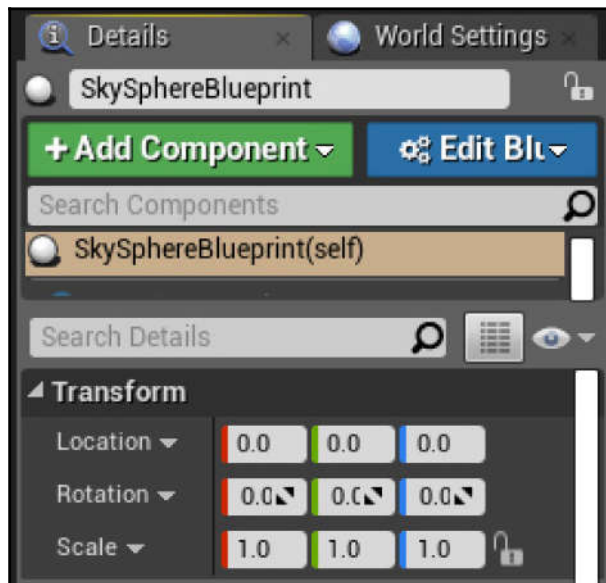
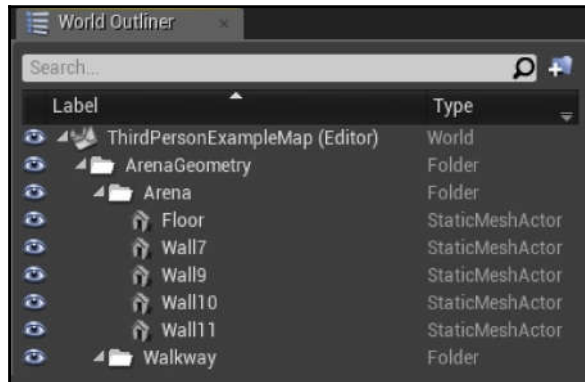
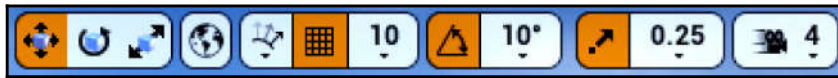
With Starter Content

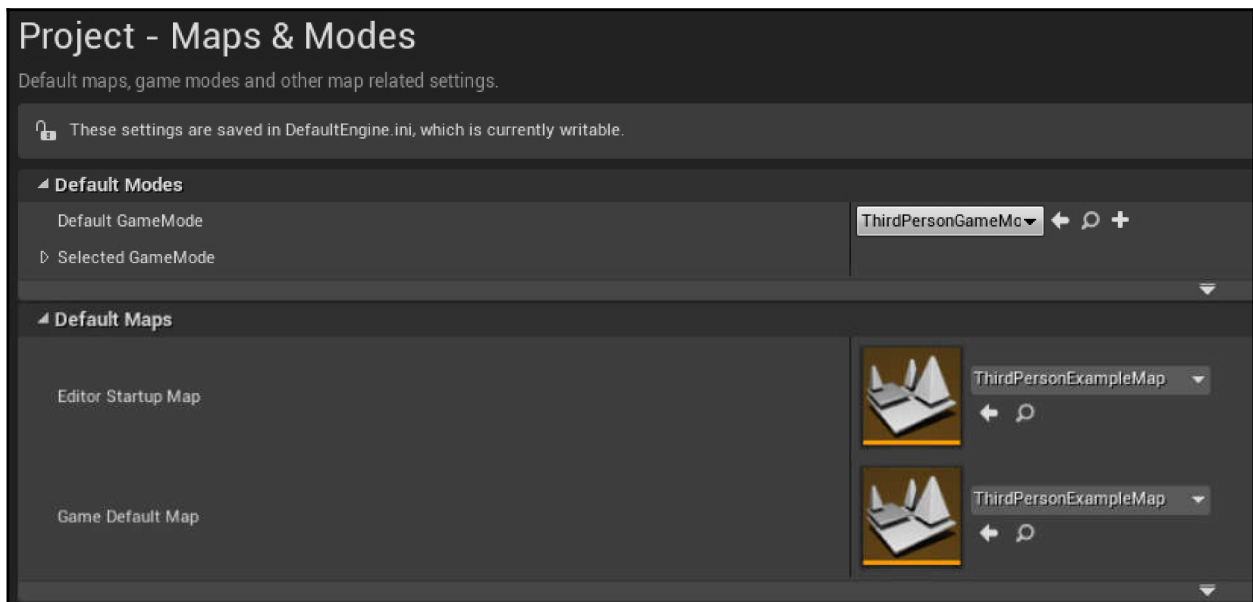
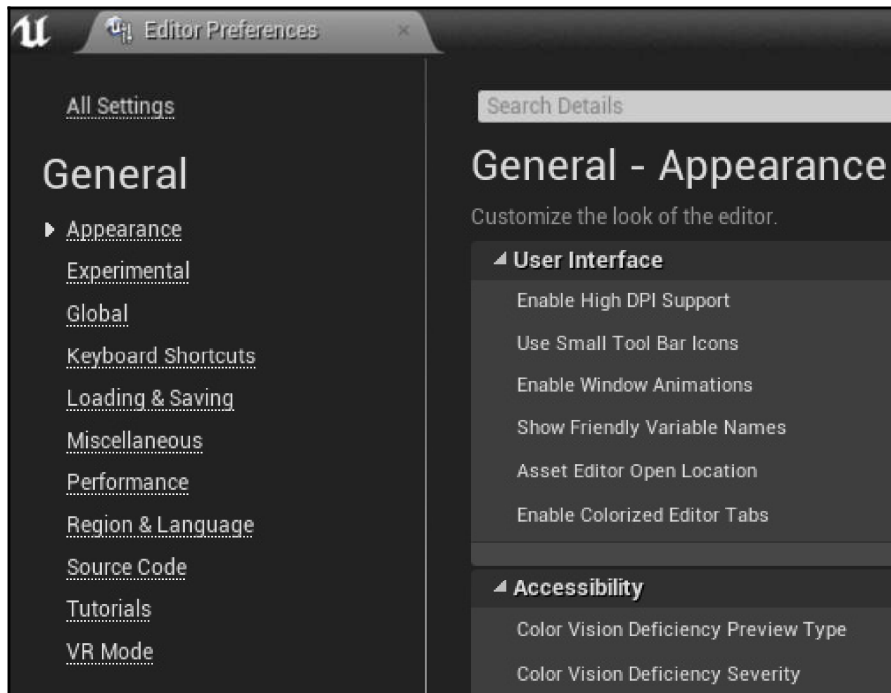
**AwesomeGame**  
EDITOR

Unreal Editor 4.21.1 - AwesomeGame  
Copyright © 1998-2018 Epic Games, Inc. All rights reserved.

Loading... 91%








## Engine - Input

Input settings, including default input action and axis bindings.

 These settings are saved in DefaultInput.ini, which is currently writable.

### Bindings

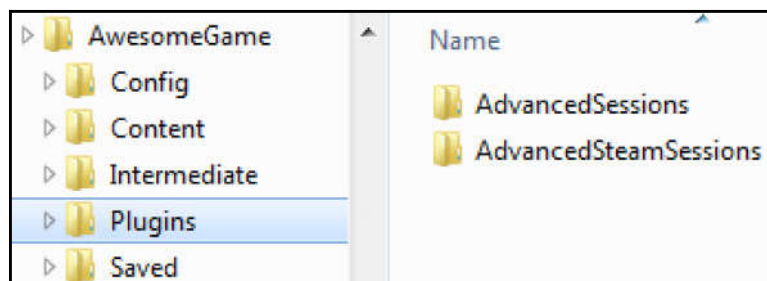
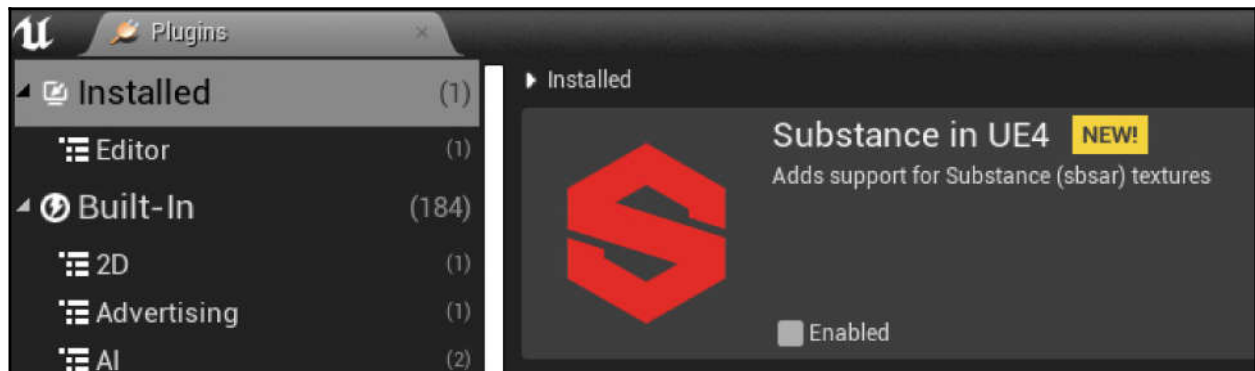
Action and Axis Mappings provide a mechanism to conveniently map keys range.

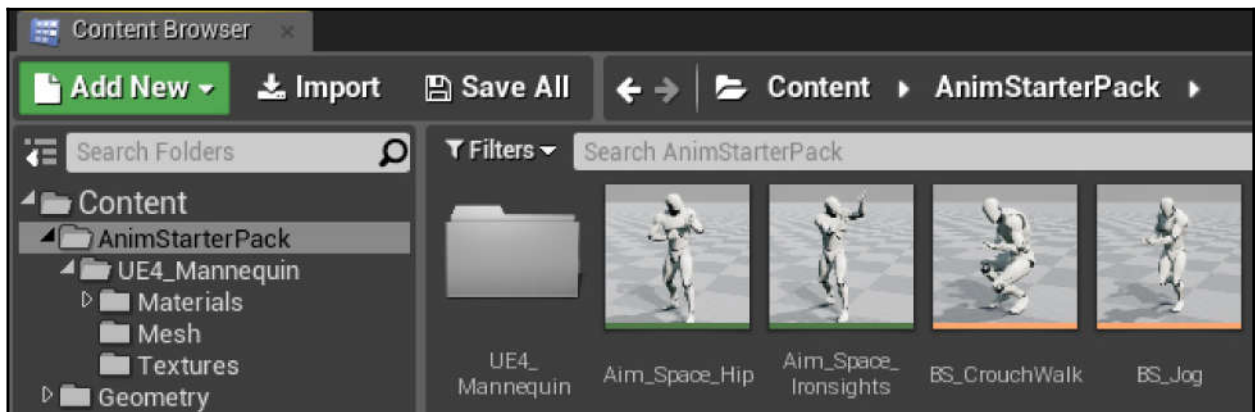
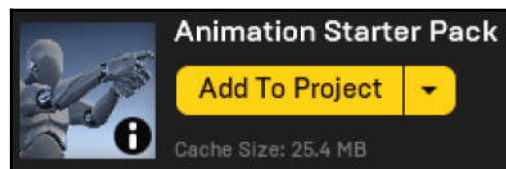
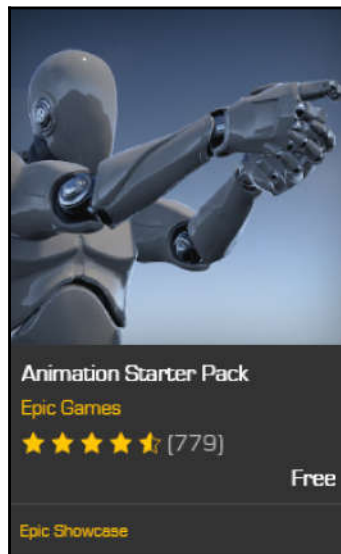
#### Action Mappings +

- ▷ Jump + ×
- ▷ ResetVR + ×

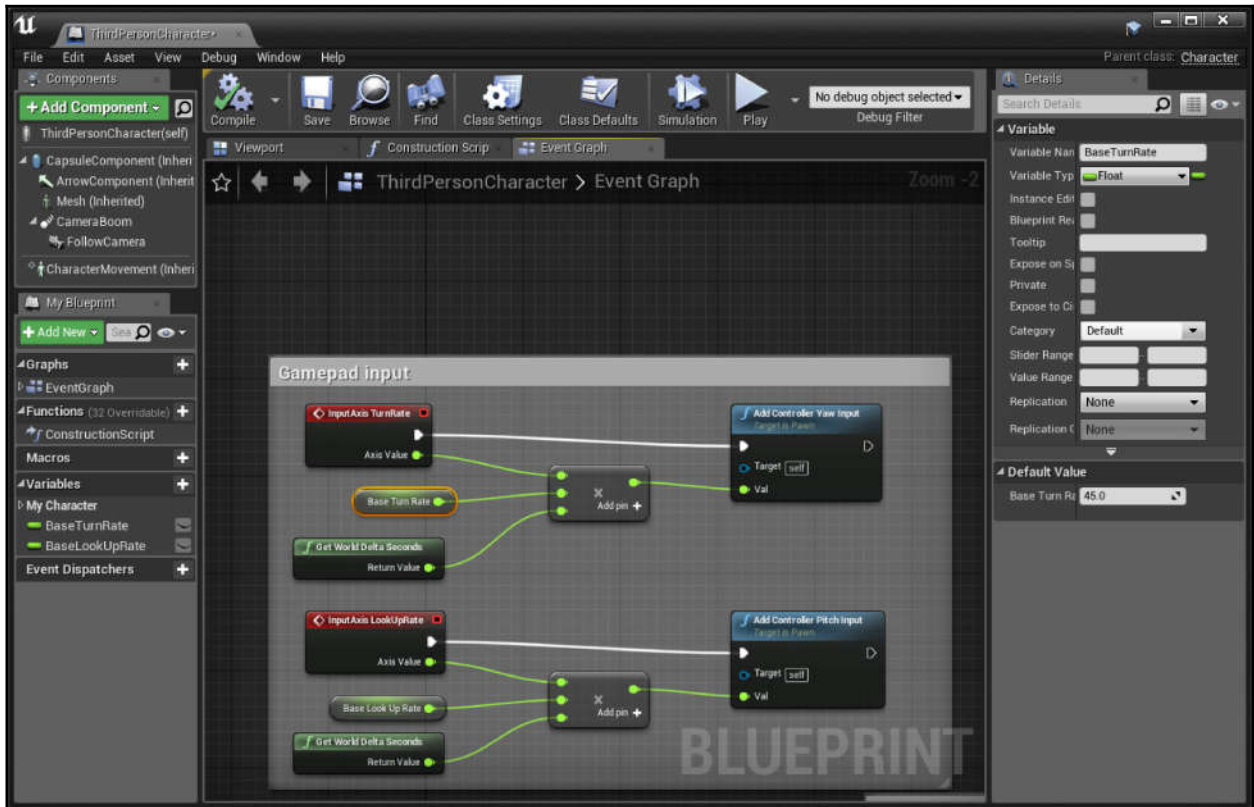
#### Axis Mappings +

- ▷ MoveForward + ×
- ▷ MoveRight + ×
- ▷ TurnRate + ×
- ▷ Turn + ×
- ▷ LookUpRate + ×
- ▷ LookUp + ×

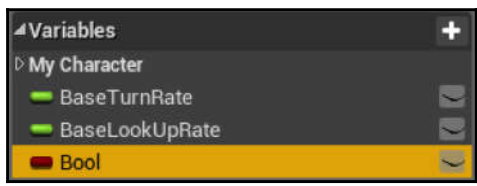




# Chapter 2: Programming Using Blueprints







Details

Search Details

### Variable

Variable Name: BaseTurnRate

Variable Type: Float

Instance Editable:

Blueprint Read Only:

Tooltip:

Expose on Spawn:

Private:

Expose to Cinematics:

Category: Default

Slider Range:  ..

Value Range:  ..


Replication: None

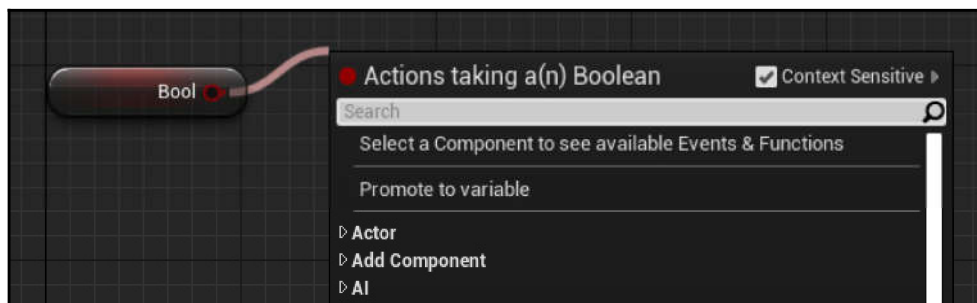
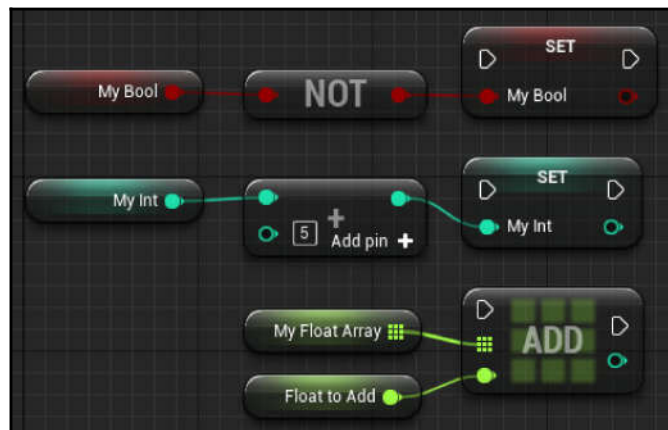
Replication Condition: None

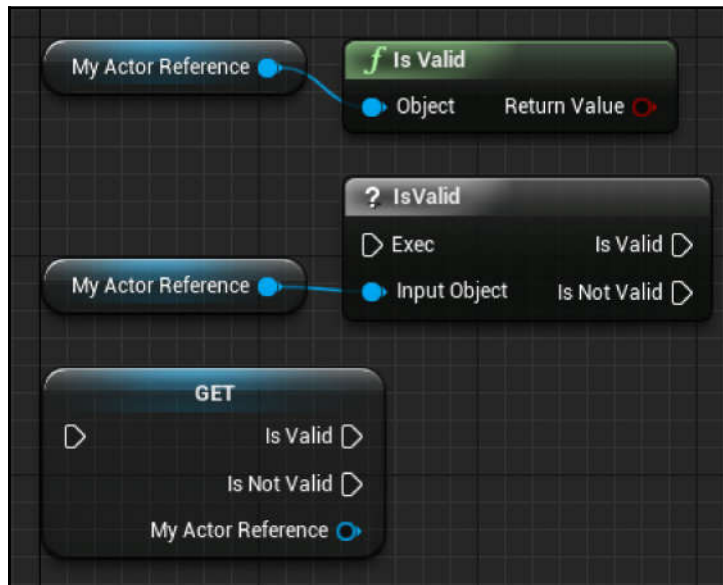
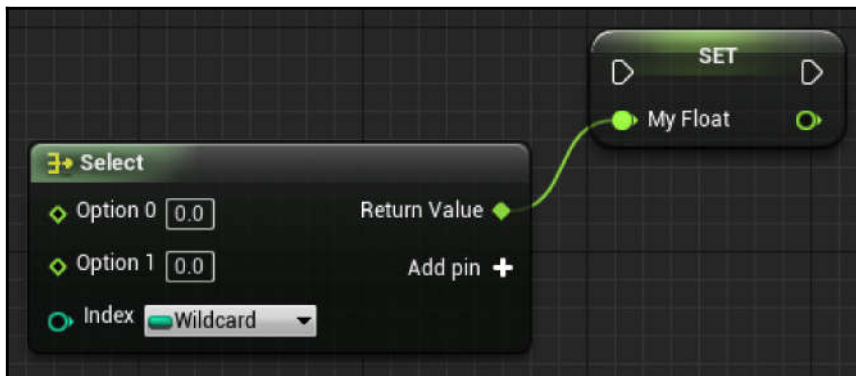
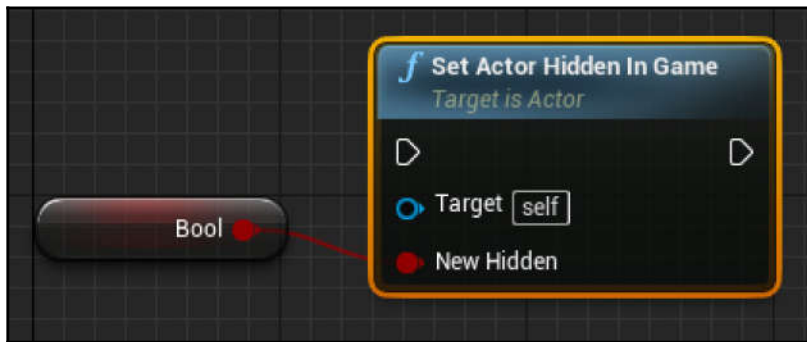
### Default Value

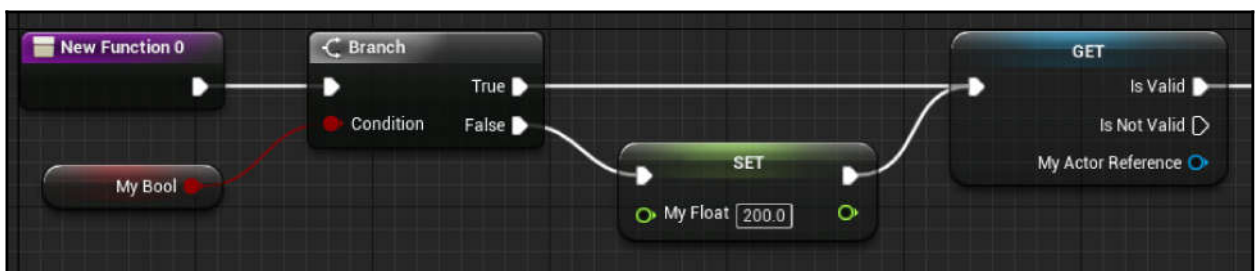
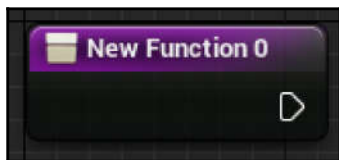
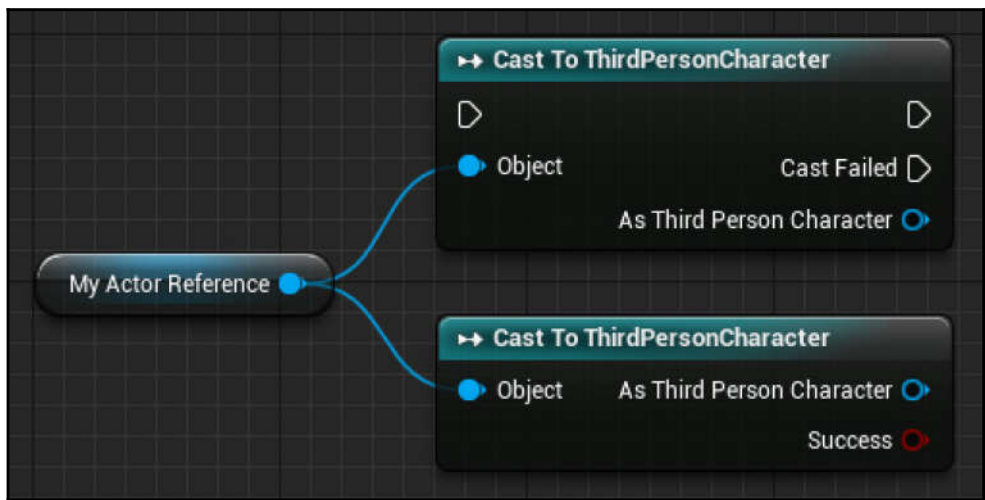
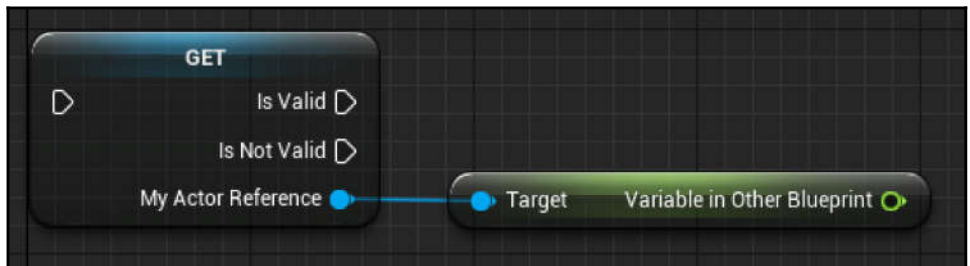
Base Turn Rate: 45.0

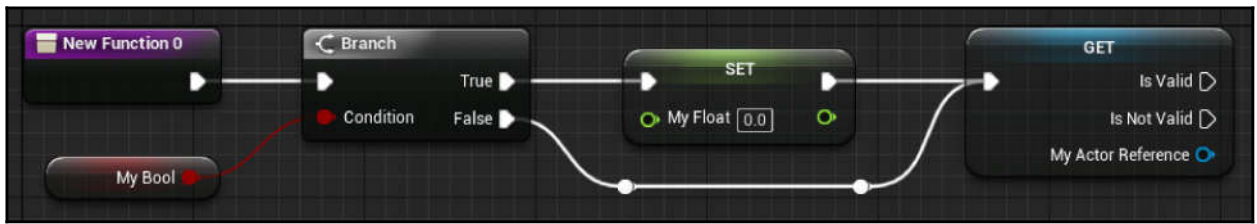
Variable Type: Float











Details

Search Details

**Graph**

Description

Category: Default

Keywords

Compact Node Title

Access Specifier: Public

Pure

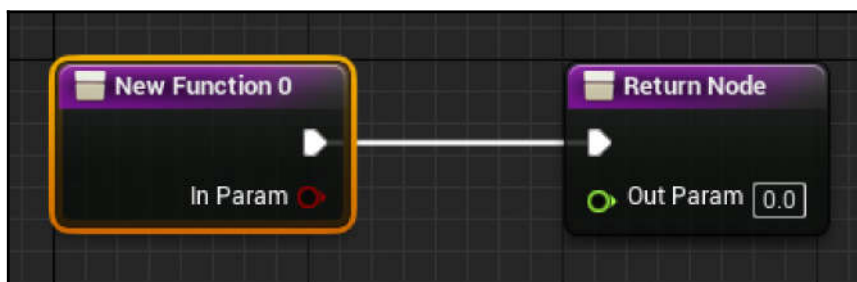
Call In Editor

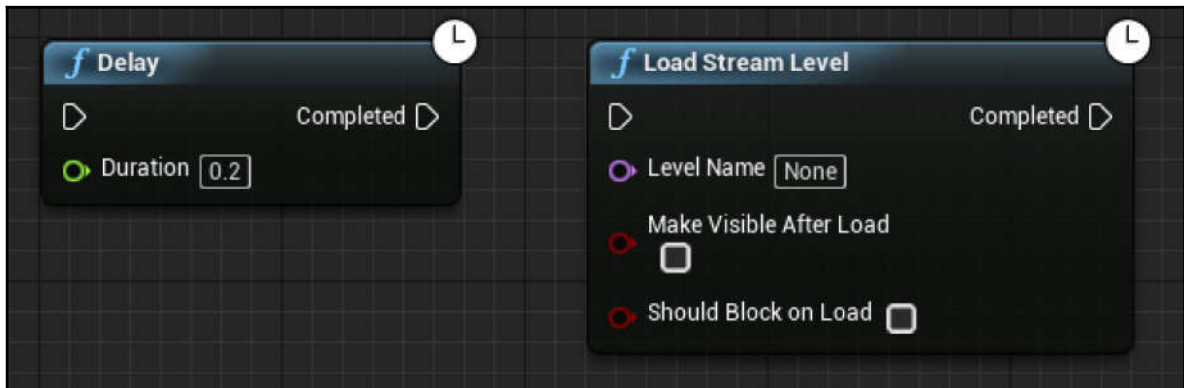
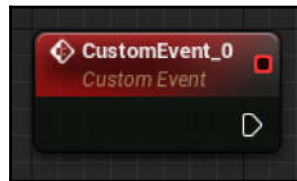
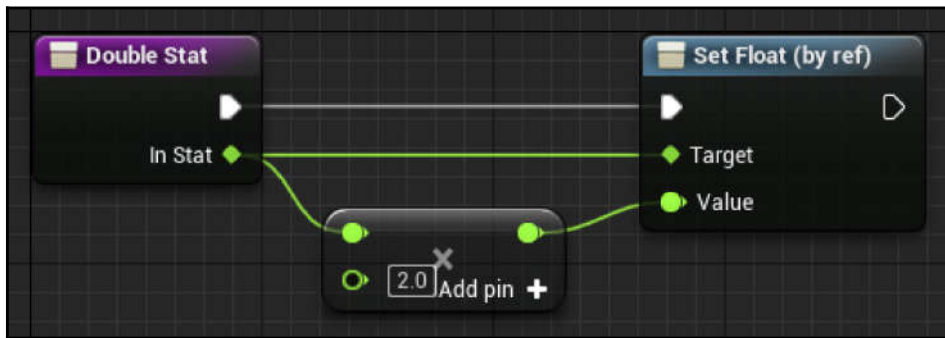
**Inputs**

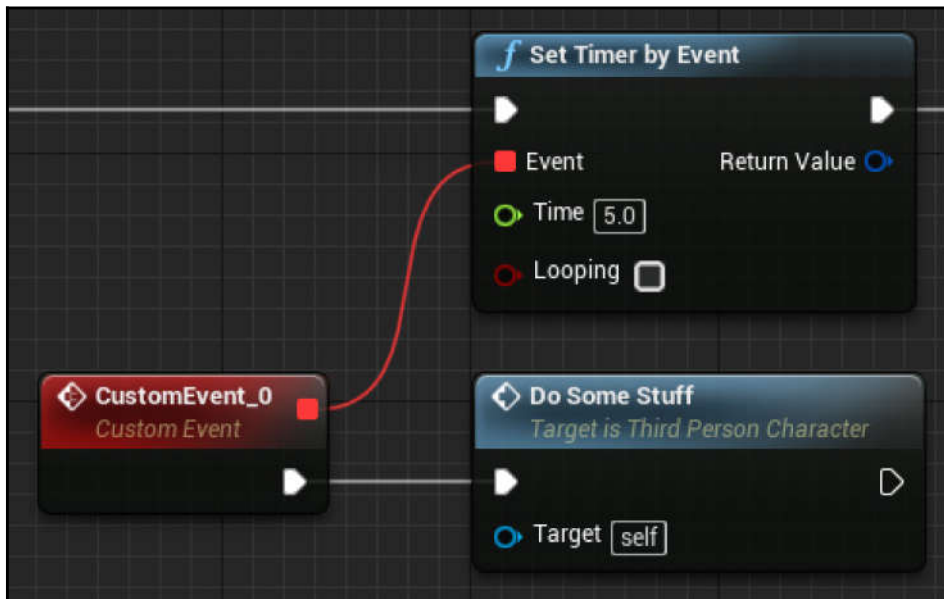
InParam: Boolean

**Outputs**

OutParam: Float





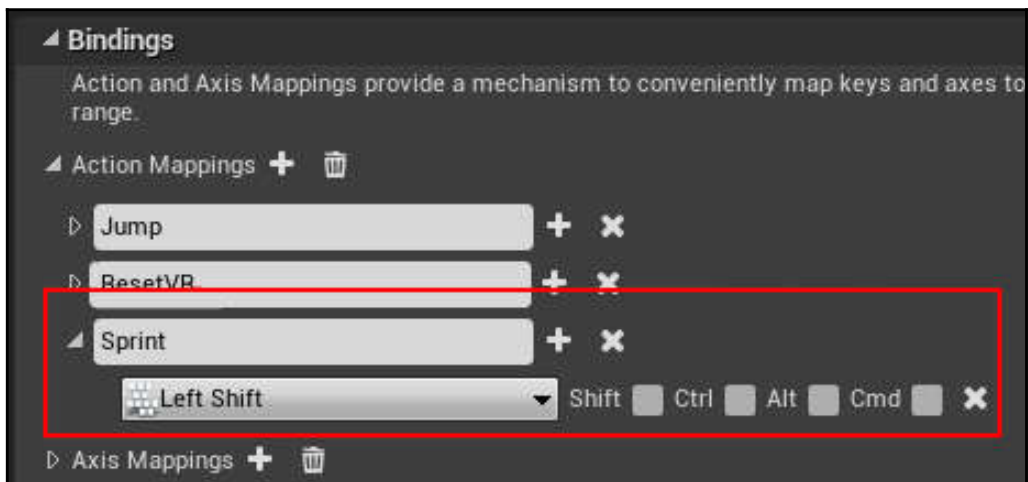
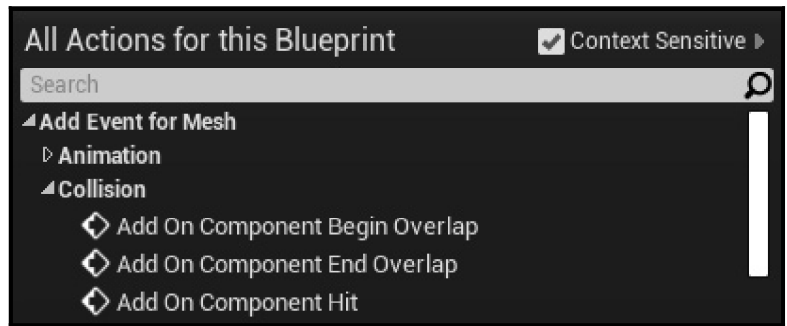
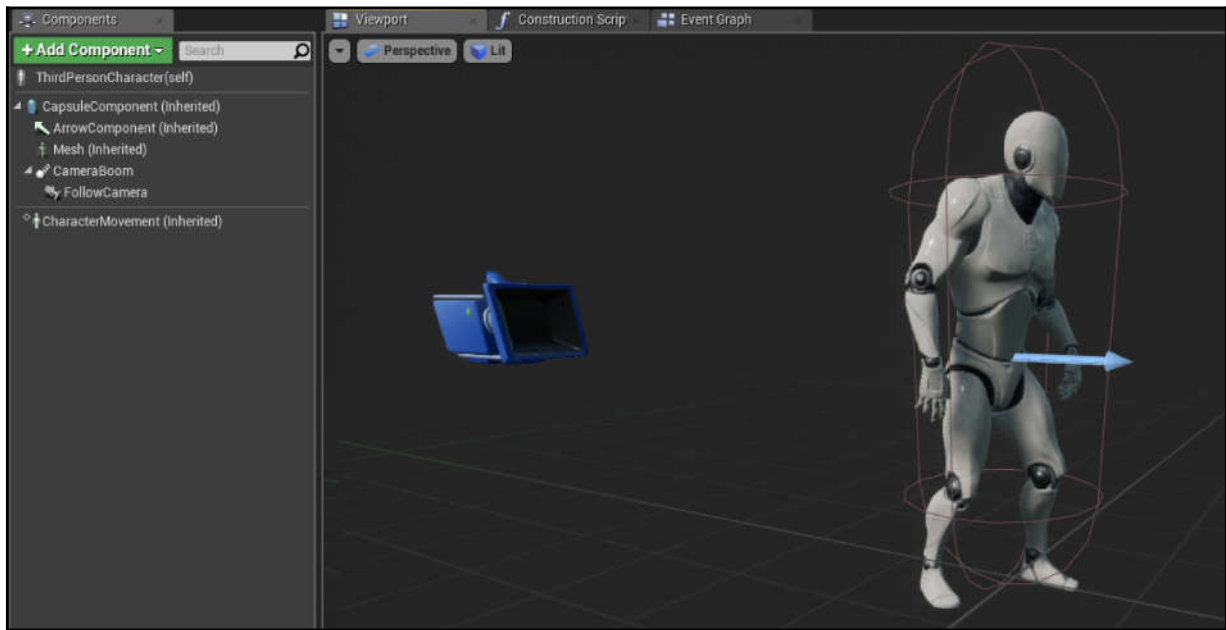


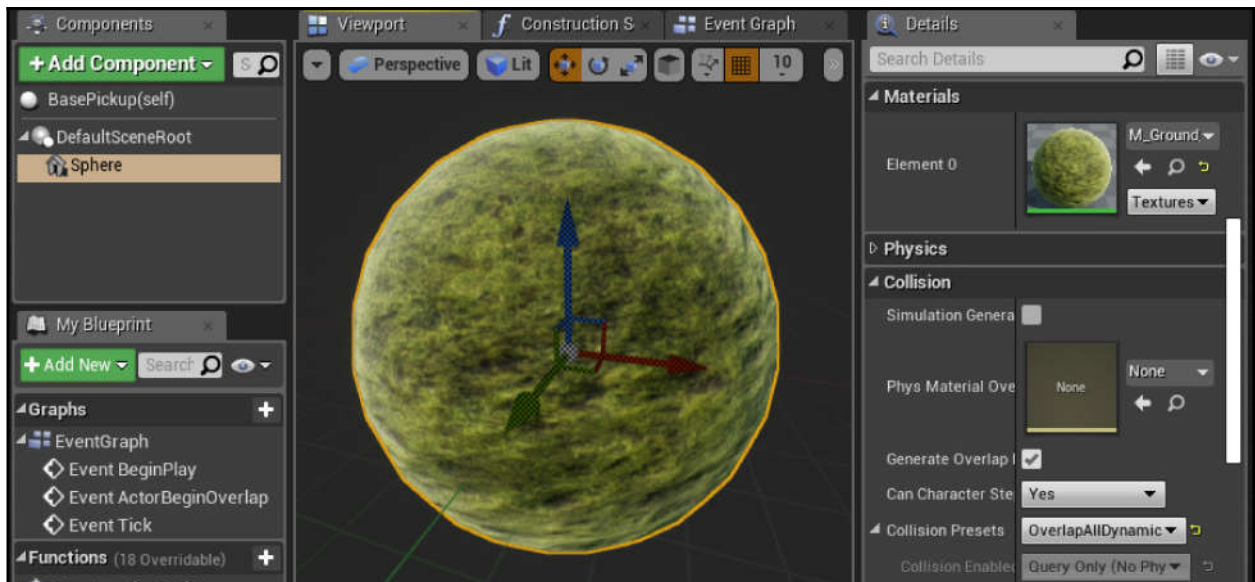
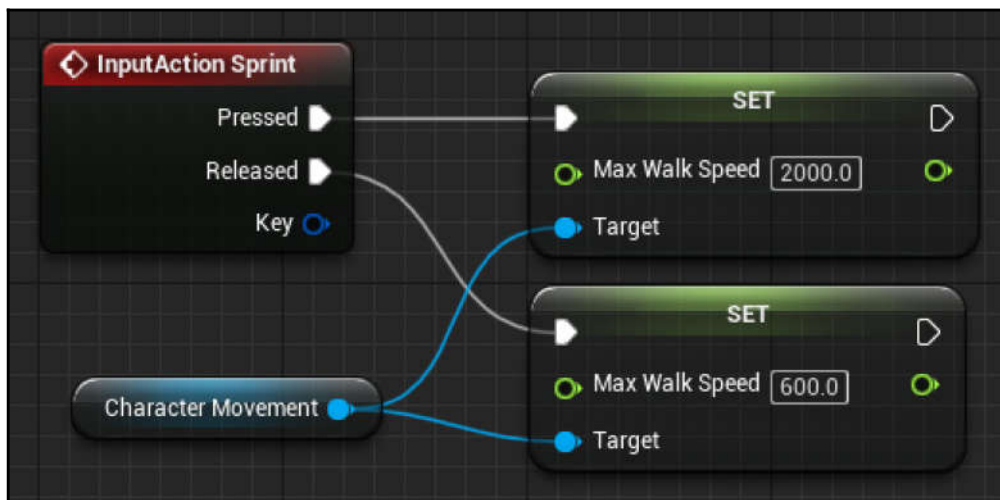
**Functions** (32 Overridable) **Override** ▾ Override Function

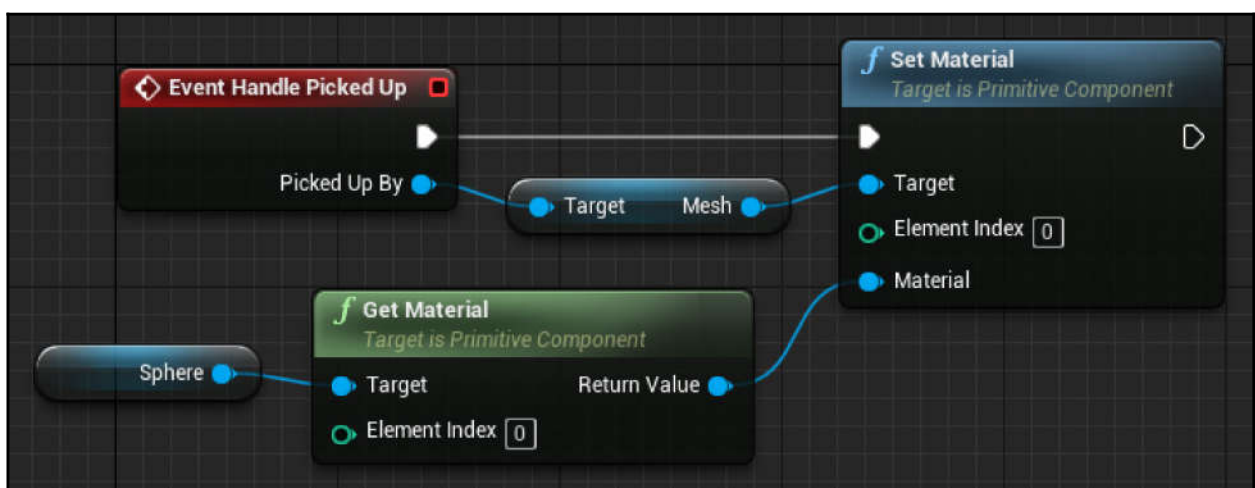
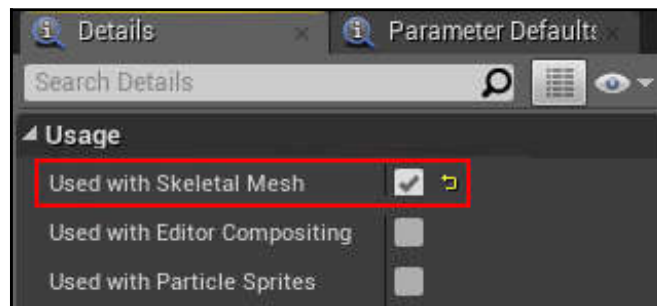
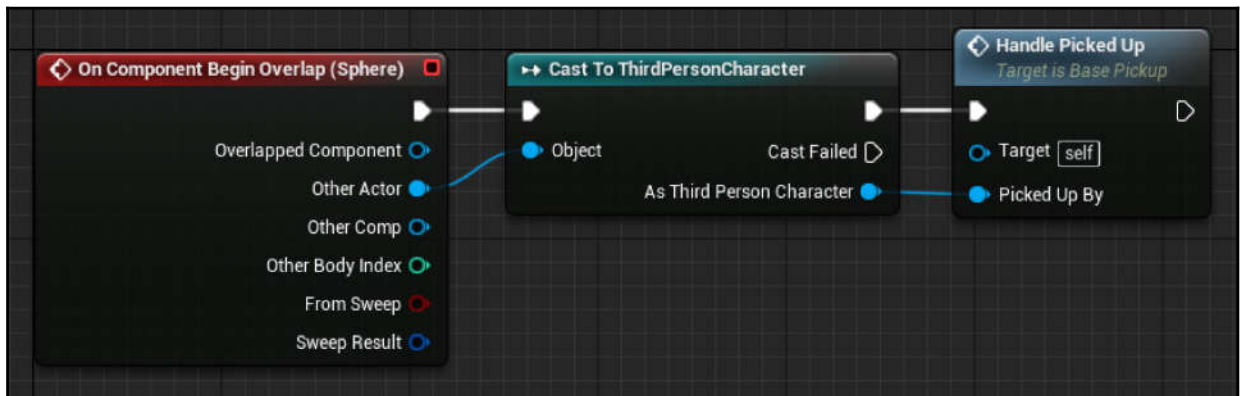
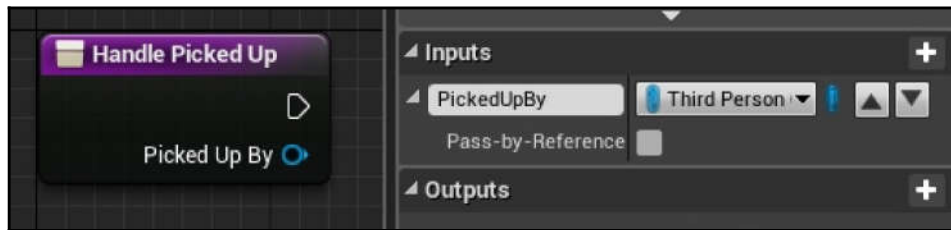
- ConstructionScript
- NewFunction\_0
- On Walking Off Ledge
- On Launched
- On Landed
- On Jumped

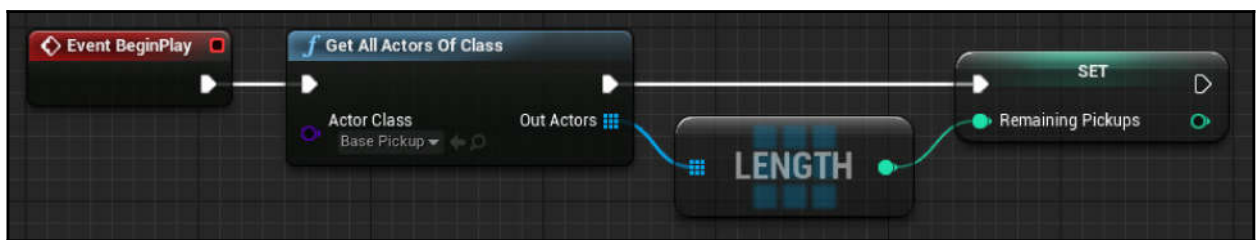
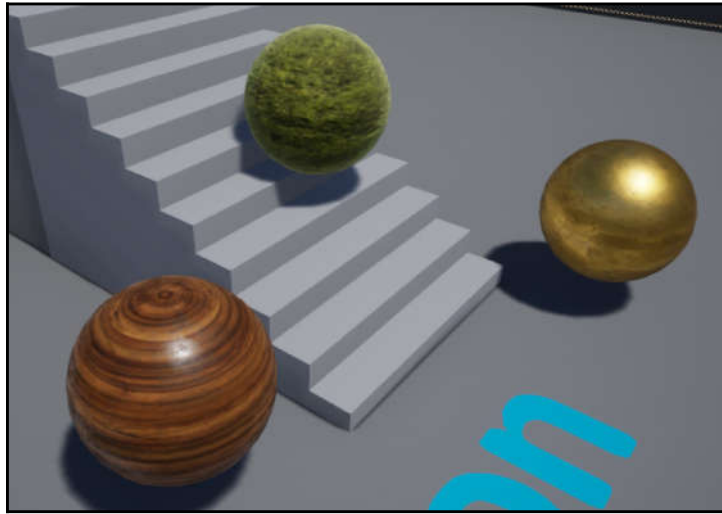


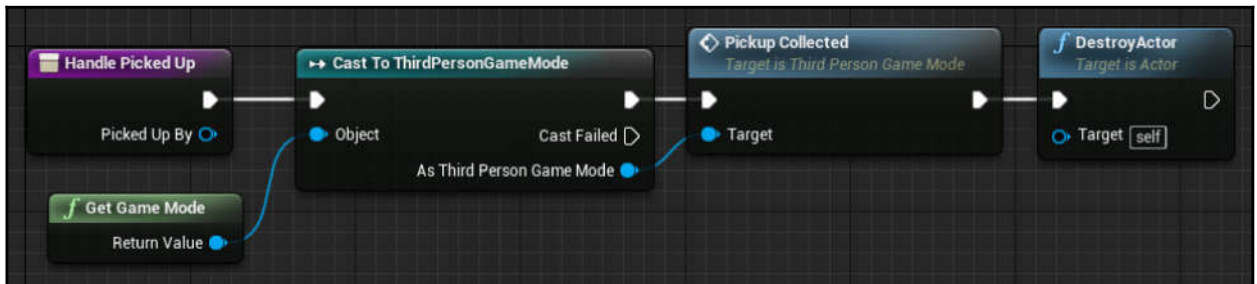
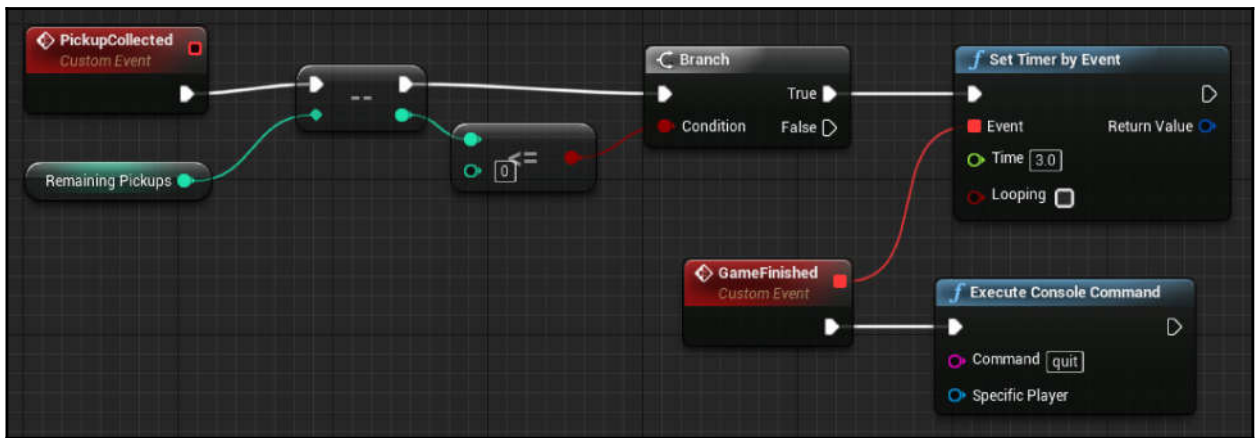
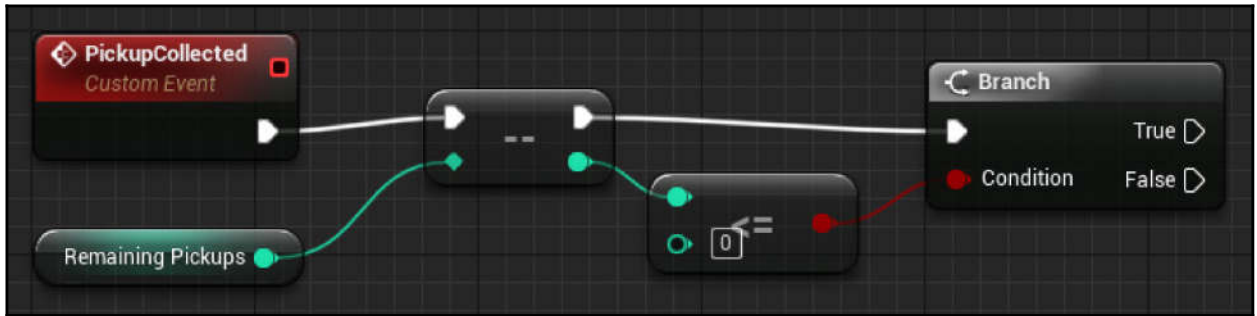


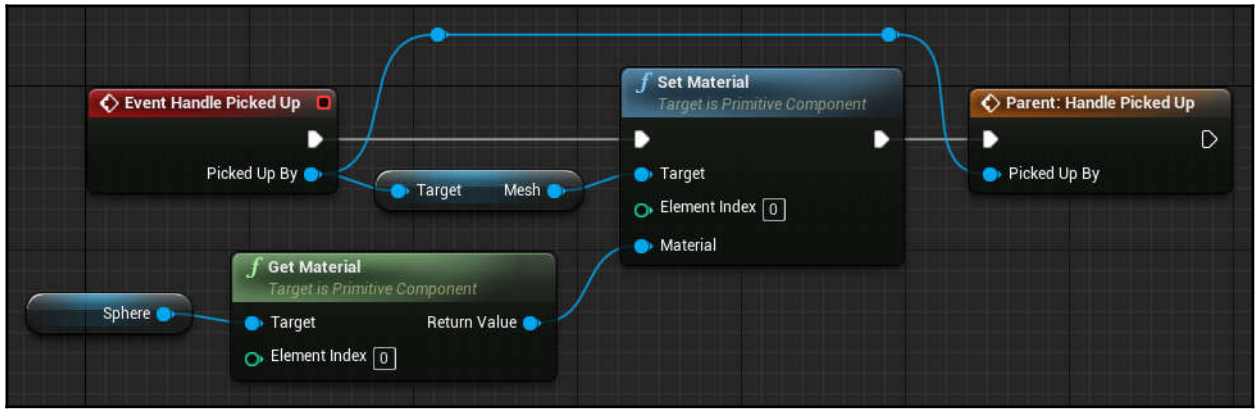




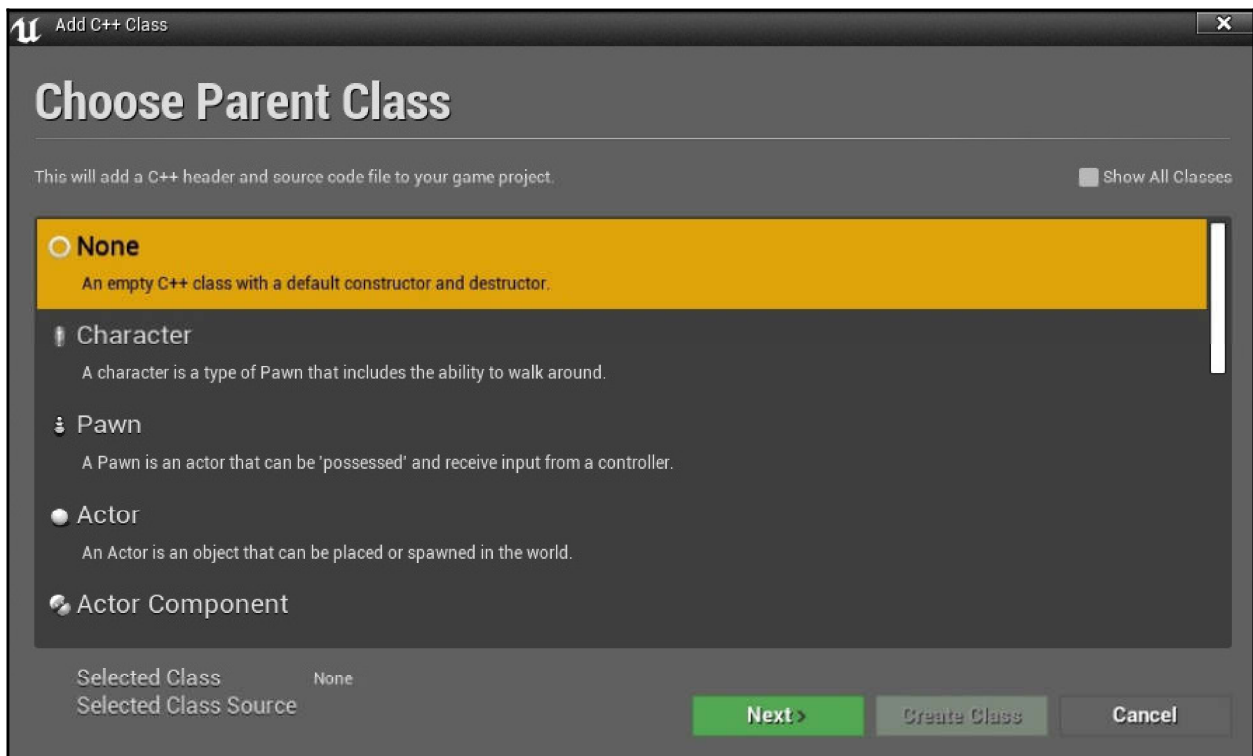
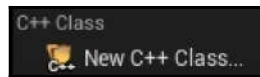
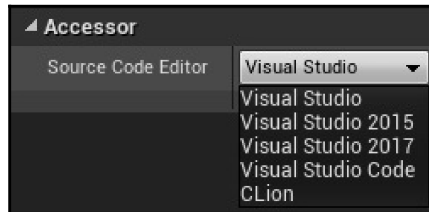


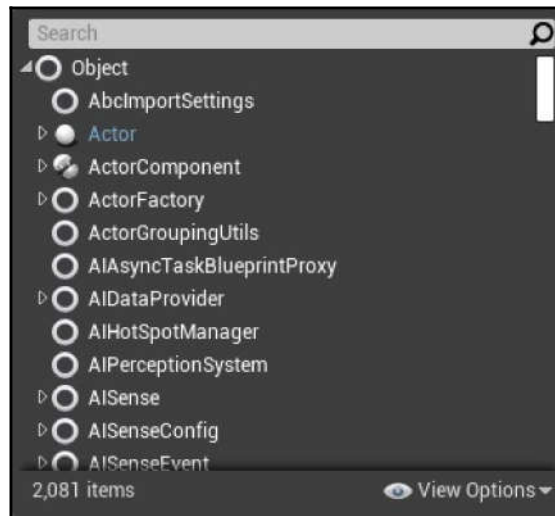






# Chapter 3: Adding C++ to a Blueprint Project





## ● Actor

An Actor is an object that can be placed or spawned in the world.

Name	<input type="text" value="MyActor"/>	<input type="text" value="AwesomeGame (Runtime)"/>	<input type="button" value="Public"/>	<input type="button" value="Private"/>
Path	<input type="text" value="R:/UnrealEngine/Projects/AwesomeGame/Source/AwesomeGame/"/>		<input type="button" value="Choose Folder"/>	
Header File	<input type="text" value="R:/UnrealEngine/Projects/AwesomeGame/Source/AwesomeGame/MyActor.h"/>			
Source File	<input type="text" value="R:/UnrealEngine/Projects/AwesomeGame/Source/AwesomeGame/MyActor.cpp"/>			



```

1 // Fill out your copyright notice in the Description page of Project Settings.
2
3 #include "MyActor.h"
4
5 // Sets default values
6 AMyActor::AMyActor()
7 {
8     // Set this actor to call Tick() every frame. You can turn this off to improve performance if you don't need it.
9     PrimaryActorTick.bCanEverTick = true;
10 }
11
12
13 // Called when the game starts or when spawned
14 void AMyActor::BeginPlay()
15 {
16     Super::BeginPlay();
17 }
18
19
20 // Called every frame
21 void AMyActor::Tick(float DeltaTime)
22 {
23     Super::Tick(DeltaTime);
24 }
25
26

```

```

1 // Fill out your copyright notice in the Description page of Project Settings.
2
3 #pragma once
4
5 #include "CoreMinimal.h"
6 #include "GameFramework/Actor.h"
7 #include "MyActor.generated.h"
8
9 UCLASS()
10 class AWESOMEGAME_API AMyActor : public AActor
11 {
12     GENERATED_BODY()
13
14 public:
15     // Sets default values for this actor's properties
16     AMyActor();
17
18 protected:
19     // Called when the game starts or when spawned
20     virtual void BeginPlay() override;
21
22 public:
23     // Called every frame
24     virtual void Tick(float DeltaTime) override;
25
26 };

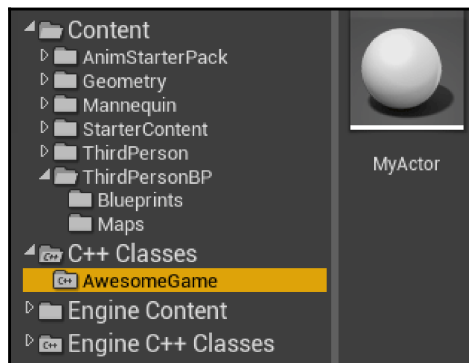
```

```

// Called when the game starts or when spawned
void AMyActor::BeginPlay()
{
    Super::BeginPlay();

    UE_LOG(LogTemp, Warning, TEXT("OUR C++ CLASS IS WORKING!"));
}

```



```

LogWorld: Bringing up level for play took: 0.00257
LogContentBrowser: Native class hierarchy updated
LogTemp: Warning: OUR C++ CLASS IS WORKING!
PIE: Play in editor start time for /Game/ThirdPers
LogBlueprintUserMessages: Late PlayInEditor Detect

```

```

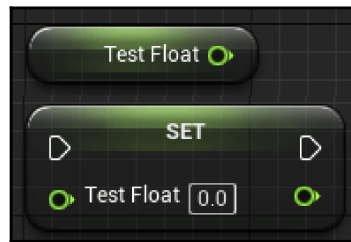
UCLASS()
class AWESOMEGAME_API AMyActor : public AActor
{
    GENERATED_BODY()

    public:
        UPROPERTY(EditAnywhere, BlueprintReadWrite)
        float TestFloat;

    public:
        // Sets default values for this actor's properties
        AMyActor();

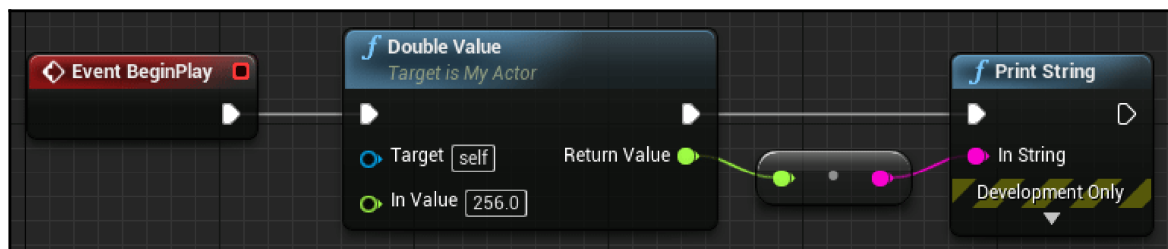
    protected:
        // Called when the game starts or when spawned
        virtual void BeginPlay() override;
};

```



```
float AMyActor::DoubleValue(float InValue)
{
    return InValue * 2.f;
}
```

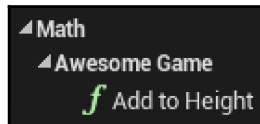
```
public:
    UFUNCTION(BlueprintCallable)
    float DoubleValue(float InValue);
```

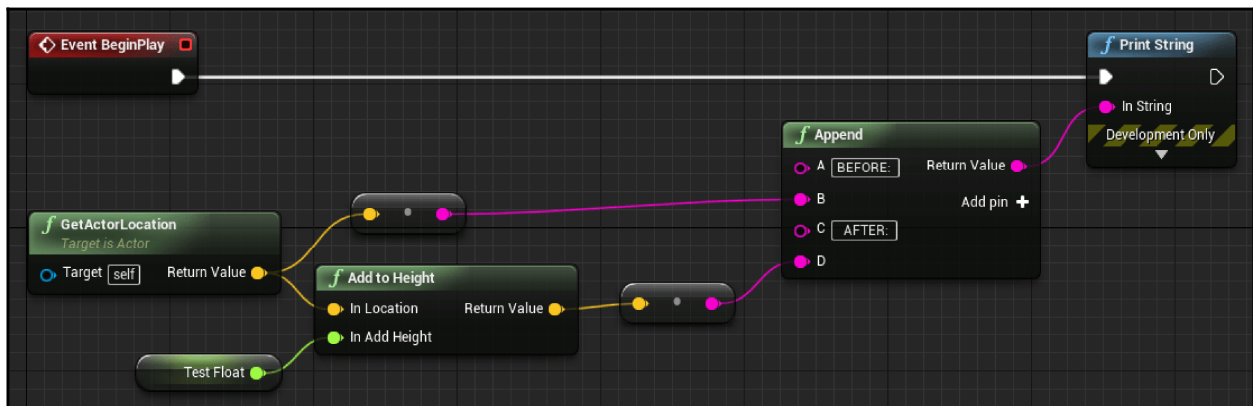


```
LogBlueprintUserMessages: [MyActor_Blueprint_5] 512.0
LogTemp: Warning: OUR C++ CLASS IS WORKING!
```

```
FVector AMyActor::AddToHeight(FVector InLocation, float InAddHeight)
{
    FVector added = InLocation;
    added.Z += InAddHeight;
    return added;
}
```

```
public:
    UFUNCTION(BlueprintPure, Category = "Math|AwesomeGame")
    FVector AddToHeight(FVector InLocation, float InAddHeight);
```





BEFORE: X=-570.000 Y=150.000 Z=190.000 AFTER: X=-570.000 Y=150.000 Z=290.000

```

void AMyActor::AddAndSubtractHeight(FVector InLocation, float InHeight, FVector& OutAdded, FVector& OutSubtracted)
{
    OutAdded = InLocation;
    OutAdded.Z += InHeight;
    OutSubtracted = InLocation;
    OutSubtracted.Z -= InHeight;
}

void AMyActor::AddAndSubtractHeight_Pure(FVector InLocation, float InHeight, FVector& OutAdded, FVector& OutSubtracted)
{
    OutAdded = InLocation;
    OutAdded.Z += InHeight;
    OutSubtracted = InLocation;
    OutSubtracted.Z -= InHeight;
}

```

```

public:
    UFUNCTION(BlueprintCallable, Category = "Math|AwesomeGame")
    void AddAndSubtractHeight(FVector InLocation, float InHeight, FVector& OutAdded, FVector& OutSubtracted);

    UFUNCTION(BlueprintPure, Category = "Math|AwesomeGame")
    void AddAndSubtractHeight_Pure(FVector InLocation, float InHeight, FVector& OutAdded, FVector& OutSubtracted);

```

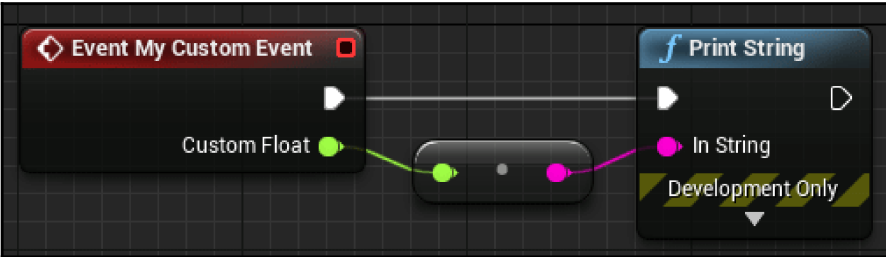


```
public:
    UFUNCTION(BlueprintImplementableEvent)
    void MyCustomEvent(float CustomFloat);
```

```
// Called when the game starts or when spawned
void AMyActor::BeginPlay()
{
    Super::BeginPlay();

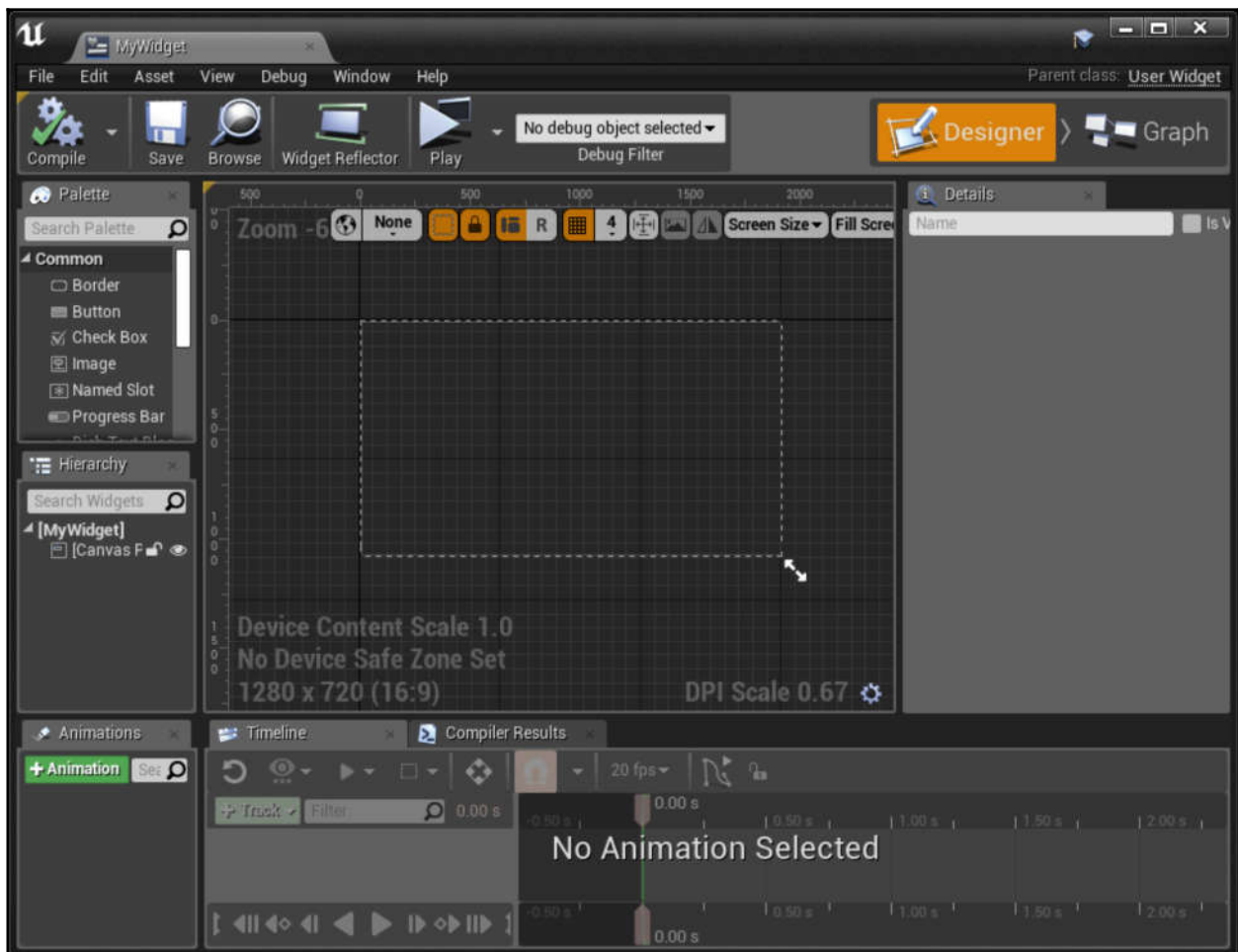
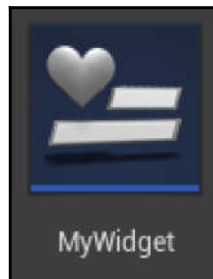
    UE_LOG(LogTemp, Warning, TEXT("OUR C++ CLASS IS WORKING!"));

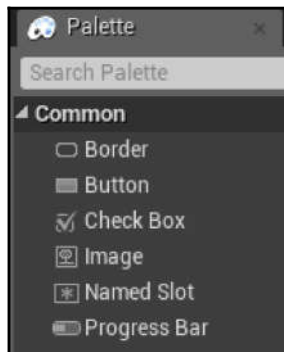
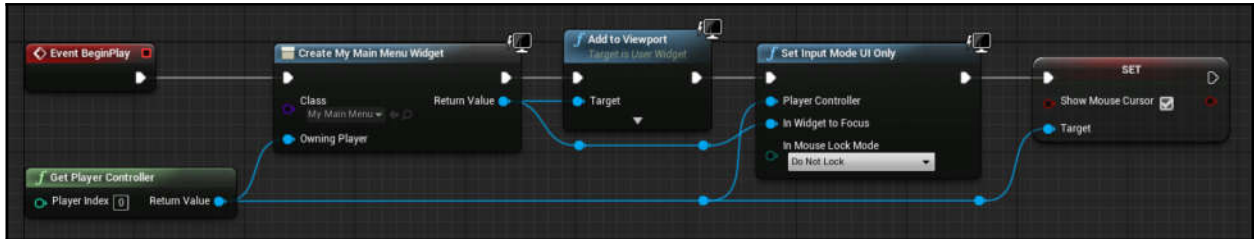
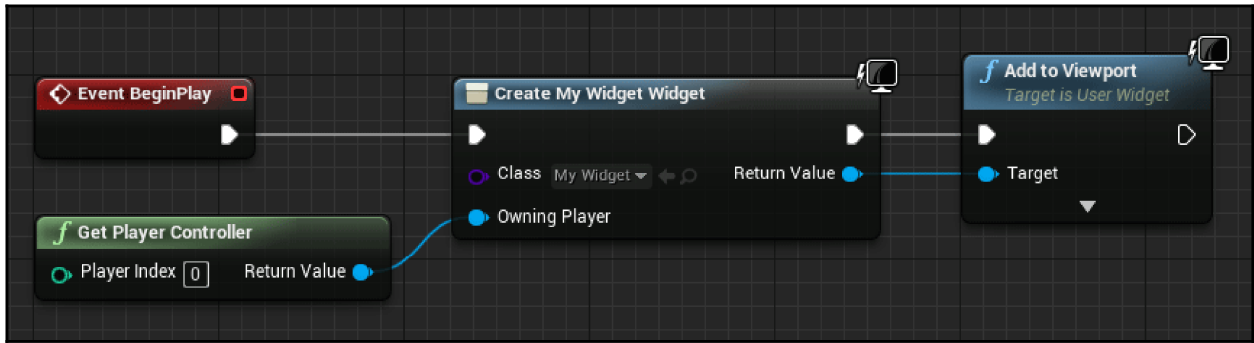
    MyCustomEvent(256.f);
}
```

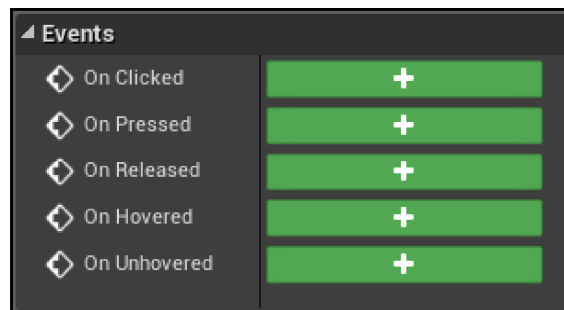
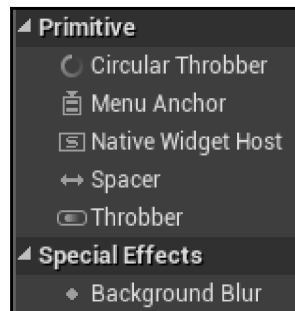
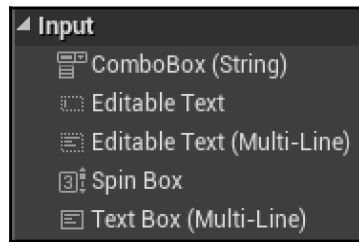


```
LogTemp: Warning: OUR C++ CLASS IS WORKING!
LogBlueprintUserMessages: [MyActor_Blueprint_5] 256.0
```

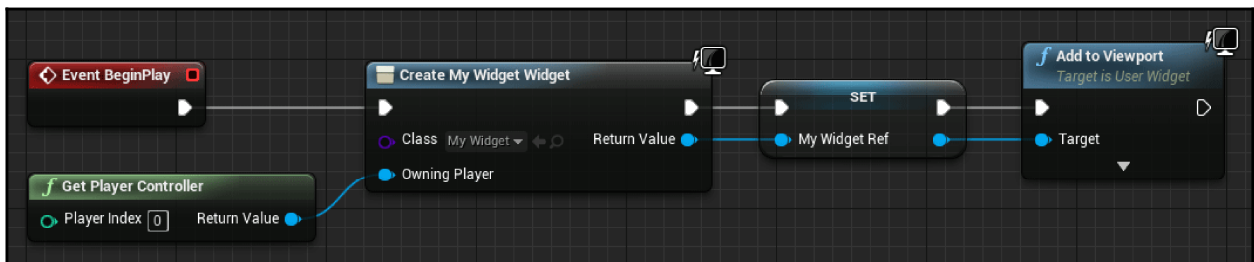
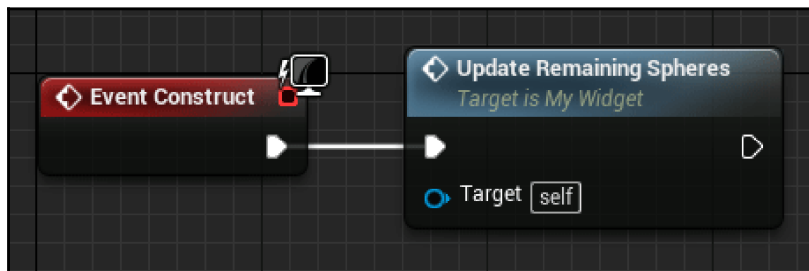
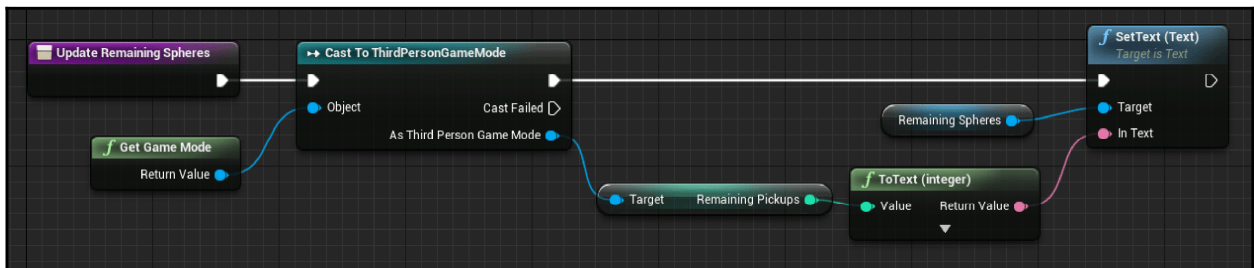
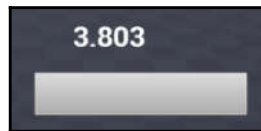
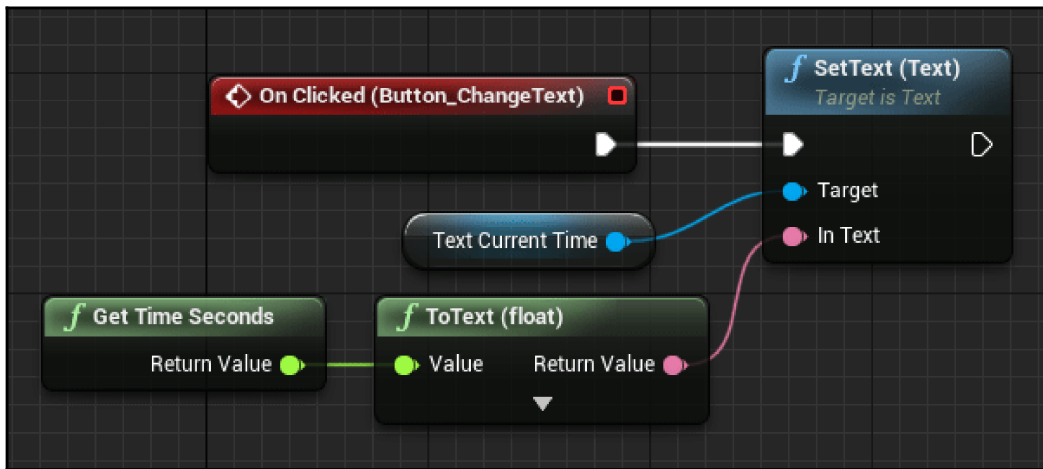
# Chapter 4: Creating HUDs and Menus Using UMG

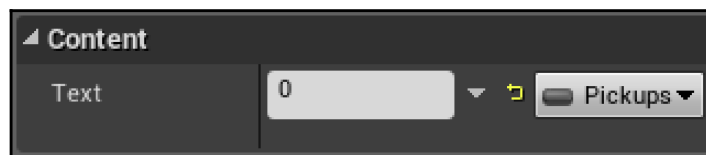
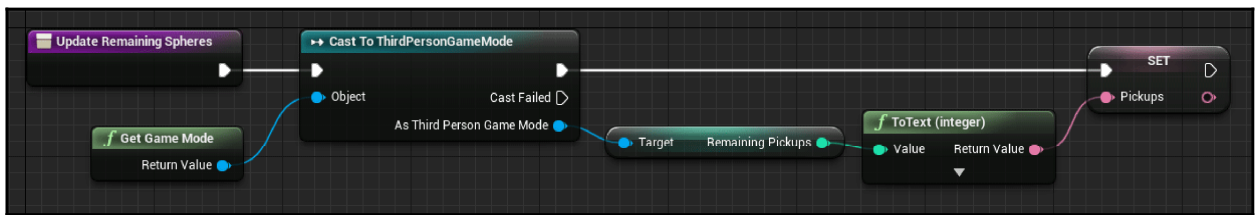
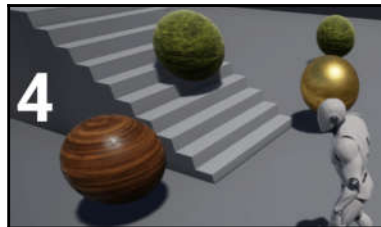
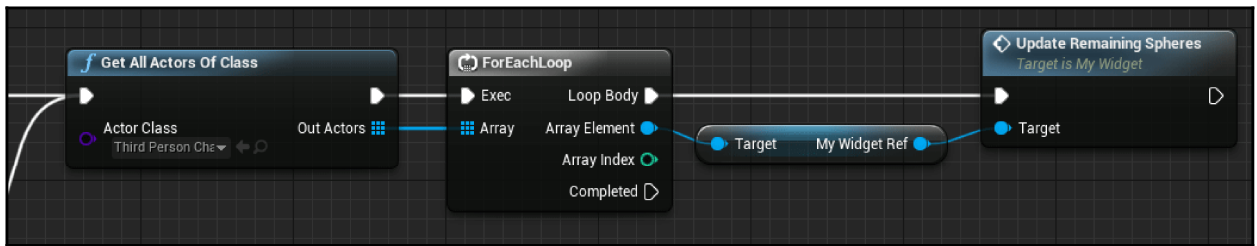
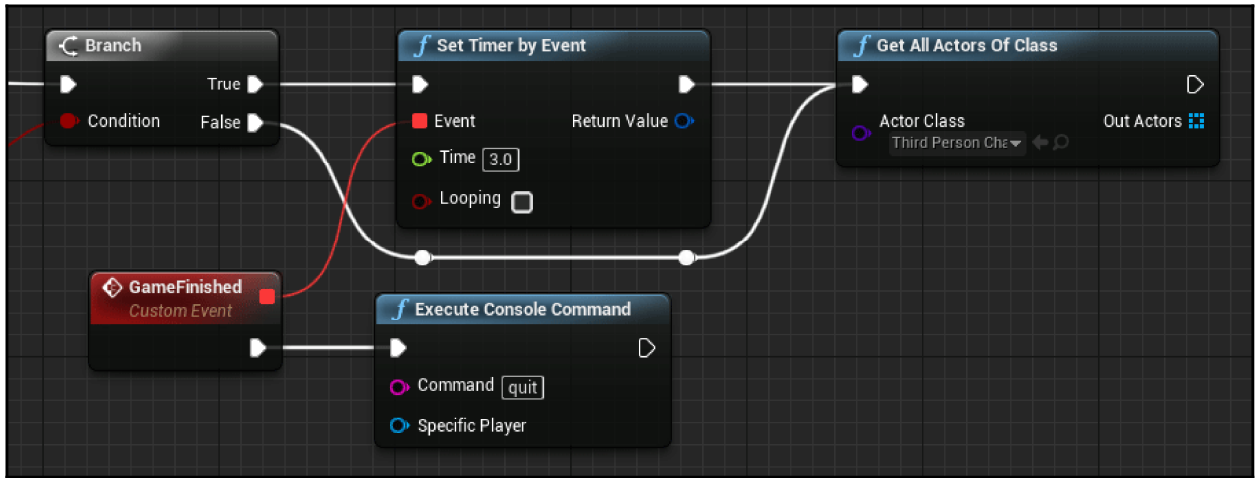


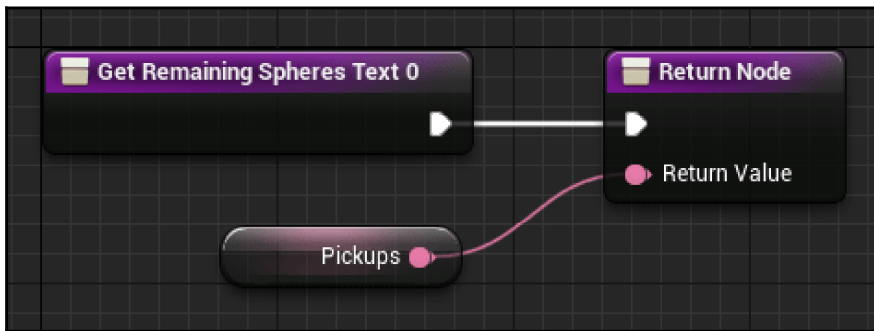






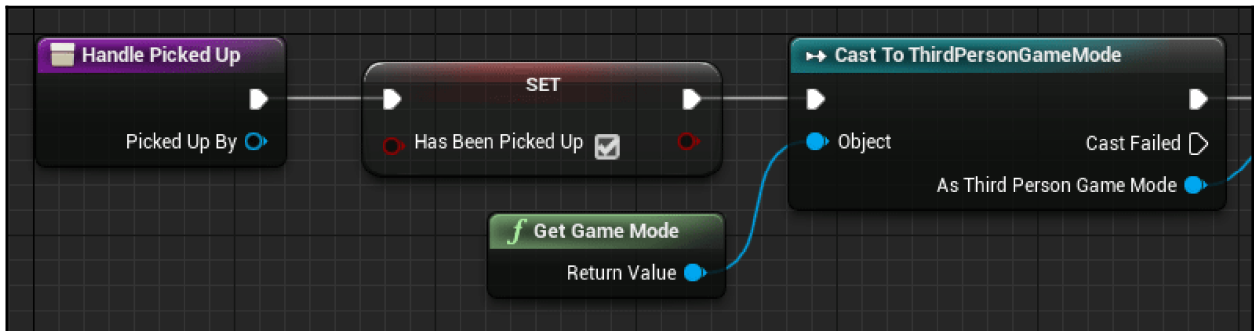
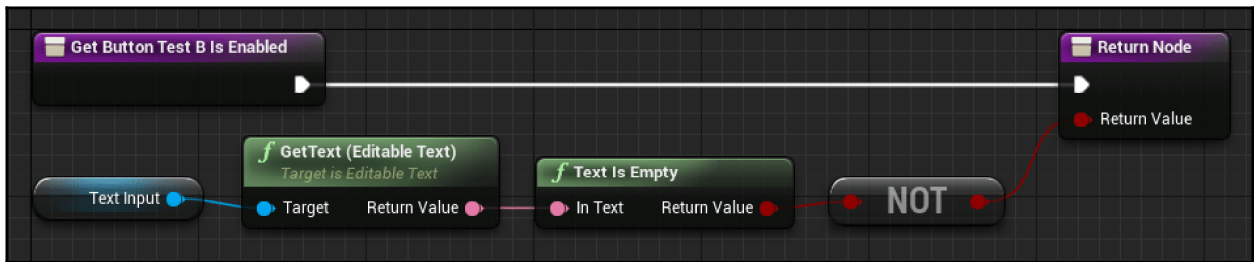


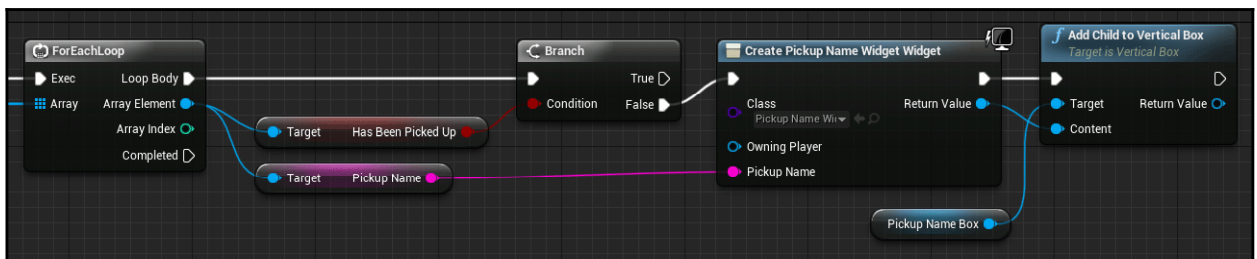
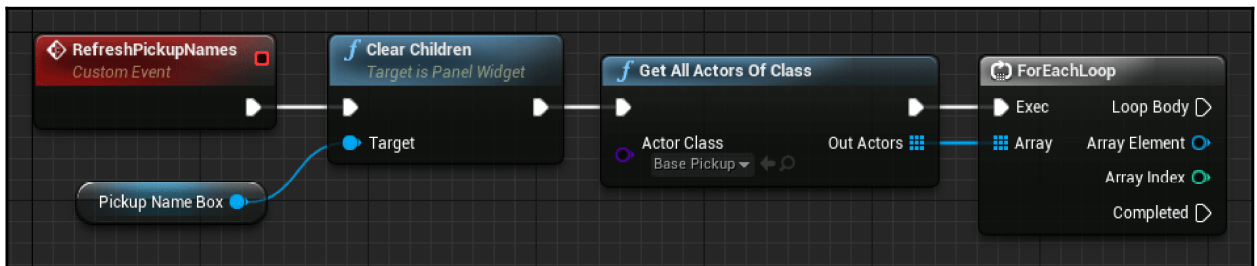
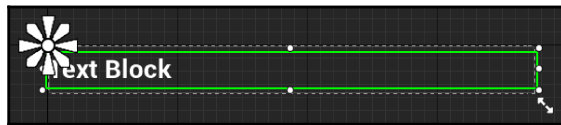
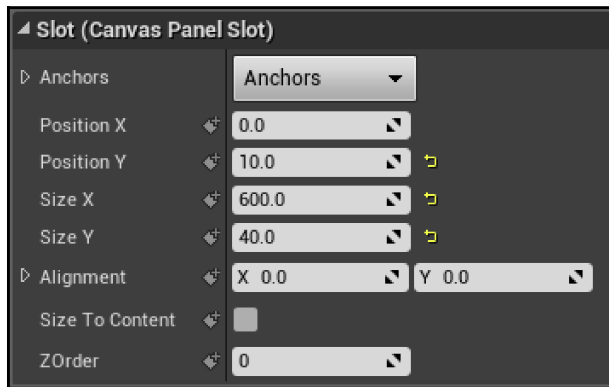
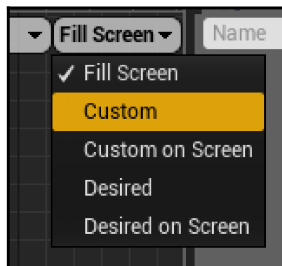


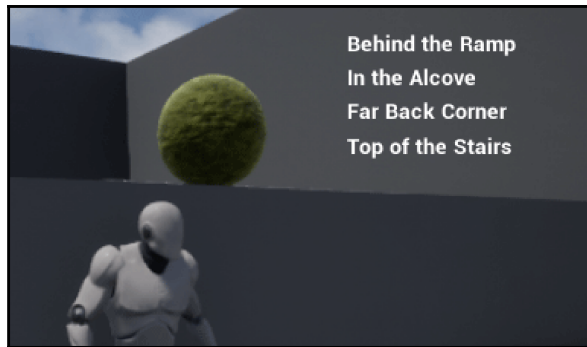
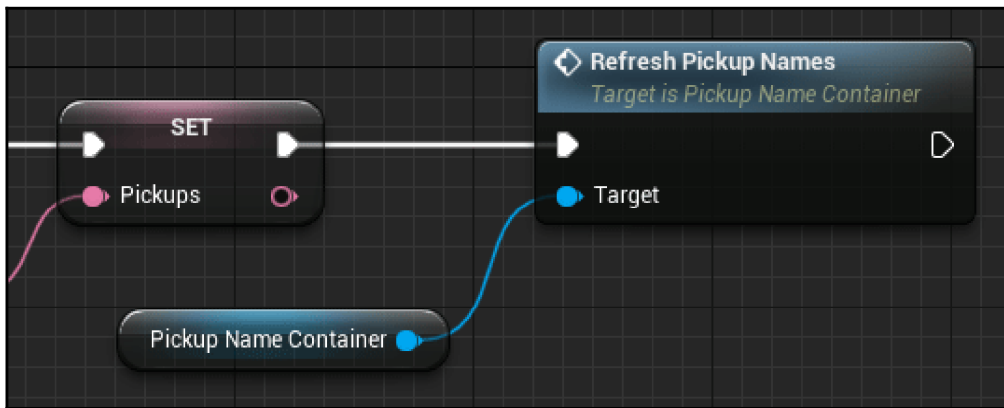
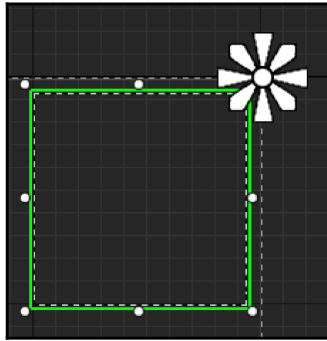


**Behavior**

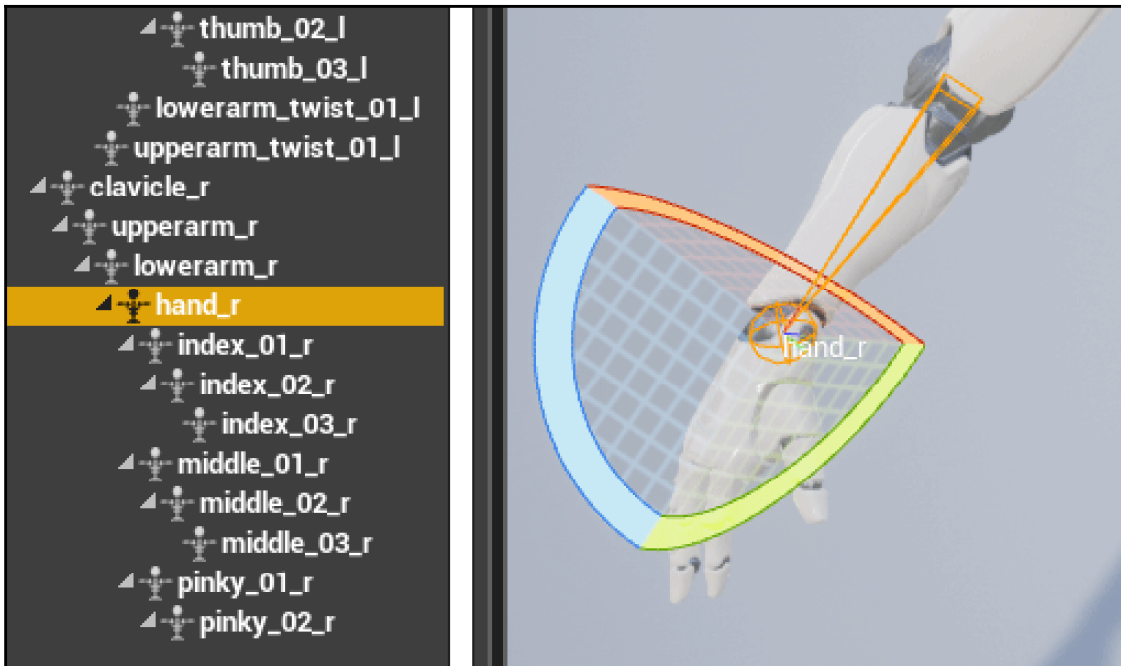
Tool Tip Text	<input type="text"/>	Bind
Is Enabled	<input checked="" type="checkbox"/>	Bind
Visibility	Visible	Bind
Render Opacity	1.0	







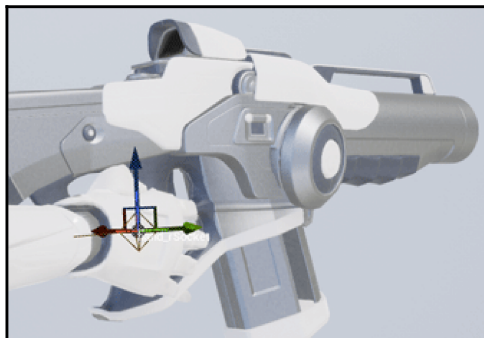
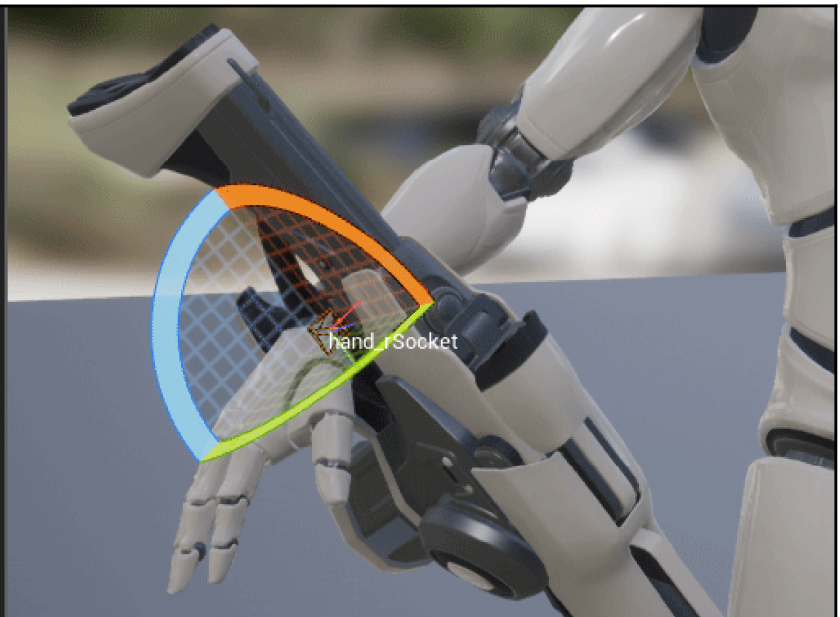
# Chapter 5: Animation Blueprints



- └─ thumb\_02\_l
- └─ thumb\_03\_l
- └─ lowerarm\_twist\_01\_l
- └─ upperarm\_twist\_01\_l
- └─ clavicle\_r
- └─ upperarm\_r
- └─ lowerarm\_r
- └─ hand\_r
- └─ index\_01\_r
- └─ index\_02\_r
- └─ index\_03\_r
- └─ middle\_01\_r
- └─ middle\_02\_r
- └─ middle\_03\_r
- └─ pinky\_01\_r
- └─ pinky\_02\_r



- index\_02\_r
  - index\_03\_r
- middle\_01\_r
  - middle\_02\_r
    - middle\_03\_r
- pinky\_01\_r
  - pinky\_02\_r
    - pinky\_03\_r
- ring\_01\_r
  - ring\_02\_r
    - ring\_03\_r
- thumb\_01\_r
  - thumb\_02\_r
    - thumb\_03\_r
- hand\_rSocket
- SK\_FPGun [Preview Only]
- lowerarm\_twist\_01\_r
- upperarm\_twist\_01\_r
- neck\_01
- head

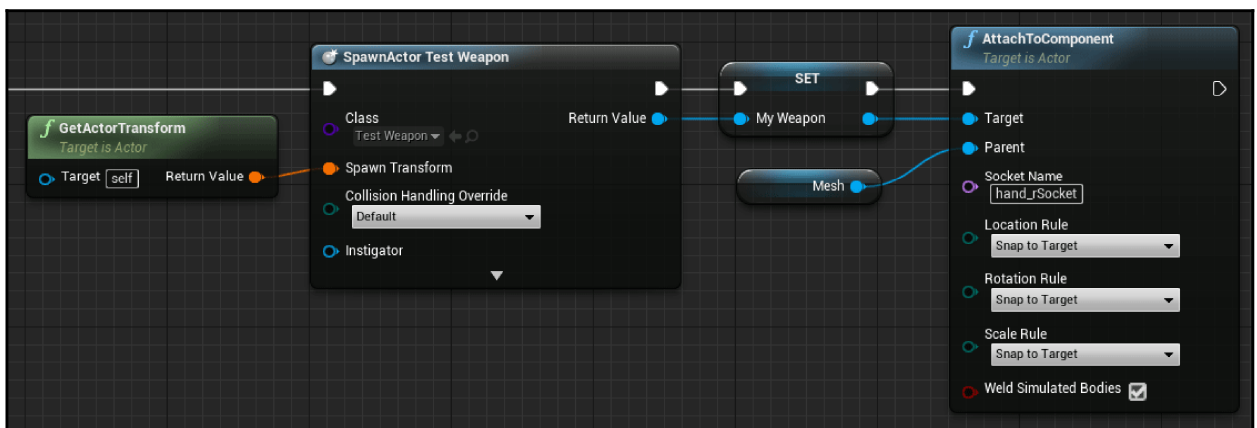


Details x Preview Scene Set x

Search Details 🔍 📄 👁

**Socket Parameters**

Socket Name	hand_rSocket		
Bone Name	hand_r X		
Relative Location	X -11.0	Y 5.0	Z 0.0
Relative Rotation	X 0.0	Y 0.0	Z 90.0
Relative Scale	X 1.0	Y 1.0	Z 1.0
Force Always Animated	<input checked="" type="checkbox"/>		





### Set up Rig

You can set up a Rig for this skeleton, then when you retarget the animation to a different skeleton with the same Rig, it will use the information to convert data.

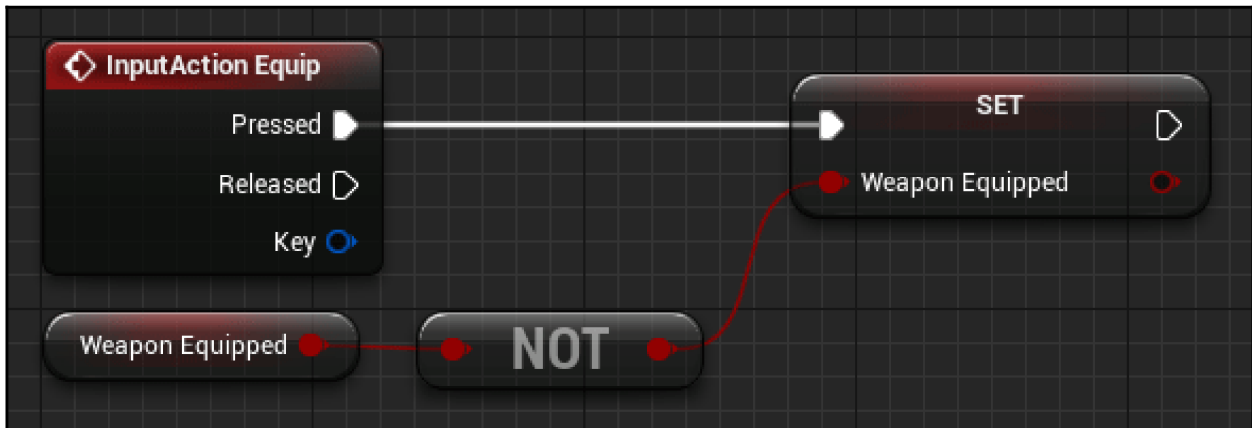
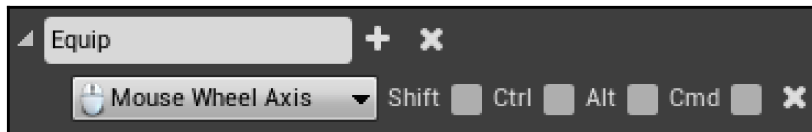
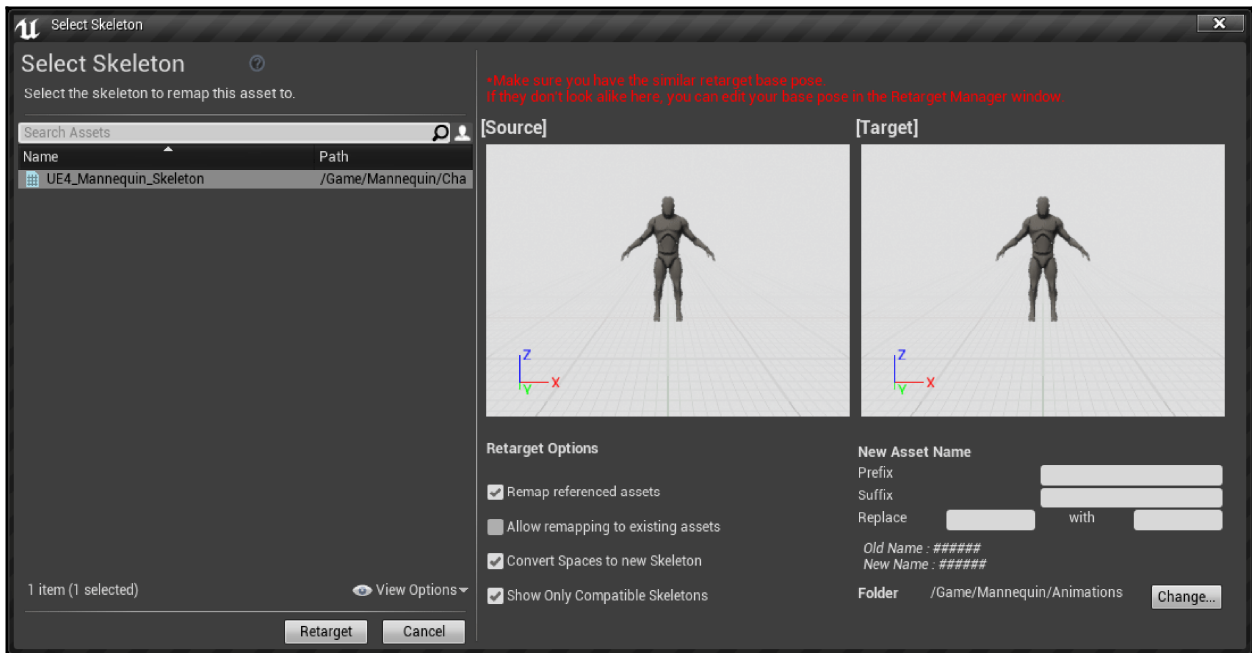
**Select Rig** None

AutoMa  Default

**Select Humanoid Rig**

Root	Root	<input type="text"/>	X
Pelvis	Pelvis	<input type="text"/>	X
spine_01	spine_01	<input type="text"/>	X
spine_02	spine_02	<input type="text"/>	X





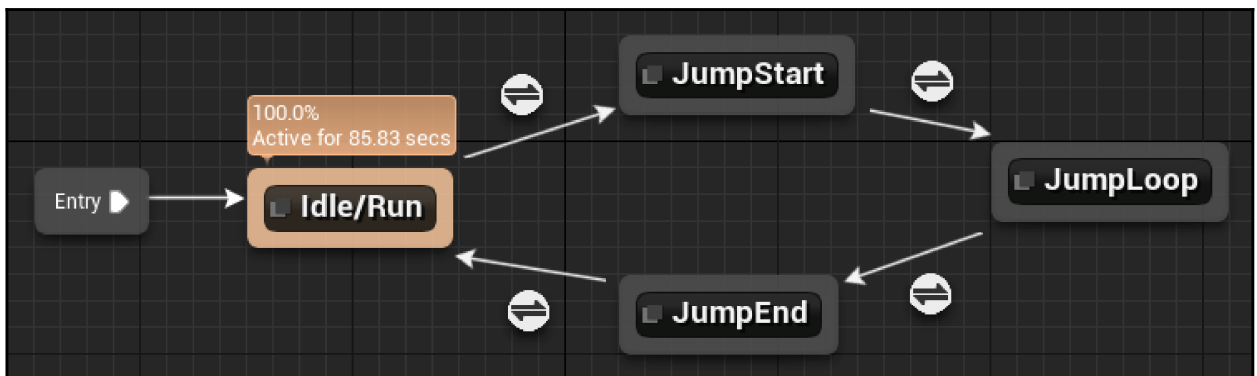
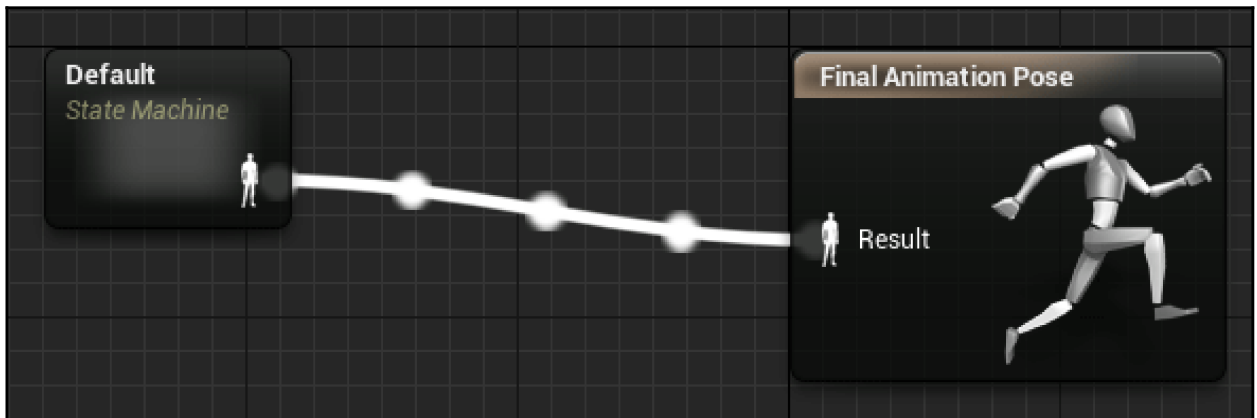
Event Blueprint Update Animation ■

Delta Time X ○

Variables

- IsInAir? ●
- Speed ●

Event Dispatchers

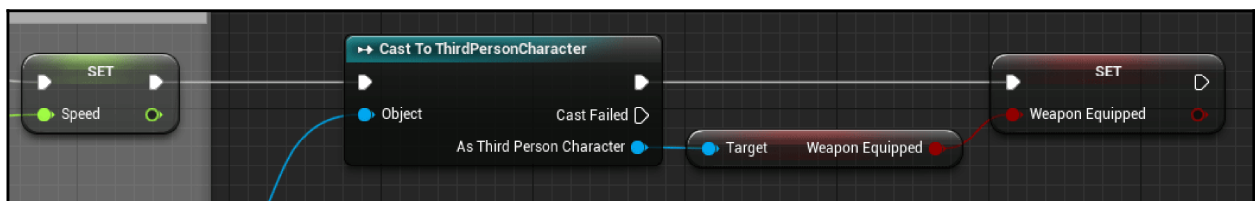
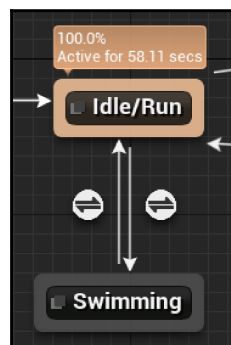


Result ⚡

Is in Air? ● → ● Can Enter Transition

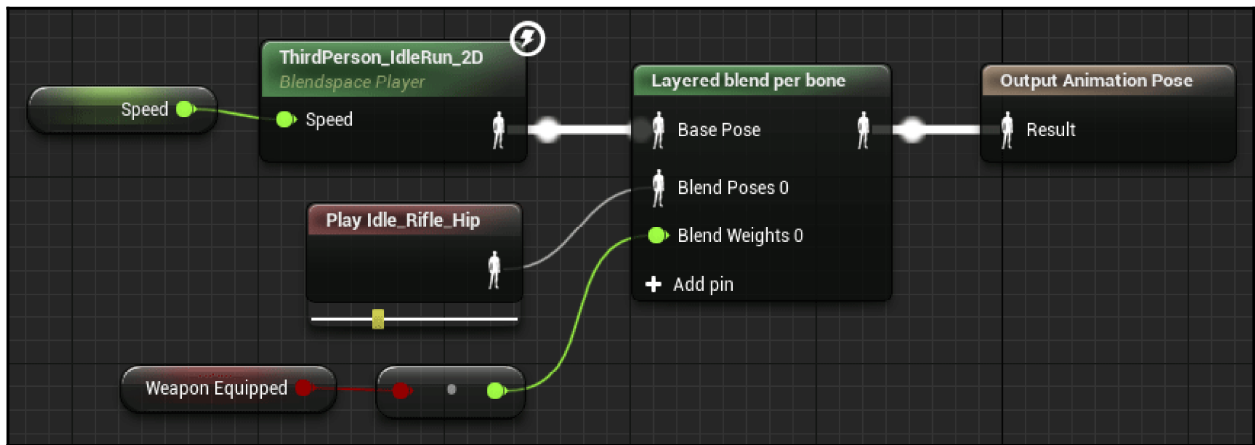


The screenshot shows the 'Anim Preview Editor' window. It has two tabs: 'Edit Preview' (selected) and 'Edit Defaults'. Below the tabs is a search bar labeled 'Search Details'. Under the 'Default' section, there are two settings: 'Is in Air?' with a checkbox and 'Speed' with a numeric input field set to '0.0'.



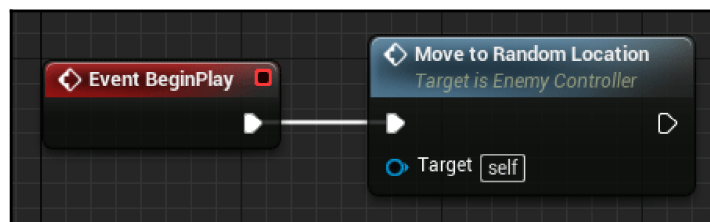
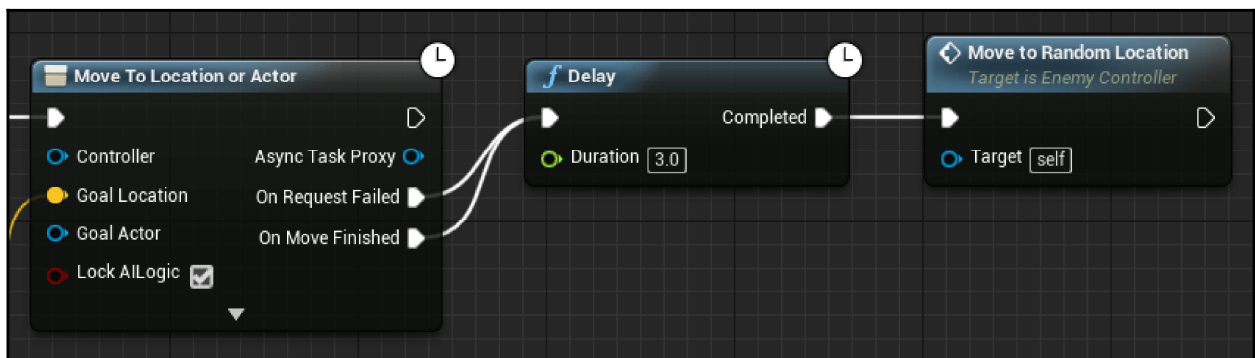
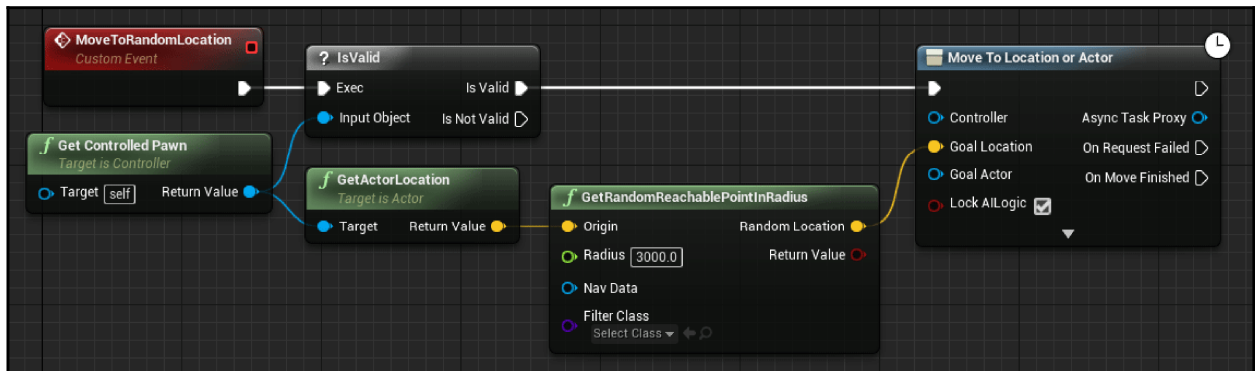
**Config**

Layer Setup	1 Array elements
0	1 members
Branch Filters	1 Array elements
0	2 members
Bone Name	spine_01
Blend Depth	0

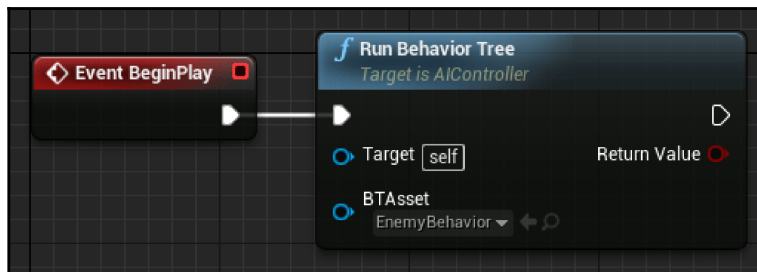
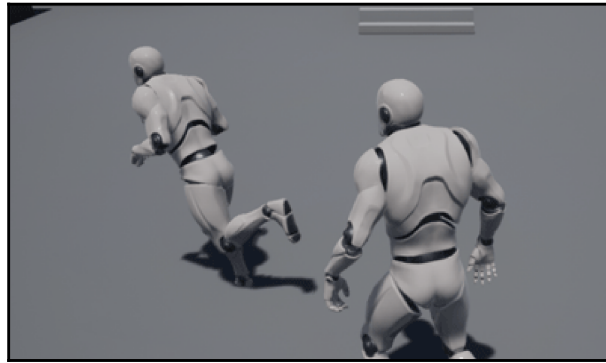
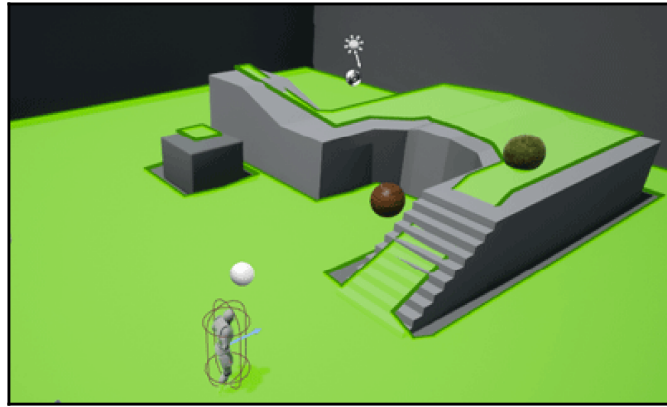


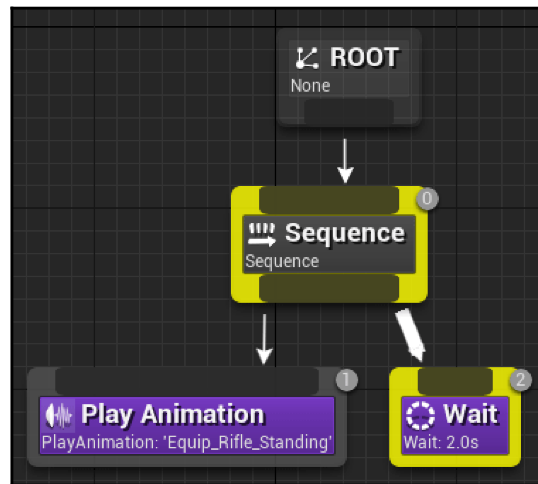
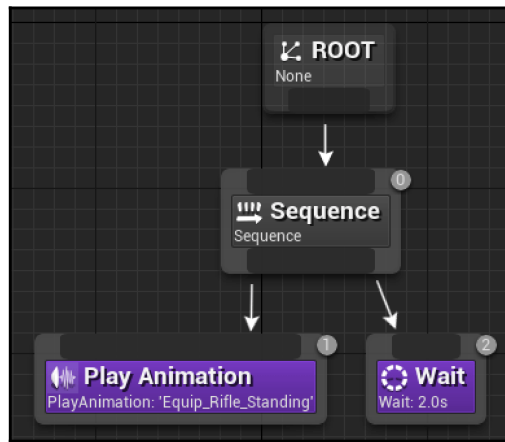


# Chapter 6: AI with Behavior Tree and Blackboard



Auto Possess AI	Placed in World
AI Controller Class	EnemyController



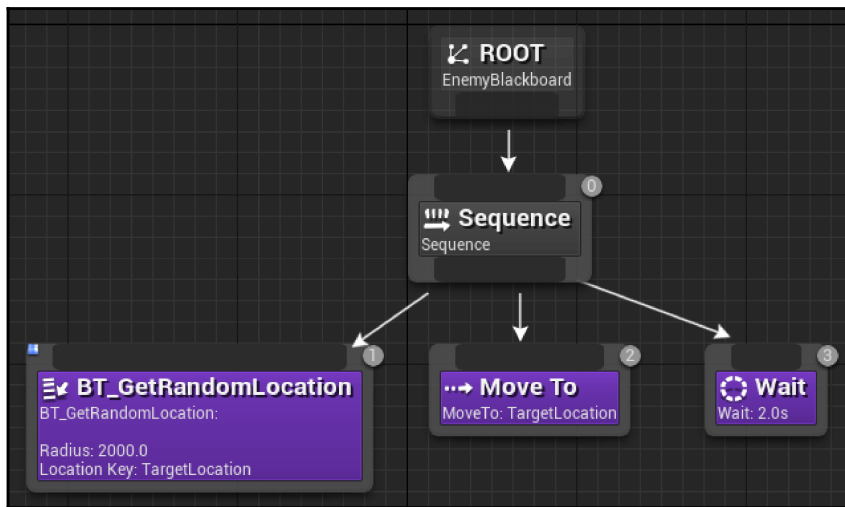
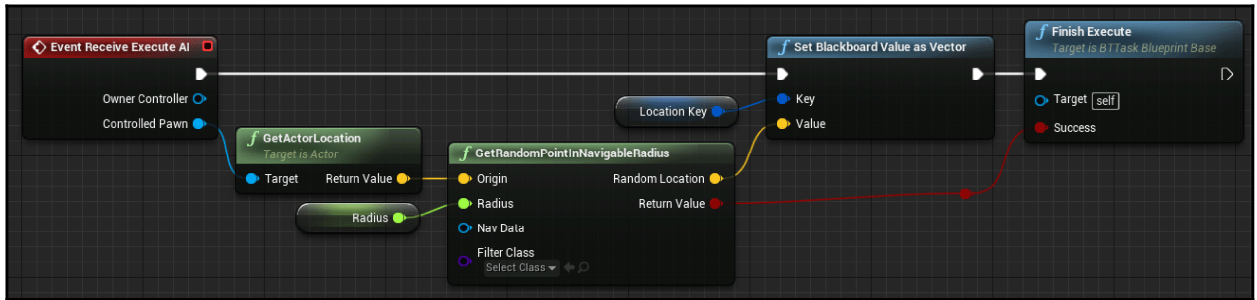


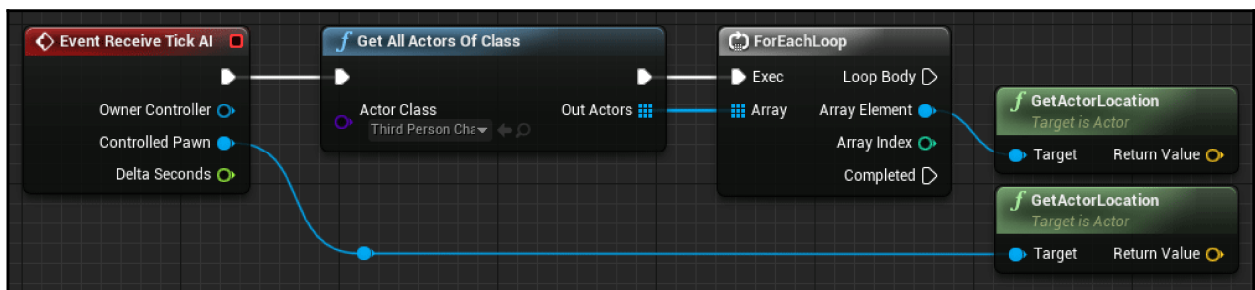
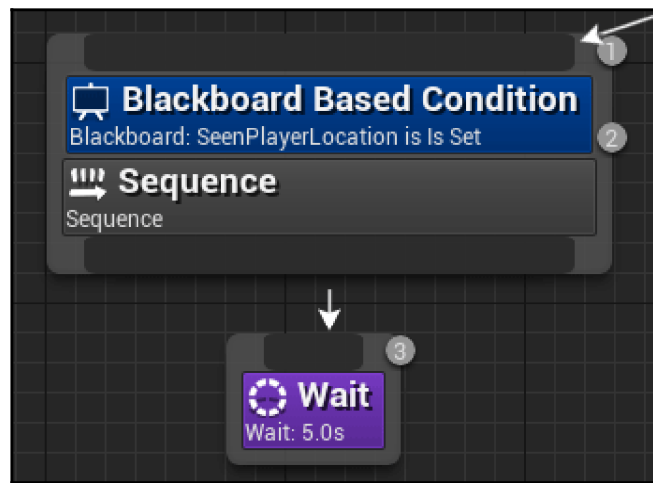
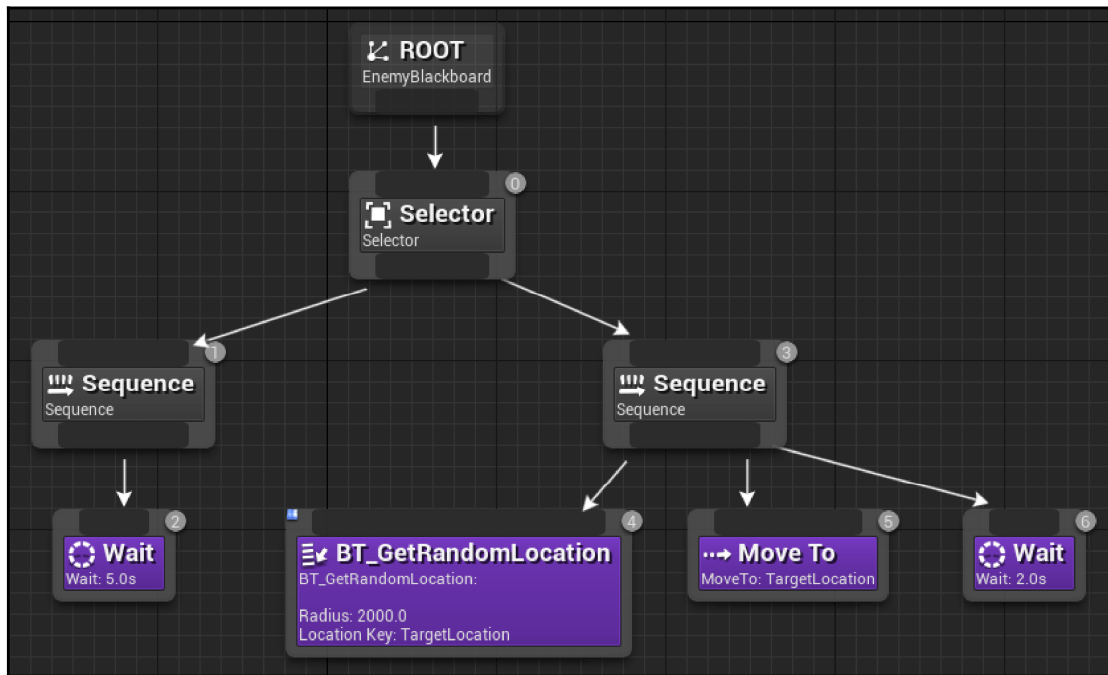
A 'New Key' menu. It has a search bar with the text 'Search'. Below the search bar is a section titled 'Keys'. Under 'Keys', there is a yellow key icon next to the text 'TargetLocation'.

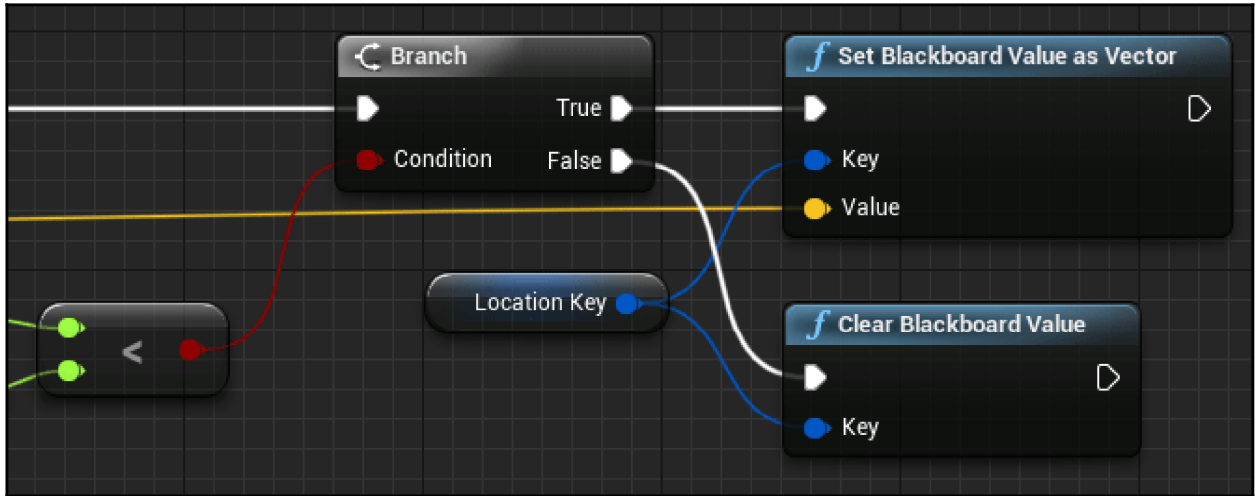
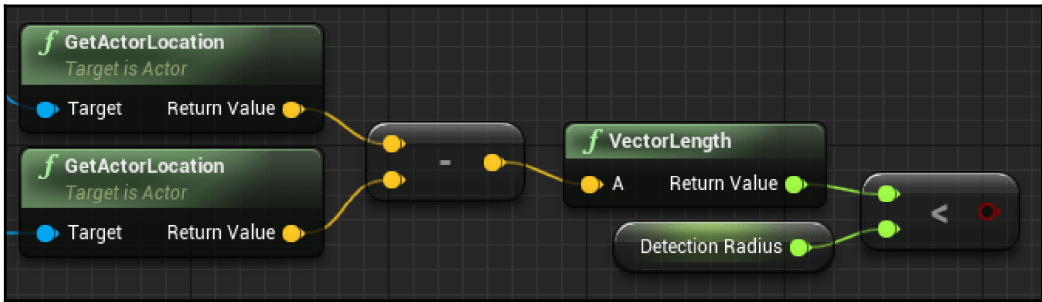
Four event nodes arranged horizontally. Each node has a red header with a diamond icon and a square icon. Below each header is a play button icon and a list of variables with blue circular indicators.

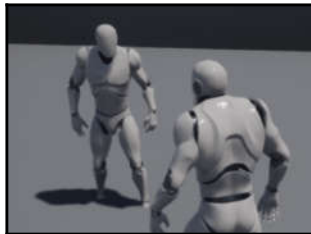
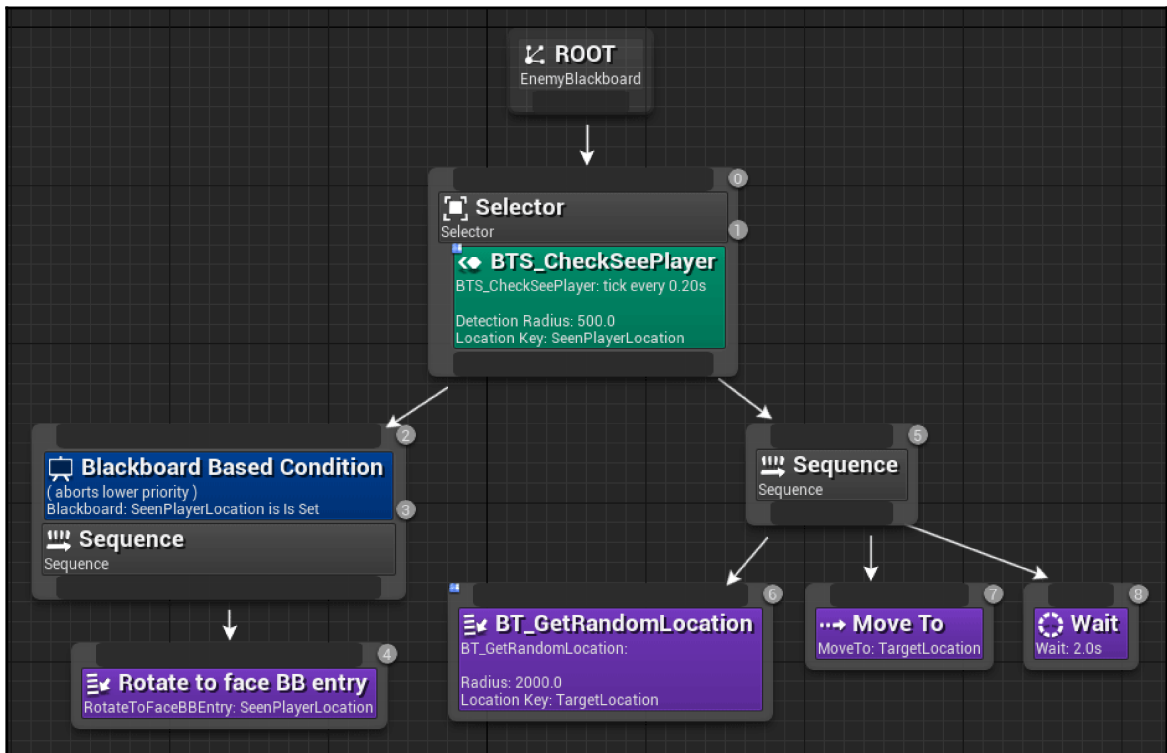
- Event Receive Execute**: Owner Actor
- Event Receive Execute AI**: Owner Controller, Controlled Pawn
- Event Receive Tick**: Owner Actor, Delta Seconds
- Event Receive Tick AI**: Owner Controller, Controlled Pawn, Delta Seconds



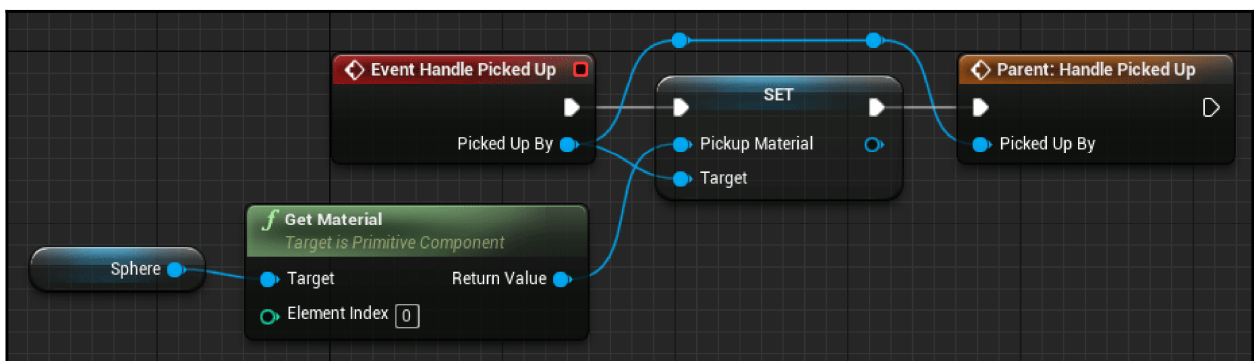
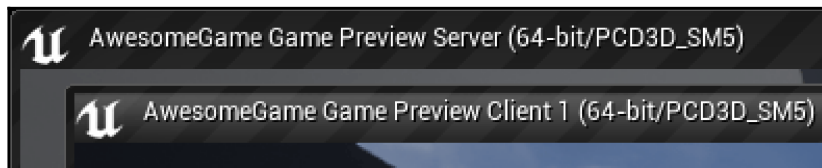
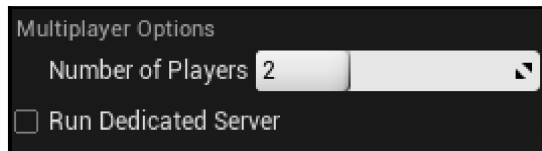


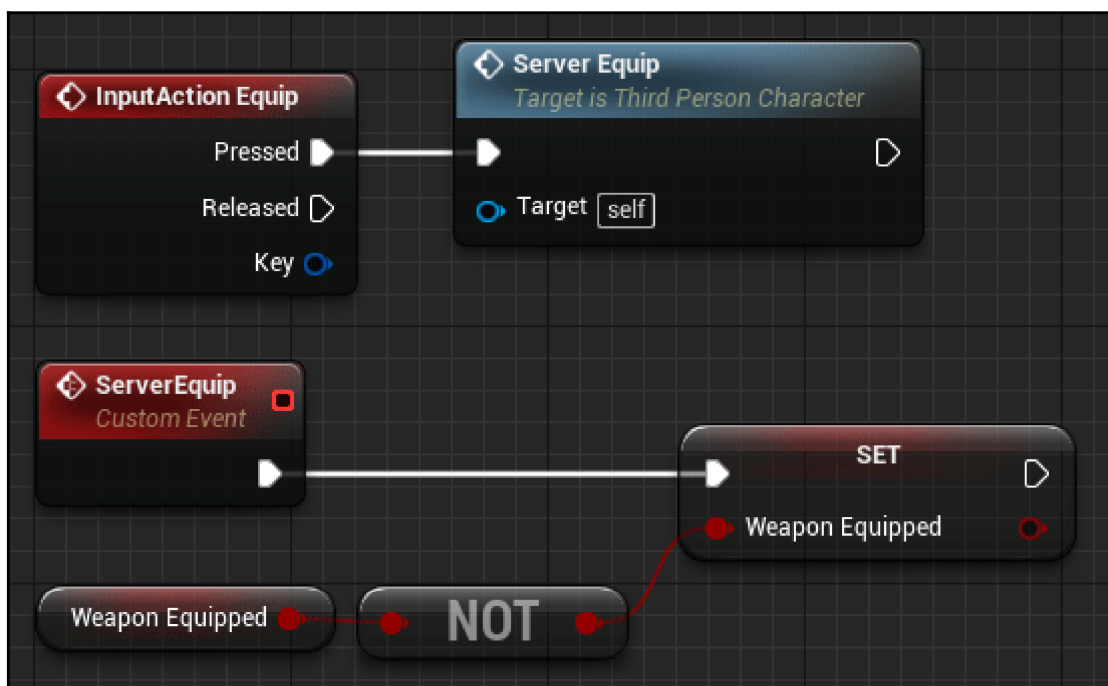
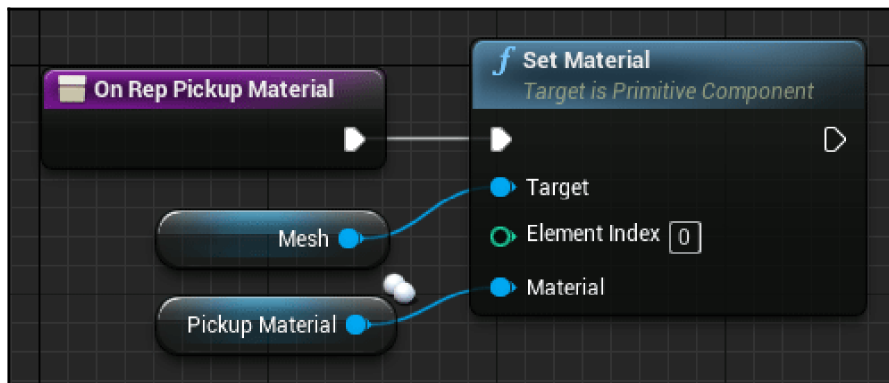






# Chapter 7: Multiplayer Games







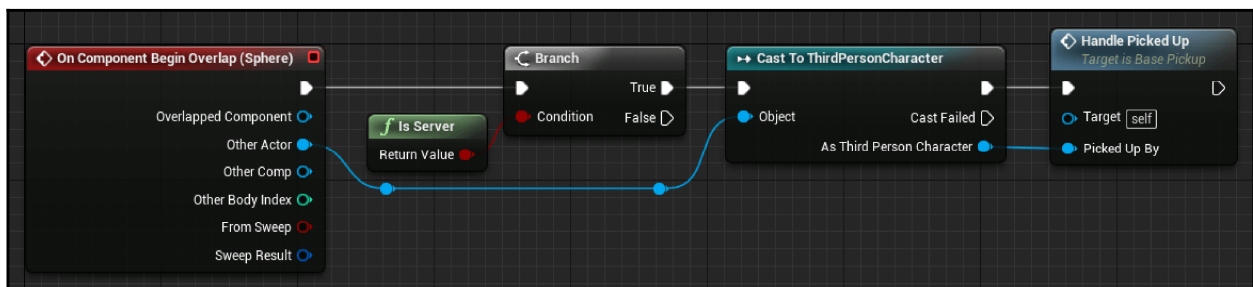
**Graph**

Replicates: **Not Replicated** (dropdown menu)

Reliable



Server: BasePickup collided!  
Client 1: BasePickup collided!





**Replication**

- Only Relevant to Owner
- Always Relevant
- Replicate Movement
- Net Load on Client
- Net Use Owner Relevancy
- Replicates

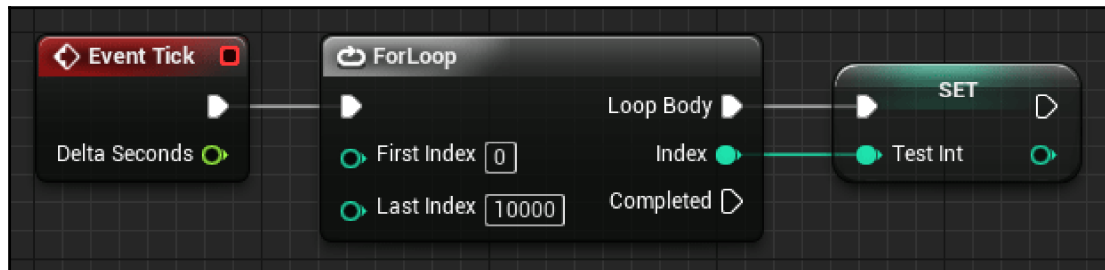
**f Get Game Mode**  
Return Value

**f Get Game State**  
Return Value

**Player State**



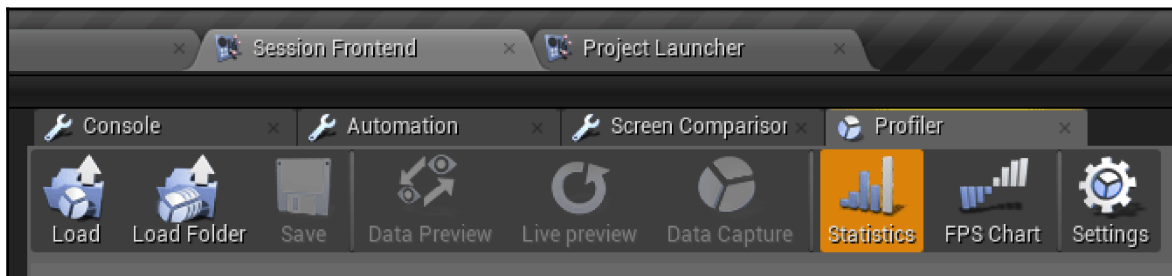
# Chapter 8: Optimization, Testing, and Packaging



```
Stat FPS Shows FPS counter  
> stat fps_
```

**15.93 FPS**  
**62.78 ms**

**PROFILING WITH AI LOGGING ON!**  
**PROFILING WITH GC VERIFY ON!**  
STATS FILE: Duration: 0:02, Filesize: 542.868 KiB  
'DisableAllScreenMessages' to suppress



Device Output Log | Device Manager | Session Frontend | Project Launcher

Window

Name Typ Devic Sta

This Application

My Sessions (1)

Other Sessions

Standalone Instan

Console | Automation | Screen Comparis | Profiler

Load | Load Folder | Save | Data Preview | Live preview | Data Capture | Statistics | FPS Chart | Settings

Rendering thread 140.47 MS

Game thread 0.0 MS

Stats dump browser

Show thread to

Search stats or groups

Group by Group Name

Sort by Stat Name

Hier | Floa | Int | Mer

AI (2) (0)

AI\_EQS (5) (0)

AICrowd (1) (0)

Anim (48) (0)

AsyncLoadGameThread (1)

Audio (6) (0)

AudioThreadCommands (2)

Canvas (6) (0)

Character (10) (0)

Collision (6) (0)

CollisionTags (3) (0)

Graph View

64.0ms 60 512.0 KB

(Threads) GameThread [0x1f88] 66.71 - (Value Min:65.138 Avg:67.027 Max:70.225 (MS) / Calls (10

0.0ms 22.0s 0.0 KB

Projects/AwesomeGame/Saved/Profiling/UnrealStats/UEDPiE\_0\_ThirdPersonExampleMa

Type OneFrame Average Maximum View mode Hierarchical Inclusive Includ

Thread None

Calling Functions	Current Function	Called Functions			
Event Name	Inc Time (MS)	Inc Time (%)	Exc Time (MS)	Exc Time (%)	Calls
↳ FMessageBus.Router [0x1de8]	67.618 ms	100.9 %	0.000 ms	0.0 %	0.7
↳ FUDPMessageProcessor.Sender [0x258f]	67.561 ms	100.8 %	0.000 ms	0.0 %	0.7
↳ RTHeartBeat 16 [0x79c]	67.052 ms	100.0 %	0.000 ms	0.0 %	1.0
↳ TaskGraphThreadNP 1 [0x2570]	67.033 ms	100.0 %	0.000 ms	0.0 %	1.0
↳ FDDCCleanup [0xbdcc]	67.032 ms	100.0 %	0.000 ms	0.0 %	0.7
↳ TaskGraphThreadNP 0 [0xf20]	67.031 ms	100.0 %	0.000 ms	0.0 %	1.0
↳ FAssetDataDiscovery [0x1304]	67.029 ms	100.0 %	0.000 ms	0.0 %	0.7
↳ PoolThread 0 [0x22b4]	67.028 ms	100.0 %	0.000 ms	0.0 %	1.0
↳ FAssetDataGatherer [0x1d80]	67.028 ms	100.0 %	0.000 ms	0.0 %	0.7

↳ TaskGraphThreadHP 6 [0x13e8]	67.027 ms	100.0 %	0.000 ms	
GameThread [0x1f88]	67.027 ms	100.0 %	0.000 ms	
FrameTime	67.020 ms	100.0 %	46.462 ms	
World Tick Time	52.326 ms	78.1 %	0.450 ms	
Tick Time	52.285 ms	99.9 %	2.106 ms	
TG_PrePhysics	52.168 ms	99.8 %	0.320 ms	
ReleaseTickGroup Block	51.893 ms	99.5 %	0.187 ms	
Game TaskGraph Tasks	51.886 ms	100.0 %	0.546 ms	
FTickFunctionTask	51.880 ms	100.0 %	1.441 ms	
ThirdPersonCharacter_C/Game/ThirdPersonBP/Maps/UEDPiE_0_ThirdPersonExampleMap.ThirdPersonExampleMap.PersistentLevel.ThirdPersonCharacter	51.738 ms	99.7 %	0.367 ms	
Blueprint Time	51.418 ms	99.4 %	0.430 ms	
Function/Game/ThirdPersonBP/Blueprints/ThirdPersonCharacter.ThirdPersonCharacter_C.ReceiveTick	51.411 ms	100.0 %	0.685 ms	
Function/Game/ThirdPersonBP/Blueprints/ThirdPersonCharacter.ThirdPersonCharacter_C.ExecuteUbergraph_ThirdPersonCharacter	51.403 ms	100.0 %	4508.117 ms	
Self	49.540 ms	96.4 %	0.000 ms	
Function/Script/Engine.KismetMathLibrary.Add_IntInt	0.970 ms	1.9 %	0.000 ms	

Blueprints

Blueprint Nativization Method Disabled

List of Blueprint assets to nativize 0 Array elements + -

