

Enemy Artificial Intelligence (1)

13th Week, 2021

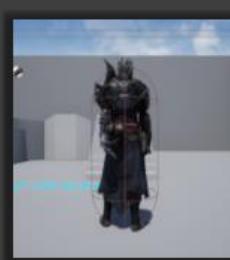
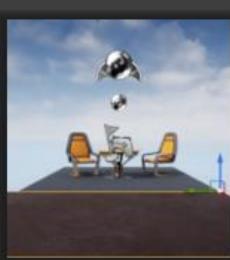
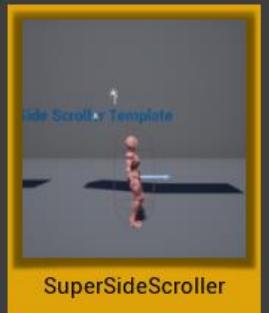


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Enemy AI (1)

- › **AI** (Artificial Intelligence)
 - An entry that is aware of its environment and performs choices that will help optimally achieve its intended purpose
 - Uses **finite state machines** to switch between more than one state based on the input it receives from the user or its environment
- › Interesting and fun AI is crucial to any game, and depending on the game you are making, this can mean a very complex or very simplistic AI.



Enemy AI (2)

- › In **SuperSideScroller** game, how the enemy will behave:
 - A very simple enemy that has a basic back and forth movement pattern and will not support any attacks; only by colliding with the player character will they be able to inflict any damage.
 - Need to set the locations to move between for the enemy AI
 - Decide whether the AI should change locations, should constantly move between locations, or should there be a pause in between selecting a new location to move to?



AI Controller

- › A **Player Controller** and an **AI Controller**
 - Both of these actors derive from the base **Controller** class
 - › A Controller is used to take control of a **Pawn** or **Character**
- › The main difference between a Player Controller and an AI Controller
 - A Player Controller relies on the input of an actual player
 - An AI Controller applies AI to the characters and responds to the environment based on the rules set forth by the AI.
- › Multiple instances of the same AI pawn can share the same AI Controller, and the same AI Controller can be used across different AI pawn classes.



Auto Possess AI (1)

- › The AI Controller must possess a *pawn*

- To possess a pawn:

```
void AController::Possess(APawn* InPawn)
```

- To unpossess a pawn:

```
void AController::UnPossess()
```

- Also `void AController::OnPossess(APawn* InPawn)` and `void AController::OnUnPossess()` functions are called whenever the `Possess()` and `UnPossess()` functions are called, respectively.



Auto Possess AI (2)

- › In Unreal Engine 4, there are two methods in which AI Pawns or Characters can be possessed by an AI Controller.
 - **Placed in World:** How you will be handling AI
 - › You will manually place these enemy actors into your game world, and the AI will take care of the rest once the game begins.
 - **Spawned:** A little more complicated
 - › Requires an explicit function call, either C++ or Blueprint, to **Spawn** an instance of a specified class
 - **Placed in World or Spawned:** A safe option if you are unsure of which method you want to use
 - › Both methods are supported



Exercise 13.01: Implementing AI Controllers

The screenshot shows the Unreal Engine Content Browser interface. On the left, the Content Browser tree view is open, showing a folder structure. A red box highlights the 'Content' folder, and the text 'Right-Click' is overlaid in red at the bottom left. In the center, a context menu is displayed over a 3D model of a character. The menu has a yellow header 'New Folder' and includes options like 'Import Asset', 'Create Basic Asset' (with 'Blueprint Class' selected), and 'Create Advanced Asset' (with 'Animation' selected). The right side of the screen shows a list of 26 actors, including various ledge and floor assets, with a 'View Options' dropdown. The bottom right corner says 'Select an object to view details.'



This screenshot shows the Content Browser panel of the Unreal Engine 4 Editor. The top navigation bar includes "Add/Import", "Save All", and a breadcrumb path "Content > Enemy > ". Below this is a search bar labeled "Search Paths" and "Filters" with a search term "Search Enemy". The main content area displays a folder structure under "Content": "Enemy", "Geometry", "MainCharacter" (selected and highlighted in yellow), "Mannequin", "SideScrollerCPP", "StarterContent", and "C++ Classes". Within the "MainCharacter" folder, there are three sub-folders: "AI" (highlighted in yellow and has a red arrow pointing to it from the previous screenshot), "Blueprints", and "Materials". At the bottom of the Content Browser, a message "3 items (1 selected)" is displayed, and a "View Options" button is located in the bottom right corner.

SideScrollerExampleMap DDC SuperSideScroller

File Edit Window Help

Place Actors

Search Classes

Recently Placed

Basic

Lights

Cinematic

Visual Effects

Geometry

Volumes

All Classes

Content Browser

Add/Import Save All

Output Log

Content

Enemy

AI

Blueprints

Materials

Geometry

MainCharacter

Animation

Blueprints

Mesh

Mannequin

SideScrollerCPP

0 items

Save Current Source Control Modes Content Marketplace Settings Blueprints Cinematics Build Compile

Perspective Lit Show

New Folder Import Asset Create Basic Asset Blueprint Class Level Material Particle System

Blueprints are special assets that provide an intuitive, node-based interface that can be used to create new types of Actors and script level events; giving designers and gameplay programmers the tools to quickly create and iterate gameplay from within Unreal Editor without ever needing to write a line of code.

hold (Ctrl + Alt) for more

Drop files here or right click to create content.

World Outliner

Label Type

SideScrollerExampleMap (World) Folder

ArenaGeometry Folder

Ledges StaticMeshActor

Ledge1 StaticMeshActor

Ledge2 StaticMeshActor

Ledge3 StaticMeshActor

Ledge4 StaticMeshActor

Ledge5 StaticMeshActor

Ledge6 StaticMeshActor

Ledge7 StaticMeshActor

Ledge8 StaticMeshActor

Ledge9 StaticMeshActor

Floor StaticMeshActor

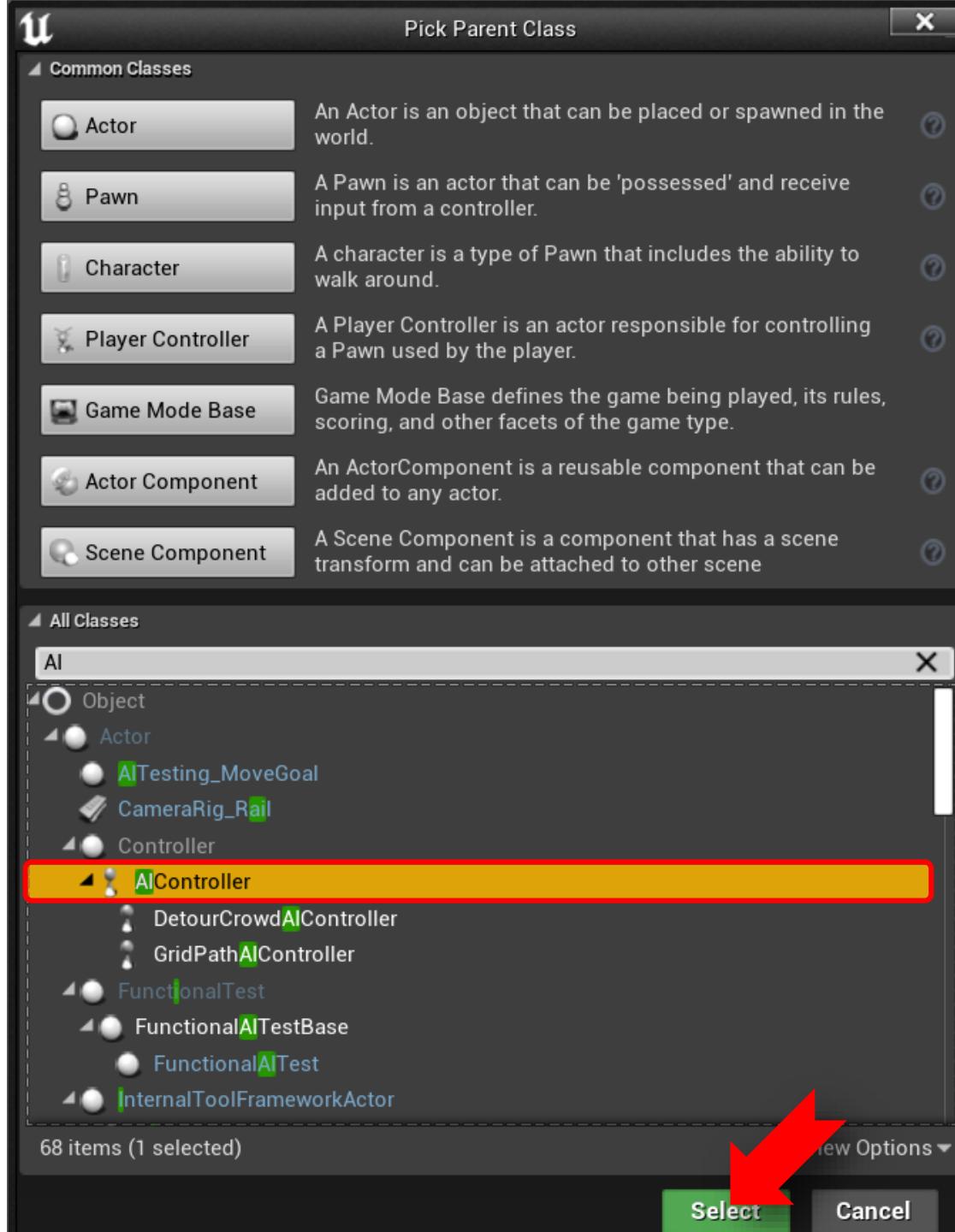
26 actors View Options

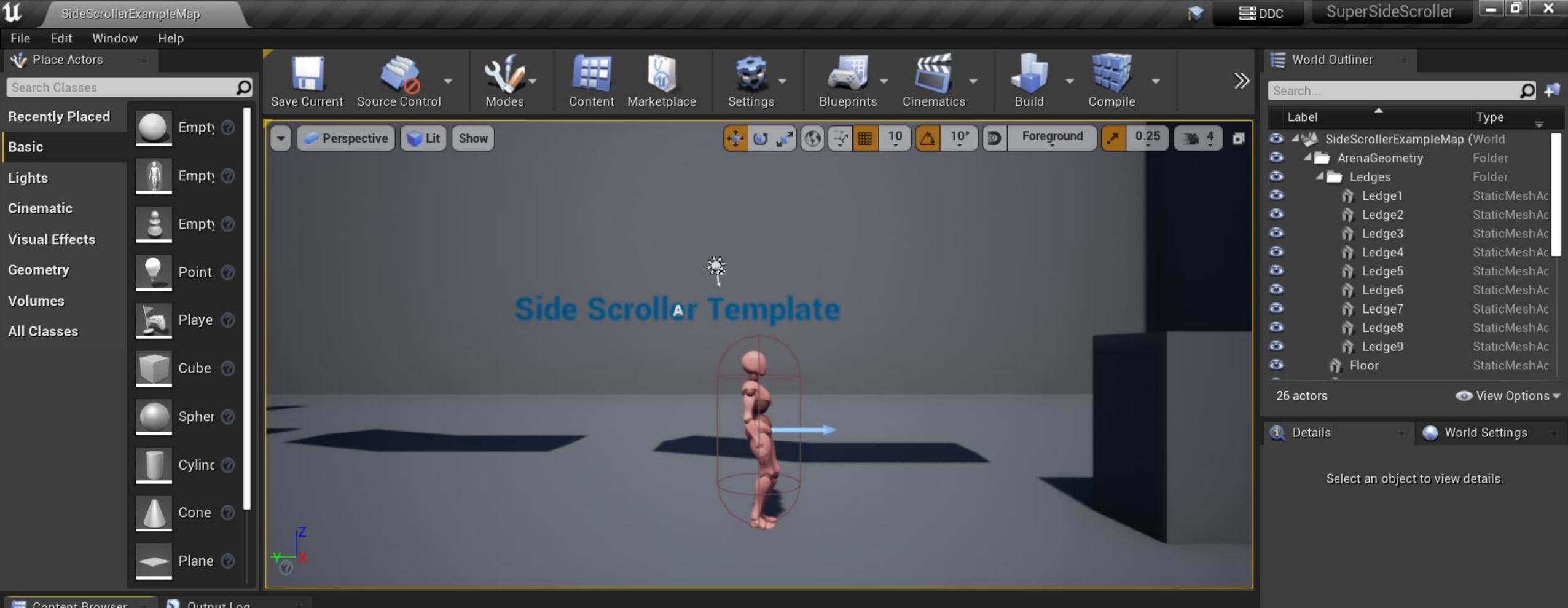
Details World Settings

Select an object to view details.

Right-Click

View Options

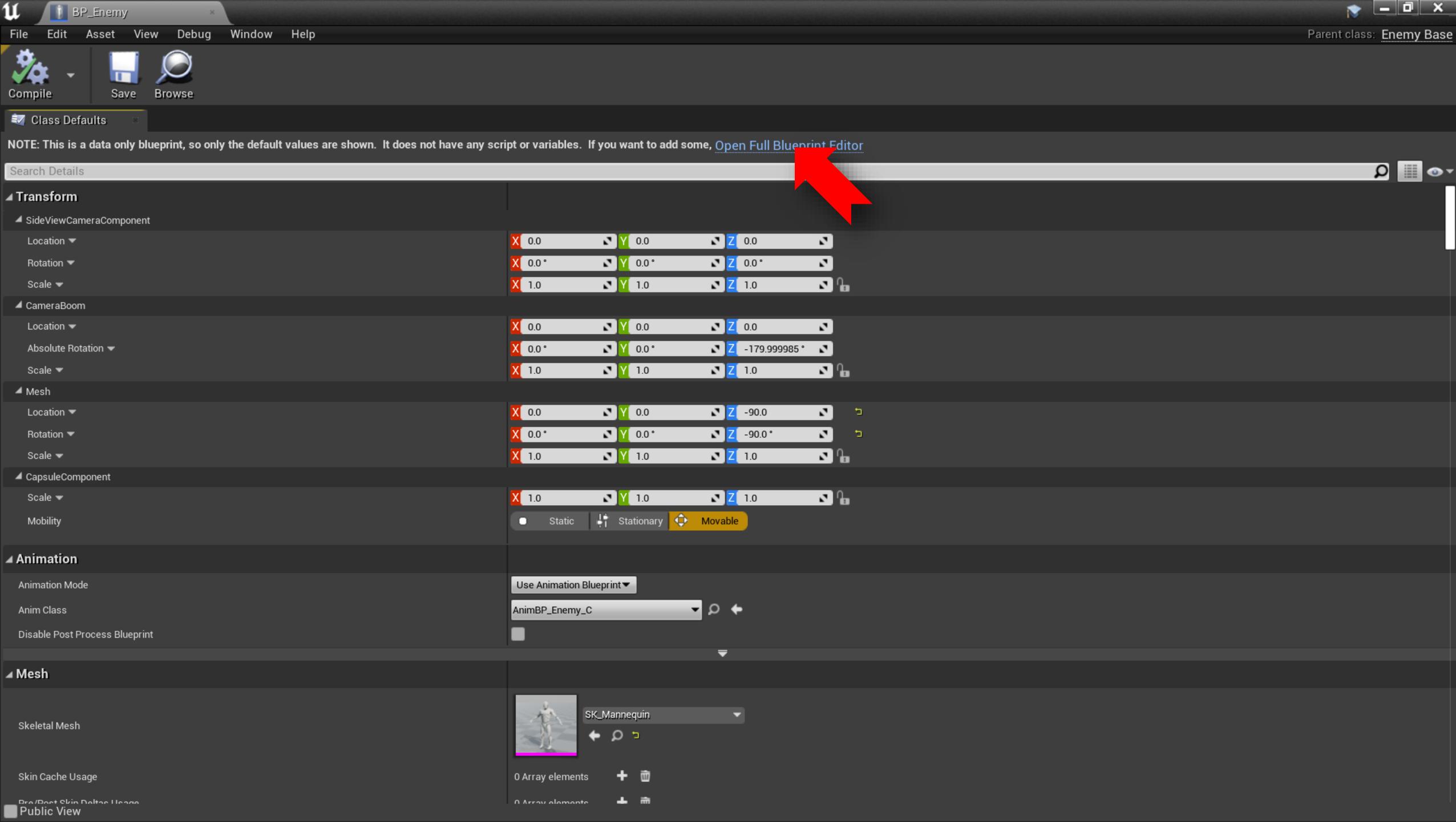


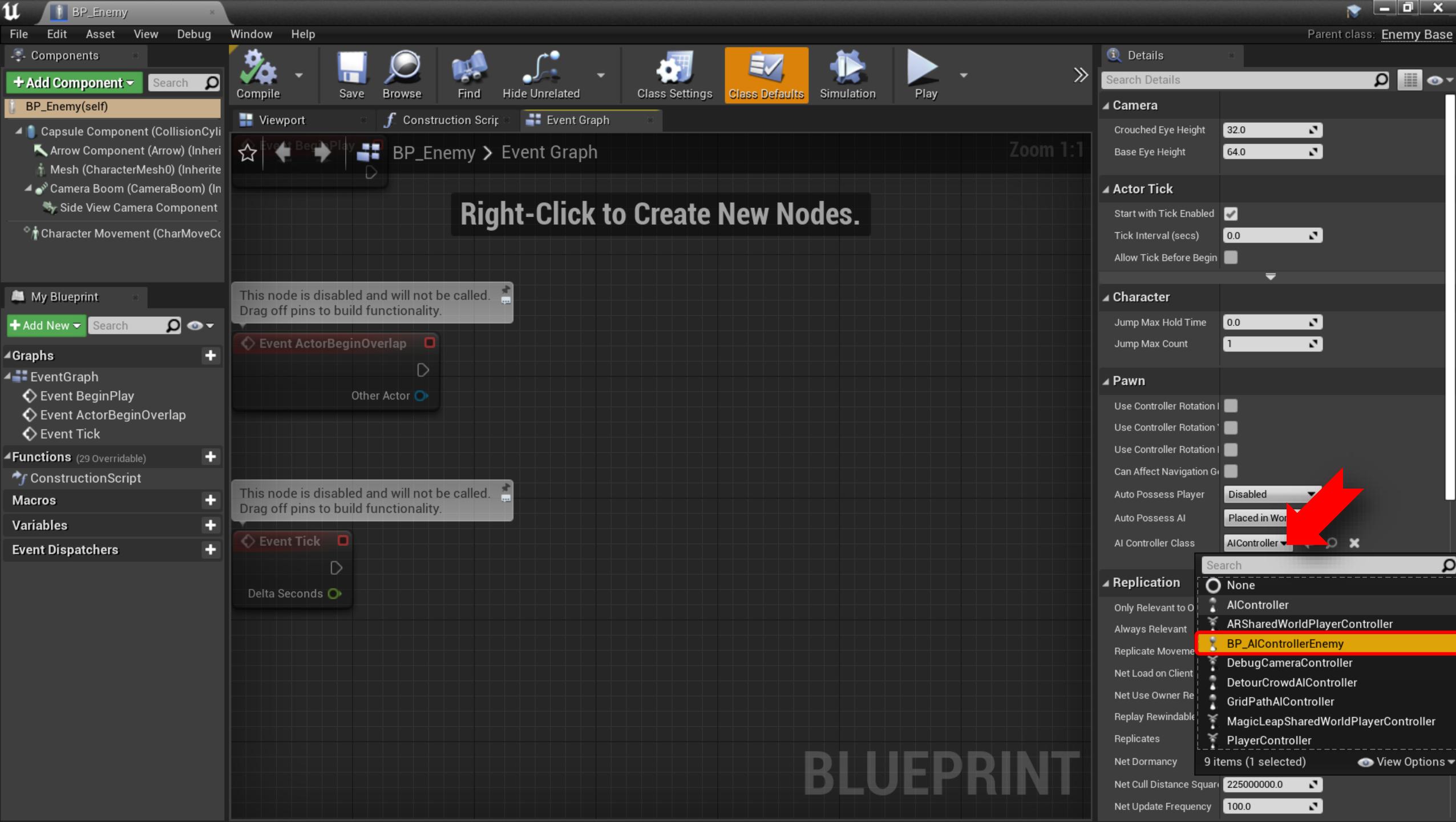


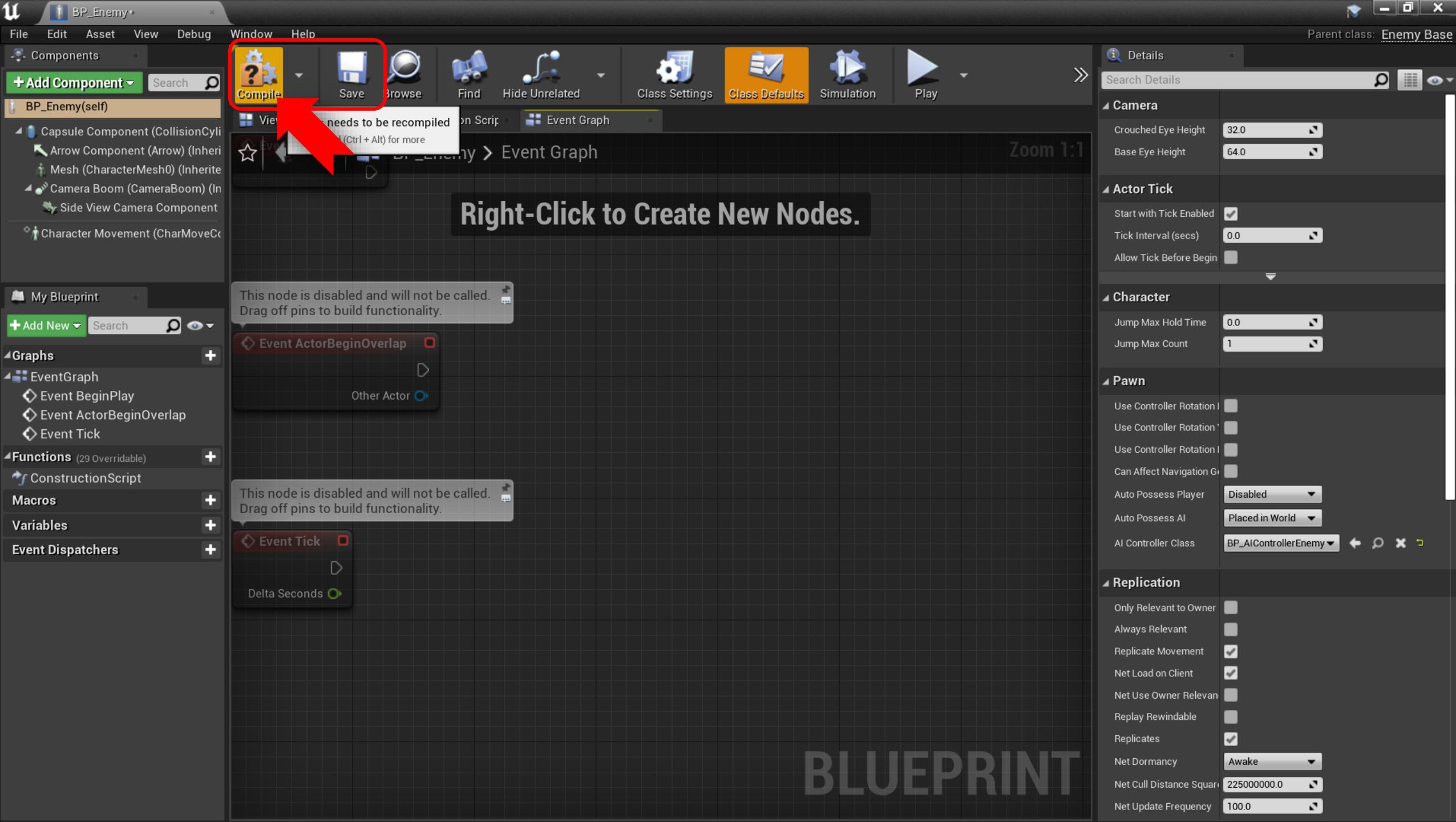
This screenshot shows the "Content Browser" panel from the Unreal Engine 4 Editor. The browser tree on the left shows the "Content" folder, with "Enemy" expanded, revealing "AI", "Blueprints", "Materials", and "BP_AIController". The "BP_AIController" asset is highlighted with a yellow border. The search bar at the top right contains the text "Search AI". Below the browser tree, it says "1 item (1 selected)".



The screenshot shows the Content Browser panel. The left sidebar lists Content, Enemy, AI, Blueprints, Materials, Geometry, MainCharacter, Animation, Blueprints, Mesh, Mannequin, and SideScrollerCPP. The main area displays two items: AnimBP_Enemy and BP_Enemy. A red arrow points to the BP_Enemy thumbnail, which is highlighted with a yellow border. The status bar at the bottom indicates "2 items (1 selected)".





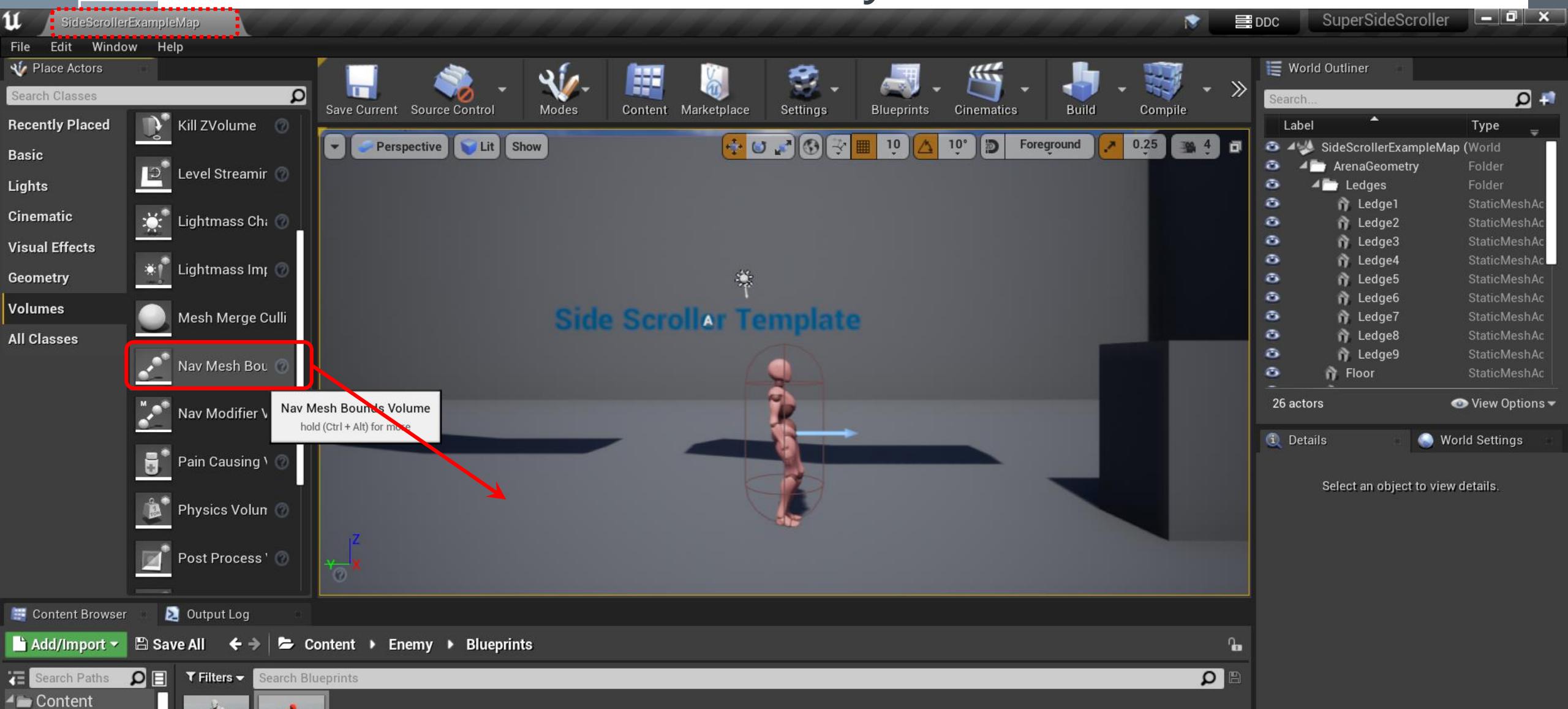


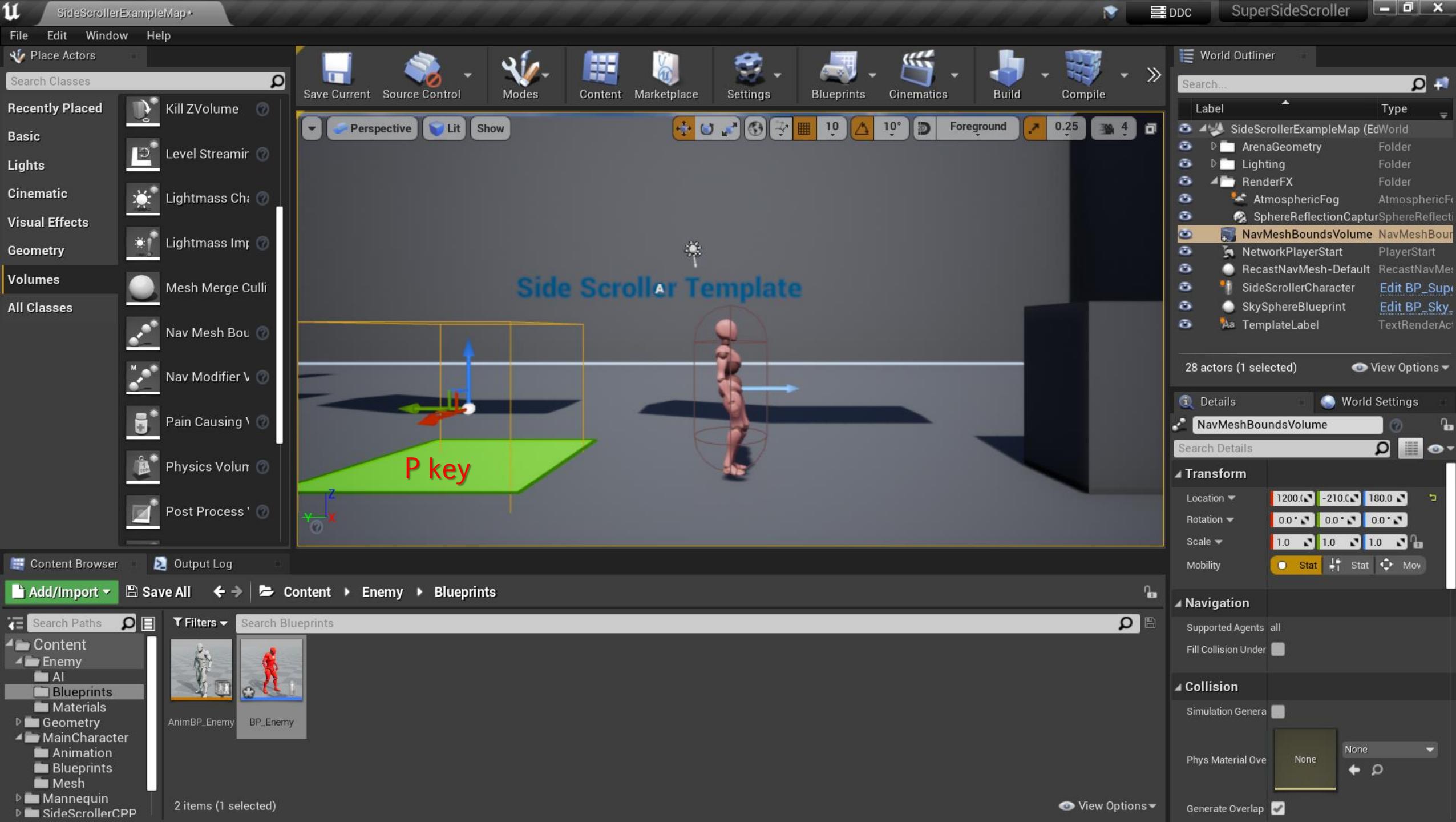


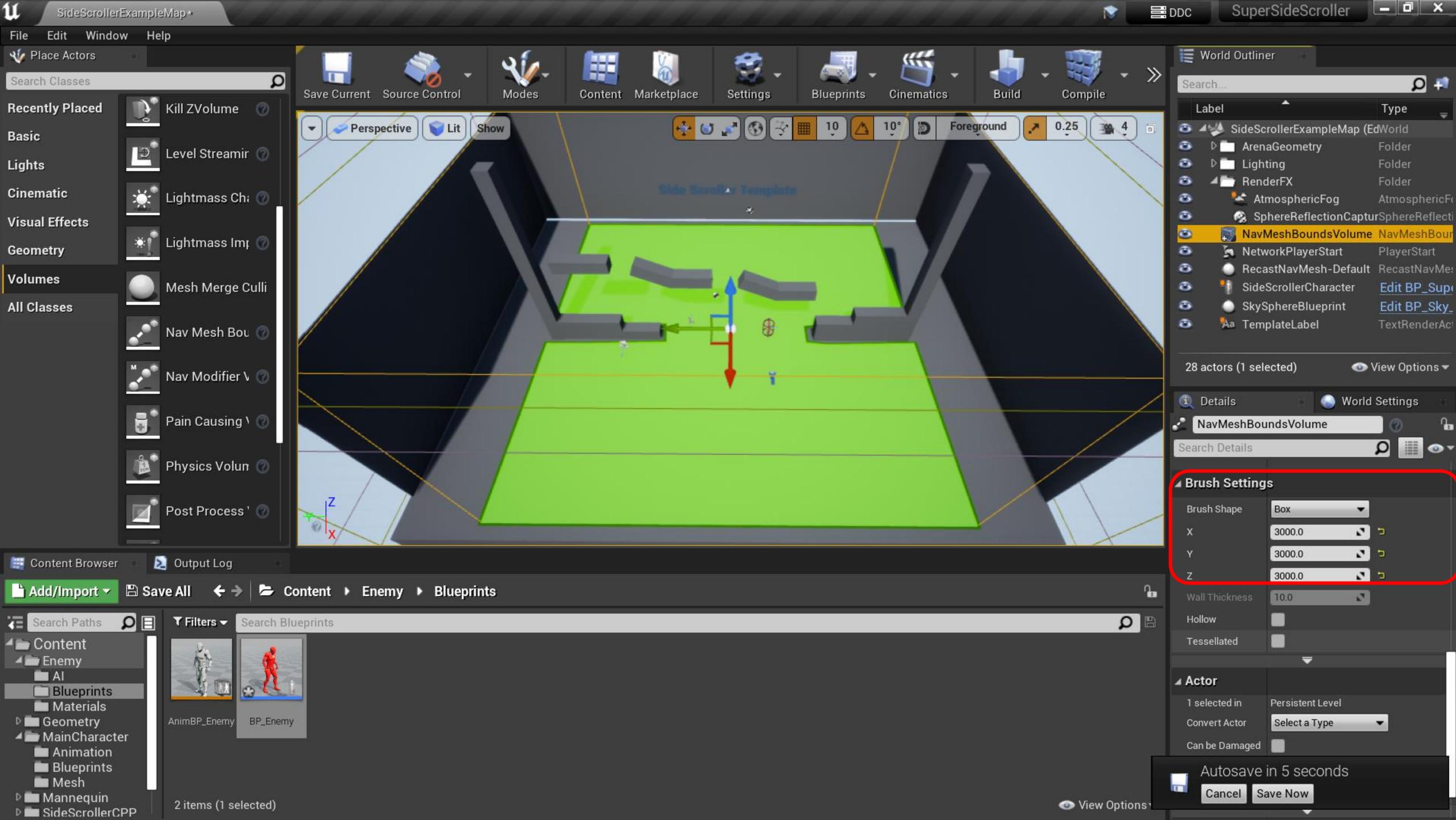
Navigation Mesh

- › One of the most crucial aspects of any AI, especially in video games, is the ability to navigate the environment in a sophisticated manner.
- › We will need a **Navigation Mesh** or **Nav Mesh** in our world, so that our AI can effectively navigate the playable bounds of the game world.
- › Unreal Engine 4 also support a **Dynamic Navigation Mesh**, which allows the Nav Mesh to update in real-time as dynamic objects move around the environment.

Exercise 13.02: Implementing a Nav Mesh Volume for the AI Enemy

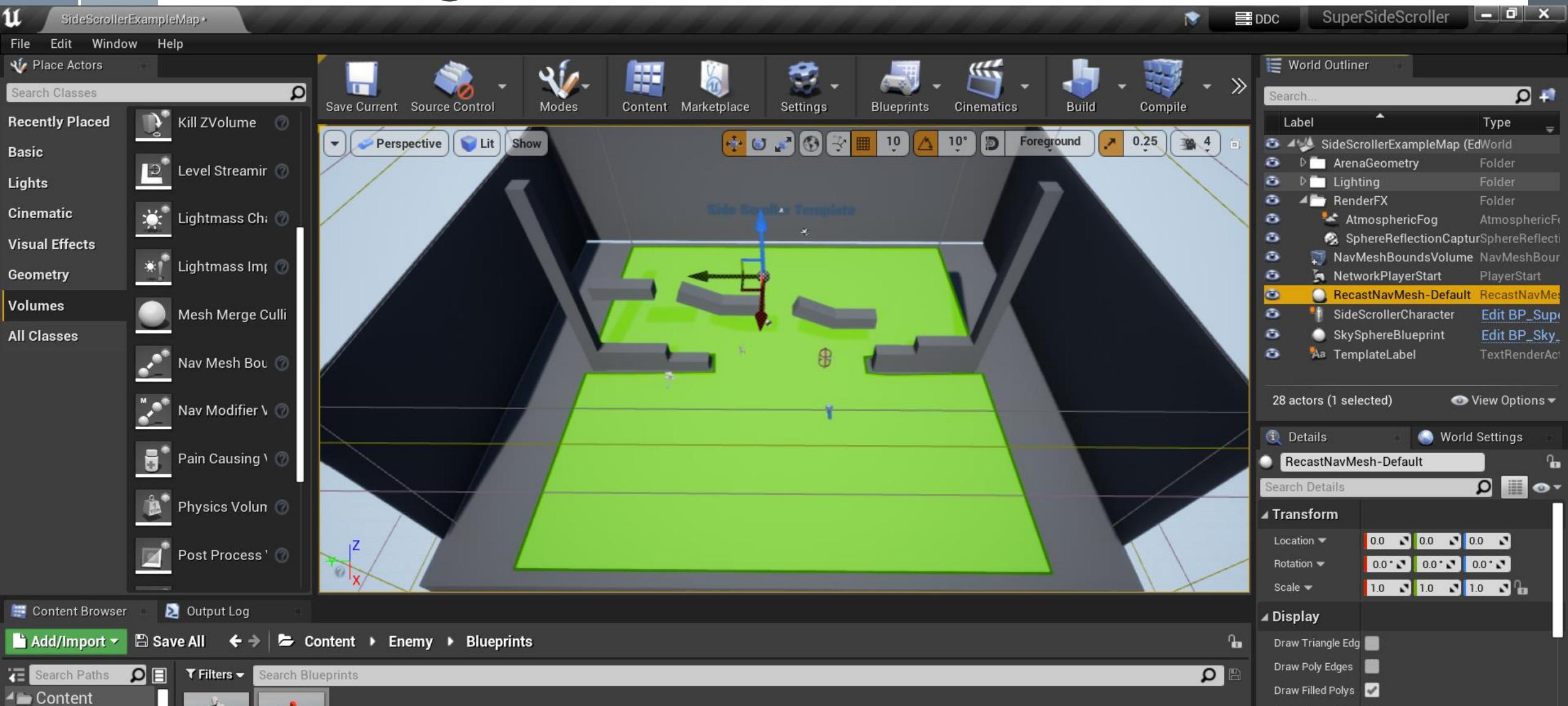








Recasting The Nav Mesh (1)





Recasting The Nav Mesh (2)

- › The **RecastNavMesh** acts as the “brain” of the Nav Mesh because it contains the parameters needed to adjust the Nav Mesh that directly influences how the AI navigates the given area.
 - **Display** (visual debug display of generated navigable area)
 - **Generation**
 - › **Cell Size**
 - › **Agent Radius**
 - › **Agent Height** (the Half Height of the collision component)
 - › **Agent Max Slope** (by default, 44 degrees)
 - › **Agent Max Step Height**



Exercise 13.03: Recasting Nav Mesh Volume Parameters

The screenshot displays the Unreal Engine Editor interface, specifically the 3D level editor. A green navigation mesh is visible, representing the pathfinding grid. A specific area of the mesh is highlighted with a red dashed box, indicating a region of interest or a problem area. The 'Content Browser' at the bottom left shows two enemy blueprints: 'AnimBP_Enemy' and 'BP_Enemy'. The 'Details' panel on the right shows parameters for 'RecastNavMesh-Default', with 'Cell Size' set to 5.0 and 'Agent Height' set to 192.0, both of which are highlighted with red boxes.

Content Browser:

- Add/Import
- Save All
- Content > Enemy > Blueprints

Content Browser Details:

- Content
- Enemy
- AI
- Blueprints
- Materials
- Geometry
- MainCharacter
- Animation
- Blueprints
- Mesh
- Mannequin
- SideScrollerCPP

Selected Items: 2 items (1 selected)

World Settings:

- RecastNavMesh-Default
- SideScrollerCharacter
- SkySphereBlueprint
- TemplateLabel

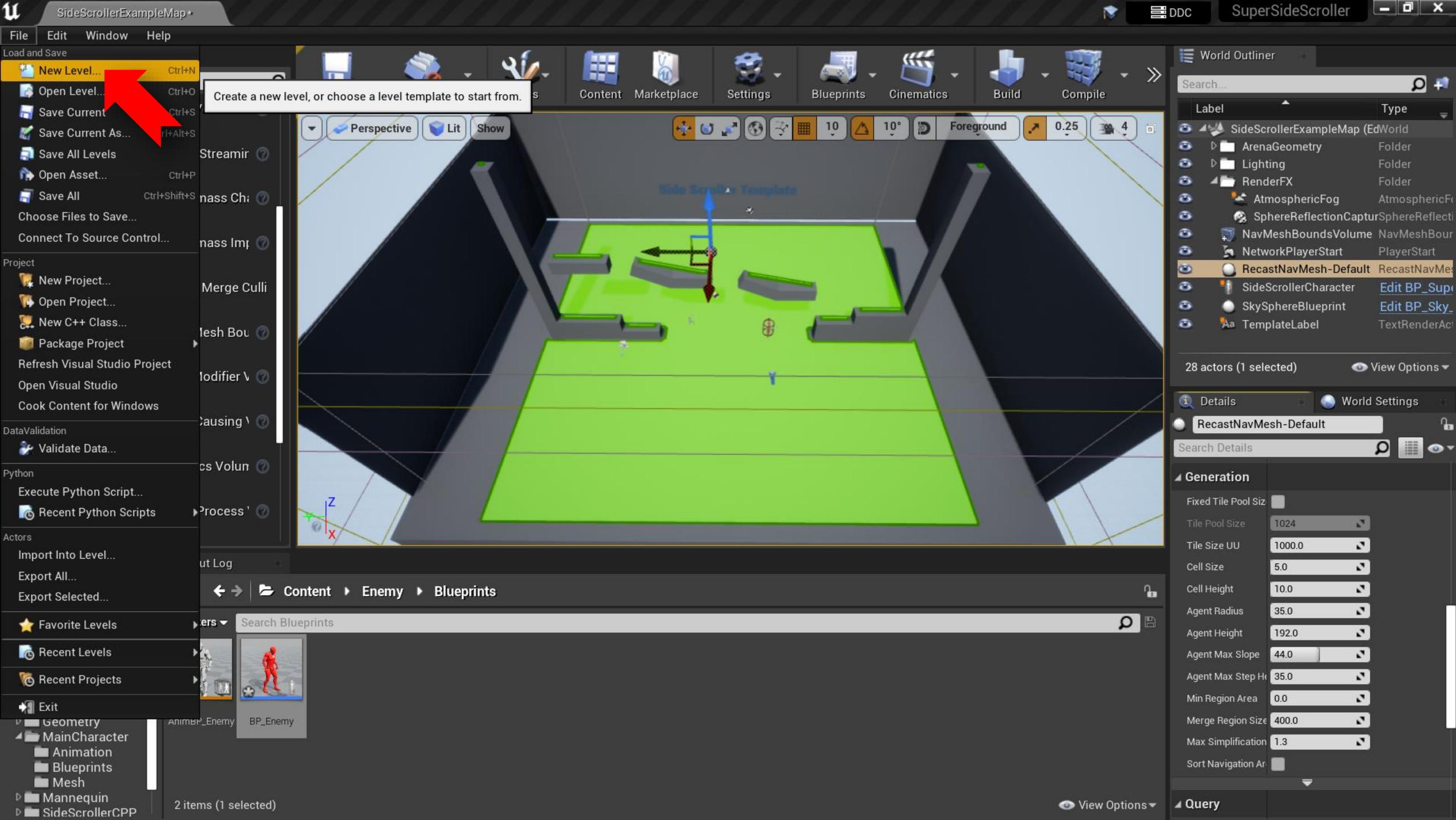
Details Panel (RecastNavMesh-Default):

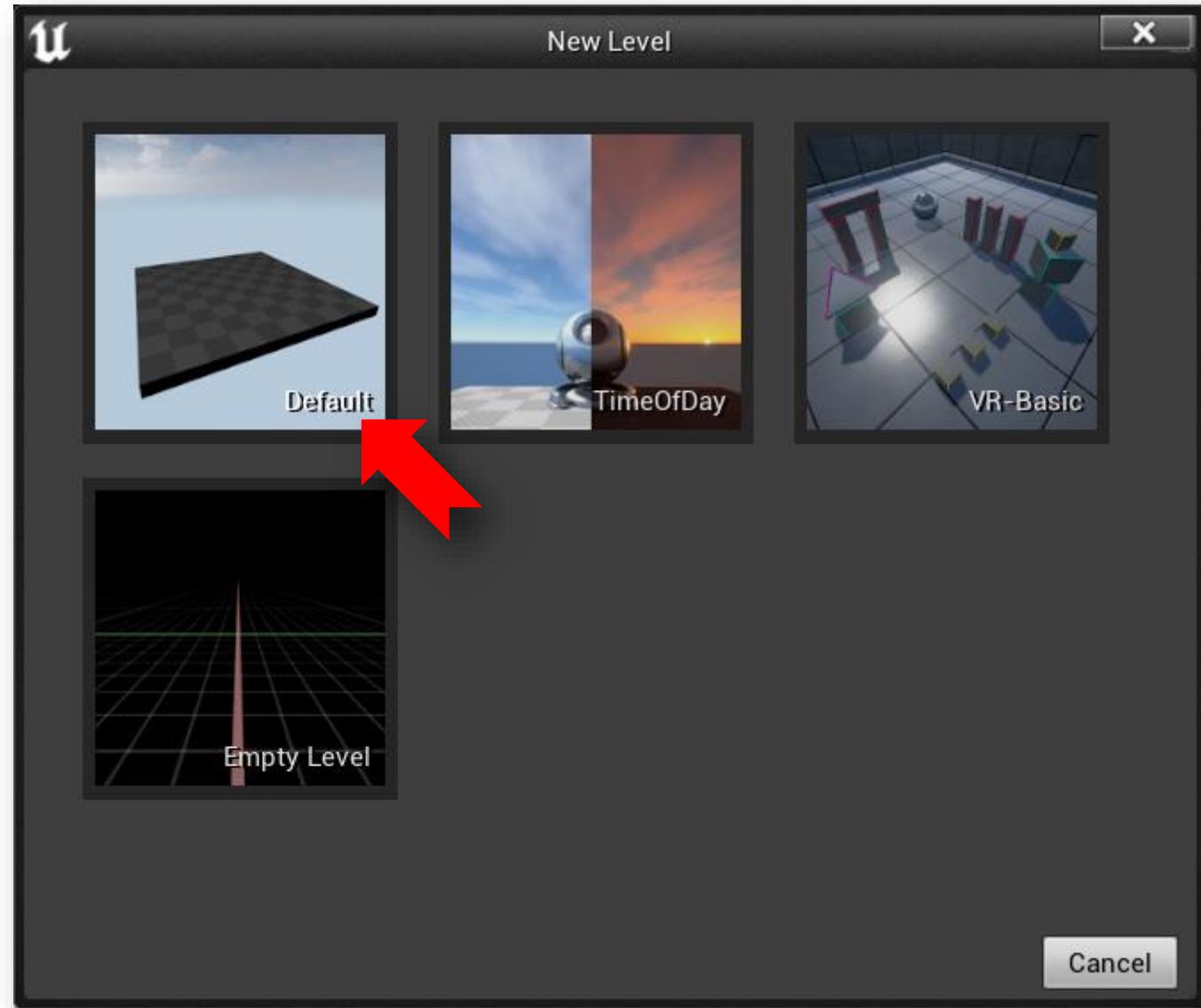
Parameter	Value
Cell Size	5.0
Cell Height	10.0
Agent Radius	35.0
Agent Height	192.0
Agent Max Slope	44.0
Agent Max Step He	35.0
Min Region Area	0.0
Merge Region Size	400.0
Max Simplification	1.3
Sort Navigation Ar	

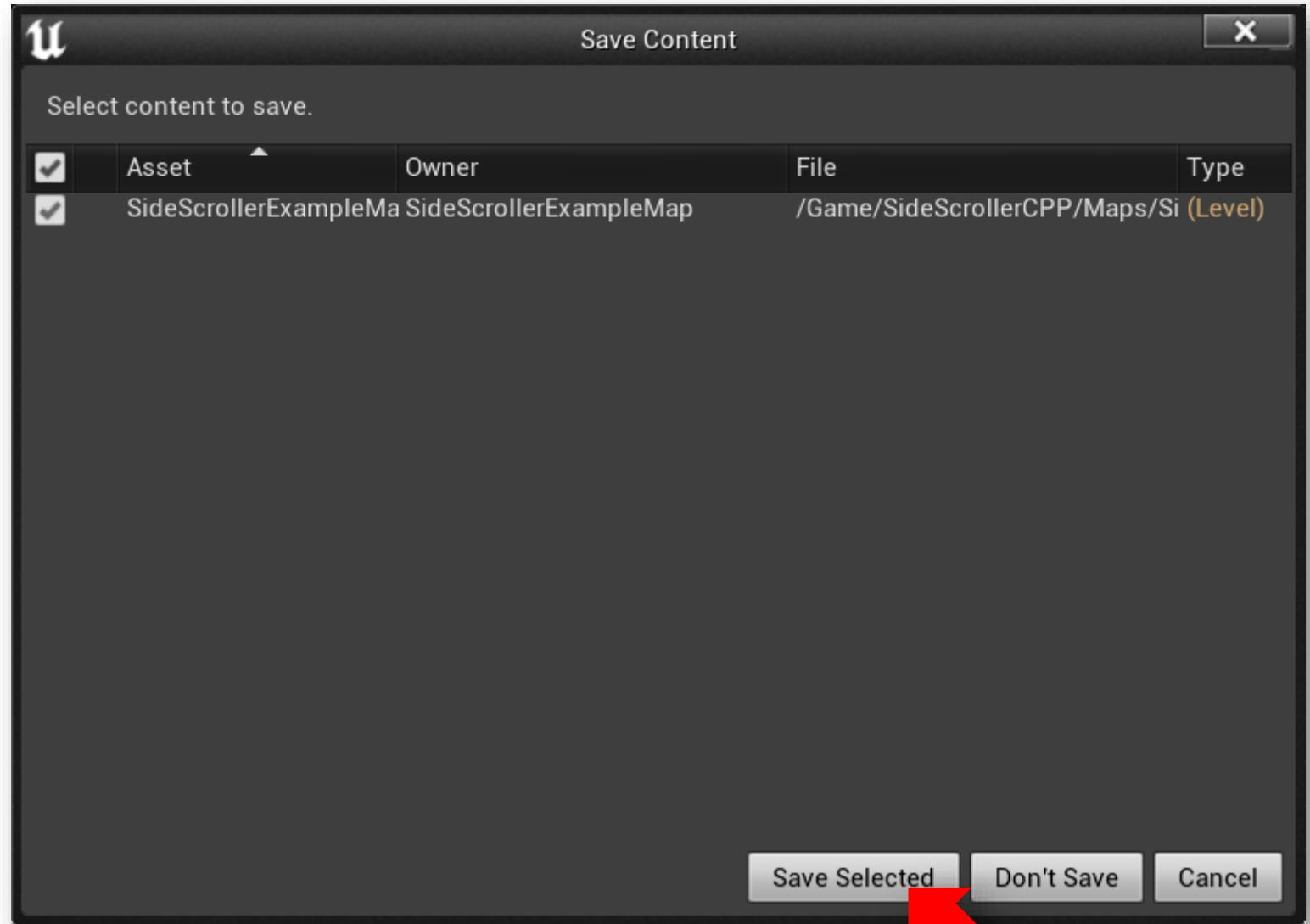


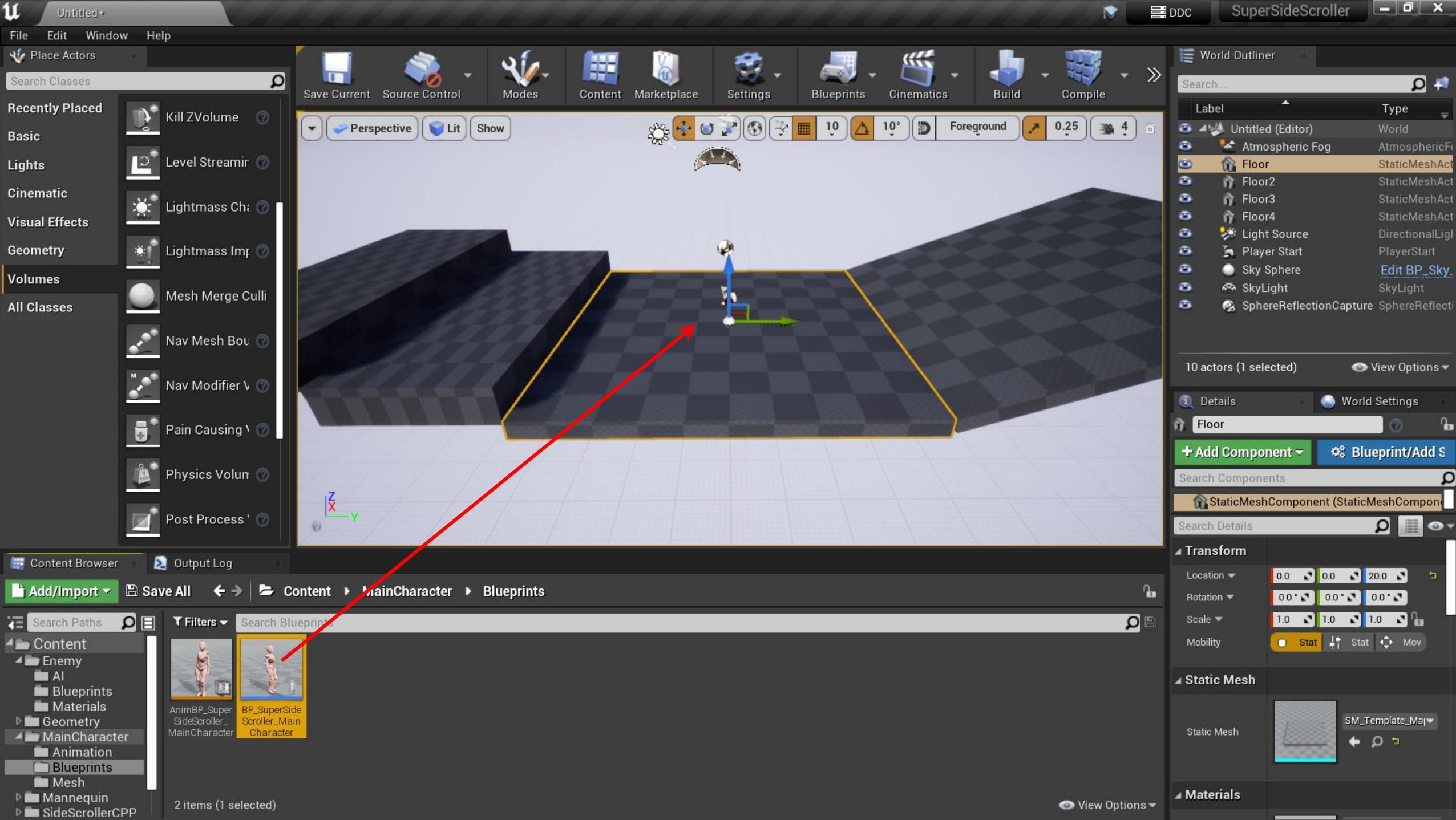
Activity 13.01: Creating a New Level

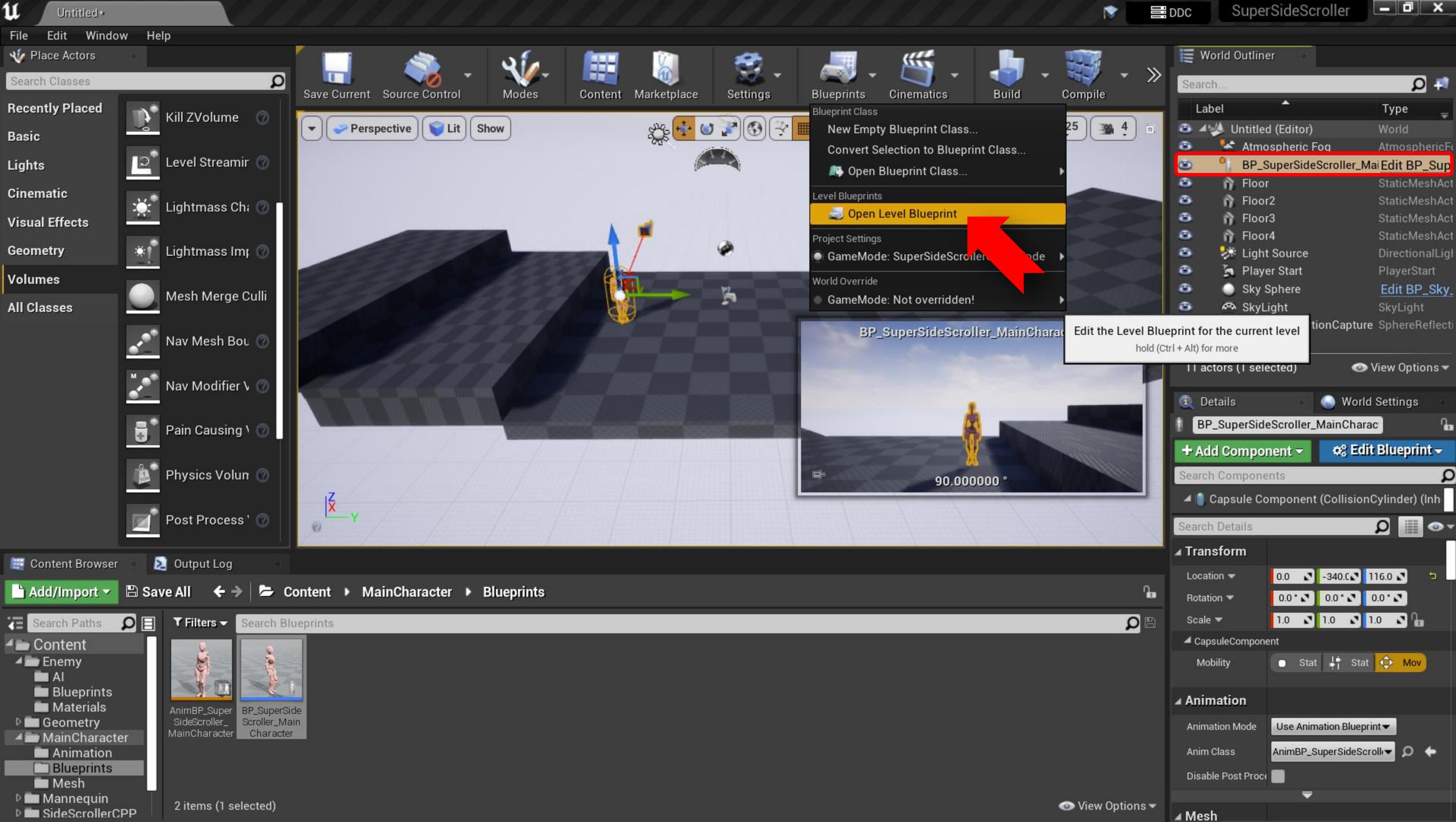
1. Create a **New Level**.
2. Name this level **SuperSideScroller**.
3. Using the static mesh assets provided default in the **Content Browser** interface in this project, create an interesting space with different elevations to navigate. Add your player character **Blueprint** to the level, and make sure it is possessed by **Player Controller 0**.
4. Add the **NavMeshBoundsVolume** actor to your level and adjust its dimensions so that it fits the space you created. In the example map provided for this activity, the dimensions set should be **1000.0, 5000.0, and 2000.0** in the *X*, *Y*, and *Z* axes, respectively

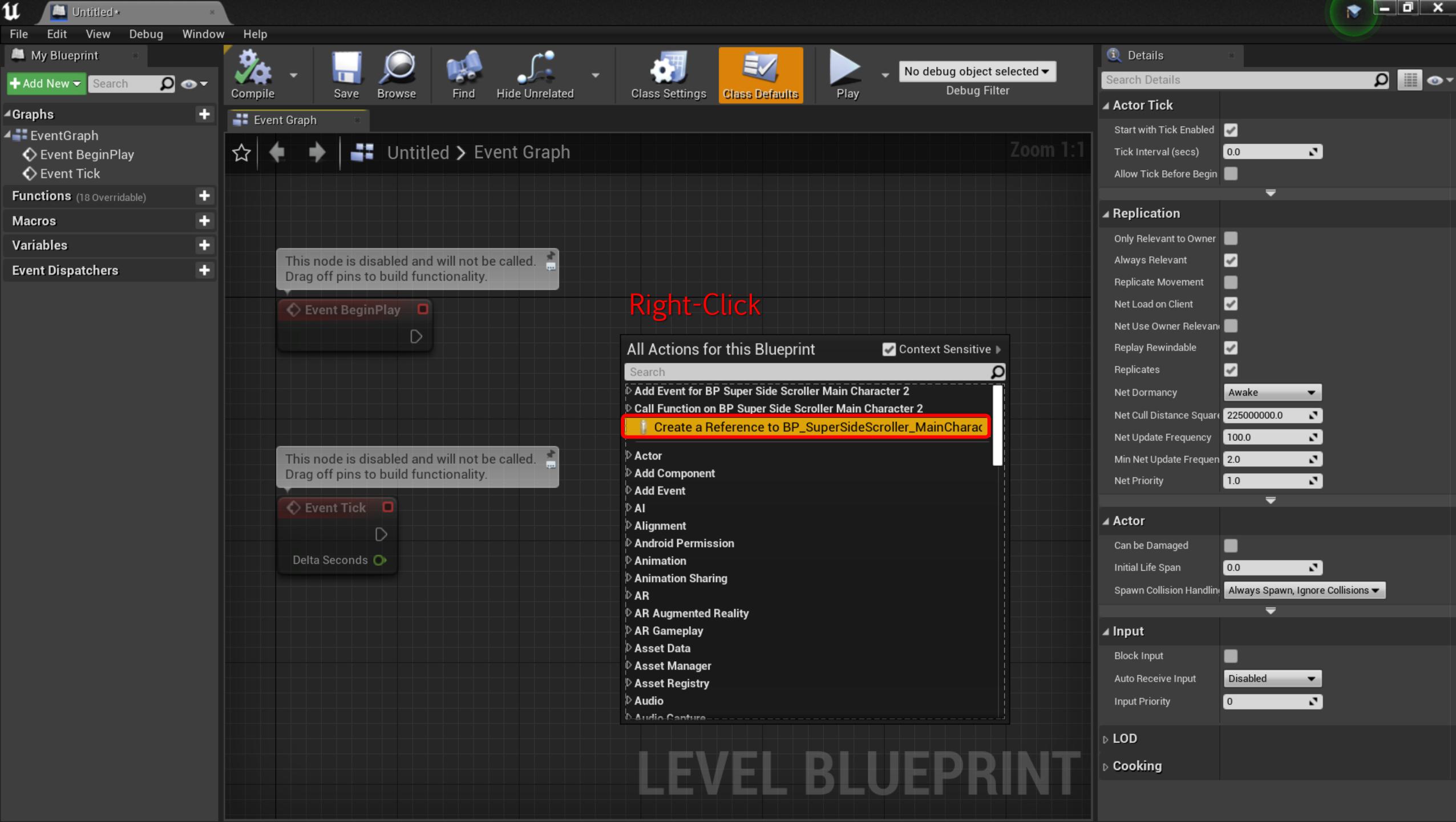


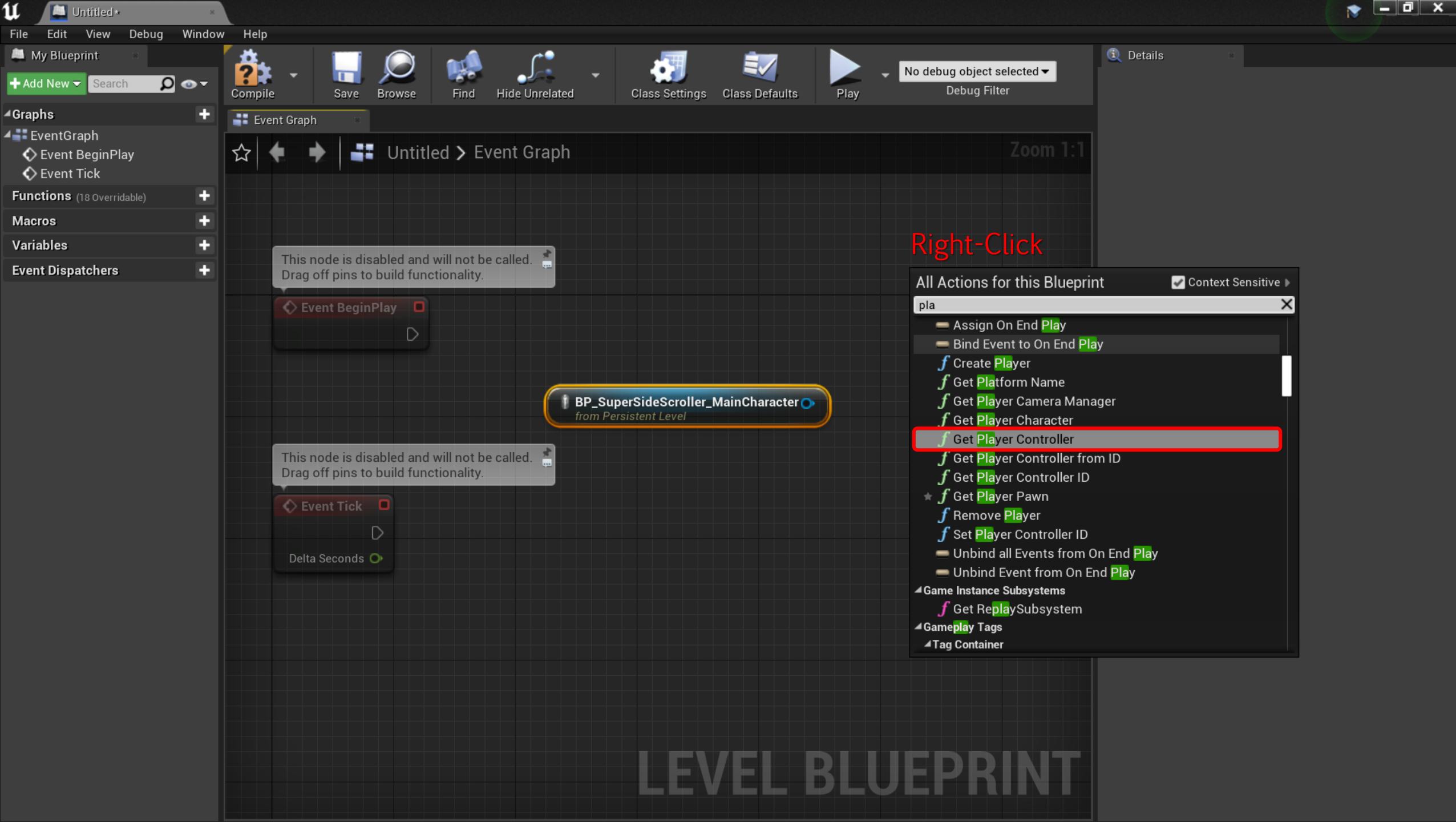










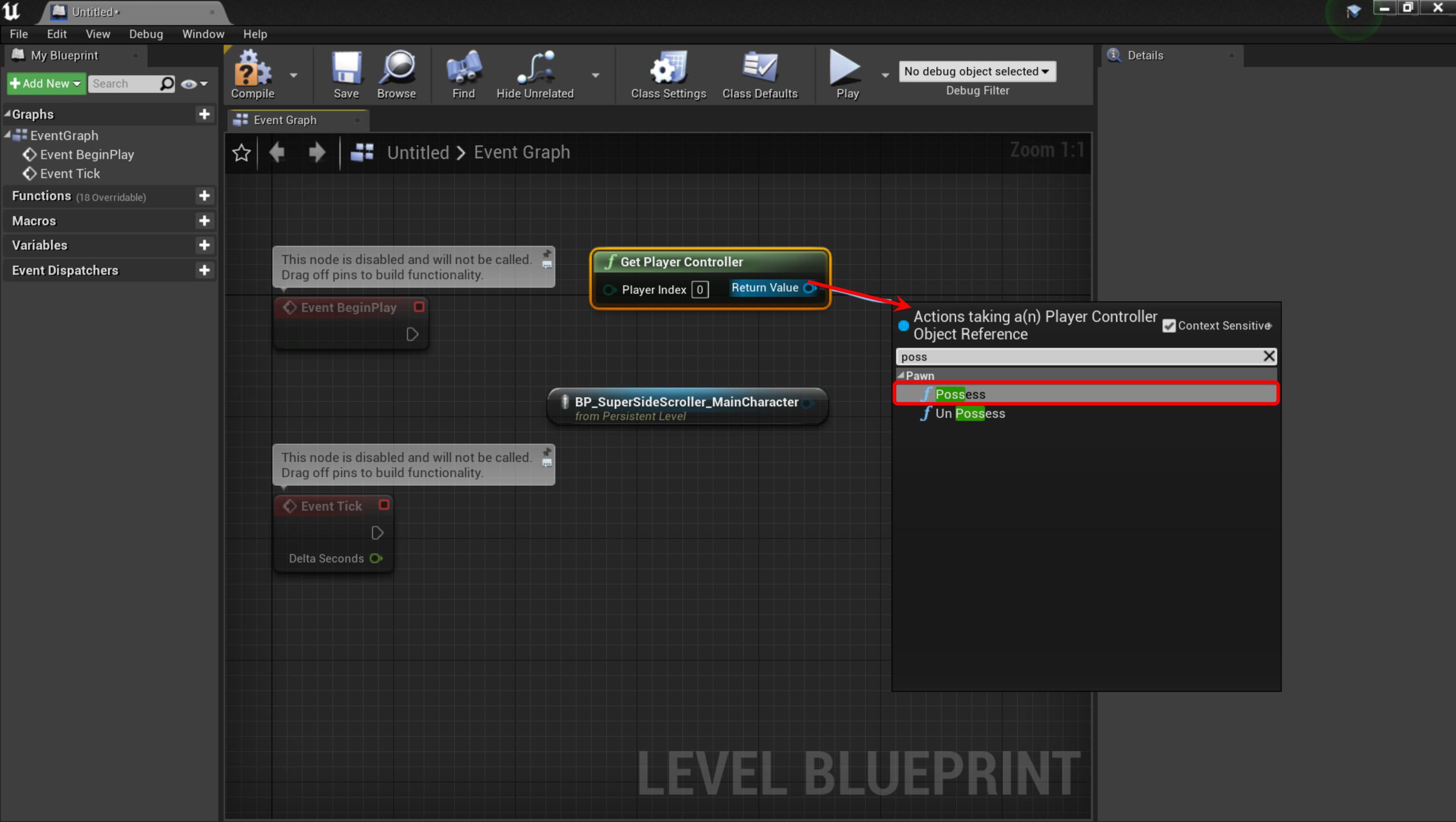


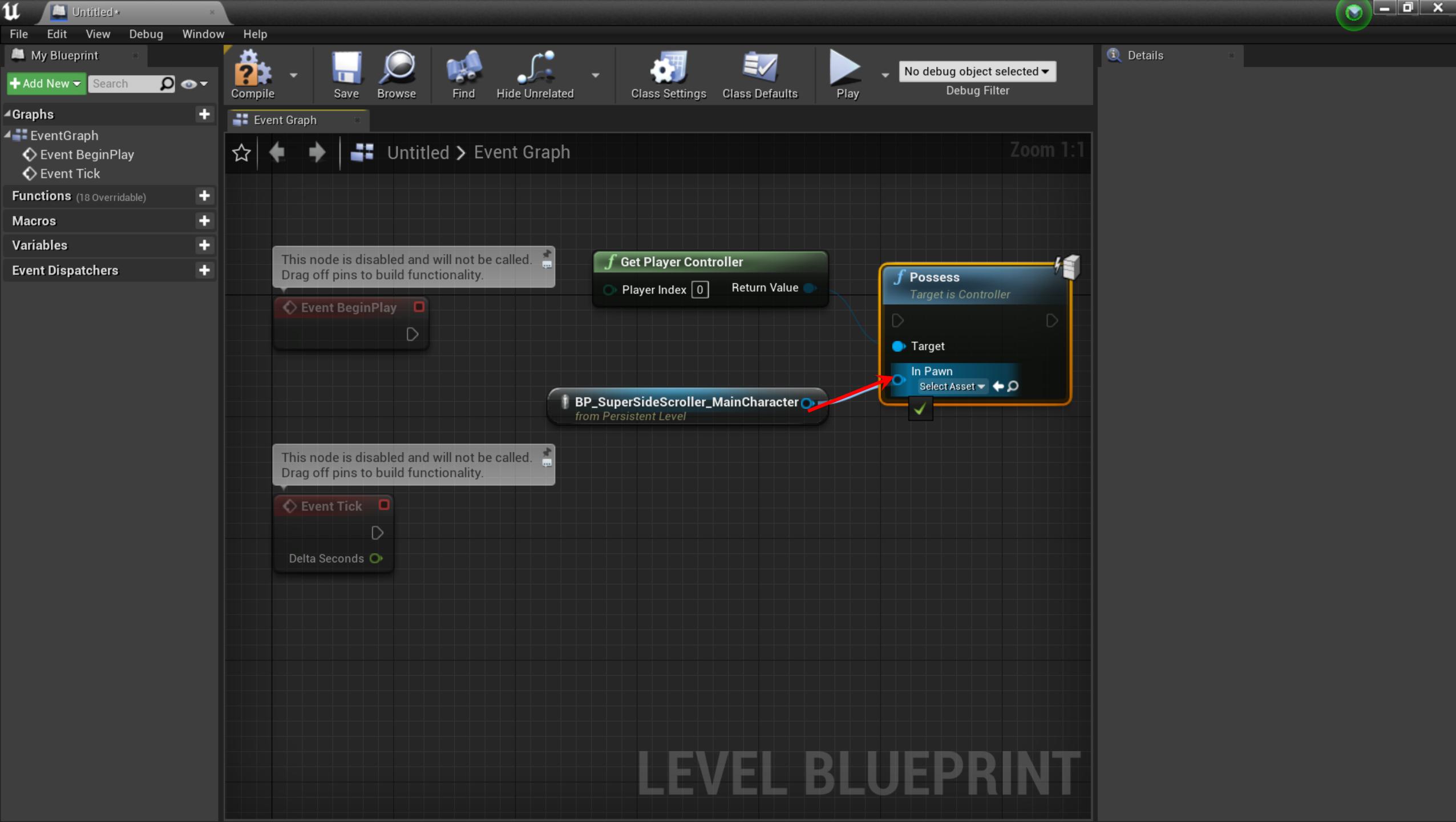
Right-Click

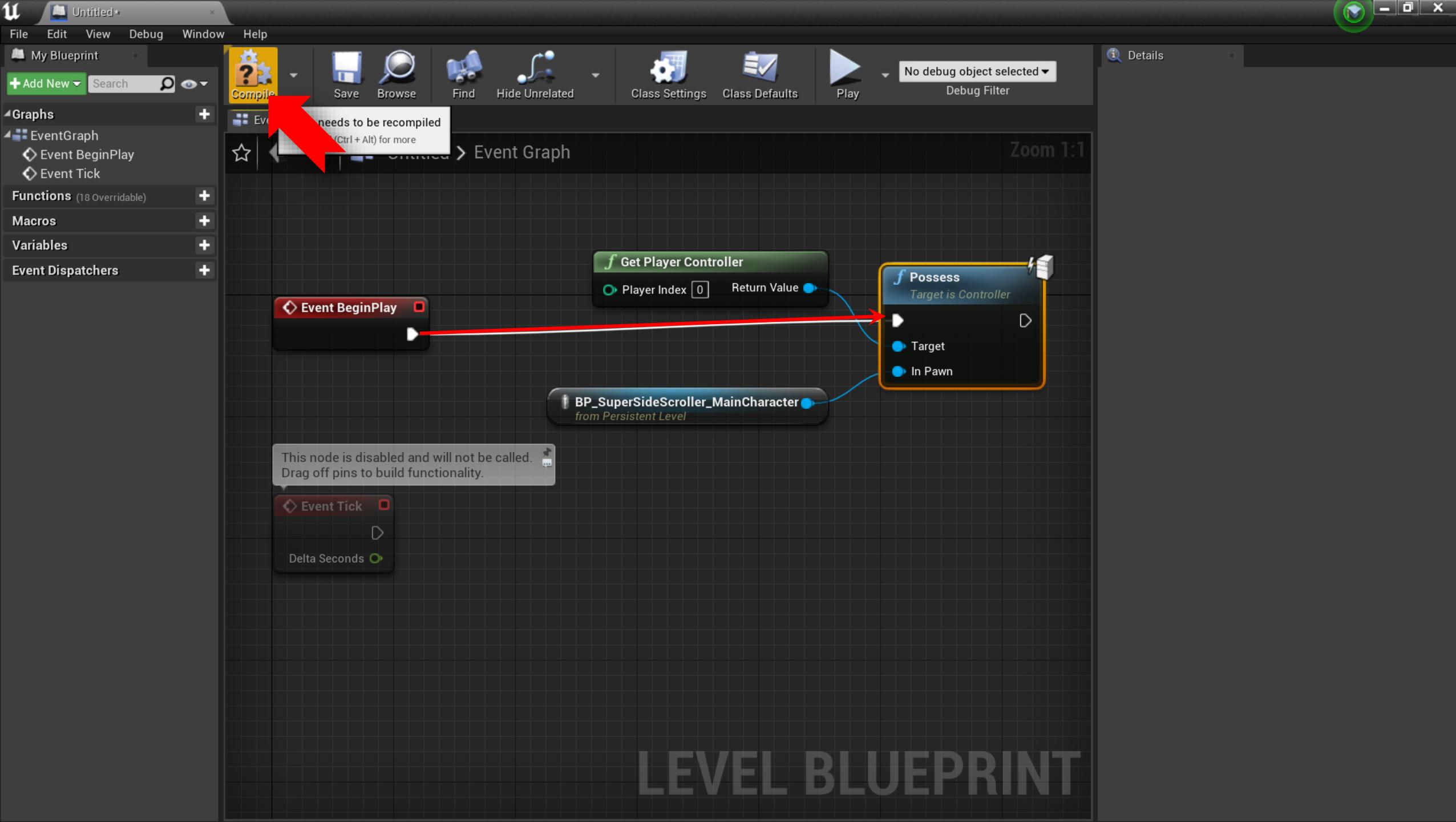
All Actions for this Blueprint

- Context Sensitive ▾
- pla
- Assign On End Play
- Bind Event to On End Play
- Create Player
- Get Platform Name
- Get Player Camera Manager
- Get Player Character
- Get Player Controller **Get Player Controller**
- Get Player Controller from ID
- Get Player Controller ID
- ★ ■ Get Player Pawn
- Remove Player
- Set Player Controller ID
- Unbind all Events from On End Play
- Unbind Event from On End Play
- ▲ Game Instance Subsystems
- f Get ReplaySubsystem
- ▲ Gameplay Tags
- Tag Container

LEVEL BLUEPRINT







Untitled*

File Edit Window Help

Place Actors

Search Classes

Recently Placed

Basic

Lights

Cinematic

Visual Effects

Geometry

Volumes

All Classes

Kill ZVolume

Level Streamir

Lightmass Ch

Lightmass Imp

Mesh Merge Culli

Nav Mesh Bou

Nav Modifier V

Pain Causing

Physics Volun

Post Process

Save Current Source Control Modes Content Marketplace Settings Blueprints Cinematics Build Compile >

LIGHTING NEEDS TO BE REBUILT (3 unbuilt objects)
'DisableAllScreenMessages' to suppress

World Outliner

Search...

Label	Type
Untitled (Play In Editor)	World
AIController	AIController
Atmospheric Fog	AtmosphericF
BP_SuperSideScroller_MEdit BP_Sup	
CameraActor	CameraActor
Floor	StaticMeshAc
Floor2	StaticMeshAc
Floor3	StaticMeshAc
Floor4	StaticMeshAc
GameNetworkManager	GameNetwor
GameSession	GameSession
GameStateBase	GameStateBa
HUD	HUD

23 actors View Options

Details World Settings

Select an object to view details.

Content Browser Output Log

Add/Import Save All Content MainCharacter Blueprints

Search Paths Filters Search Blueprints

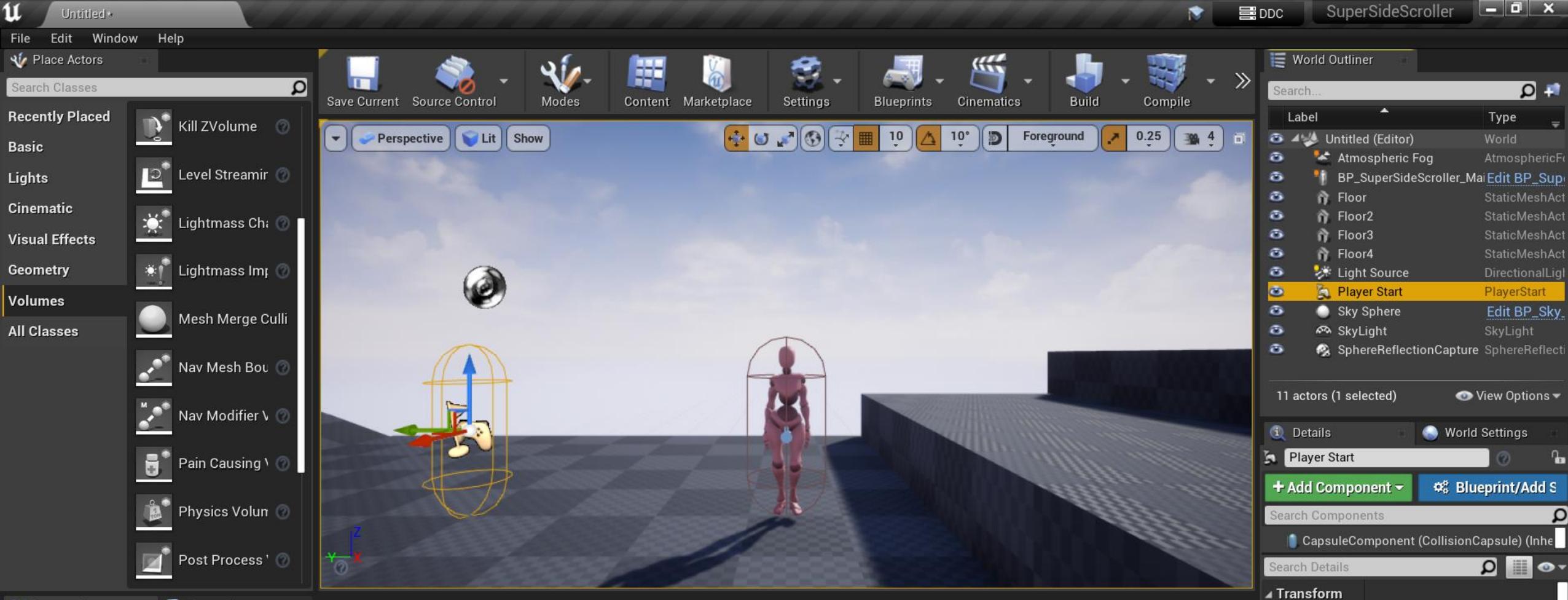
Content

- Enemy
- AI
- Blueprints
- Materials
- Geometry
- MainCharacter
 - Animation
 - Blueprints
 - Mesh
- Mannequin
- SideScrollerCPP

AnimBP_Super SideScroller_MainCharacter

BP_SuperSide Scroller_Main Character

2 items (1 selected) View Options



Content Browser

Add/Import Save All Content MainCharacter Blueprints

Content

- Enemy
- AI
- Blueprints
- Materials

Geometry

- MainCharacter
- Animation
- Blueprints
- Mesh

Mannequin SideScrollerCPP

2 items (1 selected)

View Options

World Outliner

Search...

Label	Type
Untitled (Editor)	World
Atmospheric Fog	AtmosphericFog
BP_SuperSideScroller_MainCharacter	Edit BP_SuperSideScroller_MainCharacter
Floor	StaticMeshActor
Floor2	StaticMeshActor
Floor3	StaticMeshActor
Floor4	StaticMeshActor
Light Source	DirectionalLight
Player Start	PlayerStart
Sky Sphere	Edit BP_SkySphere
SkyLight	SkyLight
SphereReflectionCapture	SphereReflectionCapture

11 actors (1 selected) View Options

Details World Settings

Player Start

+ Add Component Blueprint/Add S

Search Components

CapsuleComponent (CollisionCapsule) (Inherited)

Search Details

Transform

Location	0.0	0.0	112.00
Rotation	0.0°	0.0°	0.0°
Scale	1.0	1.0	1.0

Object

Player Start Tag None

Rendering

Actor Hidden In Game

Editor Billboard Scale 1.0

Replication

Net Load on Client

Untitled*

File Edit Window Help

Place Actors

Search Classes

Recently Placed

Basic

Lights

Cinematic

Visual Effects

Geometry

Volumes

All Classes

Kill ZVolume

Level Streamir

Lightmass Ch

Lightmass Imp

Mesh Merge Culli

Nav Mesh Bou

Nav Modifier V

Pain Causing

Physics Volun

Post Process

Save Current Source Control Modes Content Marketplace Settings Blueprints Cinematics Build Compile >

Shift+F1 for Mouse Cursor

LIGHTING NEEDS TO BE REBUILT (3 unbuilt objects)

DisableAllScreenManager to skip this

Content Browser Output Log

Add/Import Save All Content MainCharacter Blueprints

Content

Enemy AI Blueprints Materials

Geometry

MainCharacter Animation Blueprints Mesh

Mannequin SideScrollerCPP

Search Paths Filters Search Blueprints View Options

2 items (1 selected)

World Outliner

Search... Label Type

Untitled (Play In Editor) World

AIController AIController

Atmospheric Fog AtmosphericF

BP_SuperSideScroller_MEdit BP_Sup

CameraActor CameraActor

Floor StaticMeshAc

Floor2 StaticMeshAc

Floor3 StaticMeshAc

Floor4 StaticMeshAc

GameNetworkManager GameNetwork

GameSession GameSession

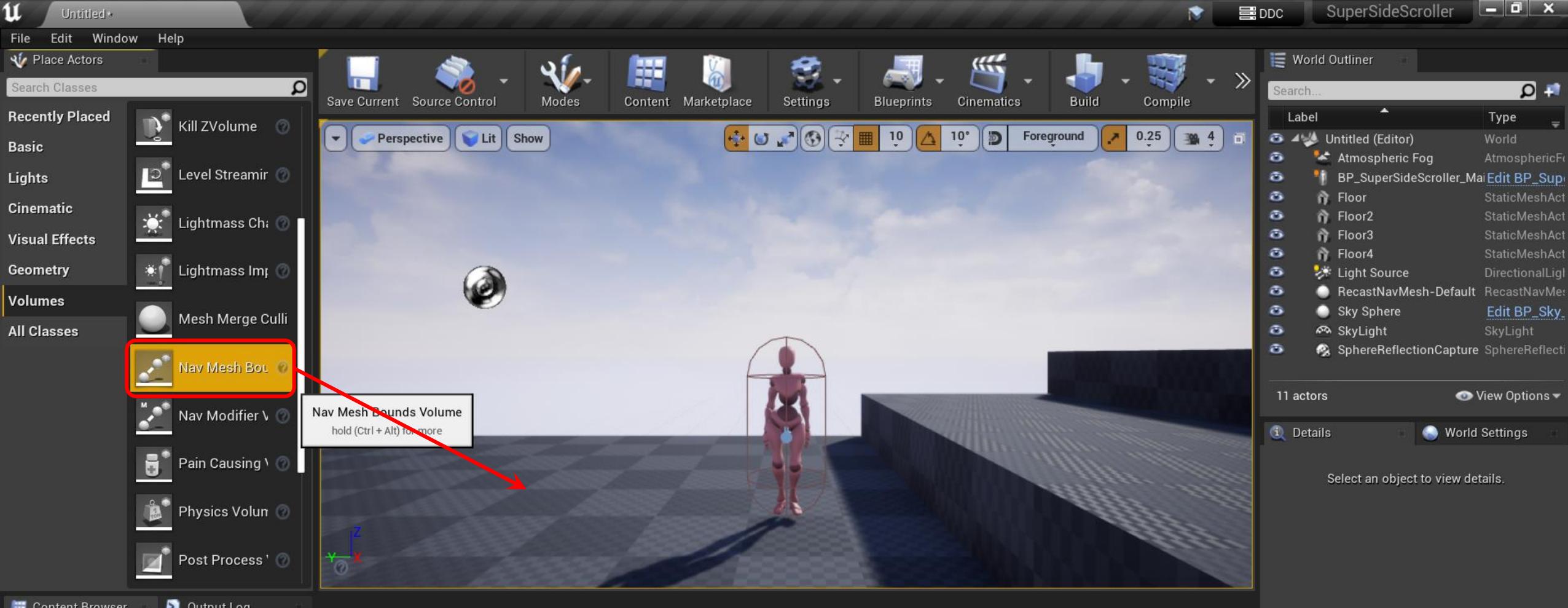
GameStateBase GameStateBa

HUD HUD

23 actors View Options

Details World Settings

Select an object to view details.



Add/Import ▾ Save All ← → Content ▶ MainCharacter ▶ Blueprints

Content Browser Output Log

Content

- Enemy
 - AI
 - Blueprints
 - Materials
- Geometry
- MainCharacter
 - Animation
 - Blueprints
 - Mesh
- Mannequin
- SideScrollerCPP

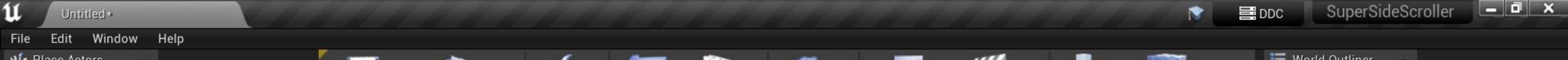
Filters ▾ Search Blueprints

AnimBP_SuperSideScroller_MainCharacter

BP_SuperSideScroller_MainCharacter

2 items (1 selected)

View Options ▾



File Edit Window Help

Place Actors

Search Classes

Recently Placed

Basic

Lights

Cinematic

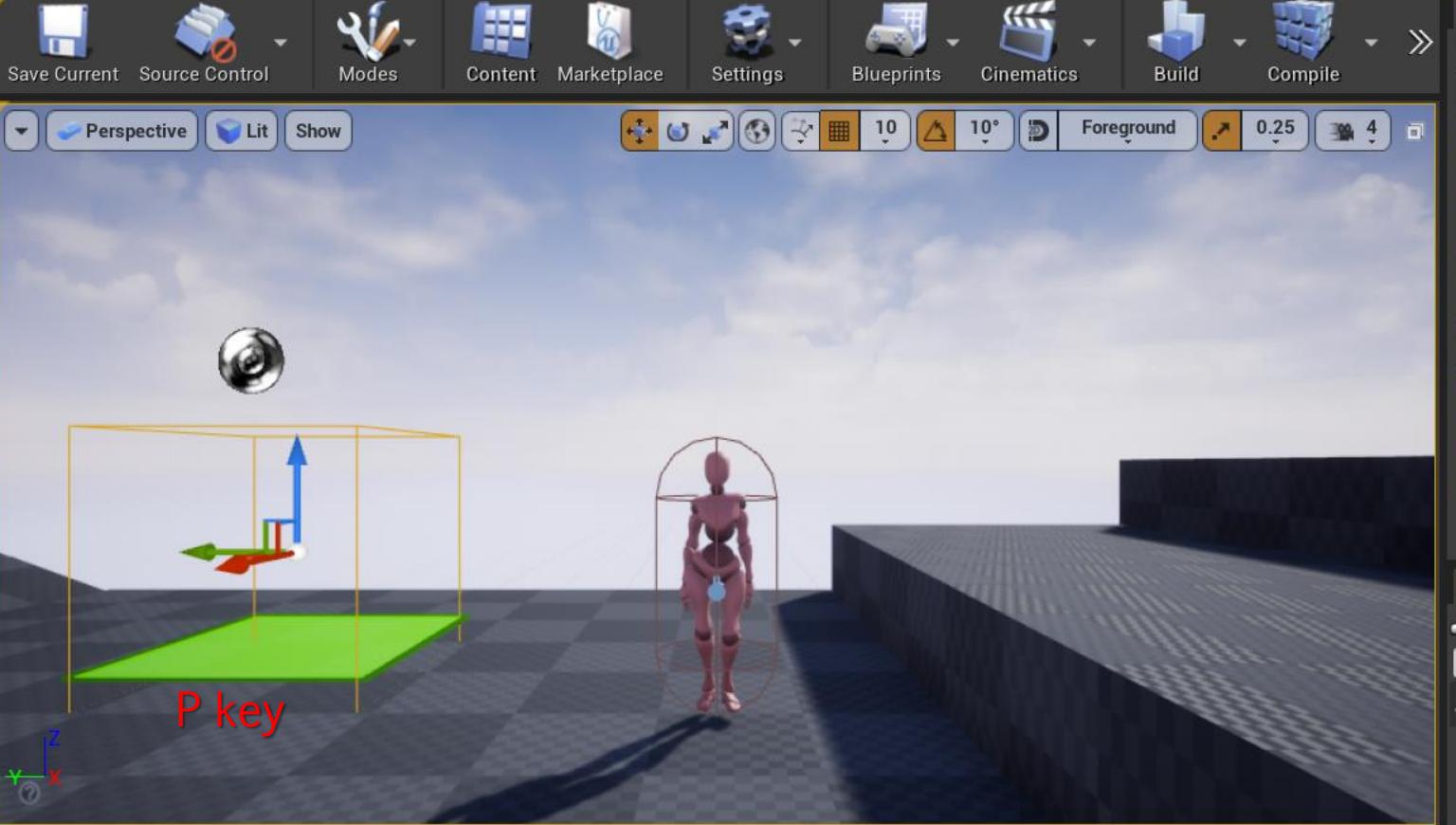
Visual Effects

Geometry

Volumes

All Classes

- Kill ZVolume
- Level Streamer
- Lightmass Ch:
- Lightmass Imp
- Mesh Merge Culli
- Nav Mesh Bou
- Nav Modifier V
- Pain Causing \
- Physics Volun
- Post Process \



World Outliner	
Search...	
Label	Type
Untitled (Editor)	World
Atmospheric Fog	AtmosphericFog
BP_SuperSideScroller_Mai	Edit BP_Super
Floor	StaticMeshAct
Floor2	StaticMeshAct
Floor3	StaticMeshAct
Floor4	StaticMeshAct
Light Source	DirectionalLigl
NavMeshBoundsVolume	NavMeshBou
RecastNavMesh-Default	RecastNavMe
Sky Sphere	Edit BP_Sky_
SkyLight	SkyLight
SphereReflectionCapture	SphereReflect

12 actors (1 selected) View Options ▾

Details	World Settings
NavMeshBoundsVolume	

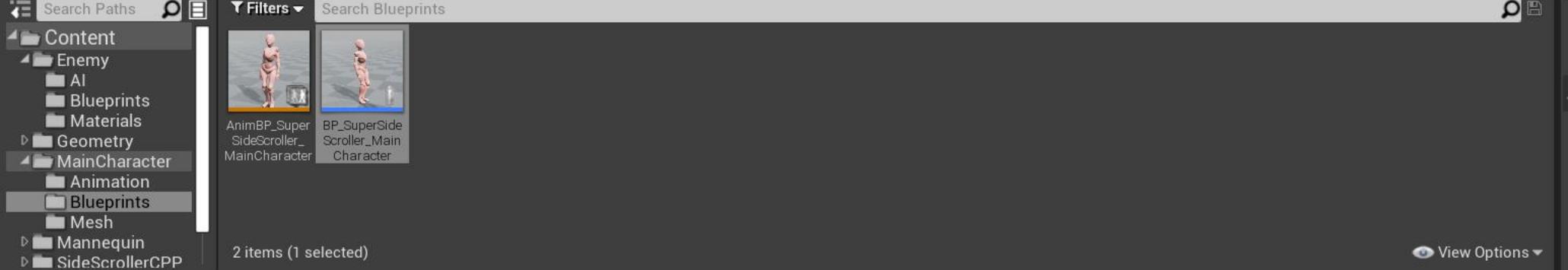
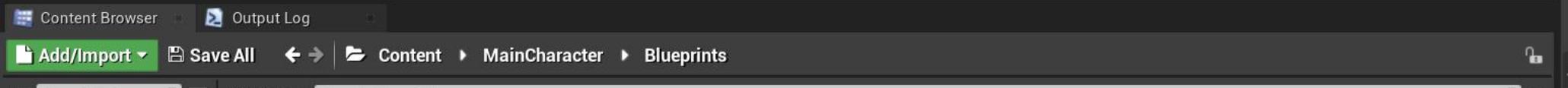
Search Details

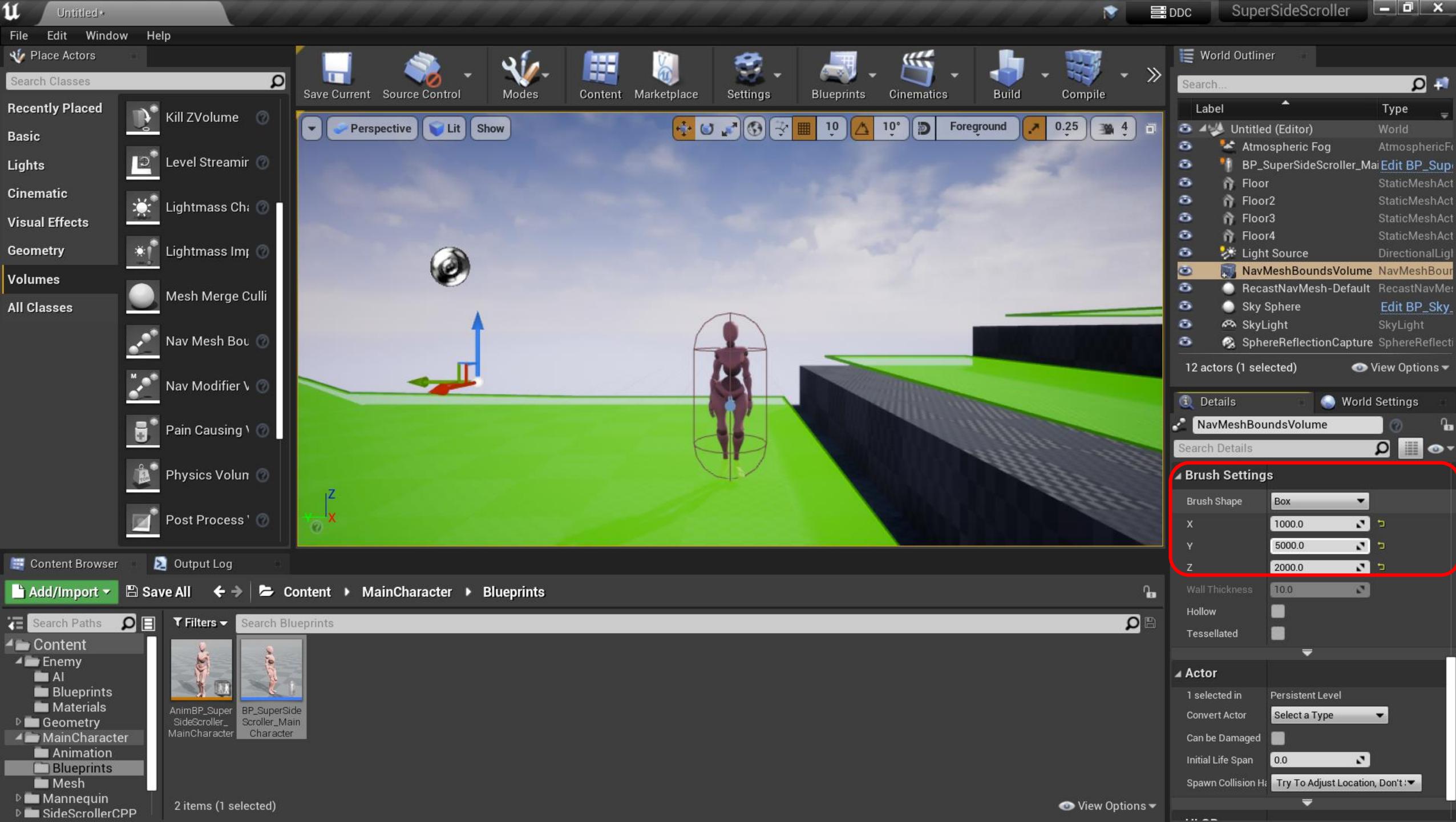
Transform
Location ▾
Rotation ▾
Scale ▾
Mobility

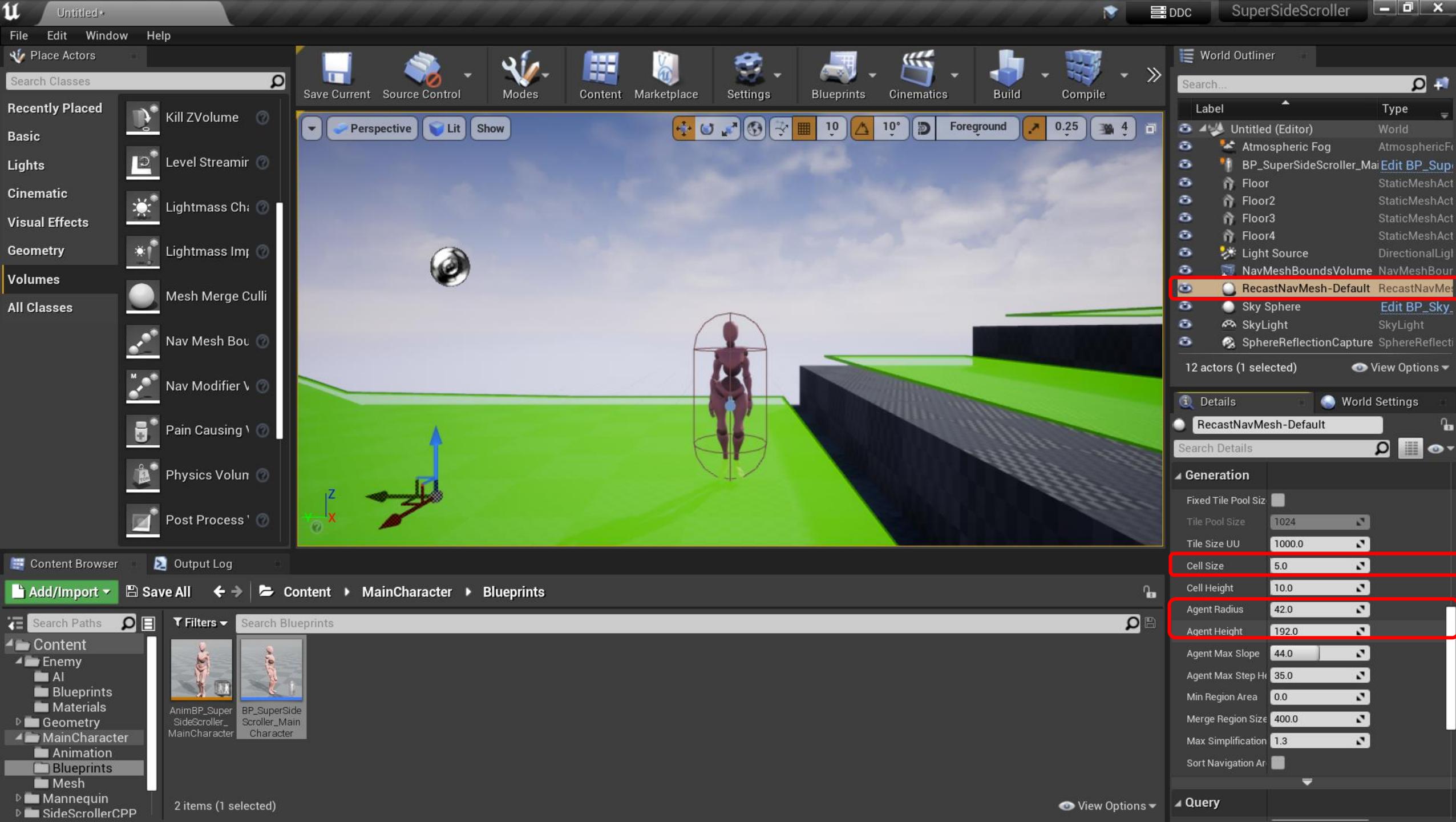
Navigation
Supported Agents all
Fill Collision Under

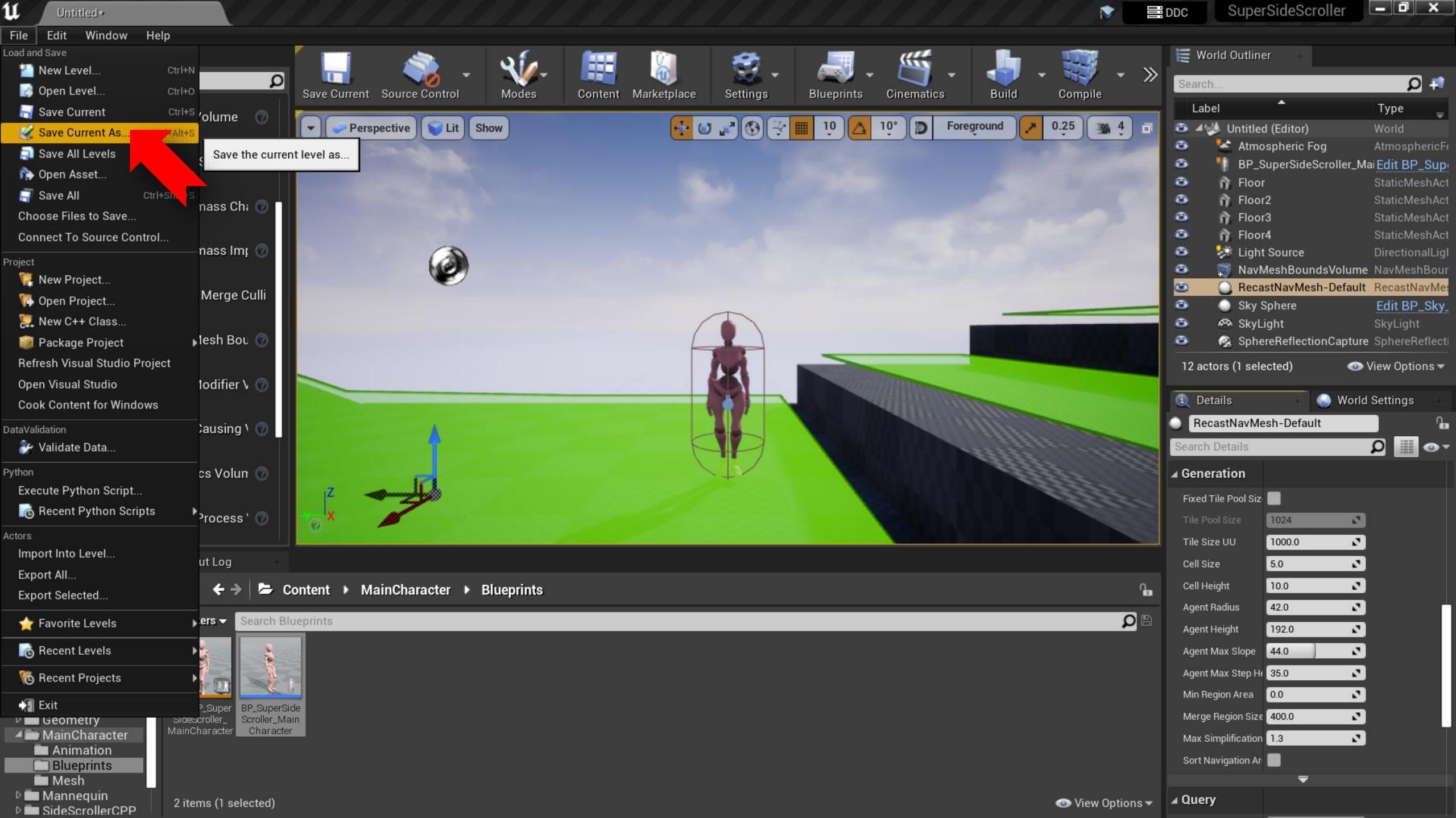
Collision
Simulation Genera
Phys Material Ove

None	None
None	None
Generate Overlap	✓











Save Level As



Search Folders



Search Assets

Side
Scroller
Example

Content

- ▷ Enemy
- ▷ Geometry
- ▷ MainCharacter
- ▷ Mannequin

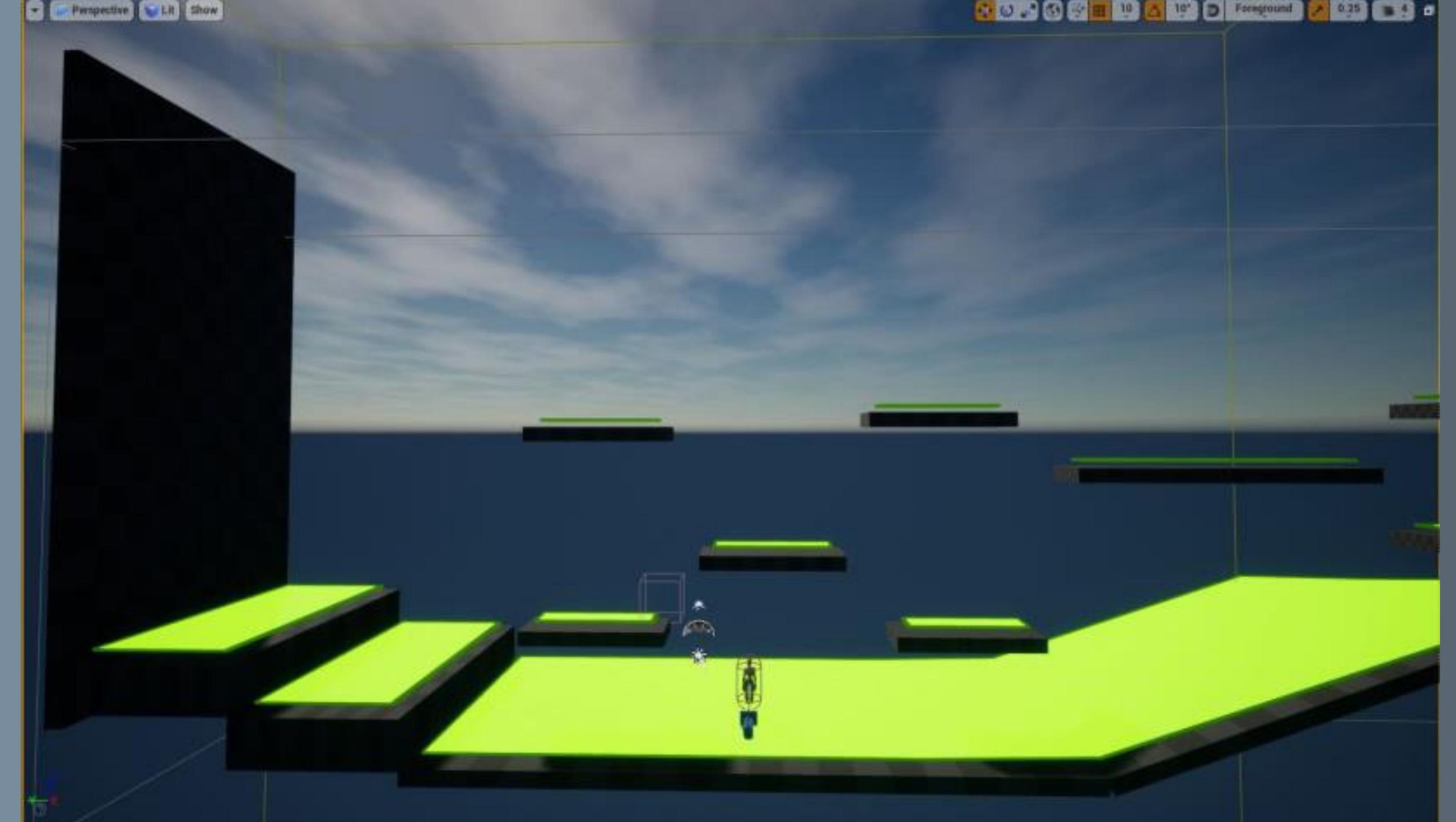
SideScrollerCPP

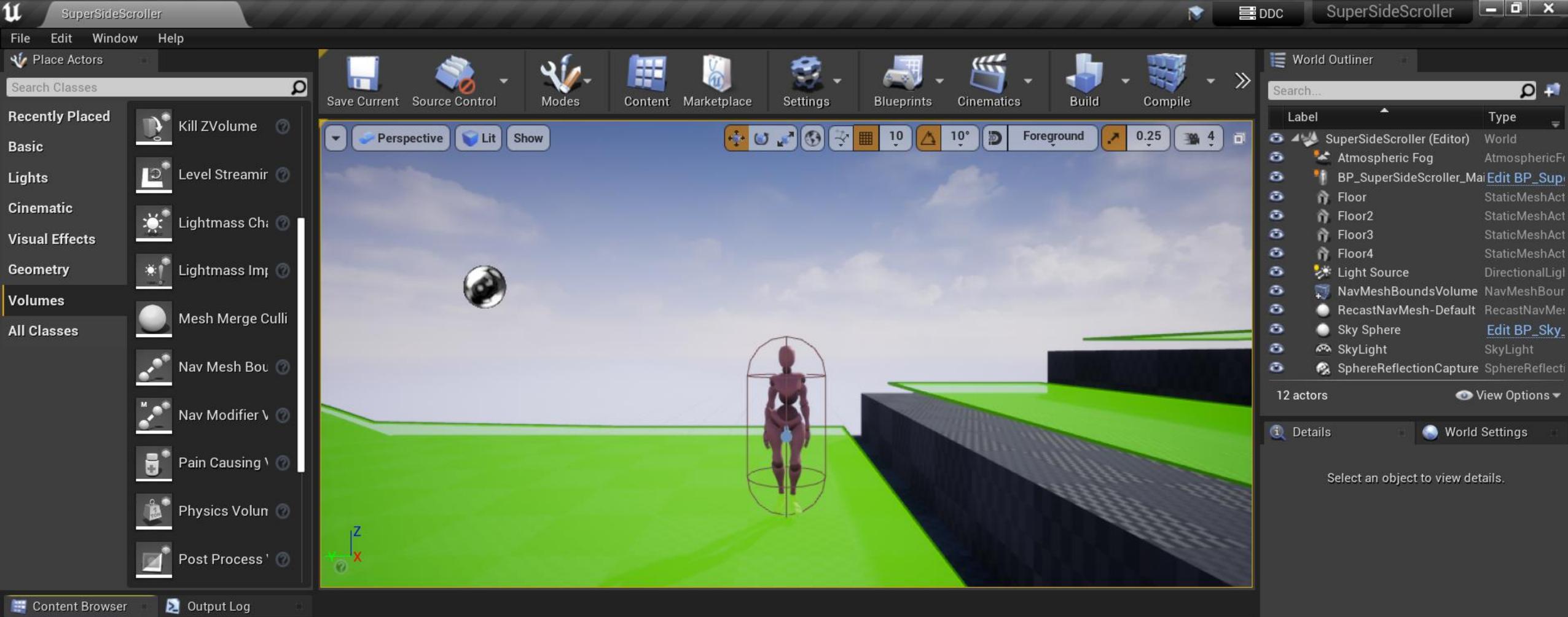
- Blueprints

Maps

- StarterContent







Add/Import ▾ Save All ← → Content ▶ SideScrollerCPP ▶ Maps

Search Paths Materials
Geometry MainCharacter
MainCharacter Animation
Blueprints Mesh
Mannequin SideScrollerCPP
Blueprints Maps
StarterContent C++ Classes

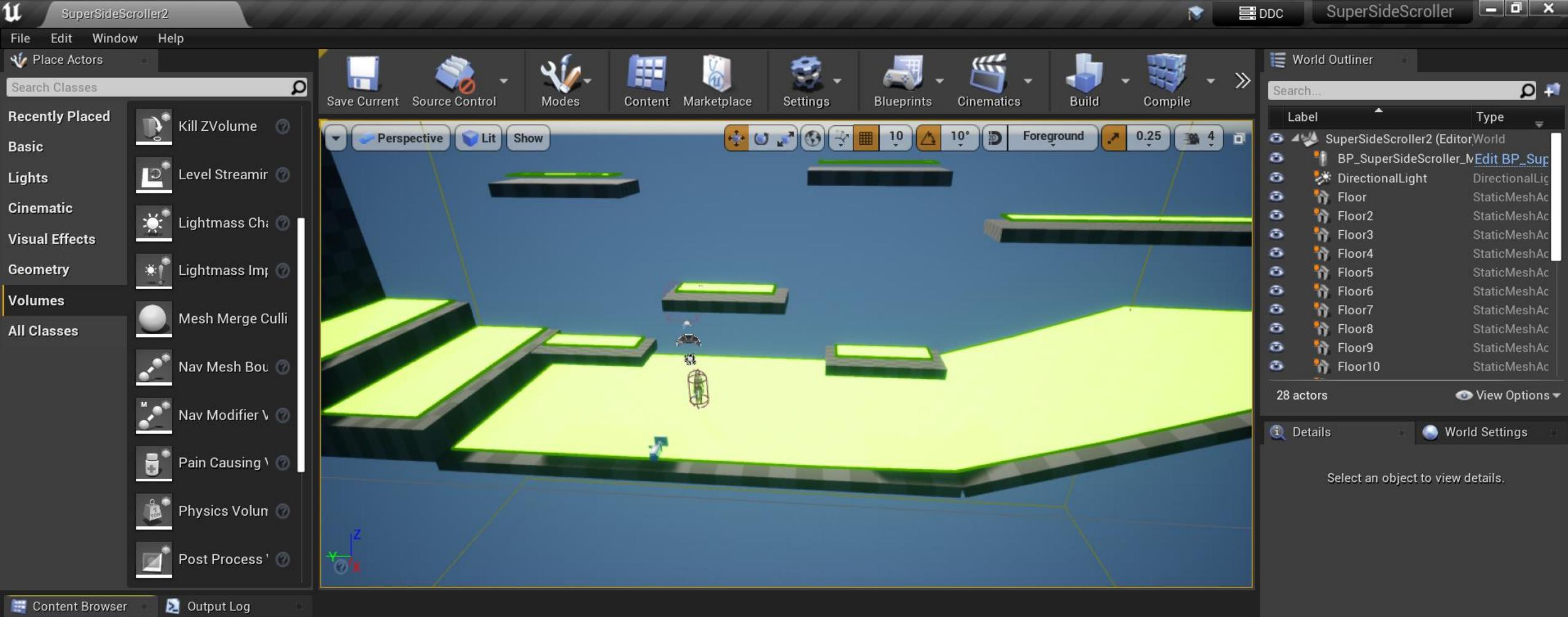
Filters ▾ Search Maps

SuperSideScroller (Level)

Path: /Game/SideScrollerCPP/Maps
Cooking Filepath Length: 149 / 260
Primary Asset Type: Map
Primary Asset Name: /Game/Maps/SuperSideScroller
Date Modified: 20. 4. 30.

5 items (1 selected) View Options ▾

The Content Browser pane shows the project structure under the SideScrollerCPP / Maps folder. It includes items like SideScrollerExampleMap, SideScrollerExampleMap_BuiltData, and SuperSideScroller. The SuperSideScroller item is highlighted with a yellow border, indicating it is selected. The pane also includes search and filter options.



Add/Import **Save All** **Content** **SideScrollerCPP** **Maps**

Search Paths **Filters** **Search Maps**

- Materials
- Geometry
- MainCharacter
- Animation
- Blueprints
- Mesh
- Mannequin
- SideScrollerCPP
- Blueprints
- Maps
- StarterContent

6 items (1 selected)

SuperSideScroller2 (Level)

Path: /Game/SideScrollerCPP/Maps
Cooking Filepath Length: 149 / 260
Primary Asset Type: Map
Primary Asset Name: /Game/SideScrollerCPP/Maps/SuperSideScroller2
Date Modified: 21. 1. 22.

View Options

SuperSideScroller2 DDC SuperSideScroller

File Edit Window Help

Place Actors

Search Classes

Recently Placed Kill ZVolume

Basic Level Streamir

Lights Lightmass Ch

Cinematic Lightmass Imp

Visual Effects Lightmass Imp

Geometry Mesh Merge Culli

Volumes Nav Mesh Bou

All Classes Nav Modifier V

Pain Causing V

Physics Volun

Post Process V

Save Current Source Control Modes Content Marketplace Settings Blueprints Cinematics Build Compile >

Shift+F1 for Mouse Cursor

World Outliner

Label Type

- SuperSideScroller2 (Play) IWorld
- BP_SuperSideScroller_MEdit BP_Sup
- CameraActor CameraActor
- DirectionalLight DirectionalLight
- Floor StaticMeshAc
- Floor2 StaticMeshAc
- Floor3 StaticMeshAc
- Floor4 StaticMeshAc
- Floor5 StaticMeshAc
- Floor6 StaticMeshAc
- Floor7 StaticMeshAc
- Floor8 StaticMeshAc
- Floor9 StaticMeshAc

39 actors View Options

Details World Settings

Select an object to view details.

Content Browser Output Log

Add/Import Save All Content SideScrollerCPP Maps

Search Paths Filters Search Maps

- MainCharacter
- Animation
- Blueprints
- Mesh
- Mannequin
- SideScrollerCPP
- Blueprints
- Maps
- StarterContent
- C++ Classes

Map Build Data Registry

SideScroller ExampleMap_BuiltData

SuperSide Scroller

SuperSide Scroller 2

SuperSide Scroller_Built Data

6 items (1 selected) View Options

File Edit Window Help

Load and Save

- New Level... Ctrl+N
- Open Level... Ctrl+O
- Save Current Ctrl+S
- Save Current As... F12+Alt+S
- Save All Levels
- Open Asset...
- Save All Ctrl+Shift+S

Choose Files to Save...

Connect To Source Control...

Project

- New Project...
- Open Project...
- New C++ Class...
- Package Project

Refresh Visual Studio Project

Open Visual Studio

Cook Content for Windows

DataValidation

- Validate Data...

Python

- Execute Python Script...
- Recent Python Scripts

Actors

- Import Into Level...
- Export All...
- Export Selected...

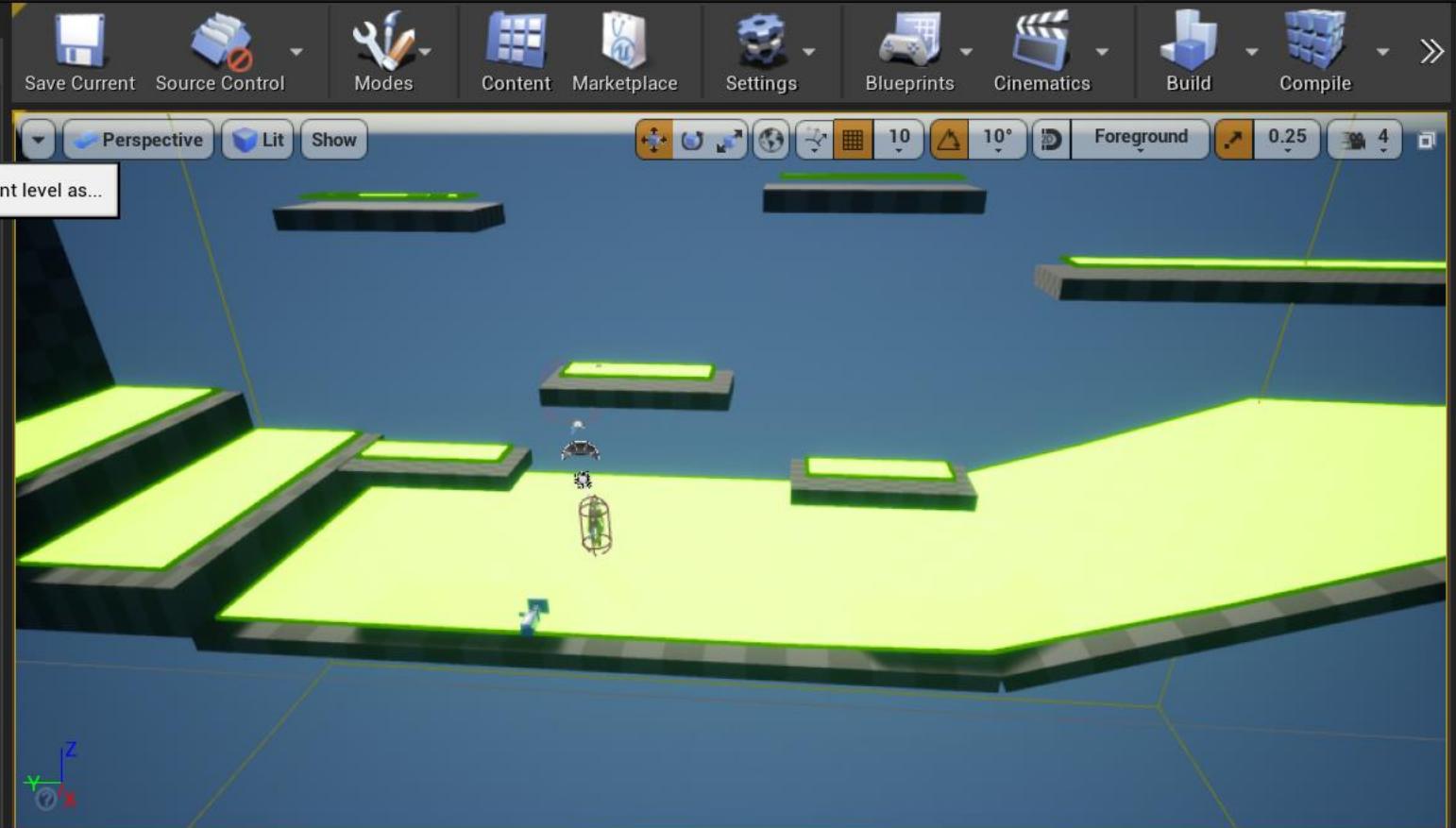
Favorite Levels

- Recent Levels
- Recent Projects

Exit

- SideScrollerCPP
- Blueprints
- Maps
- StarterContent
- C++ Classes

6 items (1 selected)



World Outliner

Search...

Label	Type
SuperSideScroller2 (Editor)World	
BP_SuperSideScroller_M	Edit BP_Sup...
DirectionalLight	DirectionalLight
Floor	StaticMeshActor
Floor2	StaticMeshActor
Floor3	StaticMeshActor
Floor4	StaticMeshActor
Floor5	StaticMeshActor
Floor6	StaticMeshActor
Floor7	StaticMeshActor
Floor8	StaticMeshActor
Floor9	StaticMeshActor
Floor10	StaticMeshActor

28 actors

View Options

Details

World Settings

Select an object to view details.



Save Level As



Search Folders



Search Assets

Side
Scroller
Example SuperSide
Scroller SuperSide
Scroller2

Content

- ▷ Enemy
- ▷ Geometry
- ▷ MainCharacter
- ▷ Mannequin
- ◀ SideScrollerCPP
- └ Blueprints
- └ Maps
- ▷ StarterContent

3 items

View Options ▾

Path: /Game/SideScrollerCPP/Maps

Name:

Save

Cancel





Behavior Trees and Blackboards (1)

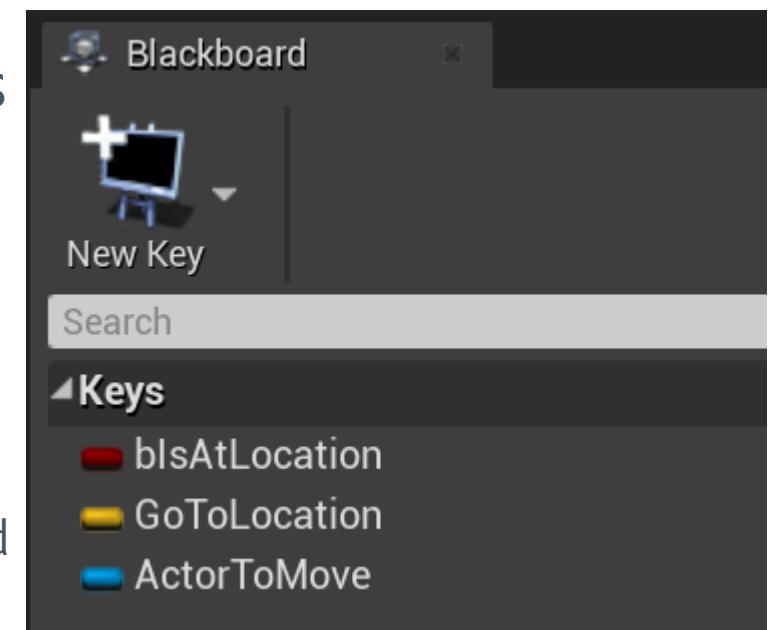
- › **Behavior trees** and **Blackboards** work together to allow our AI to follow different logical paths and make decisions based on a variety of conditions and variables.
- › A **behavior tree** (BT)
 - A visual scripting tool that allows you to tell a pawn what to do based on certain factors and parameters
 - Where you create the Tasks that you want the AI to perform such as moving to a location, or performing a custom Task you create
- › **Blackboards**
 - Where you define the set of variables that are required in order to have the behavior tree perform actions and use those value for decision-making

Behavior Trees and Blackboards (2)

› Blackboards

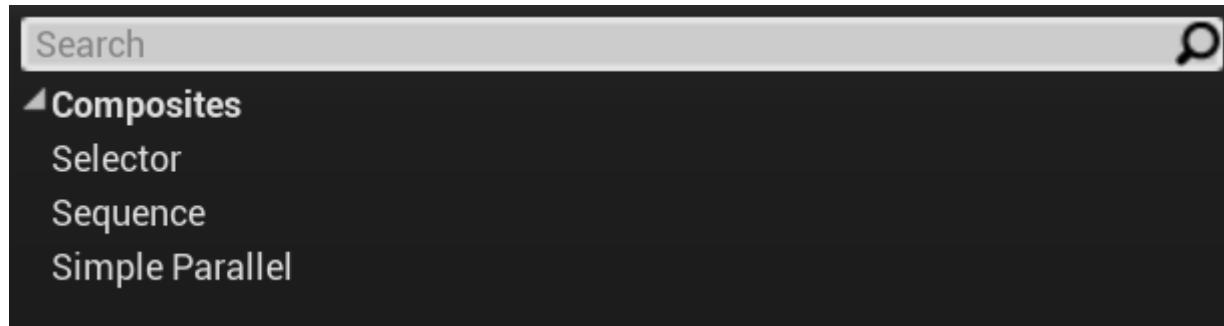
- Where you define the variables, also known as **Keys**, that will then be referenced by the **behavior tree**
- The Keys you create here can be used in **Tasks**, **Services**, and **Decorators** to serve different purposes based on how you want the AI to function.
- Without a Blackboard, behavior trees would have no way of passing and storing information across different Tasks, Services, or Decorators, rendering it useless:

An example set of variables inside a Blackboard that can be accessed in the behavior tree



Behavior Trees and Blackboards (3)

- › **Behavior trees** are composed of set of **objects** – that is, **Composites**, **Tasks**, **Decorators**, and **Services** – that work together to define how the AI will behave and respond based on the conditions and logic flow that you set.
- › **Composites**
 - Composite nodes function as a means to tell the behavior tree how to go about performing Tasks and other actions.



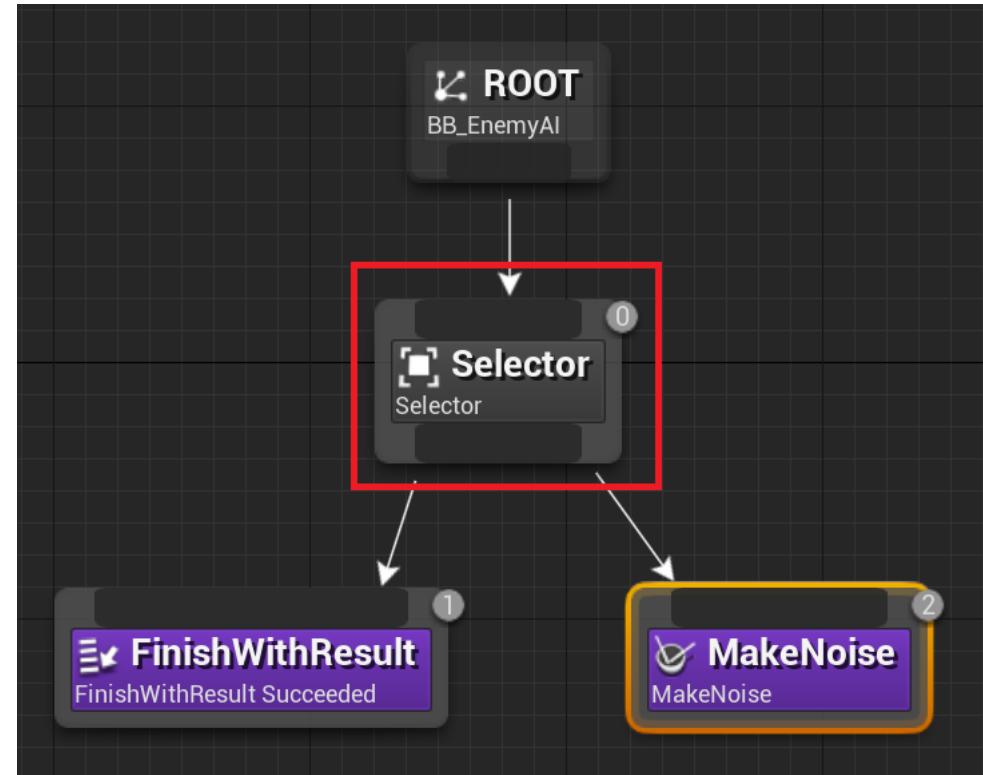
The full list of
Composite nodes –
Selector, Sequence,
and Simple Parallel

Composites (1)

› Selector

- The **Selector** composite node executes its children from left to right and will stop executing when one of the children Tasks succeeds.
- Regardless of success or failure, each Selector will attempt execution sequentially:

An example of how a Selector Composite node can be used in a behavior tree

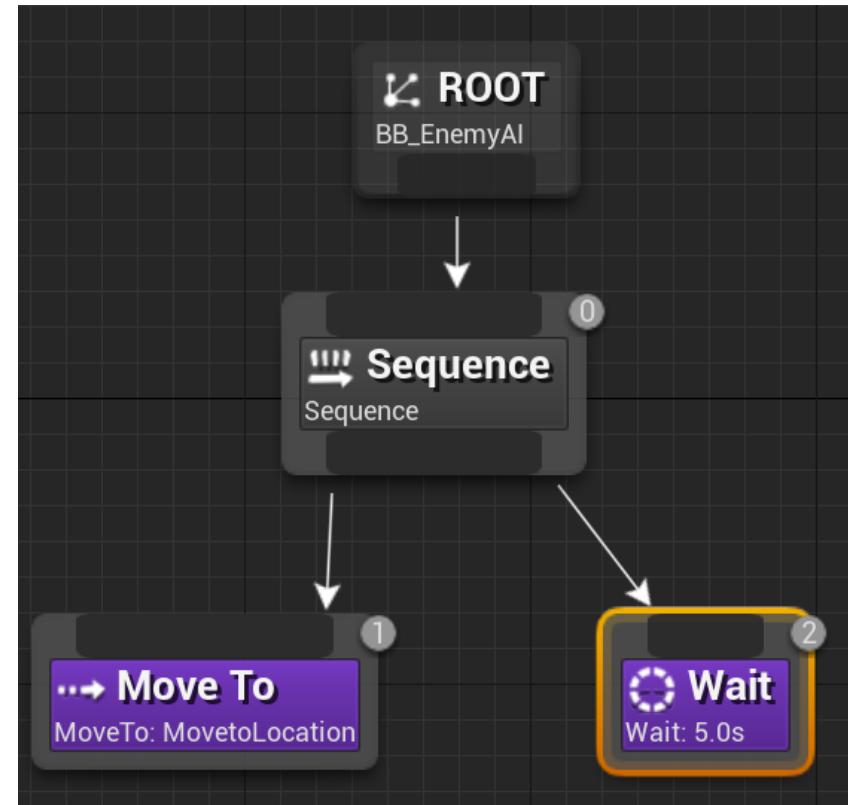


Composites (2)

› Sequence

- The **Sequence** composite node execute its children from left to right and will stop executing when one of the children Tasks fails.
- If the **Move To** task fails, the Sequence will fail and **Root** will execute again, causing the **Wait** task to never execute:

An example of how a Sequence Composite node can be used in a behavior tree

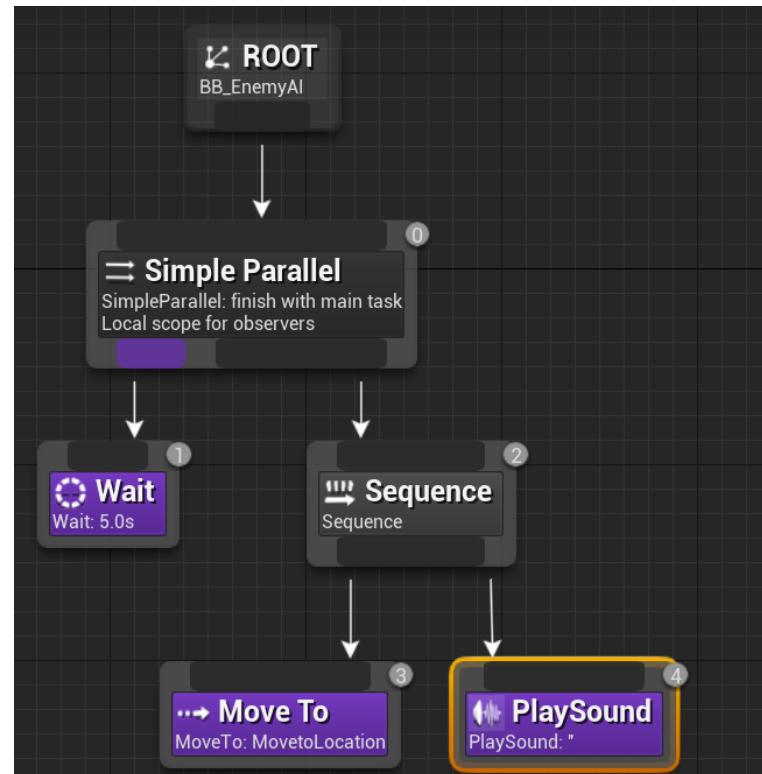


Composites (3)

› Simple Parallel

- The **Simple Parallel** composite node allows you to execute a Task and a new standalone branch of logic simultaneously.
- In the example, a task used to **Wait** for 5 seconds is being executed at the same time as a new **Sequence** of Tasks is being executed:
- Two options (**Finish Mode**)
 - › Immediate
 - › Delayed

An example of how a Sequence Composite node can be used in a behavior tree





Tasks, Decorators, and Services

- › Tasks
 - Tasks that our AI can perform
 - Built-in Tasks for us to use by default (Unreal provides)
- › Decorators
 - Conditions that can be added to Tasks or Composite nodes
 - › As an example, we can have a **Decorator** that checks whether or not the enemy know the location of the player
- › Services
 - Services can be linked with Tasks and Composite nodes.
 - A Service allows us to execute a branch of nodes based on the interval defined in the Service.
 - › You can create your own custom **Services** using Blueprints



Exercise 13.04: Creating the AI Behavior Tree and Blackboard

The screenshot shows the Unreal Engine Content Browser interface. A right-click context menu is open over the 'Content' folder in the left sidebar. The menu path is: Content > AI > Artificial Intelligence > Behavior Tree. The 'Behavior Tree' option is highlighted with a red arrow pointing to it. The main content area displays a 3D level editor with a green floor and blue walls. On the floor, there are several floating icons representing different game assets. The right side of the screen shows the Details panel for the selected 'RecastNavMesh-Default' asset, which includes settings for generation and query parameters.

Cinematic
Visual Effects
Geometry
Volumes
All Classes

Lightmass Ch:
Lightmass Imp:
Mesh Merge Cu:
Nav Mesh Bou:
Nav Modifier V:
Pain Causing V:
Physics Volu:
Post Process

Content Browser Output Log

Add/Import Save All

Search Paths Filters

Content
Enemy
AI
Blueprints
Materials
Geometry
MainCharacter
Animation
Blueprints
Mesh
Mannequin
SideScrollerCPP

BP_AIController
Enemy

1 item

Folder
New Folder
Import Asset
Import to /Game/Enemy/AI...
Create Basic Asset
Blueprint Class
Level
Material
Particle System
Create Advanced Asset
Animation
Artificial Intelligence
Blendables
Blueprints
Editor Utilities
Foliage
FX
Live Link
Materials & Textures
Media
Miscellaneous
Paper2D
Physics
Sounds
User Interface

Floor16
Floor17
Floor18
Floor19
LightmassImportanceVc
NavMeshBoundsVolume
PostProcessVolume
RecastNavMesh-Default
SkyAtmosphere
SkyDomeMesh
SkyLight

StaticMeshAc
StaticMeshAc
StaticMeshAc
StaticMeshAc
PostProcess
RecastNavMe
SkyAtmosph
StaticMeshAc
SkyLight

28 actors (1 selected) View Options

Details World Settings

RecastNavMesh-Default

Search Details

Generation

Fixed Tile Pool Size
Tile Pool Size
Tile Size UU
Cell Size
Cell Height
Agent Radius
Agent Height
Agent Max Slope
Agent Max Step He
Min Region Area
Merge Region Size
Max Simplification
Sort Navigation Ar

Query

Right-Click

SuperSideScroller • DDC SuperSideScroller

File Edit Window Help

Place Actors

Search Classes

Recently Placed

Basic

Lights

Cinematic

Visual Effects

Geometry

Volumes

All Classes

Save Current Source Control Modes Content Marketplace Settings Blueprints Cinematics Build Compile

Perspective Lit Show

10 10° Foreground 0.25 4

Floor13 StaticMeshAc

Floor14 StaticMeshAc

Floor15 StaticMeshAc

Floor16 StaticMeshAc

Floor17 StaticMeshAc

Floor18 StaticMeshAc

Floor19 StaticMeshAc

LightmassImportanceVcLightmassImp

NavMeshBoundsVolumNavMeshBou

PostProcessVolume PostProcess

RecastNavMesh-Default RecastNavMe

SkyAtmosphere SkyAtmospher

SkyDomeMesh StaticMeshAc

SkyLight SkyLight

28 actors (1 selected) View Options

Details World Settings

RecastNavMesh-Default

Search Details

Generation

Fixed Tile Pool Size 1024

Tile Pool Size 1000.0

Cell Size 5.0

Cell Height 10.0

Agent Radius 42.0

Agent Height 192.0

Agent Max Slope 44.0

Agent Max Step He 35.0

Min Region Area 0.0

Merge Region Size 400.0

Max Simplification 1.3

Sort Navigation Ar

Query

Add/Import Save All Content > Enemy > AI

Content Browser Output Log

Search Paths Filters Search AI

Content

Enemy

AI

Blueprints

Materials

Geometry

MainCharacter

Animation

Blueprints

Mesh

Mannequin

SideScrollerCPP

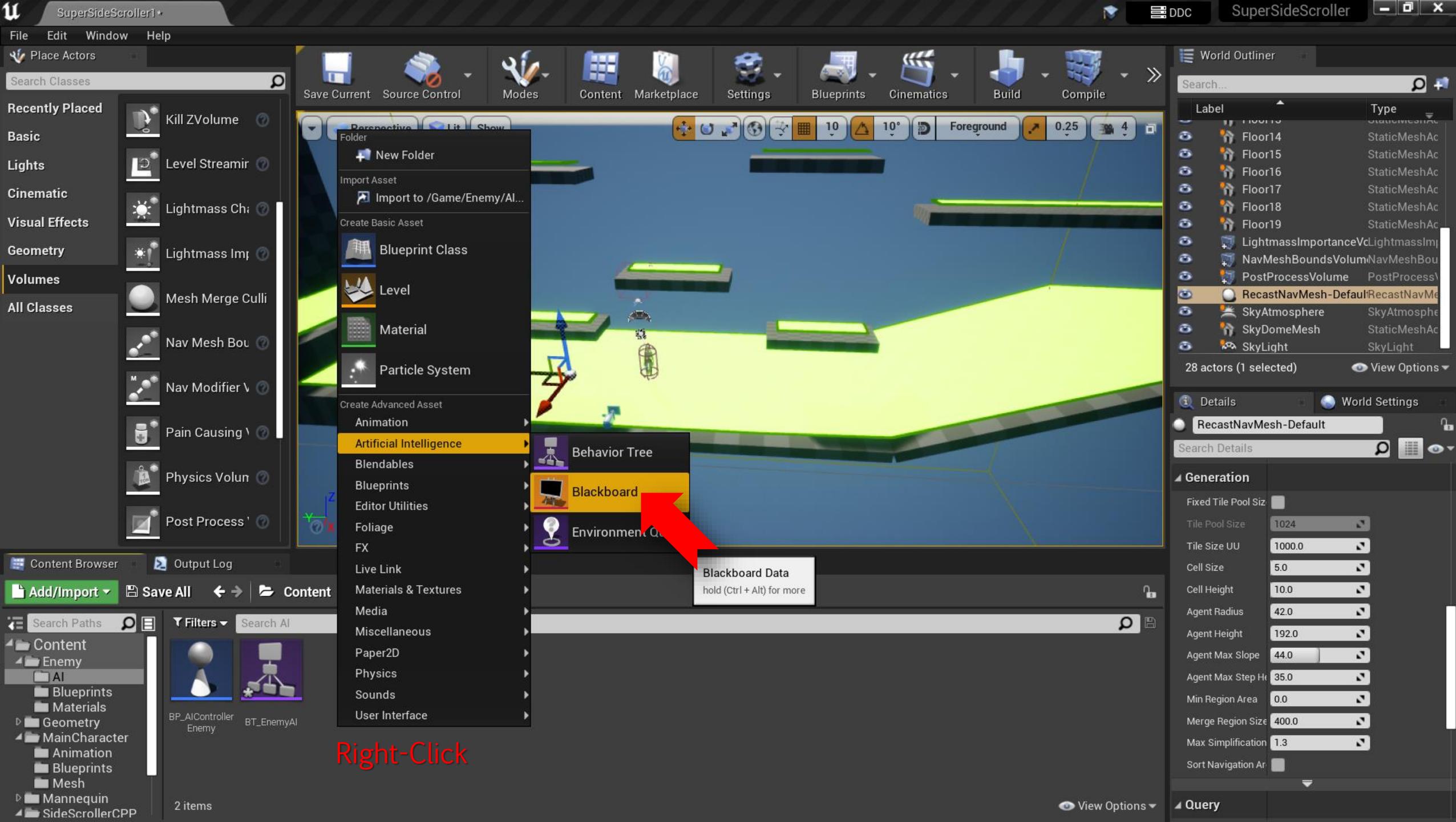
BP_AIController

BT_EnemyAI

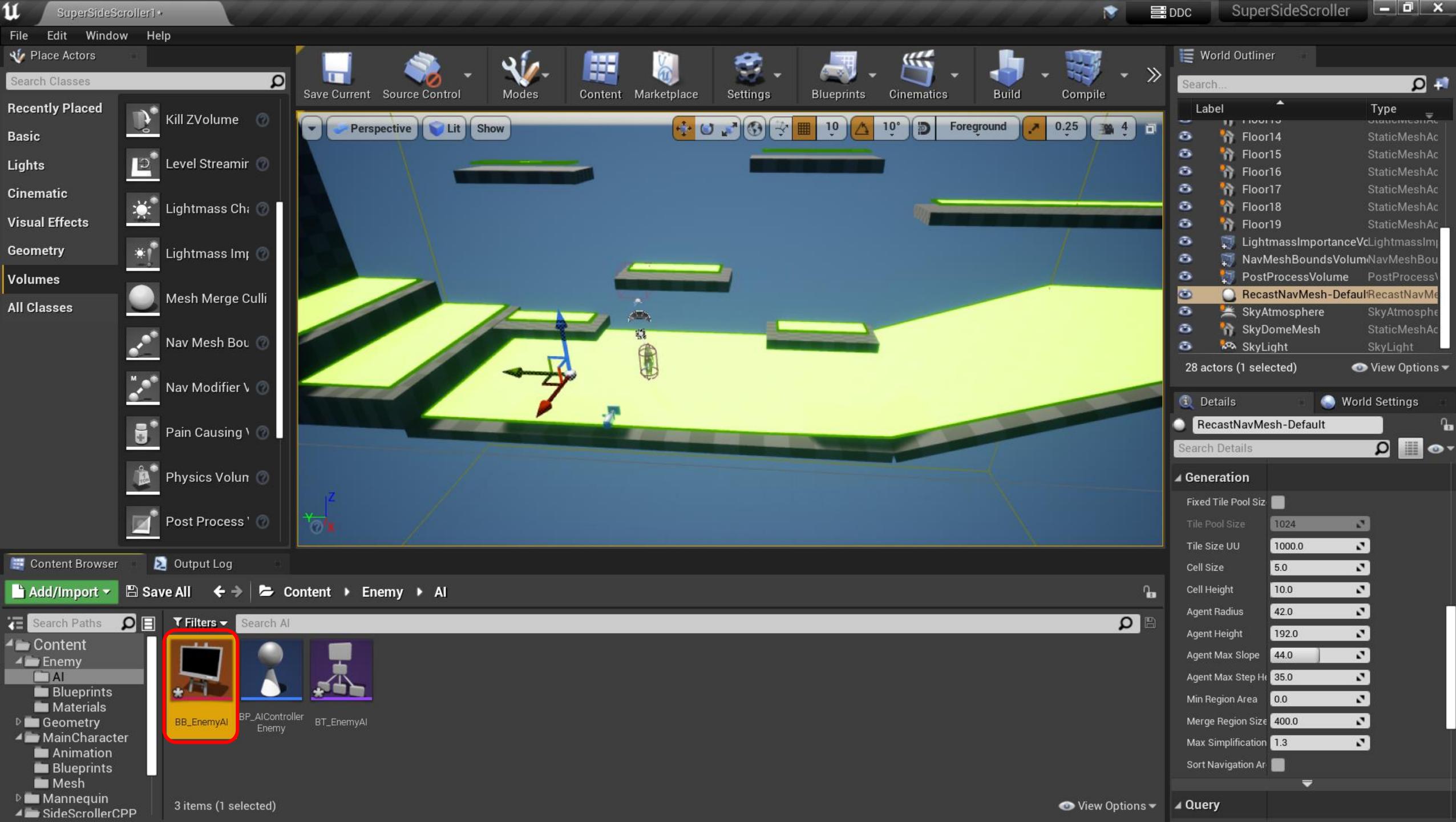
2 items (1 selected)

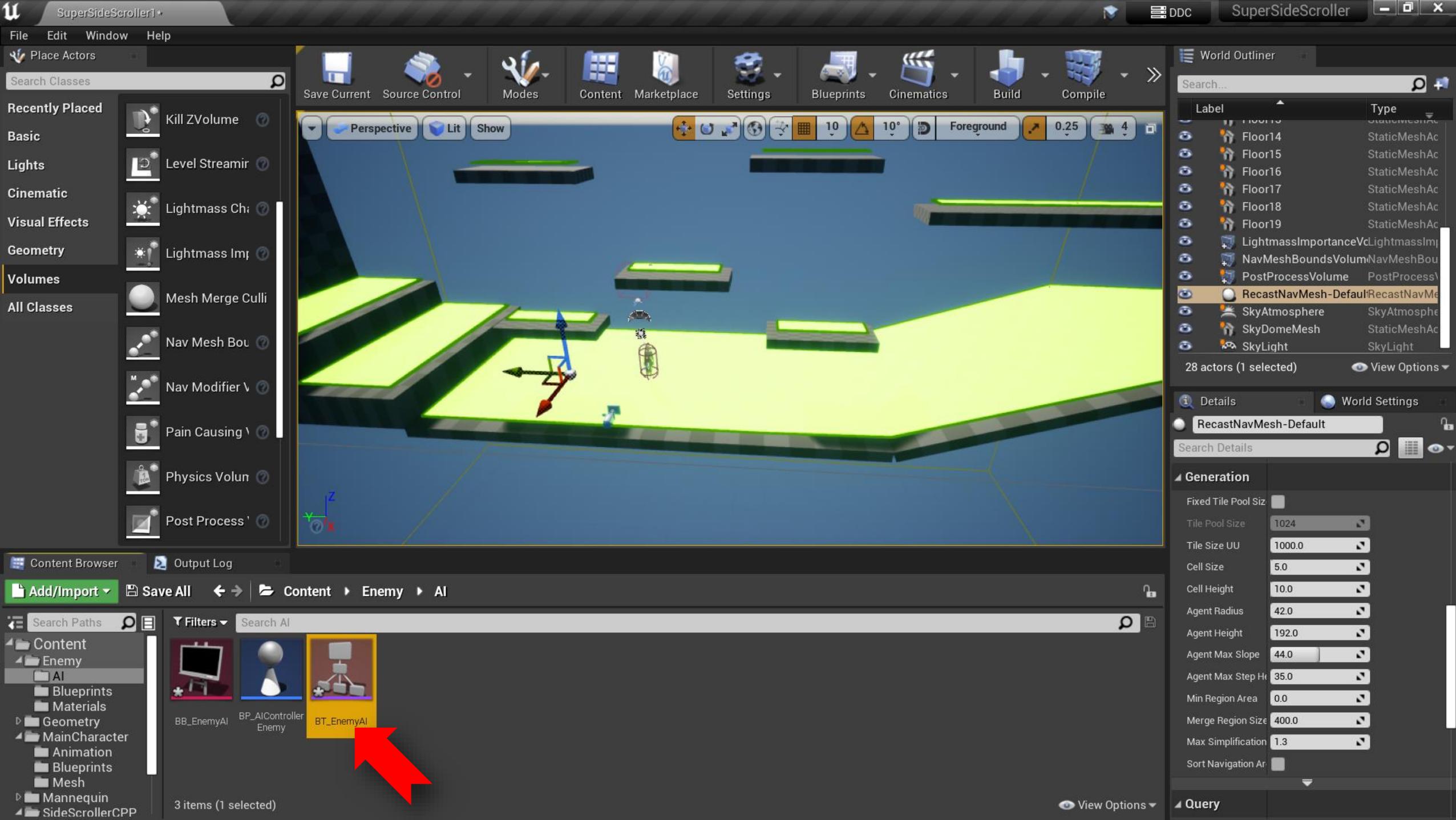
View Options

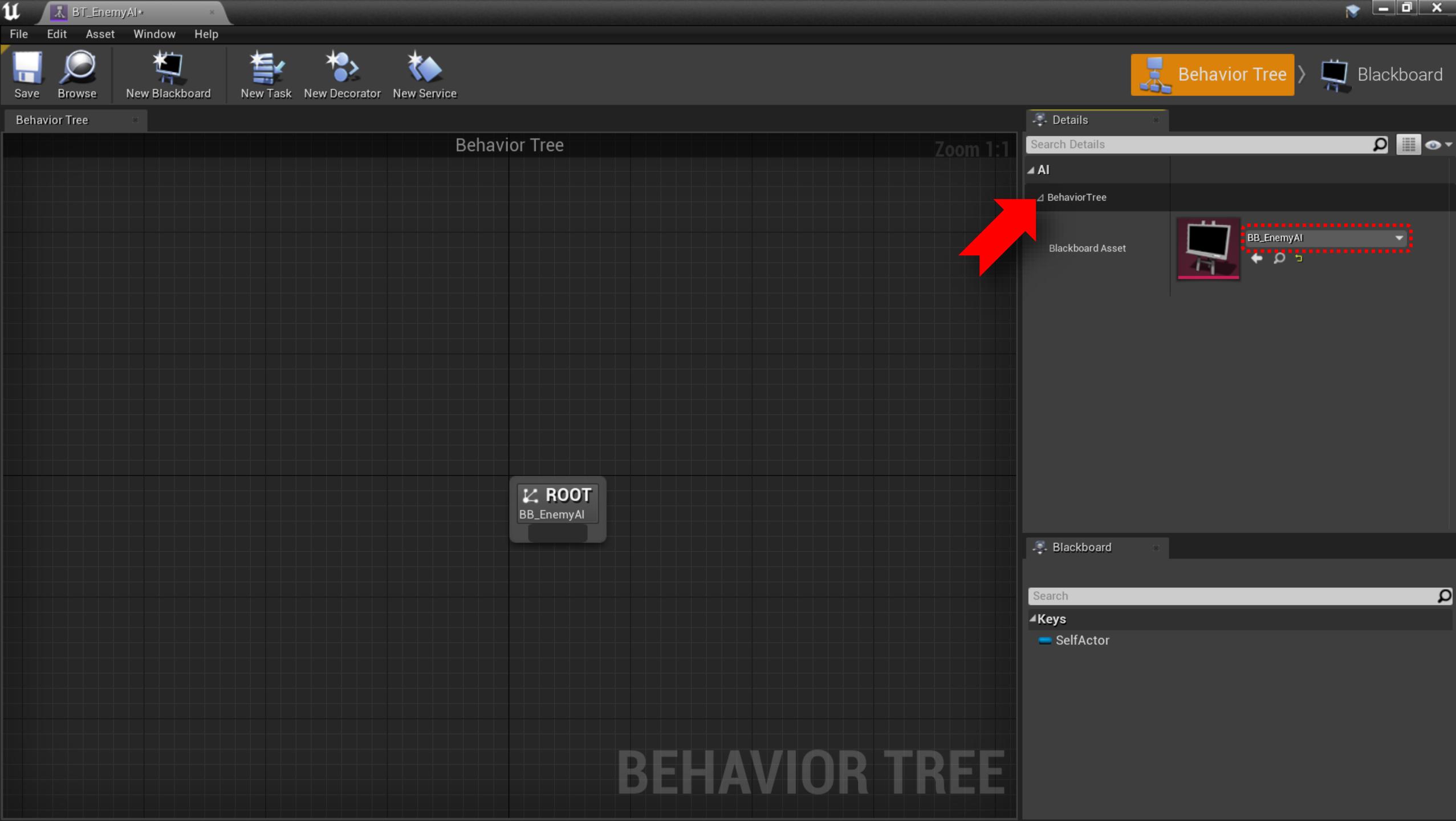
The screenshot displays the Unreal Engine 4 Editor interface. The main area is the 3D level editor showing a perspective view of a level with floating rectangular platforms and a character model. The right side features the World Outliner, which lists 28 selected actors, including various floor meshes and a RecastNavMesh component. The bottom left shows the Content Browser, where the BT_EnemyAI blueprint is selected and highlighted with a red box. The top menu bar includes File, Edit, Window, Help, Place Actors, and a search bar for classes. The toolbar at the top has icons for Save Current, Source Control, Modes, Content, Marketplace, Settings, Blueprints, Cinematics, Build, and Compile. The bottom navigation bar includes Add/Import, Save All, and a path browser.

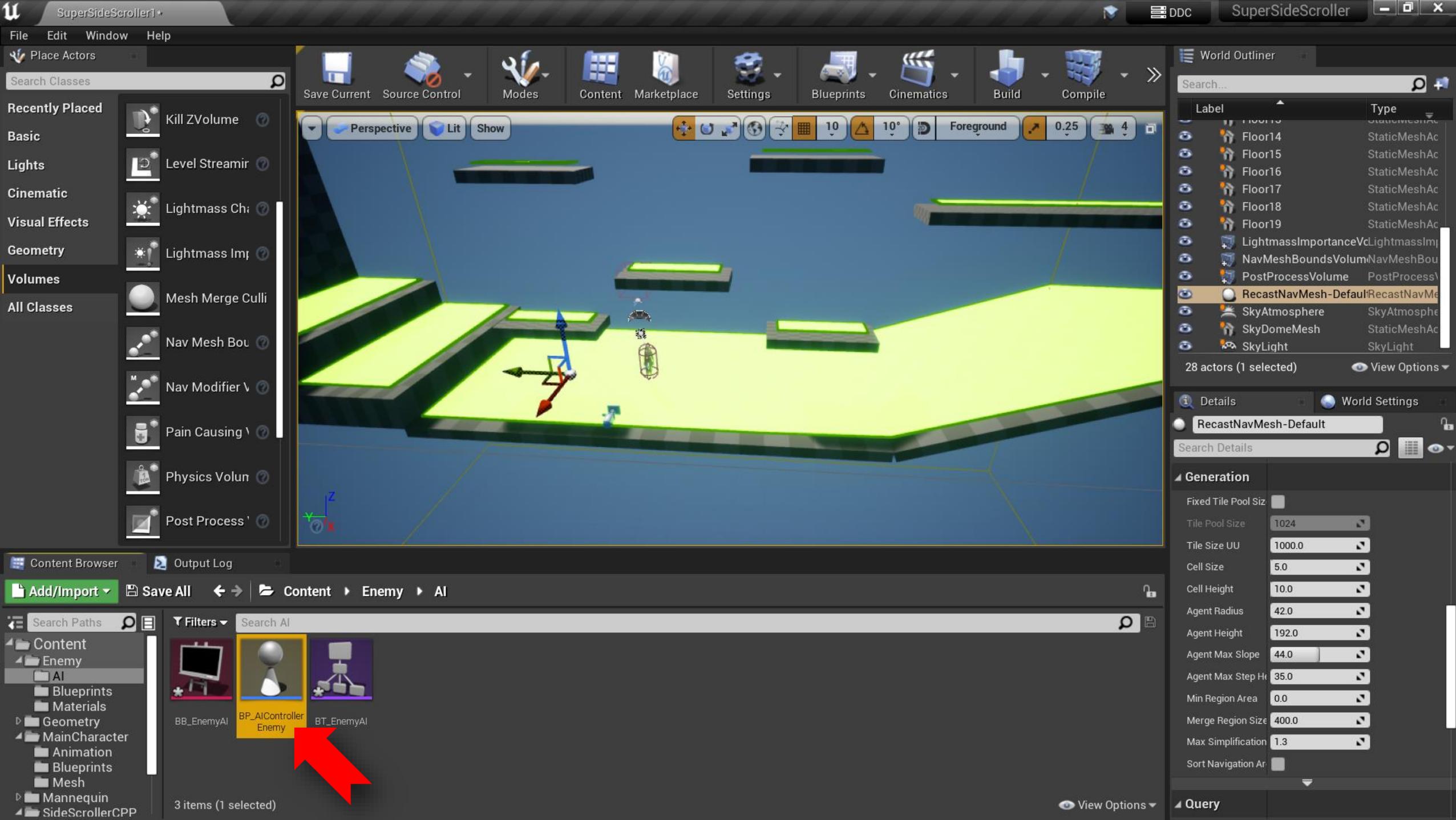


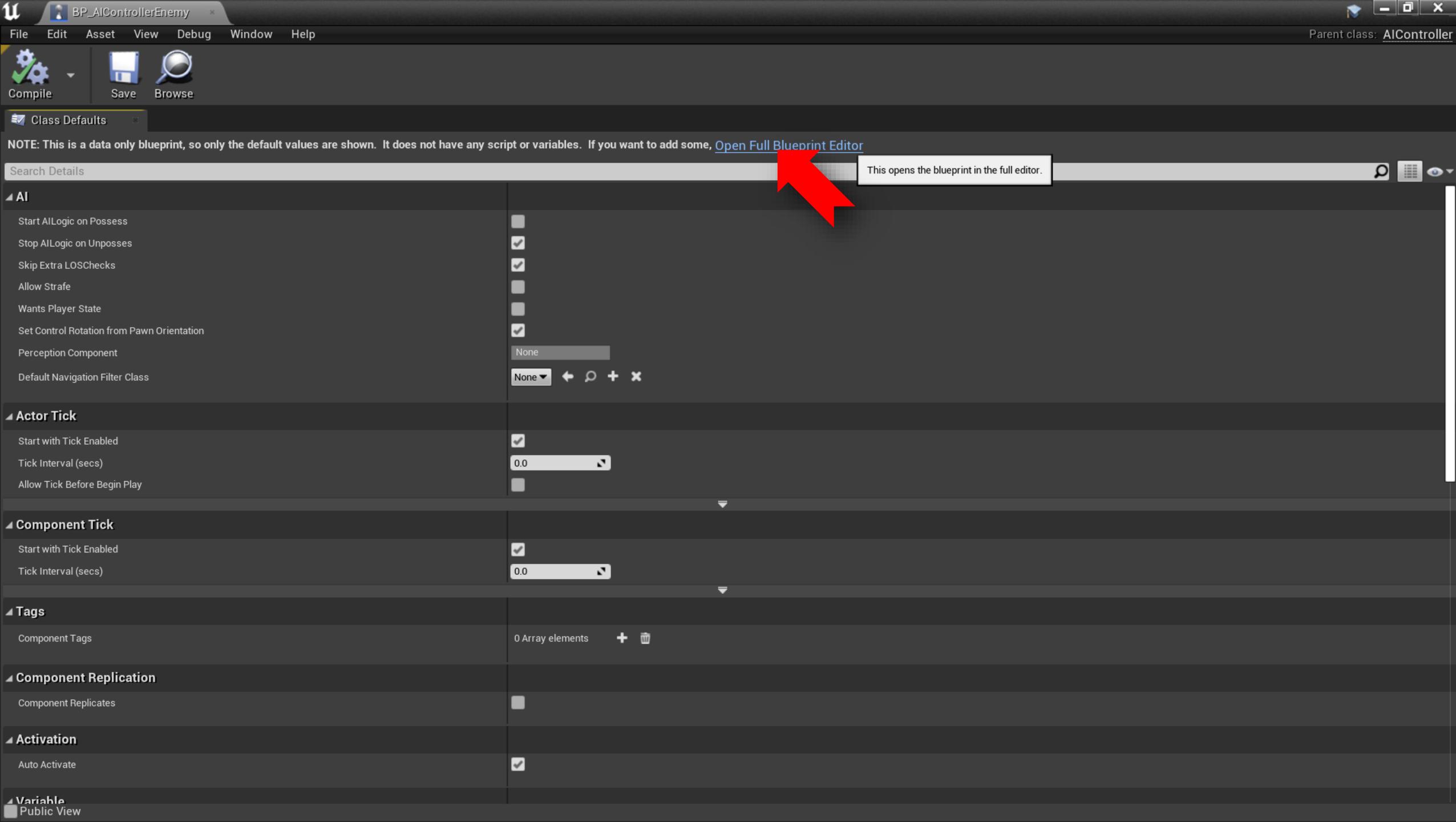
Right-Click

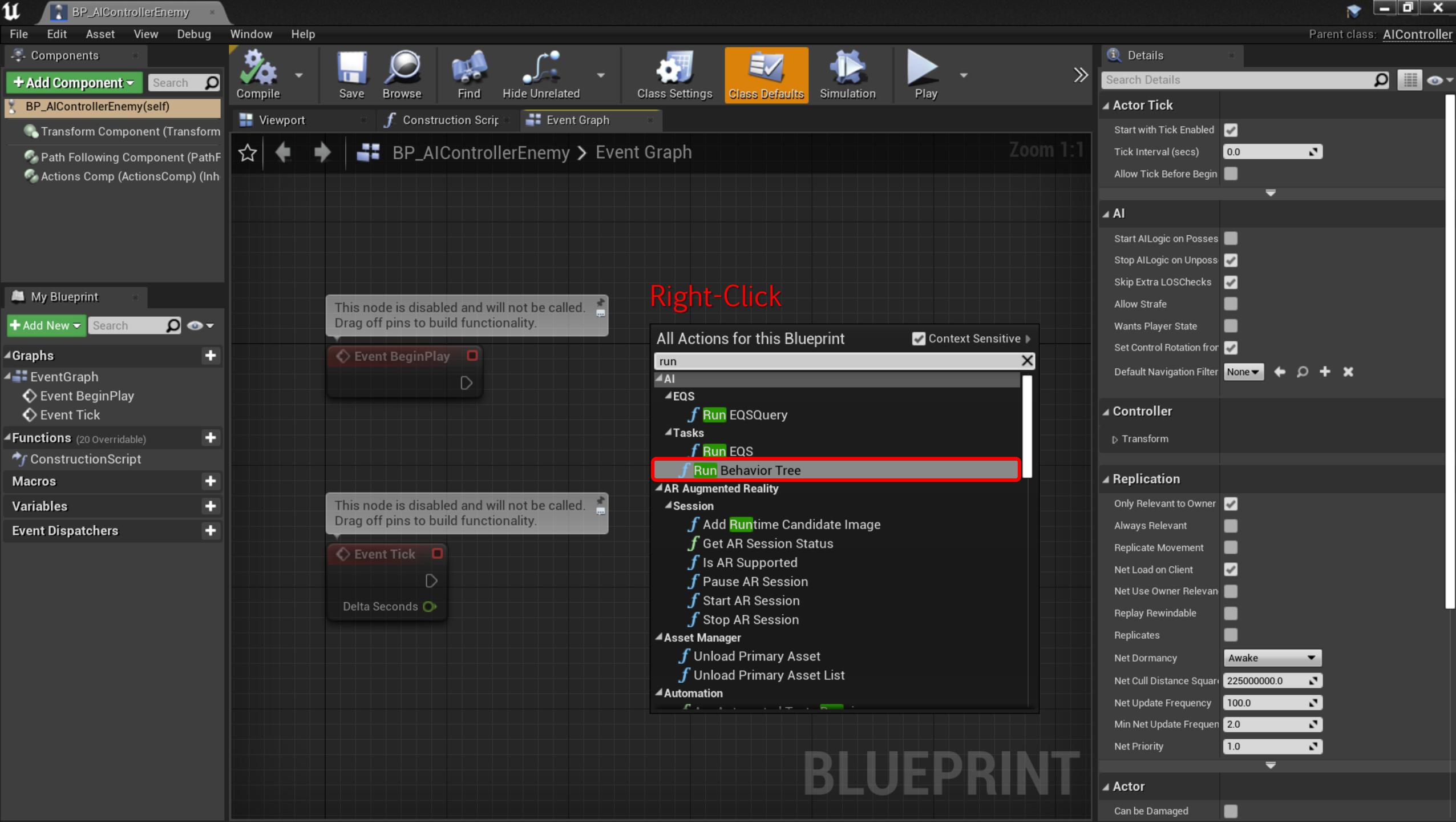


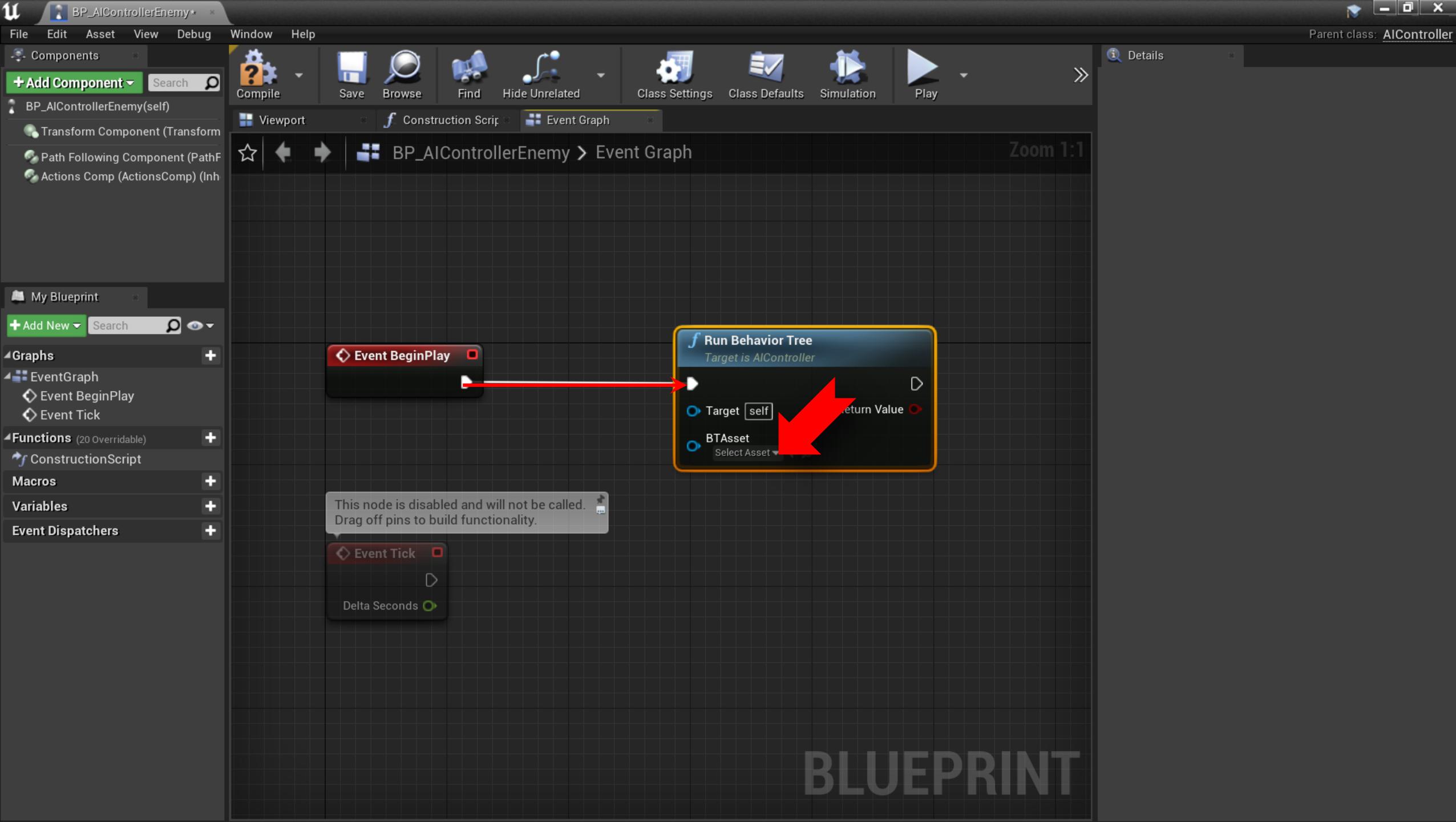


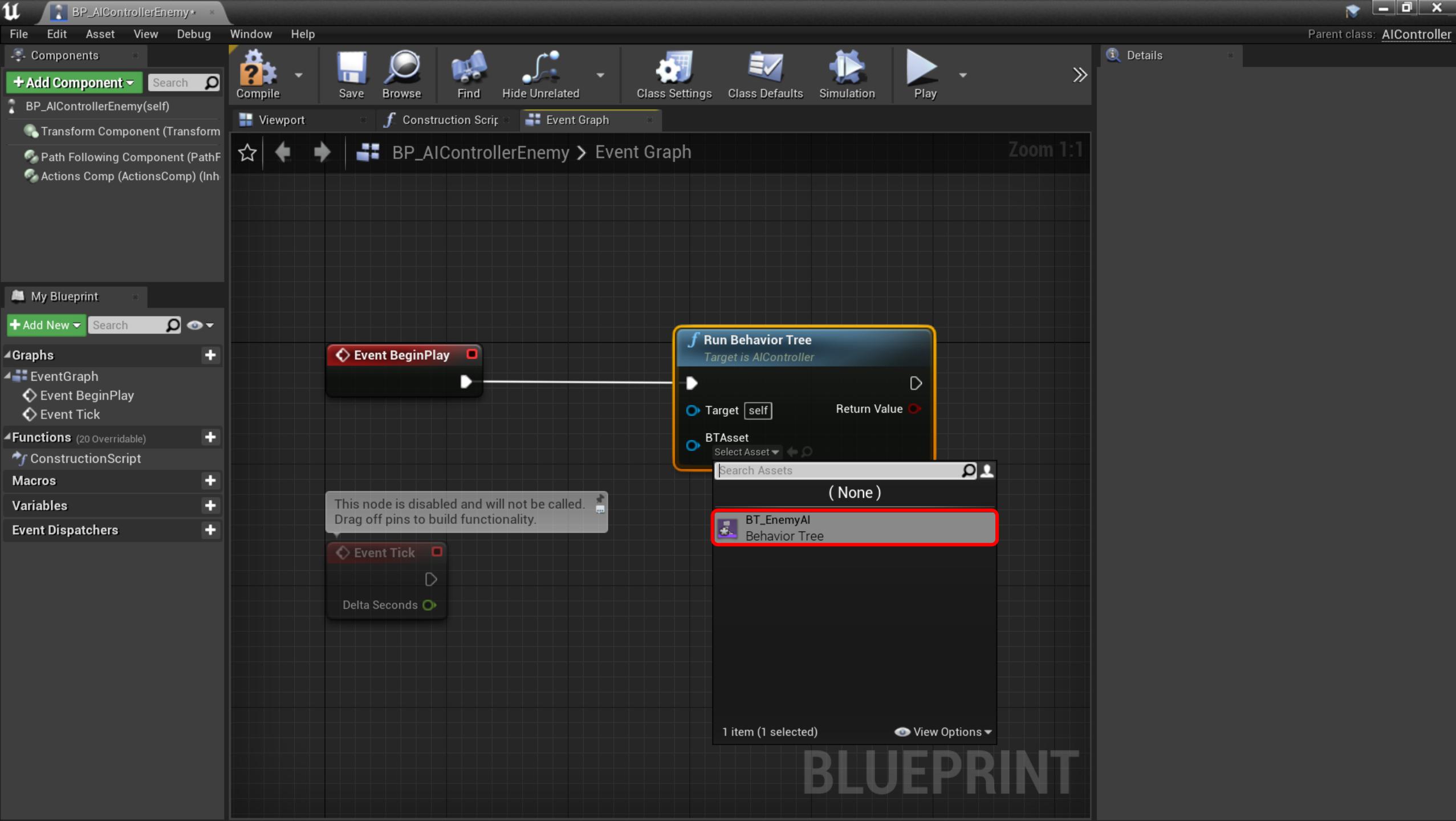


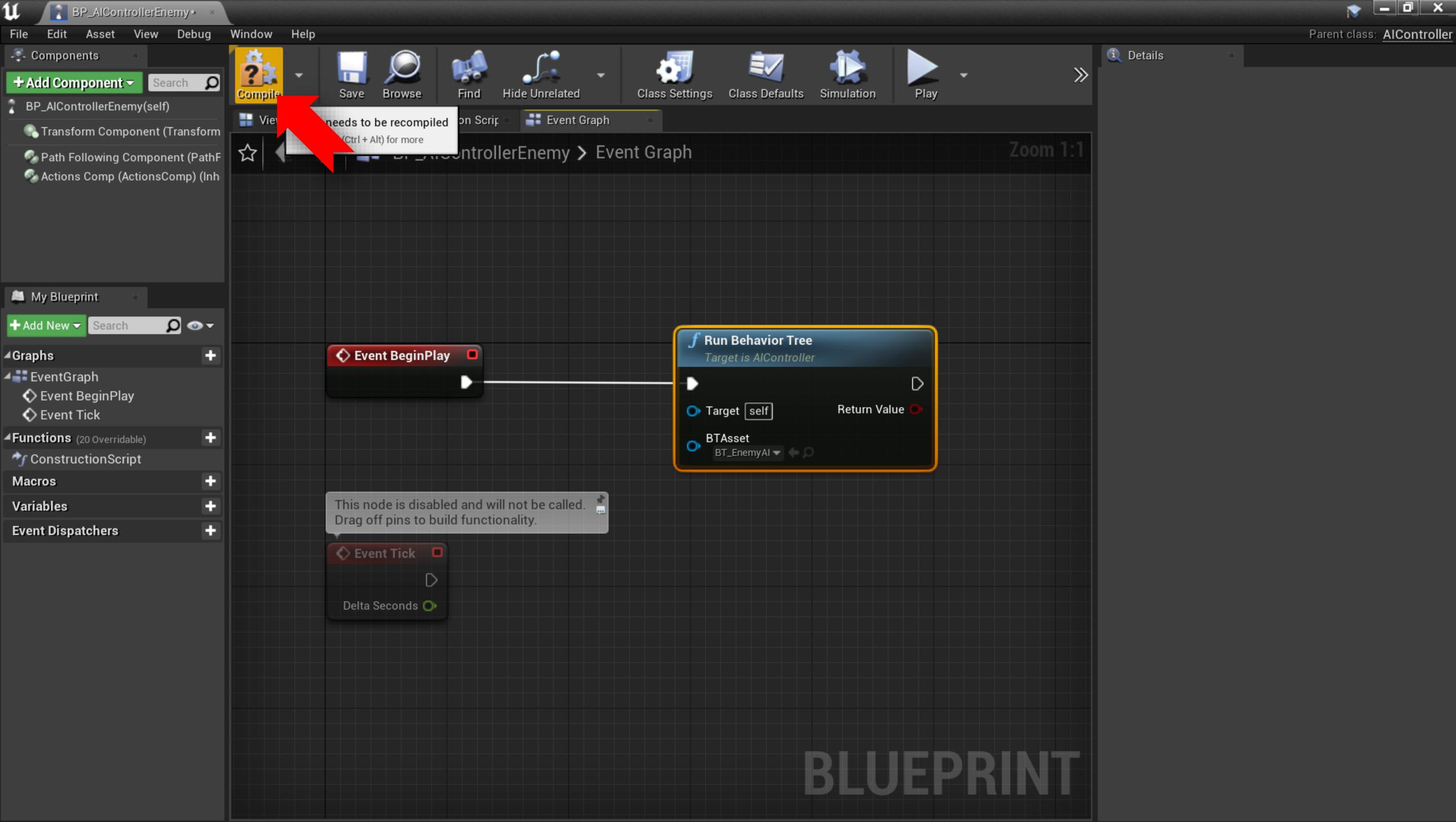






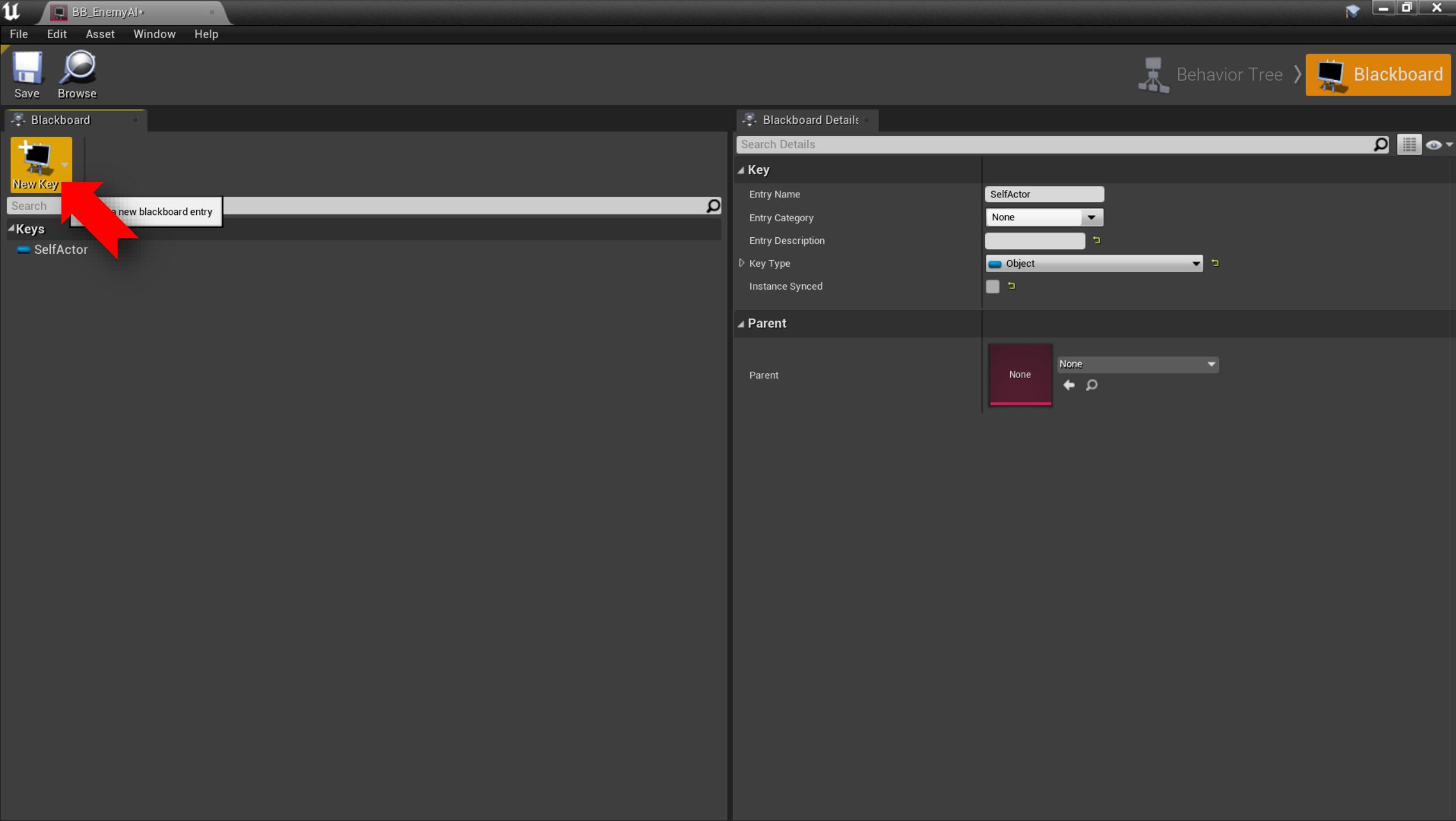


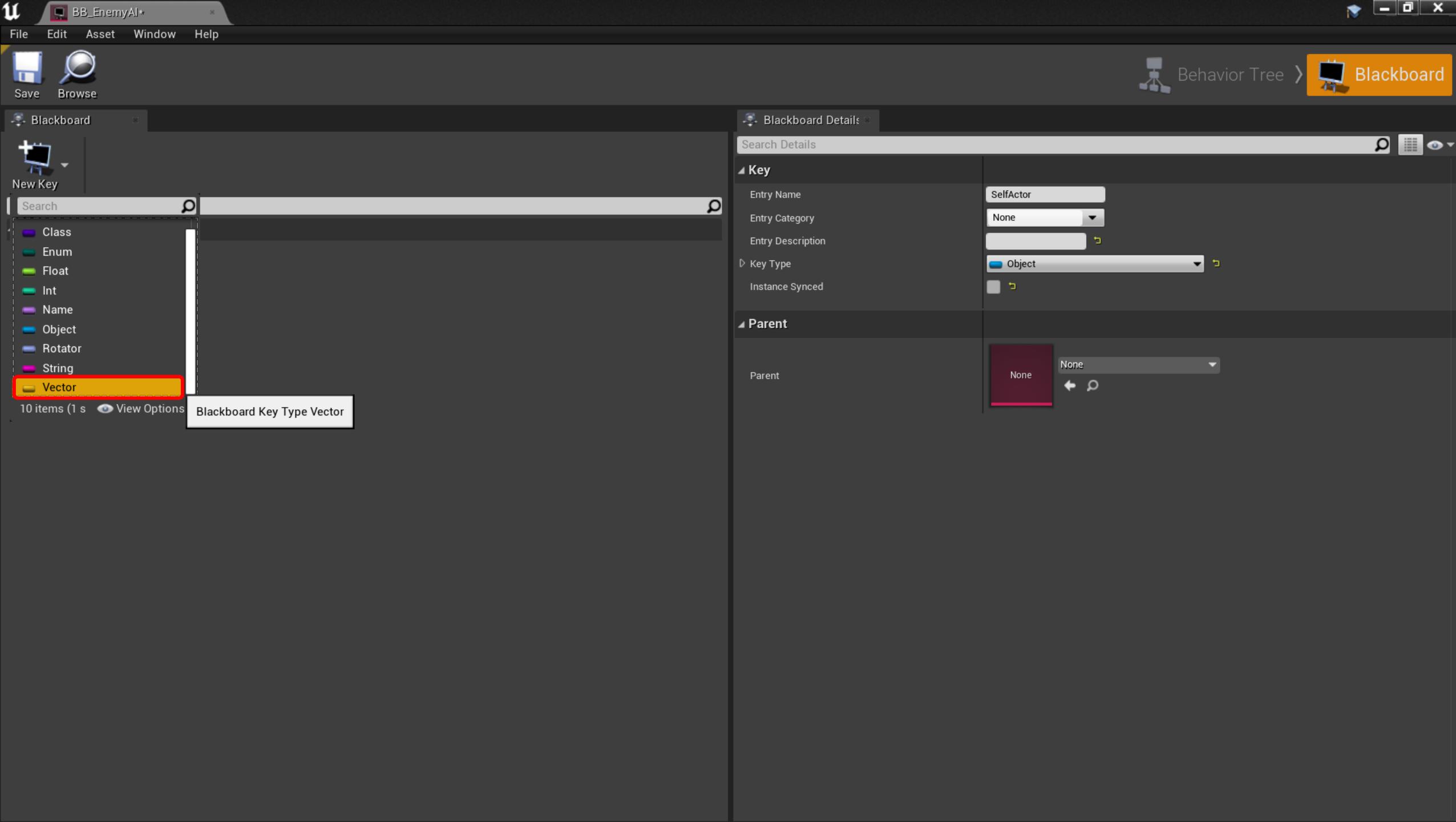


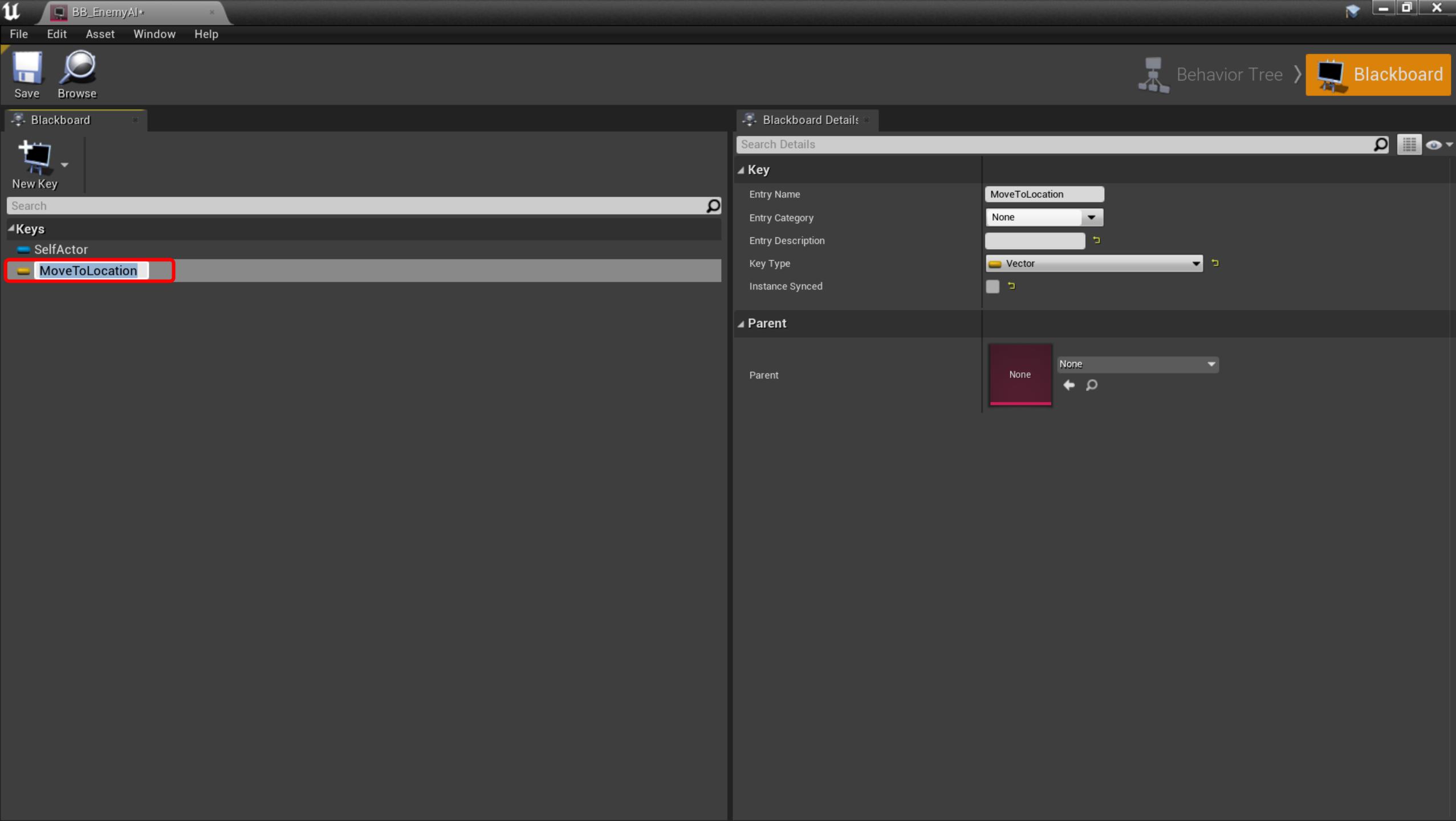


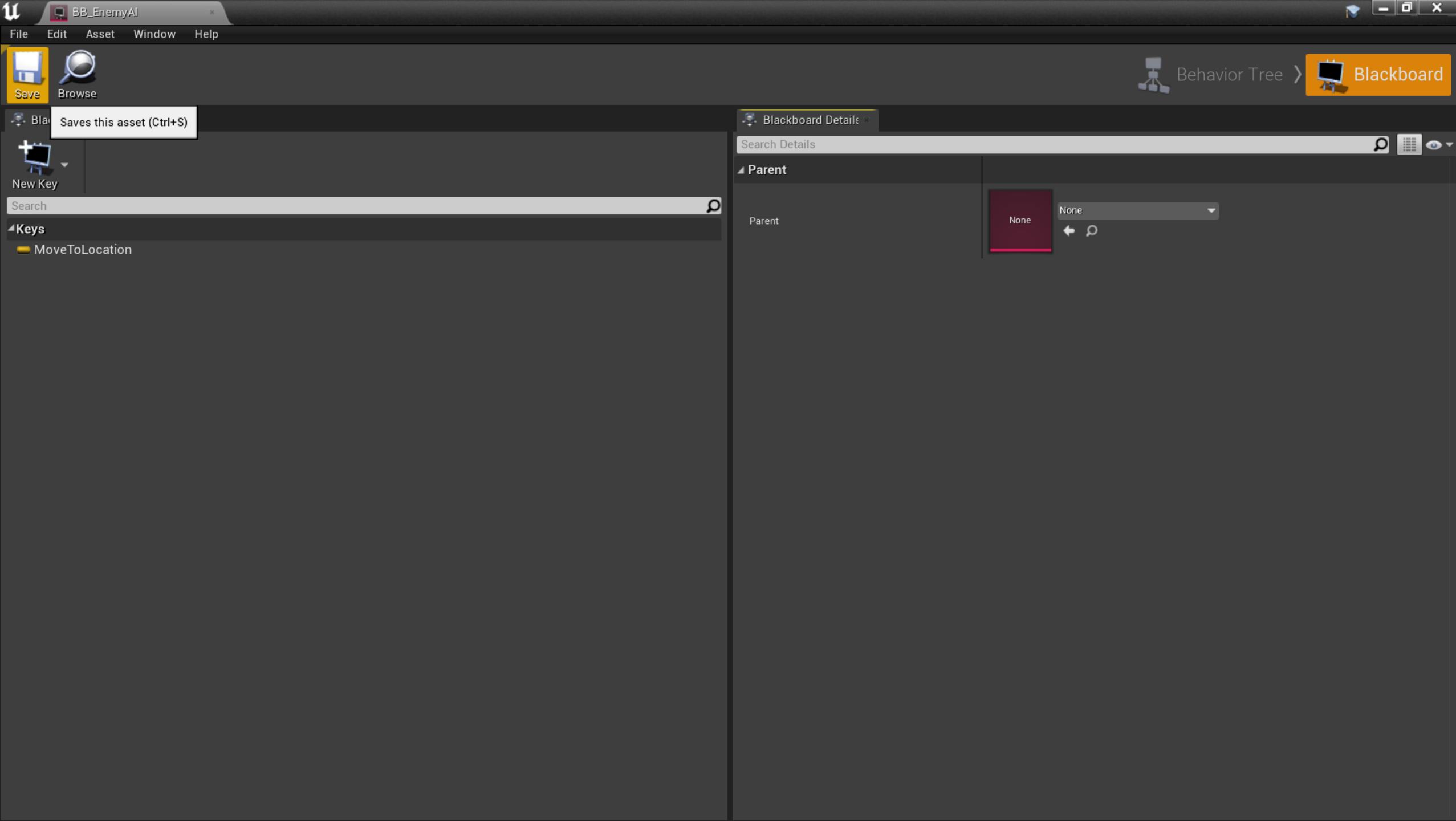
Exercise 13.05: Creating a New Behavior Tree Task

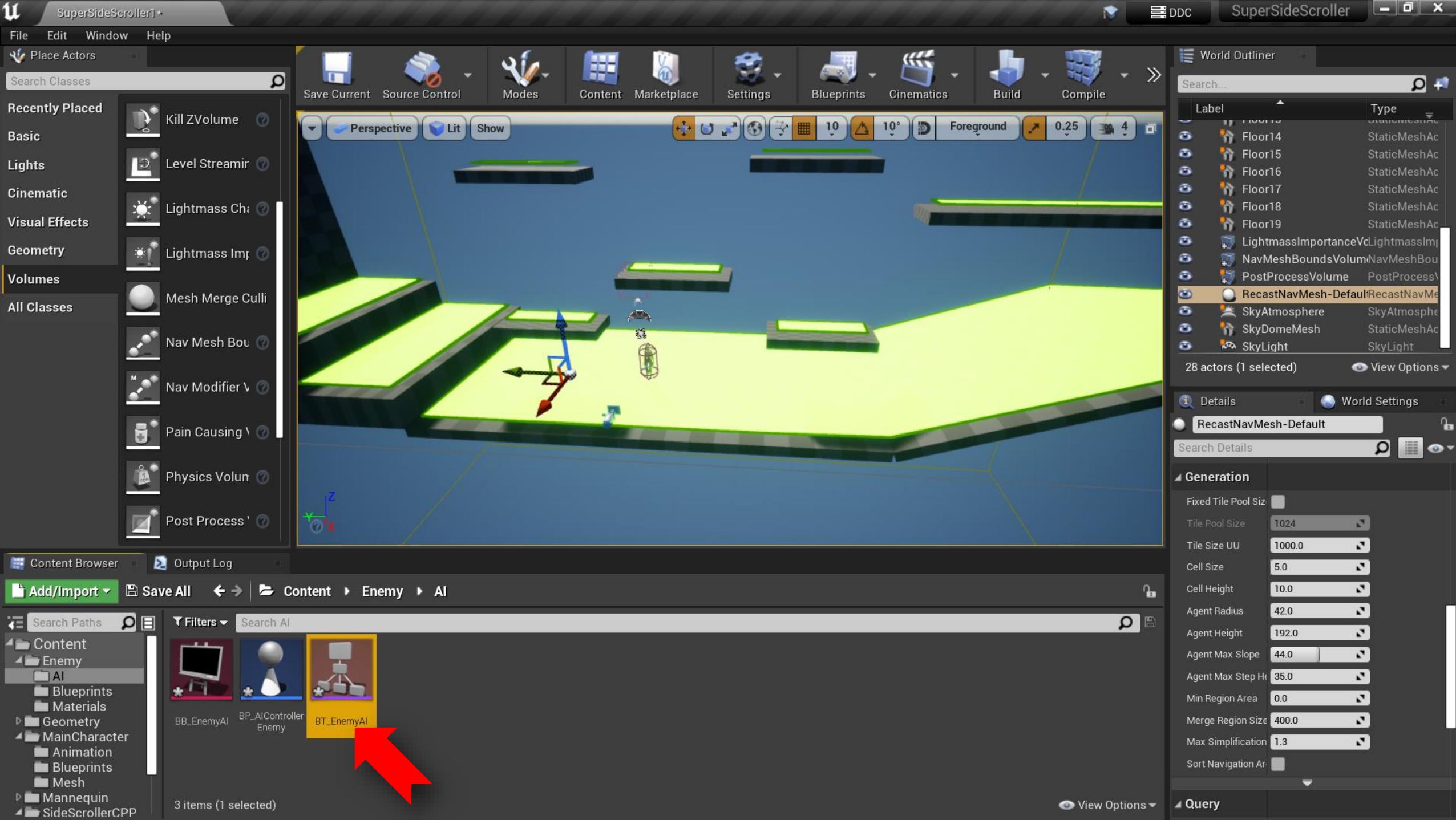


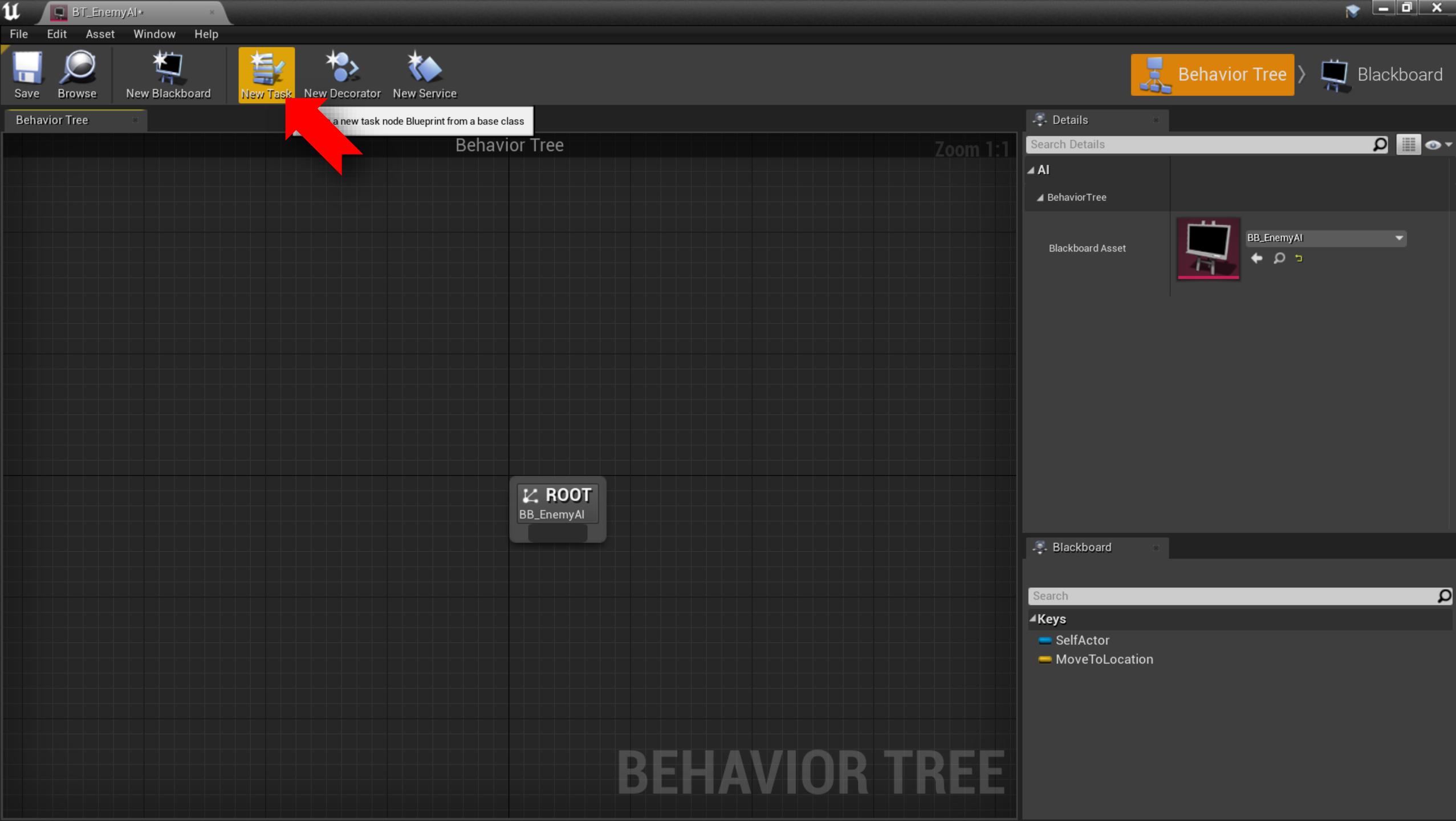


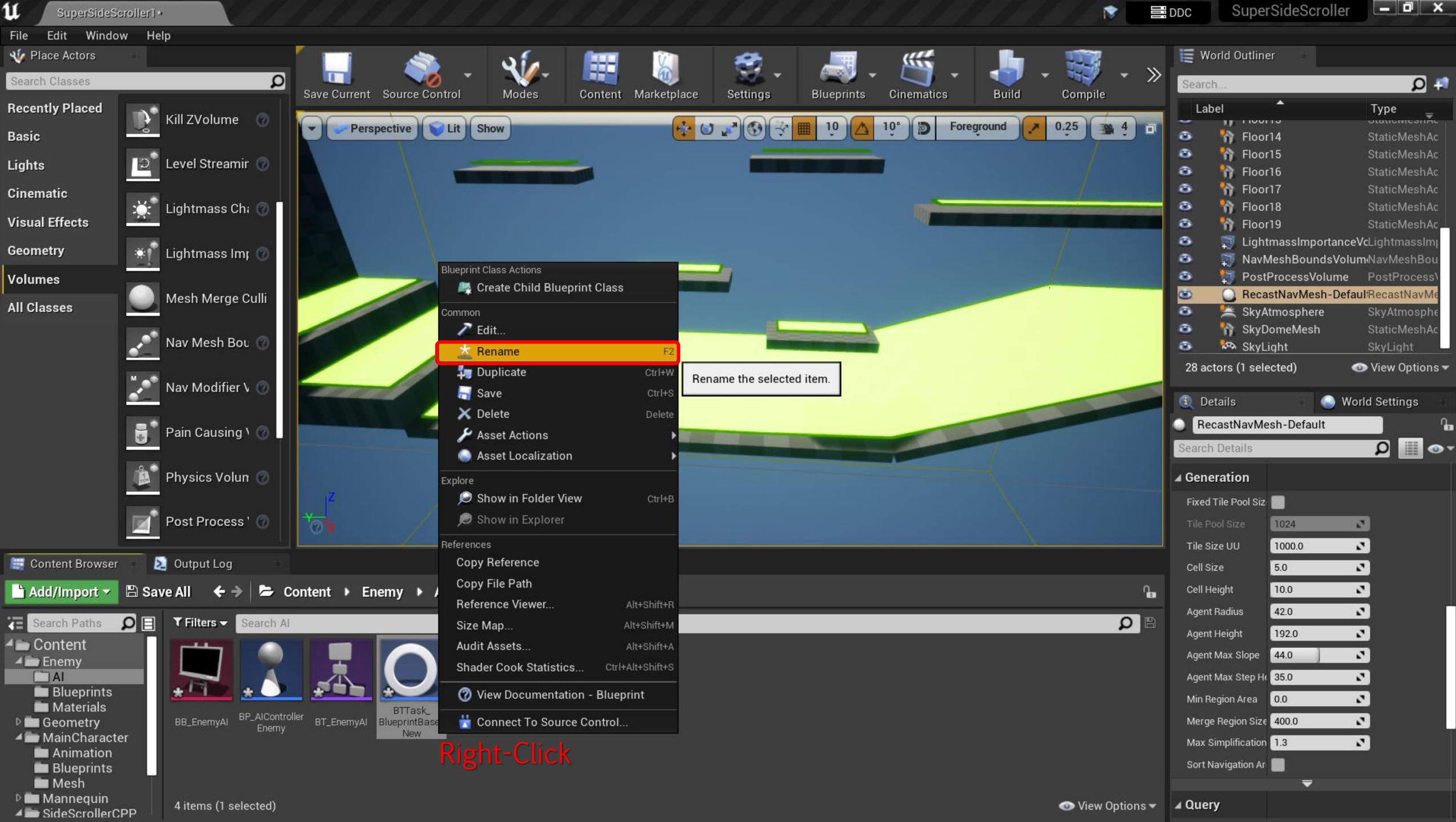












Right-Click

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File Edit Window Help

Place Actors Search Classes

Recently Placed Basic Lights Cinematic Visual Effects Geometry Volumes All Classes

Save Current Source Control Modes Content Marketplace Settings Blueprints Cinematics Build Compile

Perspective Lit Show

10 10° Foreground 0.25 4

Kill ZVolume Kill ZVolume

Level Streamer Level Streamer

Lightmass Ch: Lightmass Ch:

Lightmass Imp: Lightmass Imp:

Mesh Merge Culli Mesh Merge Culli

Nav Mesh Bou: Nav Mesh Bou:

Nav Modifier V: Nav Modifier V:

Pain Causing \ Pain Causing \

Physics Volu: Physics Volu:

Post Process' Post Process'

Content Browser Output Log

Add/Import Save All Content > Enemy > AI

Search Paths Filters Search AI

Content Enemy AI Blueprints Materials

Geometry MainCharacter Animation Blueprints Mesh Mannequin SideScrollerCPP

BB_EnemyAI BP_AIController Enemy BT_EnemyAI

BTTTask_Find Location

World Outliner Search... Label Type

Floor13 StaticMeshAc

Floor14 StaticMeshAc

Floor15 StaticMeshAc

Floor16 StaticMeshAc

Floor17 StaticMeshAc

Floor18 StaticMeshAc

Floor19 StaticMeshAc

LightmassImportanceVcLightmassImp LightmassImportanceVcLightmassImp

NavMeshBoundsVolumNavMeshBou NavMeshBoundsVolumNavMeshBou

PostProcessVolume PostProcessVolume

RecastNavMesh-Default RecastNavMesh-Default

SkyAtmosphere SkyAtmosphere

SkyDomeMesh StaticMeshAc

SkyLight SkyLight

28 actors (1 selected) View Options

Details World Settings

RecastNavMesh-Default

Search Details

Generation

Fixed Tile Pool Size 1024

Tile Pool Size 1000.0

Cell Size 5.0

Cell Height 10.0

Agent Radius 42.0

Agent Height 192.0

Agent Max Slope 44.0

Agent Max Step He 35.0

Min Region Area 0.0

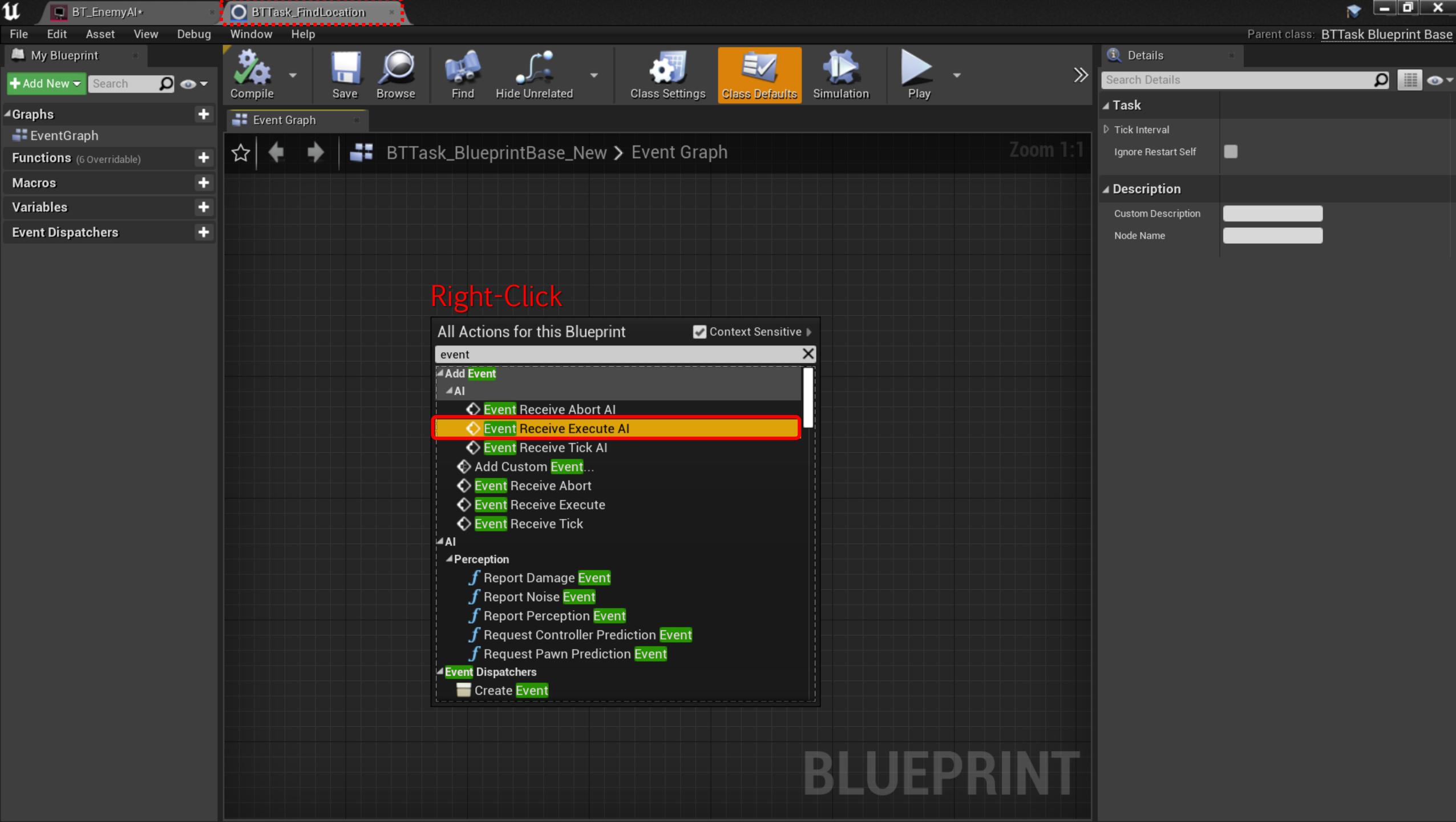
Merge Region Size 400.0

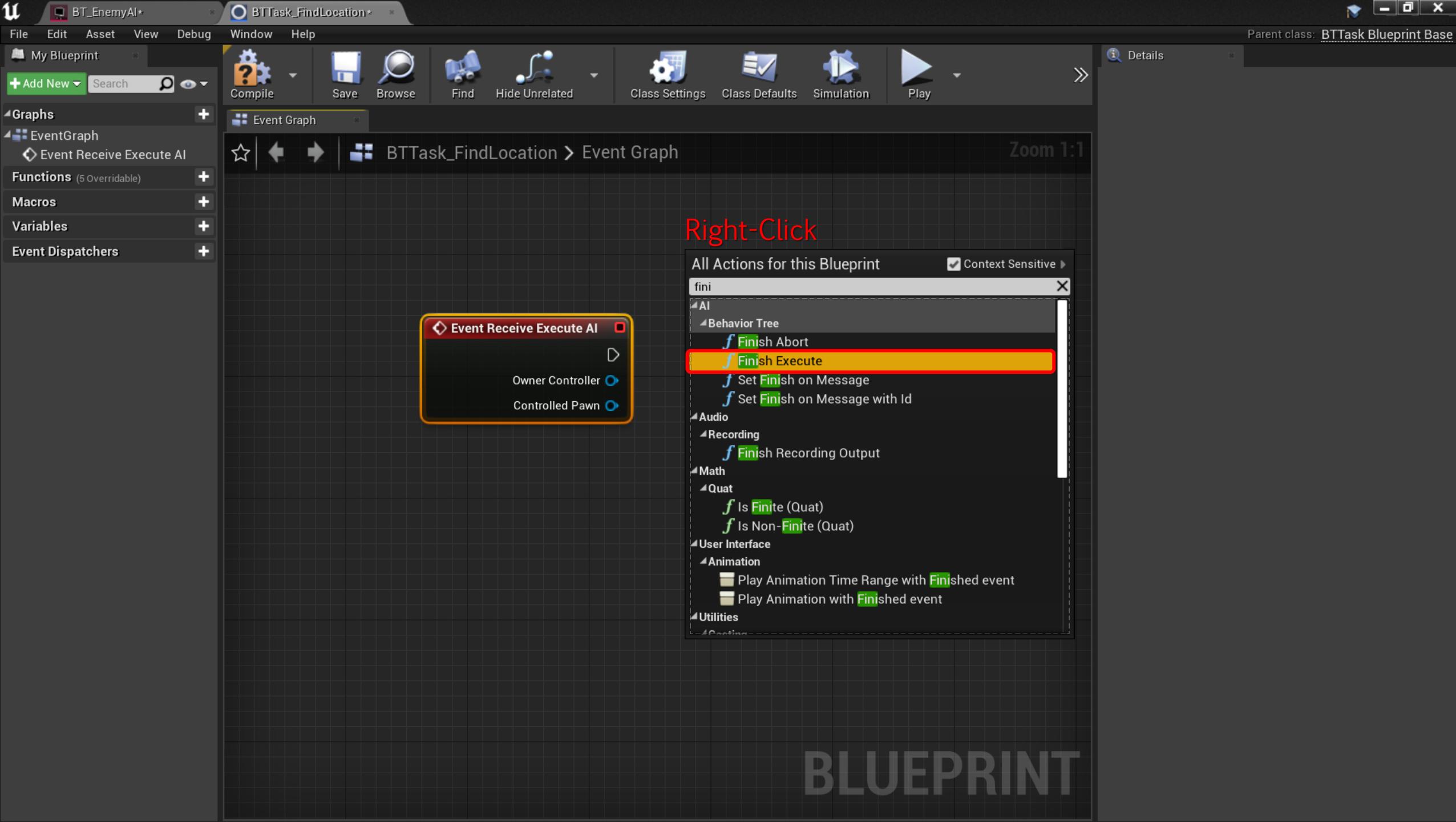
Max Simplification 1.3

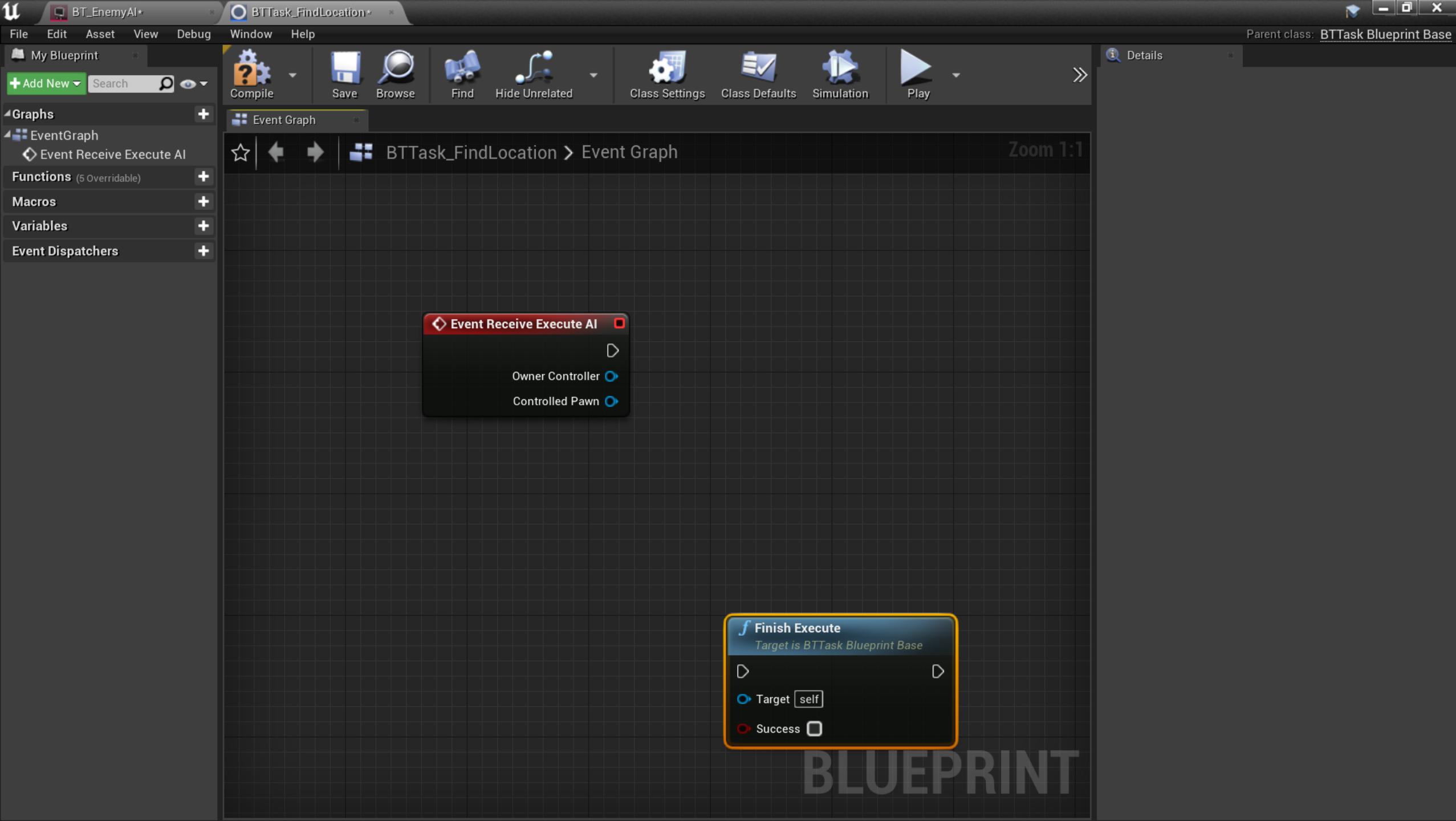
Sort Navigation Ar

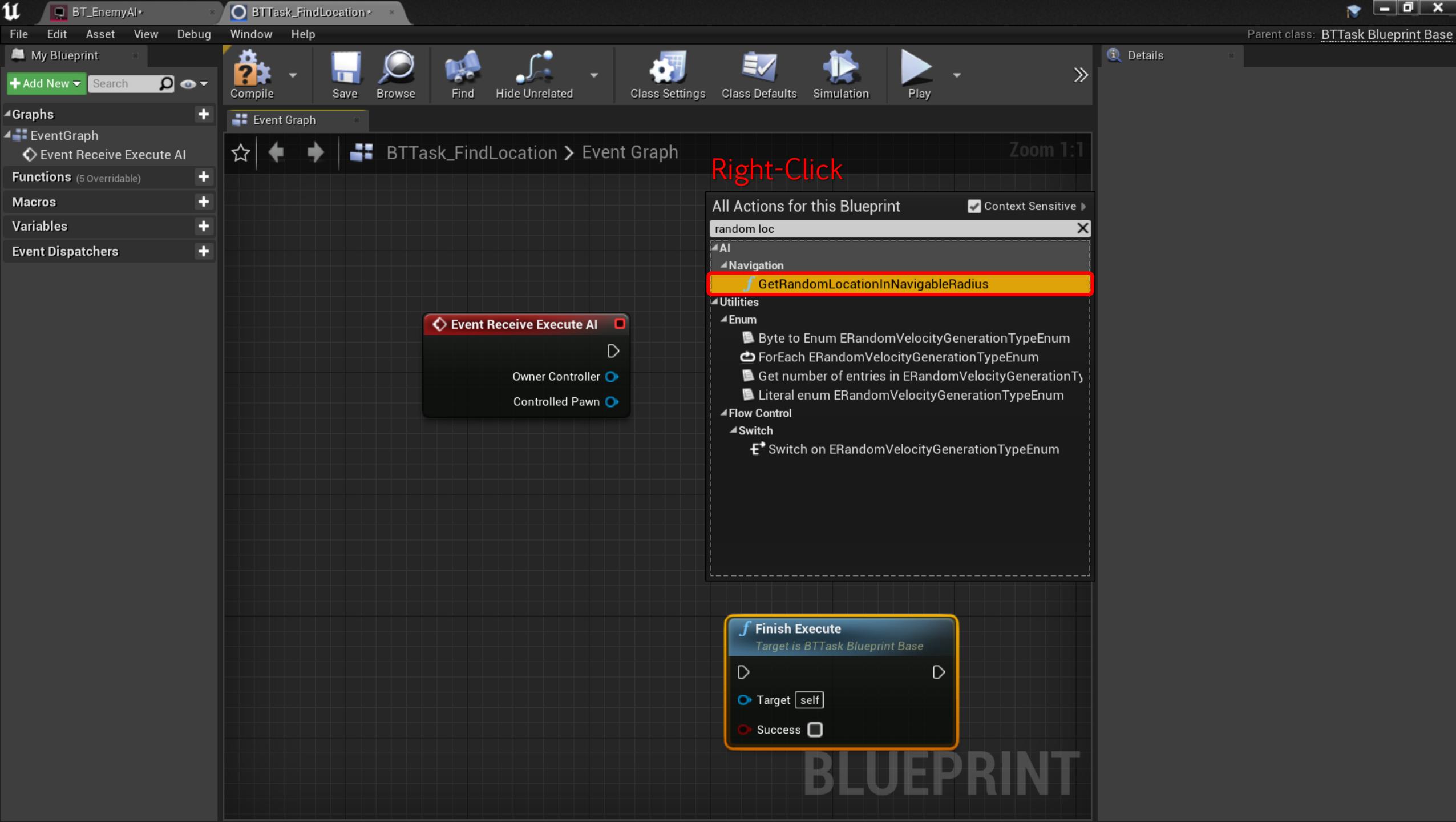
Query

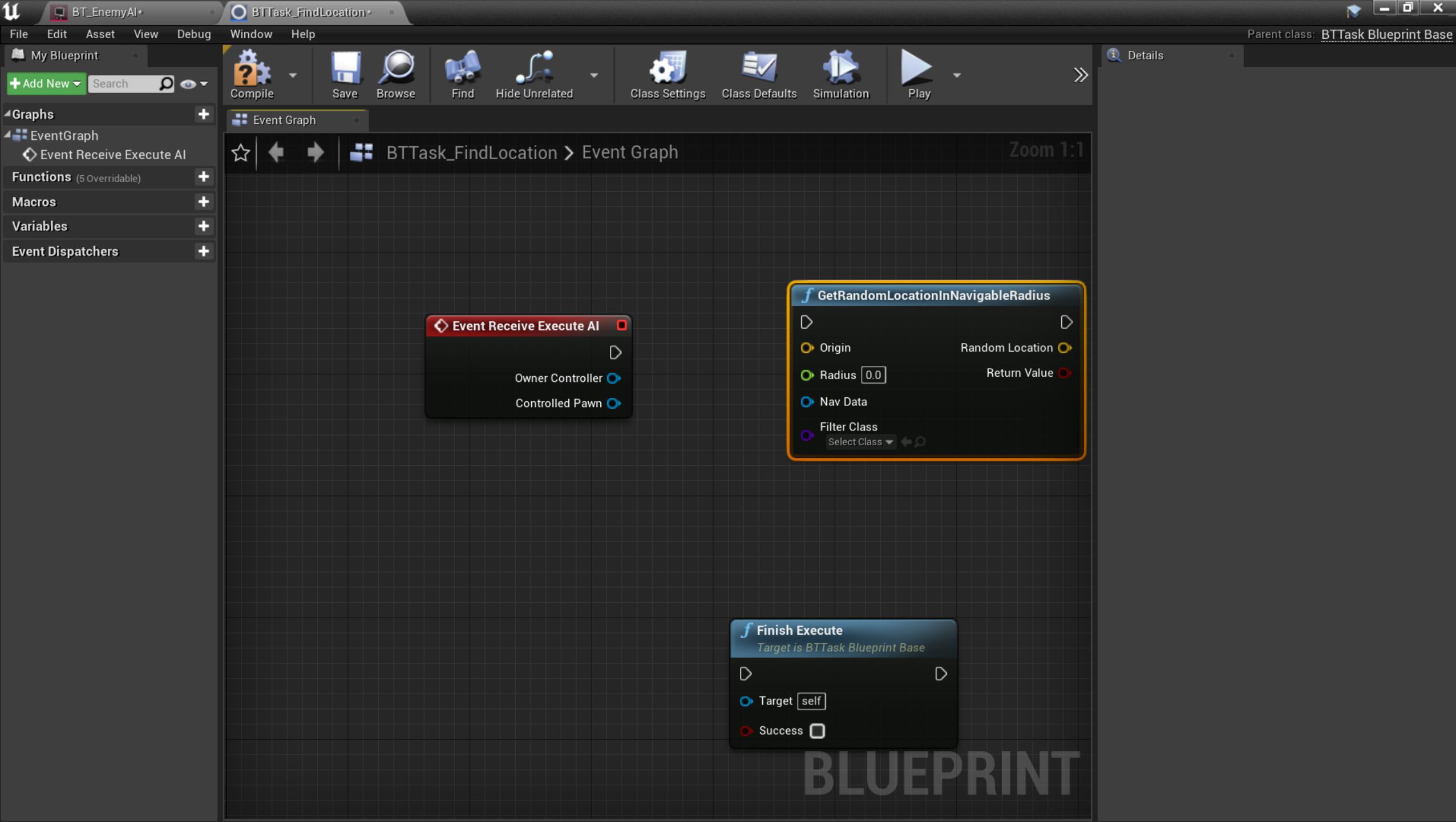
The screenshot shows the Unreal Engine 4 Editor interface. The main view is the Perspective Viewport displaying a 3D level with several floating rectangular platforms. A character model is positioned on one of the platforms. The interface includes toolbars at the top with icons for Save Current, Source Control, Modes, Content, Marketplace, Settings, Blueprints, Cinematics, Build, and Compile. Below the toolbar are buttons for Perspective, Lit, and Show modes, along with camera controls (10, 10°, Foreground, 0.25, 4). On the left, the Content Browser lists various assets under the Content, Enemy, and AI categories. The AI category contains BB_EnemyAI, BP_AIController, and BT_EnemyAI. The BT_EnemyAI asset is highlighted with a yellow border. The World Outliner panel on the right lists 28 selected actors, including various floor meshes and a RecastNavMesh-Default component. The Details panel shows settings for the RecastNavMesh-Default component, such as Fixed Tile Pool Size (1024), Tile Pool Size (1000.0), and Cell Size (5.0). The bottom navigation bar shows the current path: Add/Import > Save All > Content > Enemy > AI.

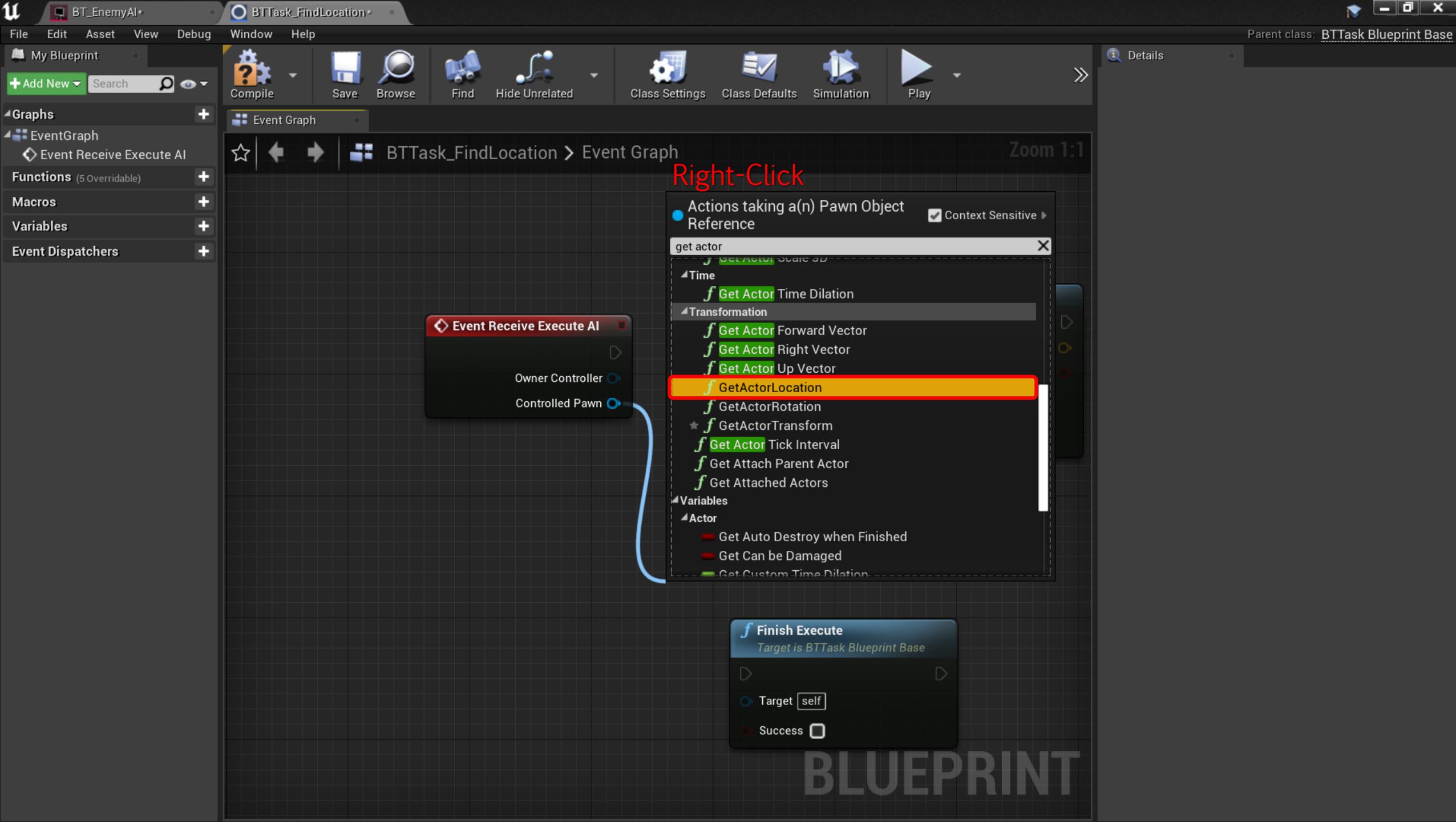


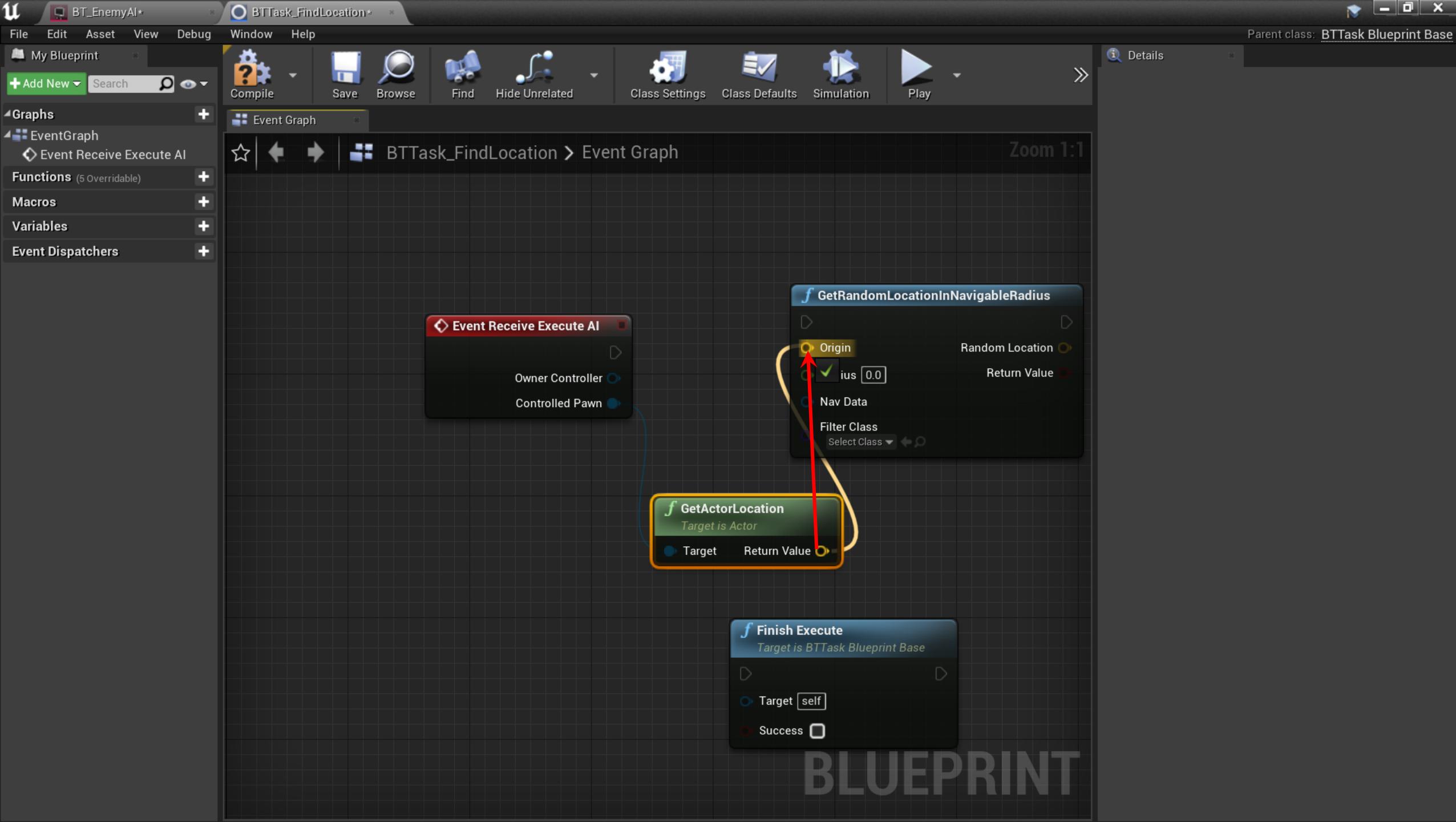


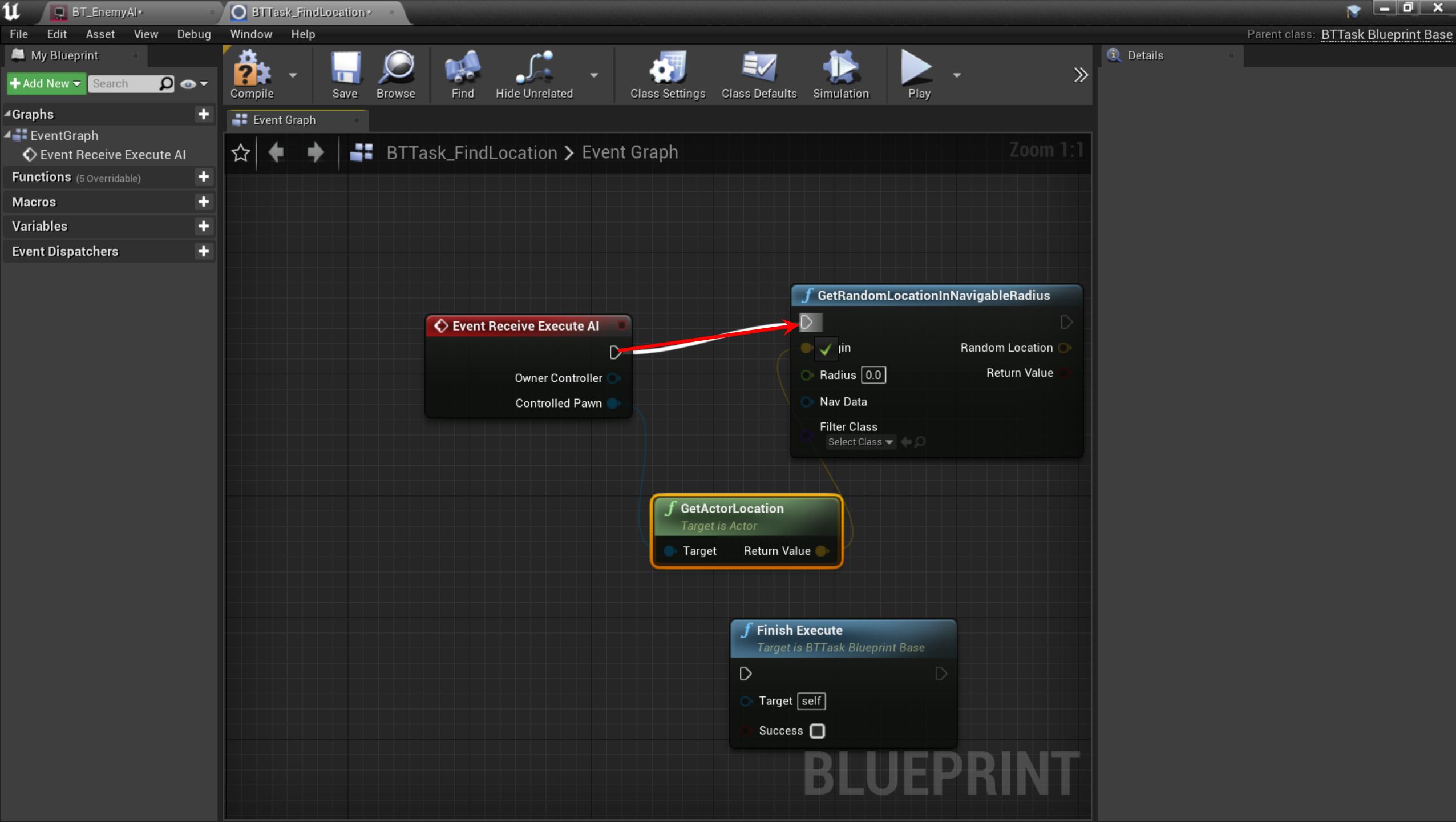


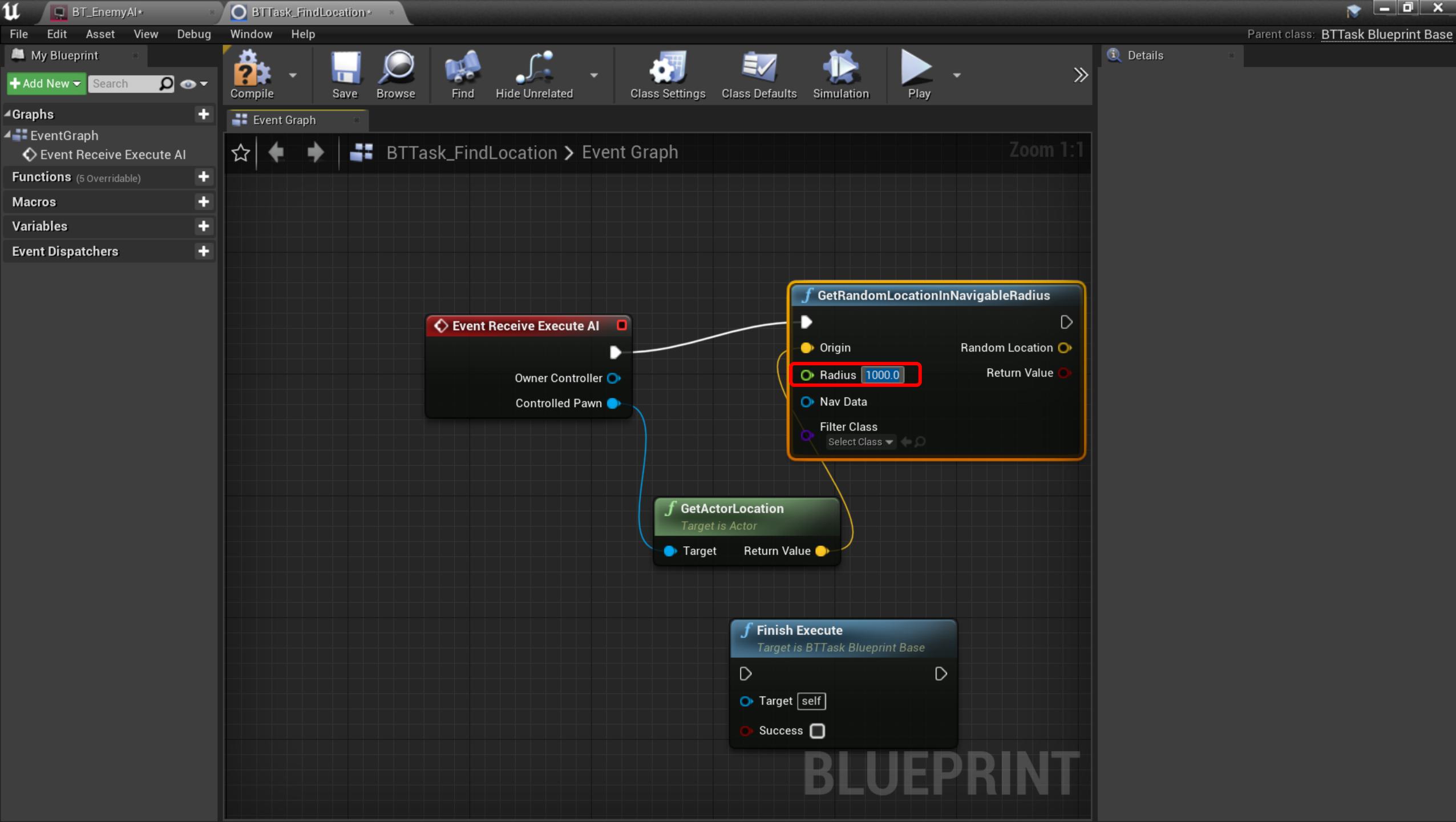


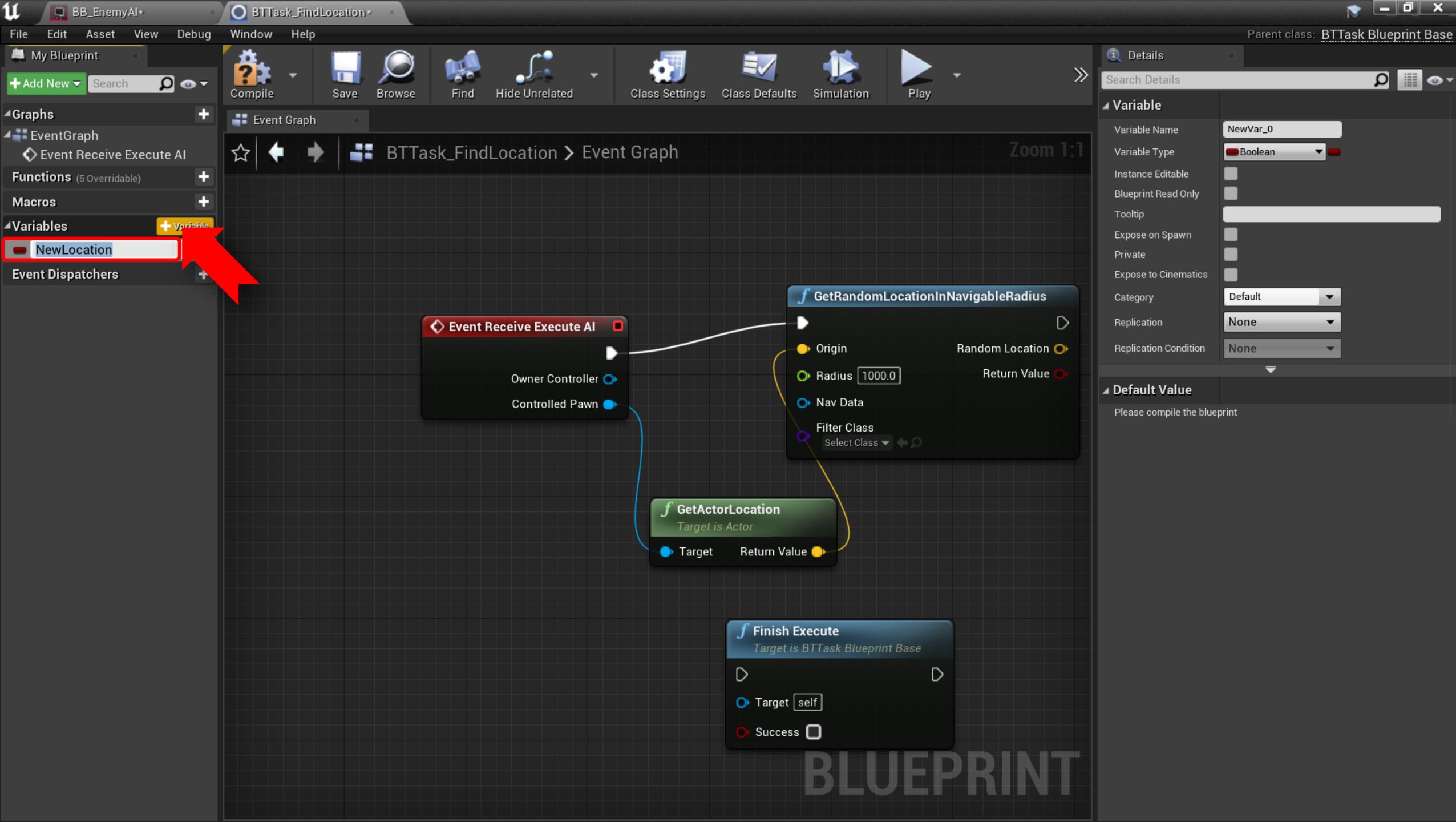


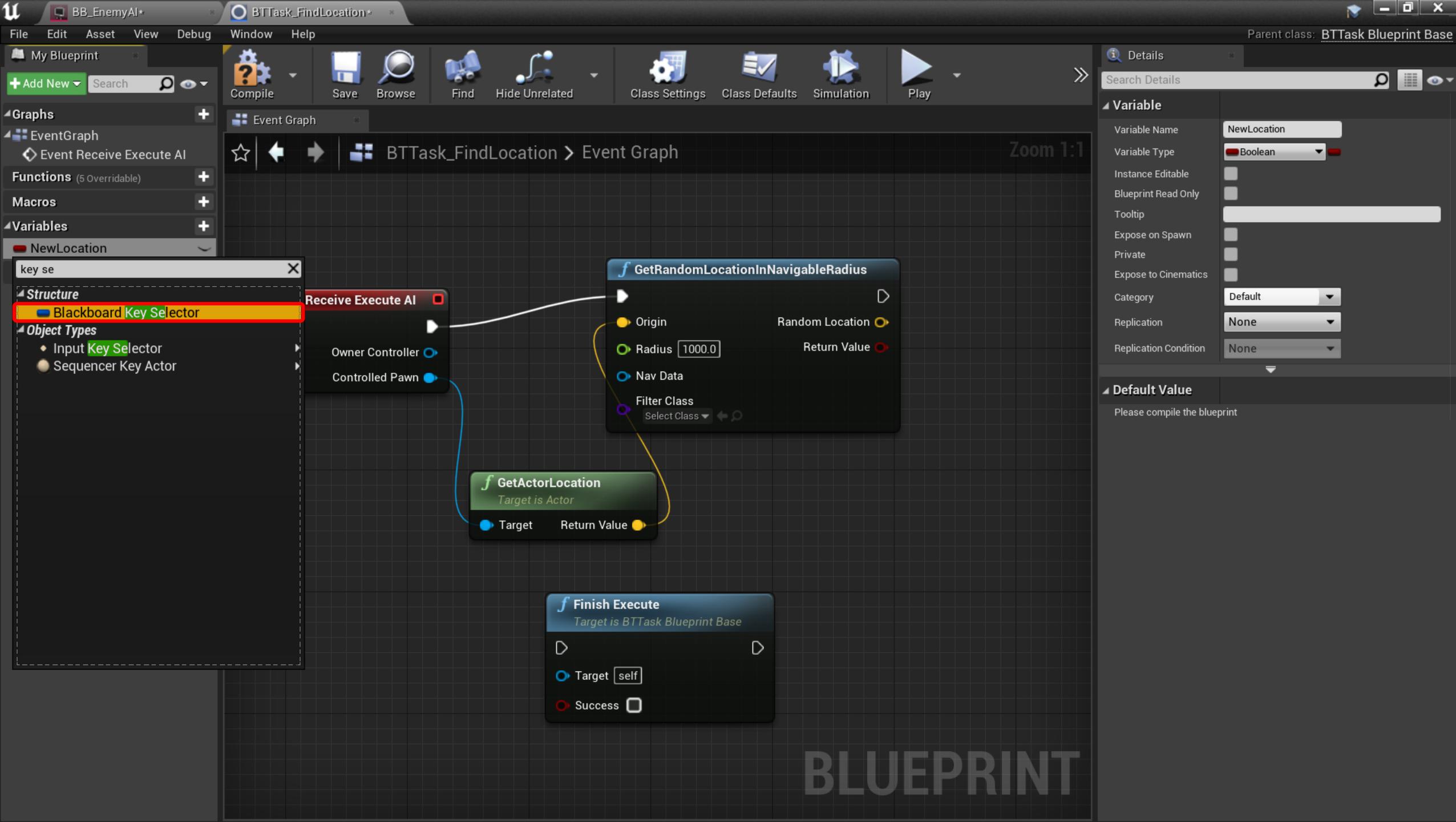


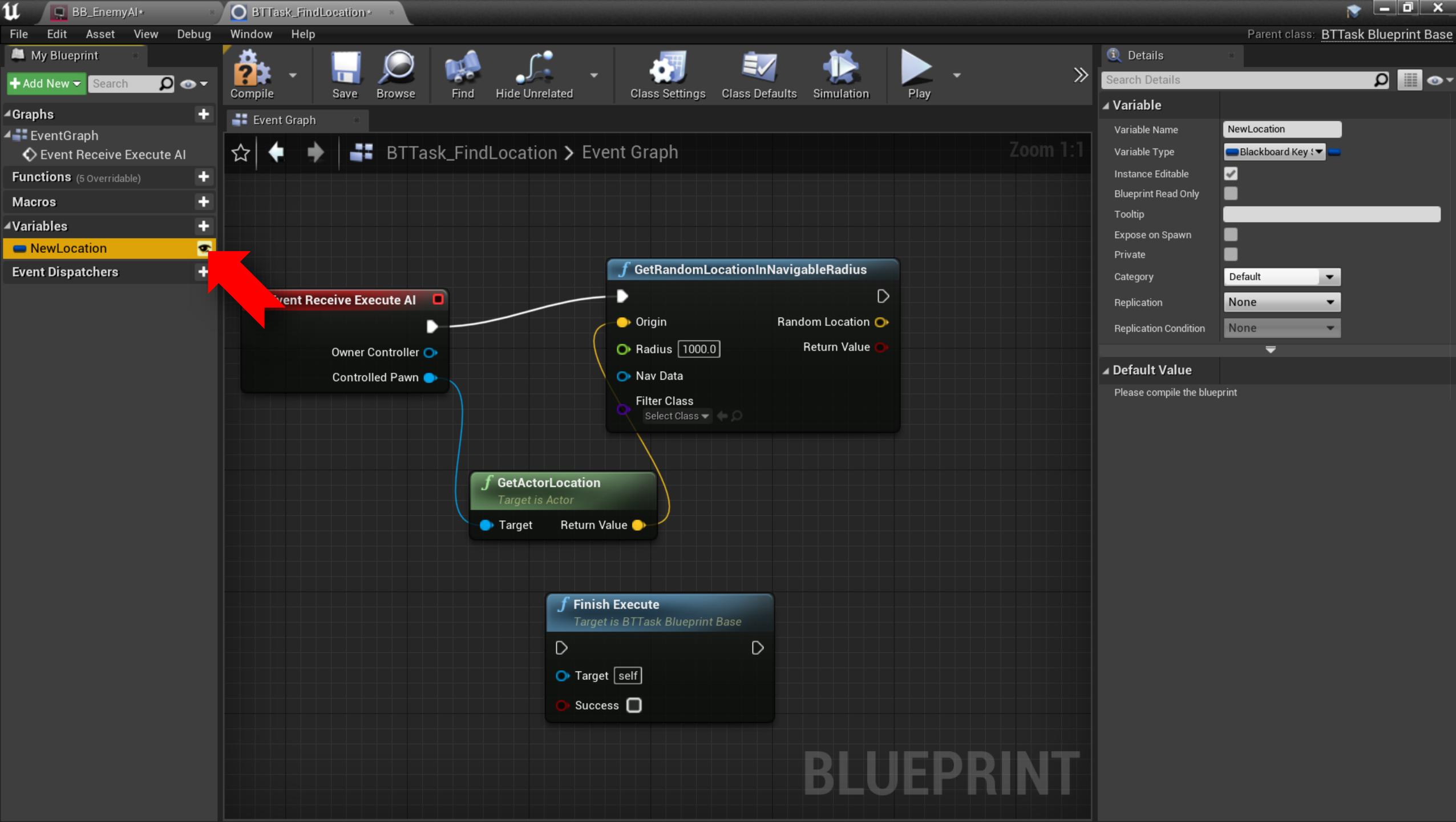


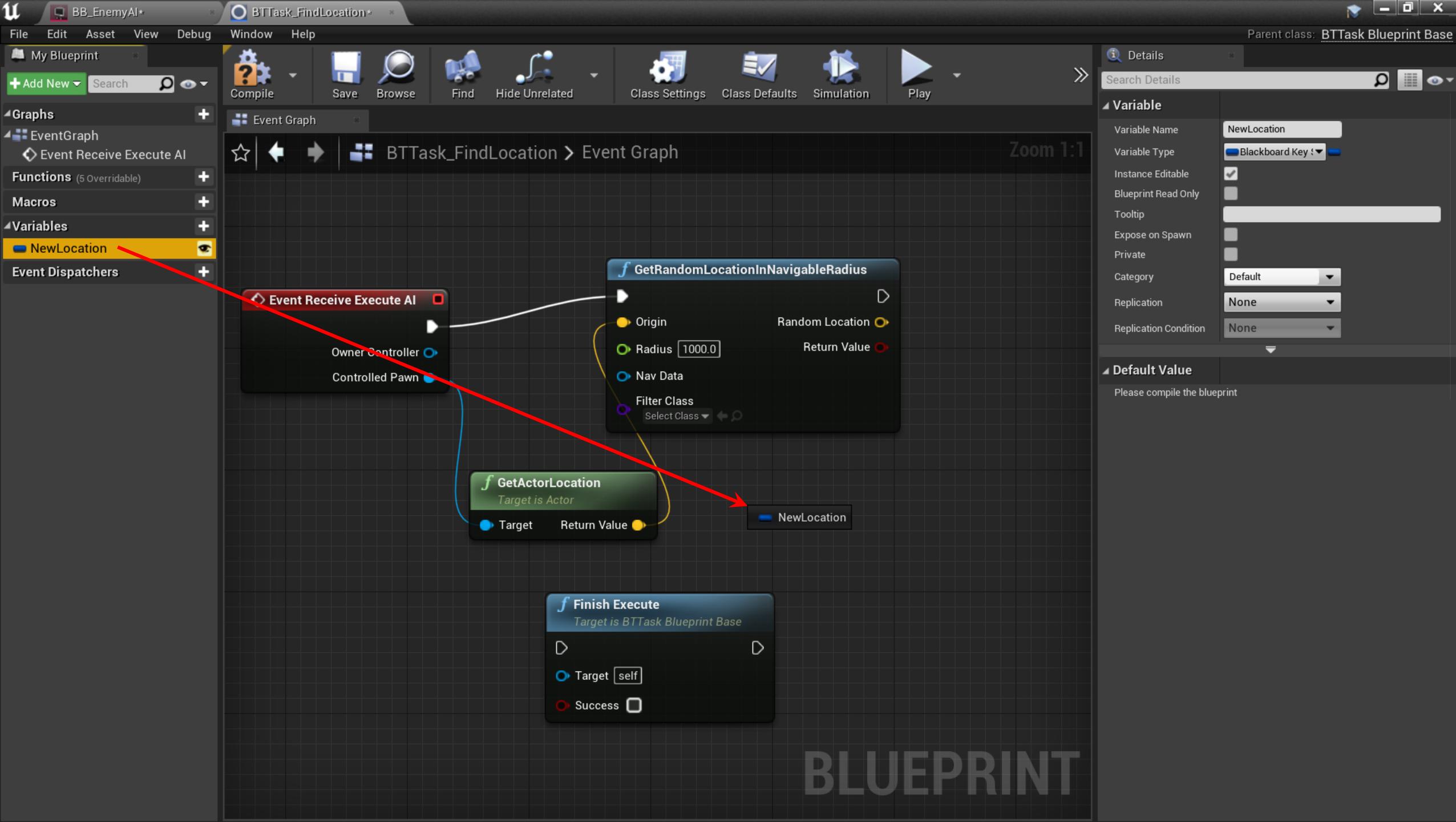


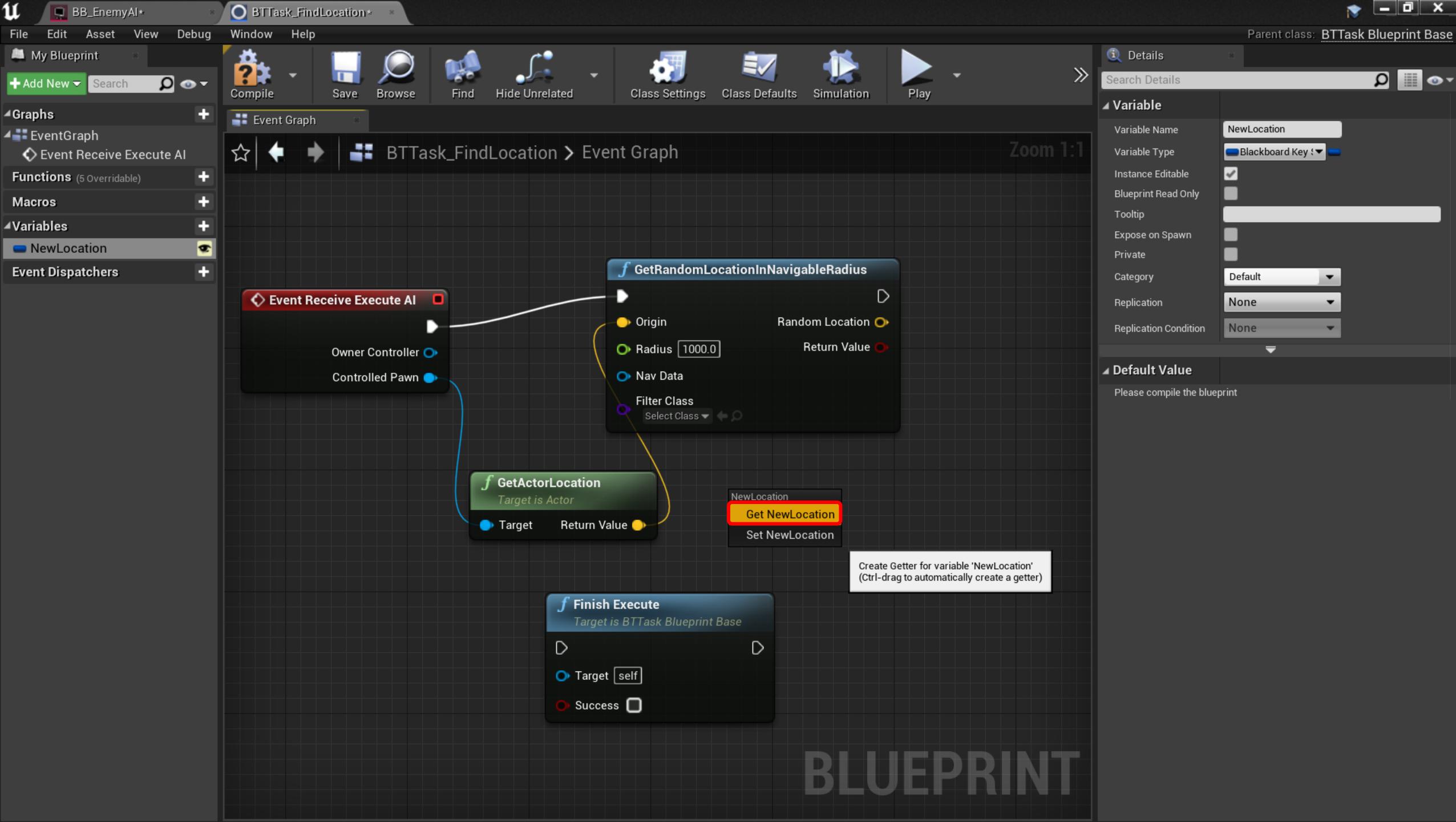


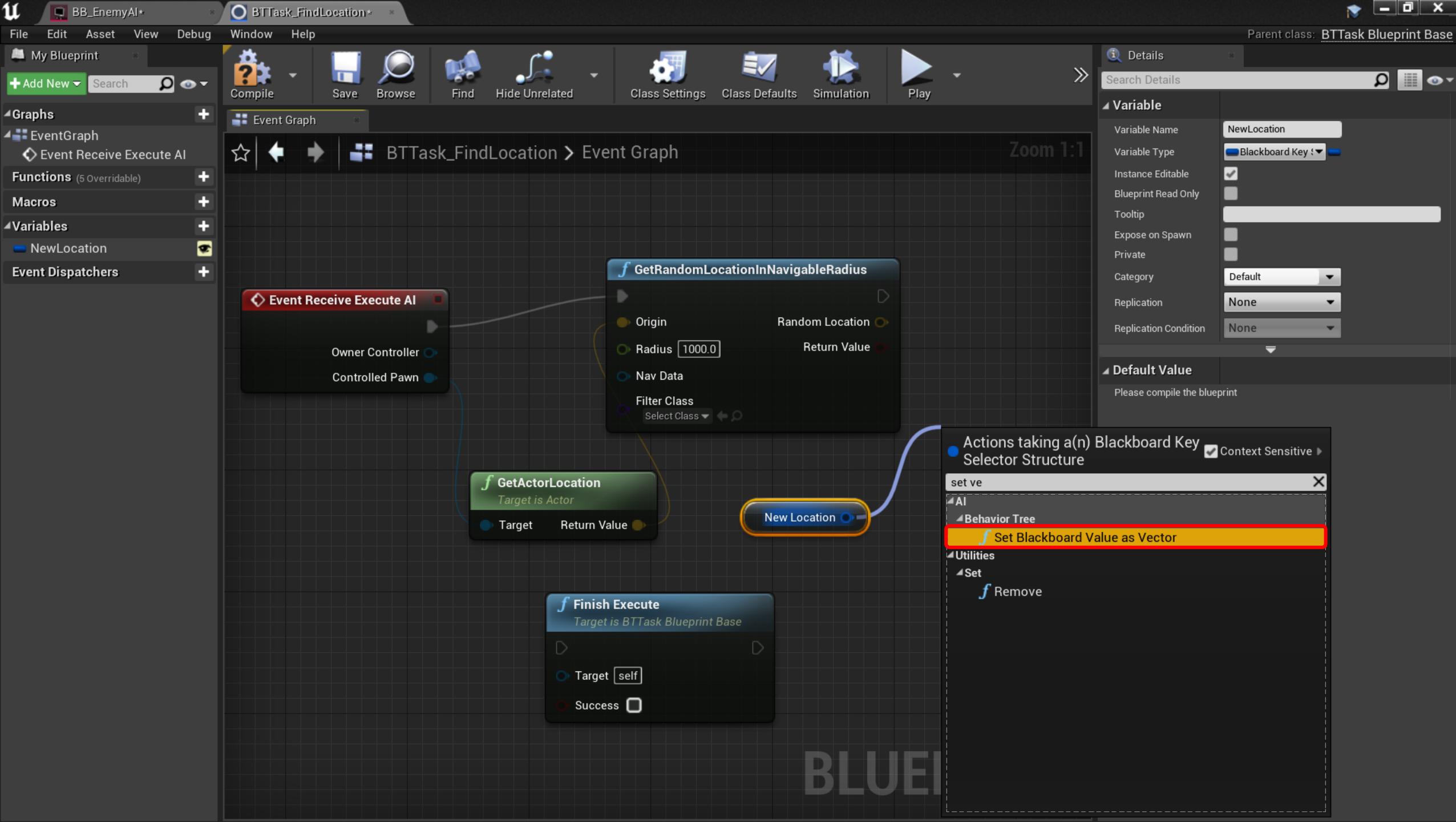


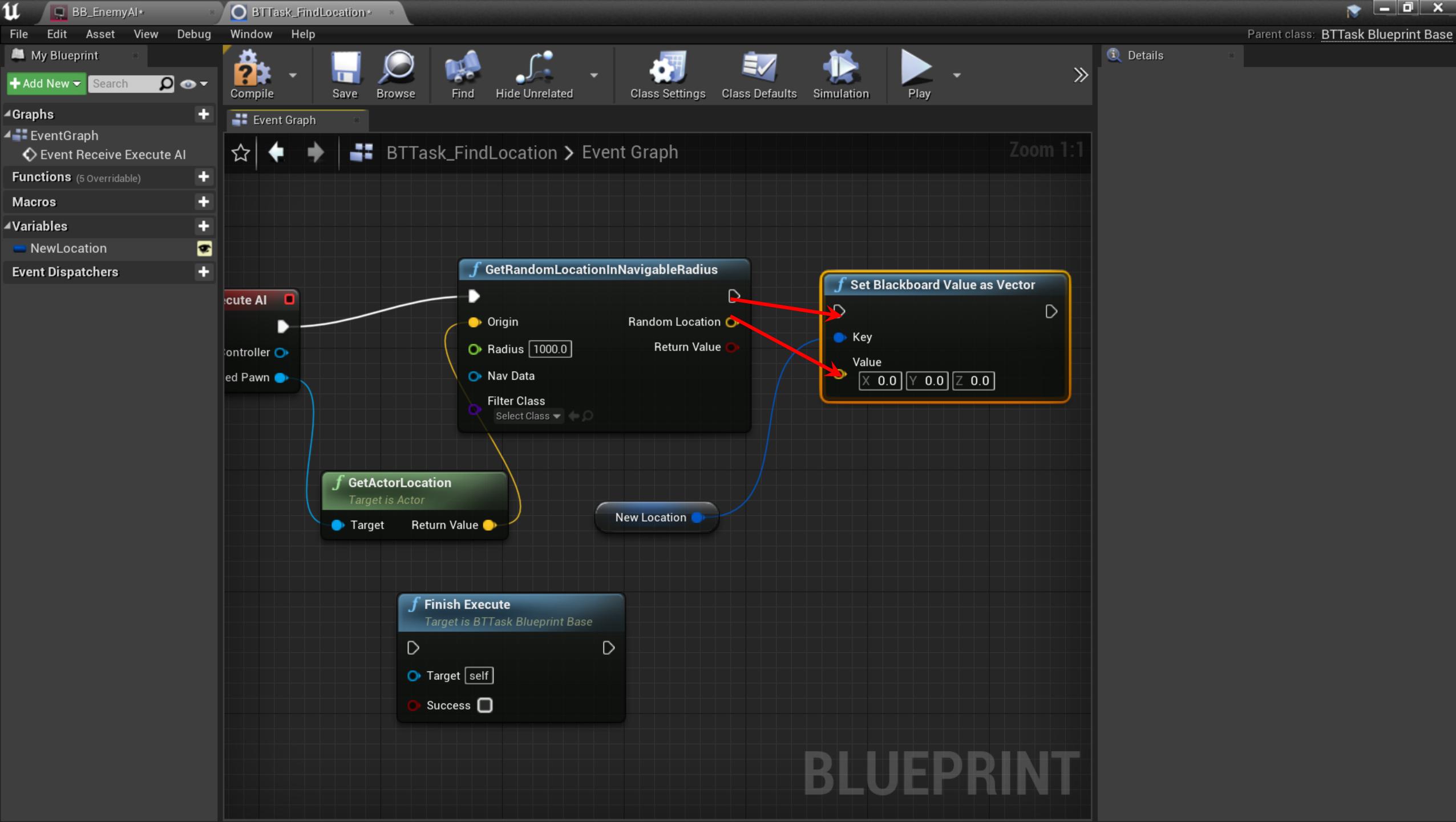


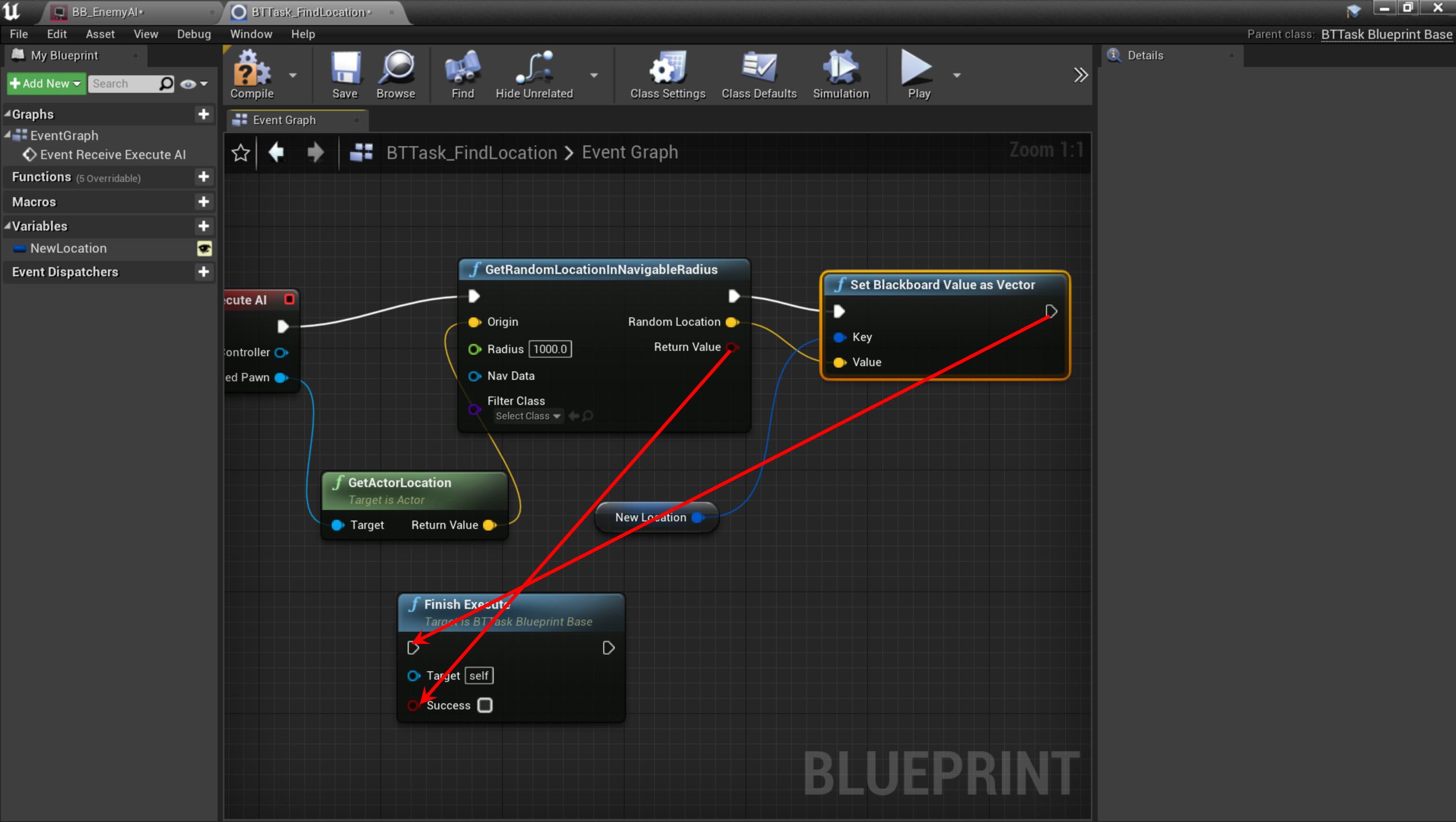


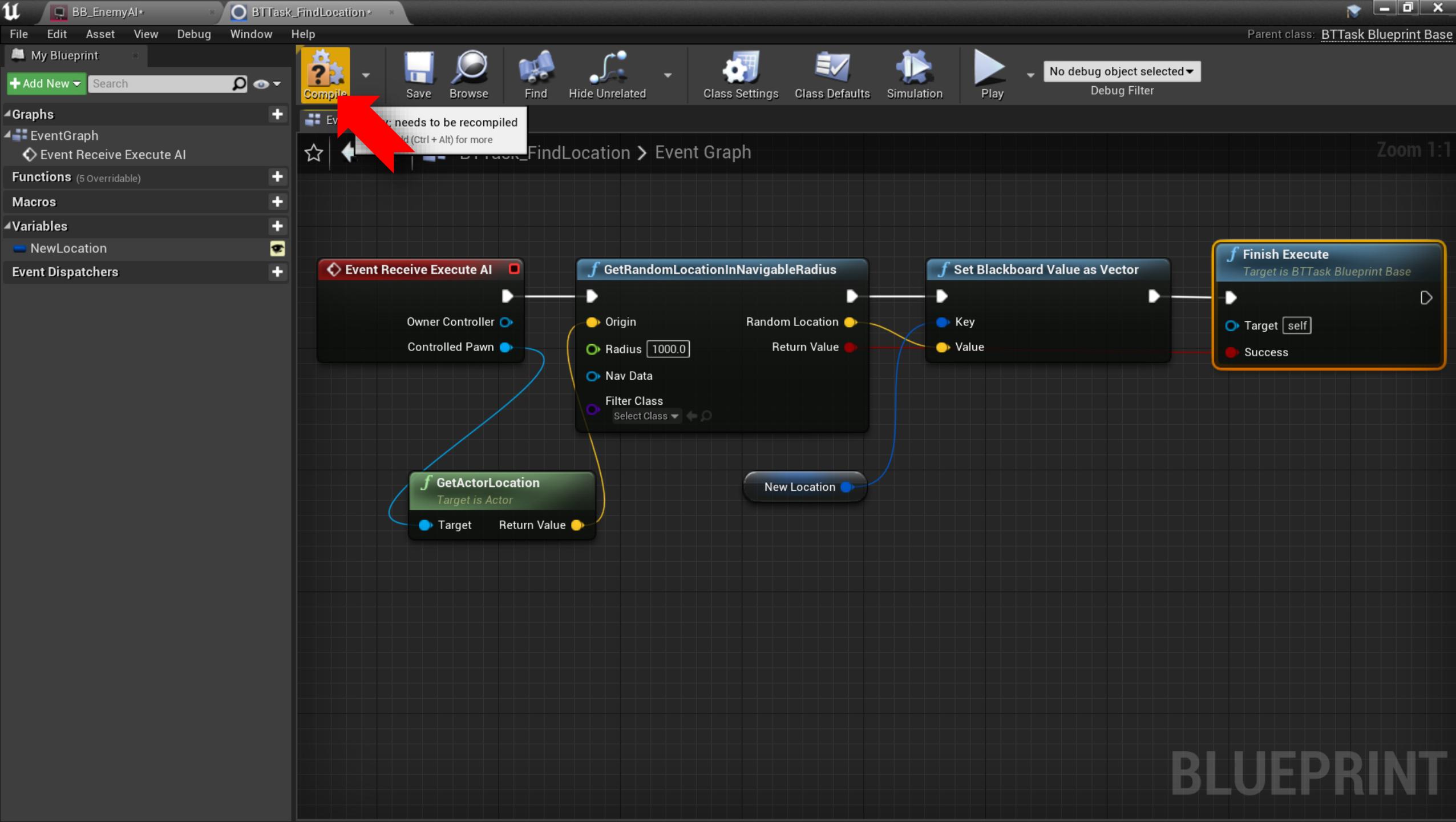






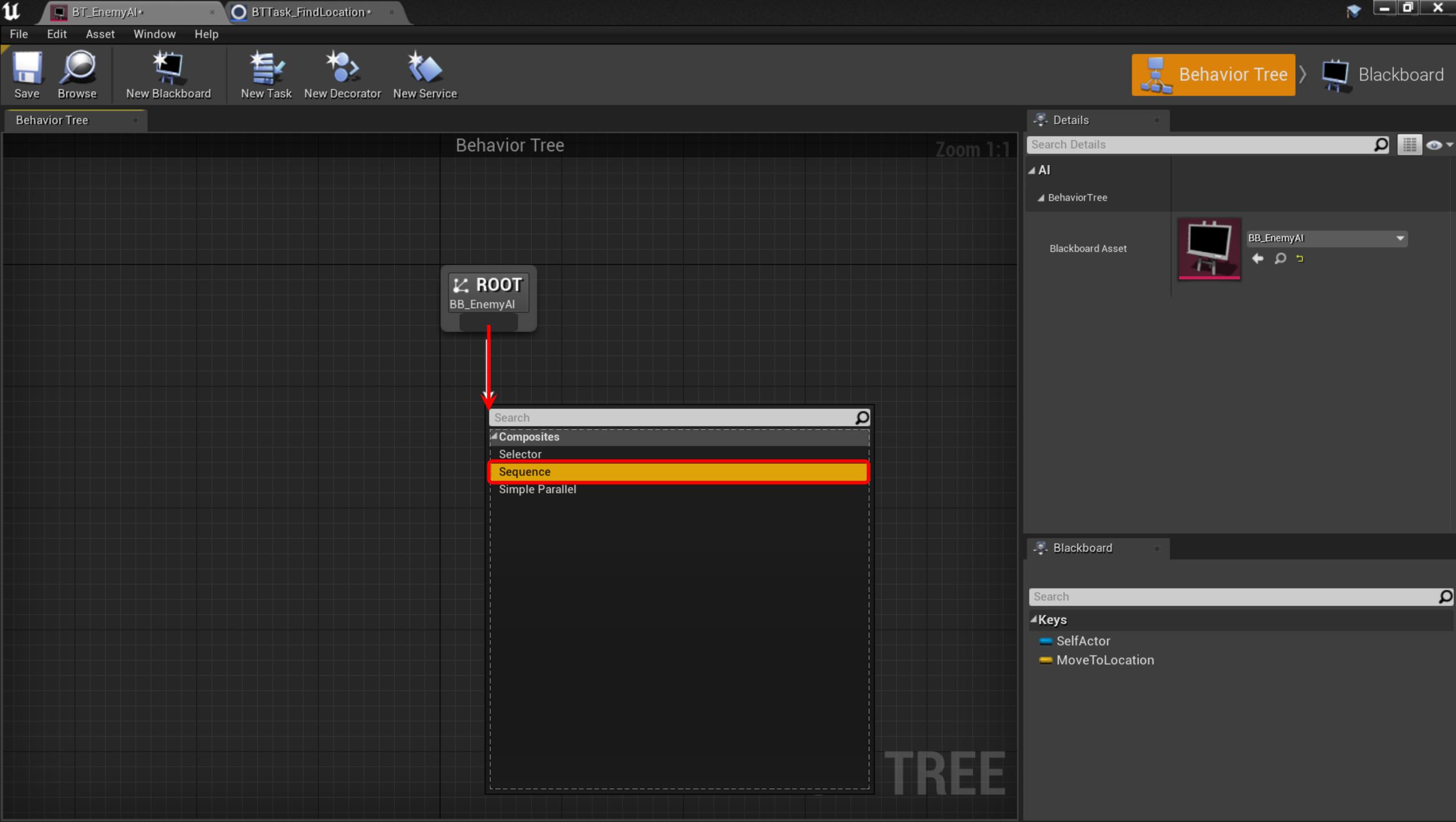


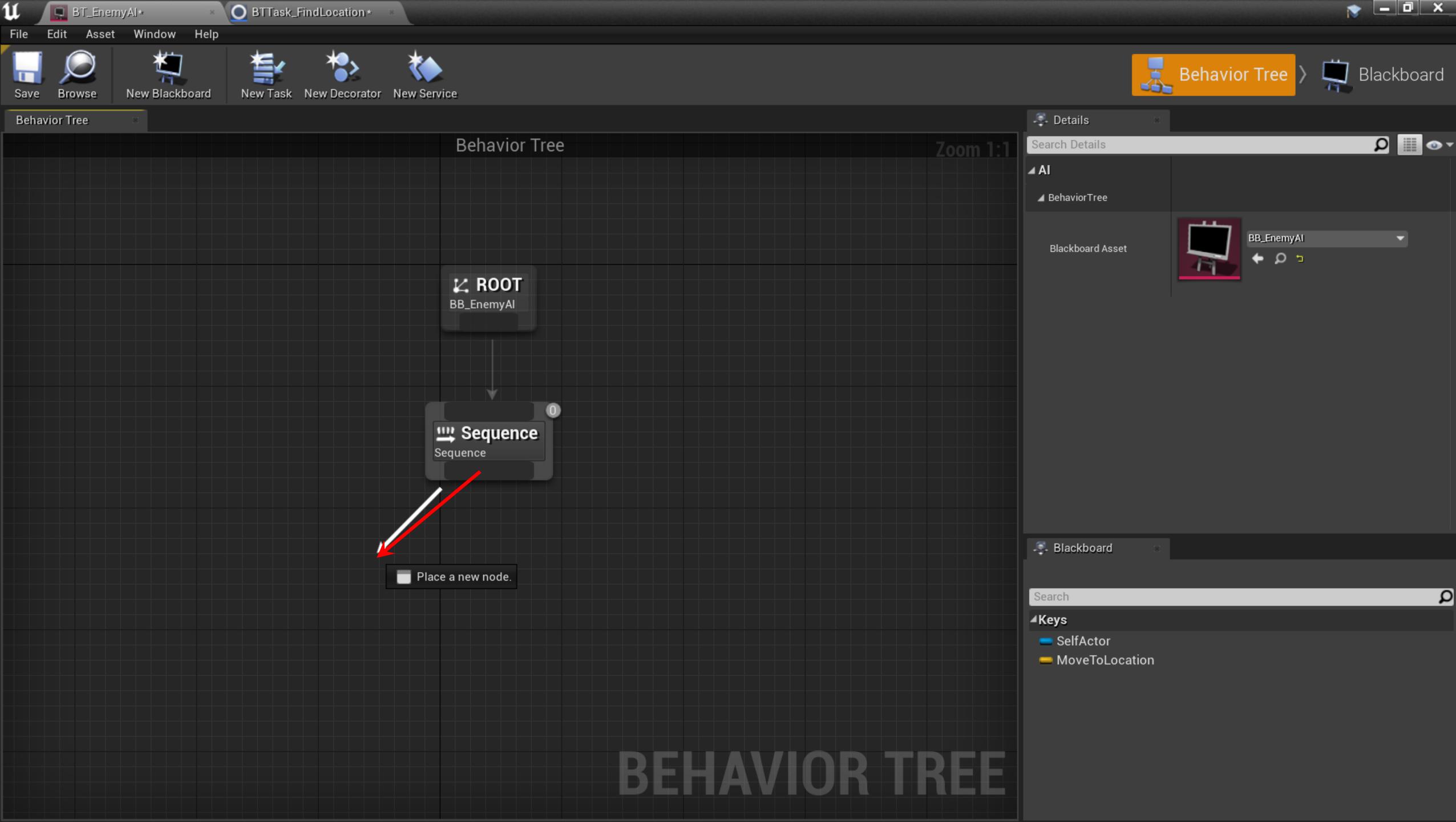




Exercise 13.06: Creating the Behavior Tree Logic







File Edit Asset Window Help

Save Browse New Blackboard New Task New Decorator New Service

Behavior Tree

Behavior Tree Blackboard

Search Details

AI BehaviorTree Blackboard Asset BB_EnemyAI

Blackboard

Search Keys SelfActor MoveToLocation

Zoom 1:1

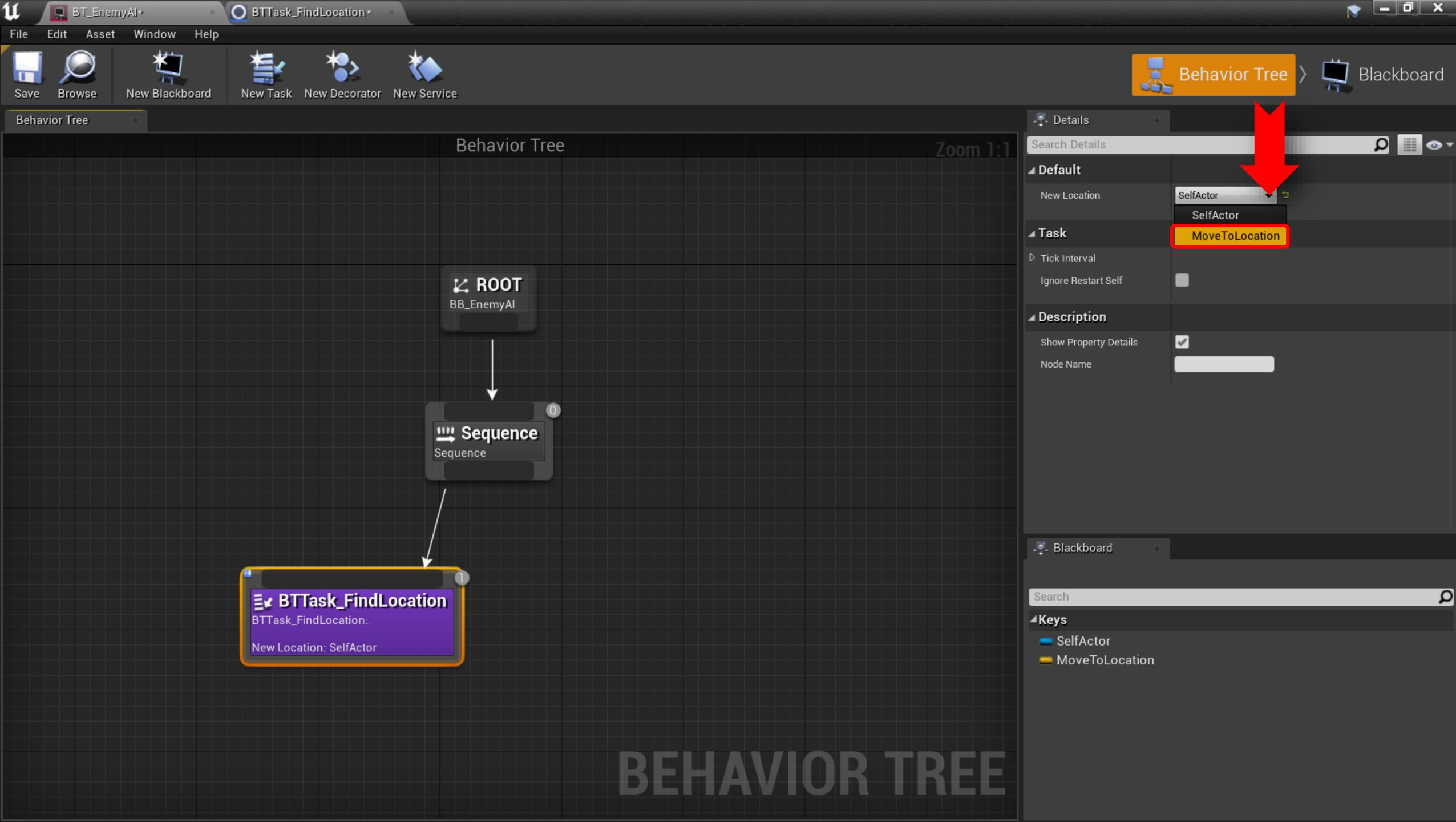
Behavior Tree

Composites Tasks

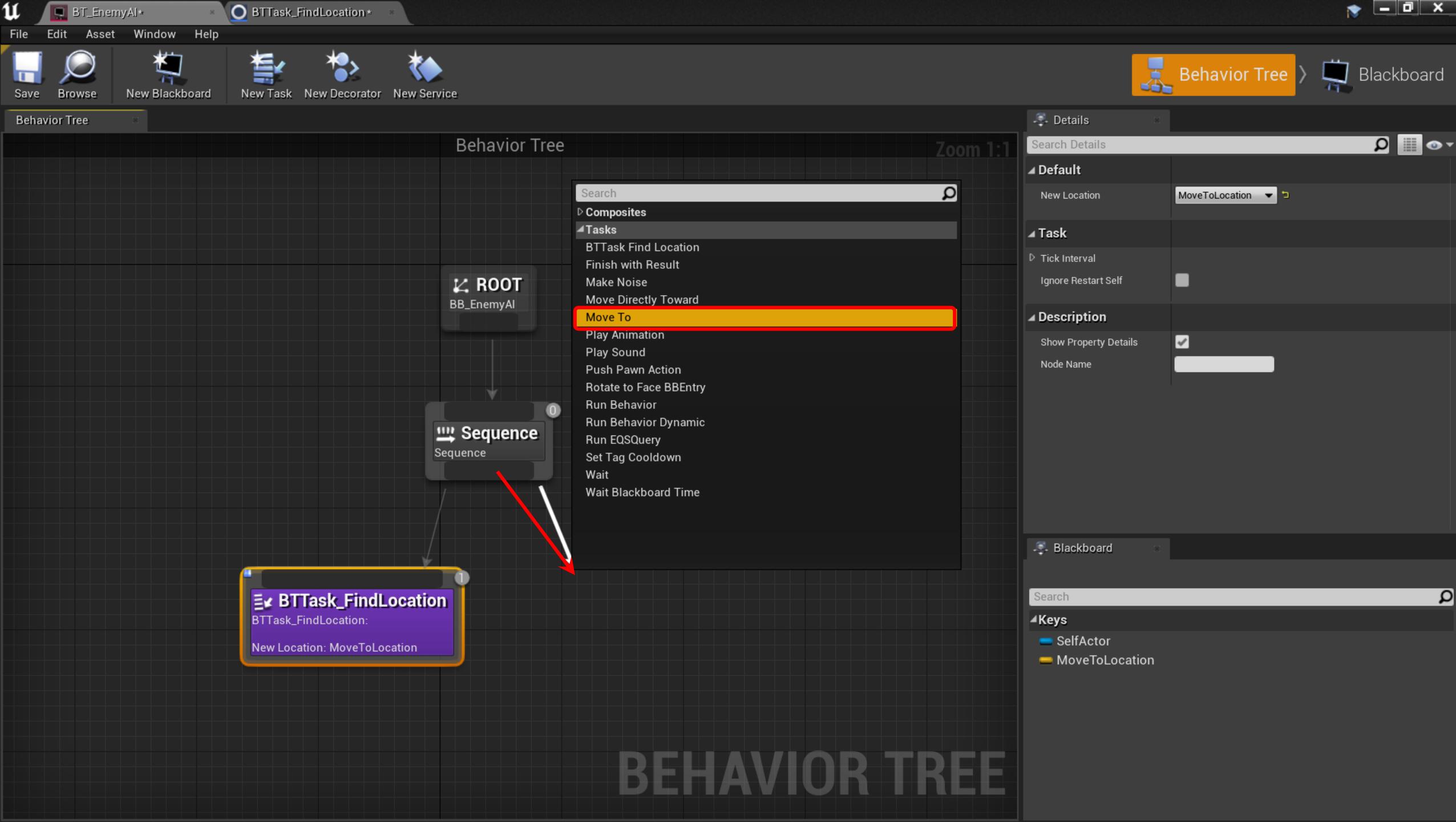
BTTTask Find Location

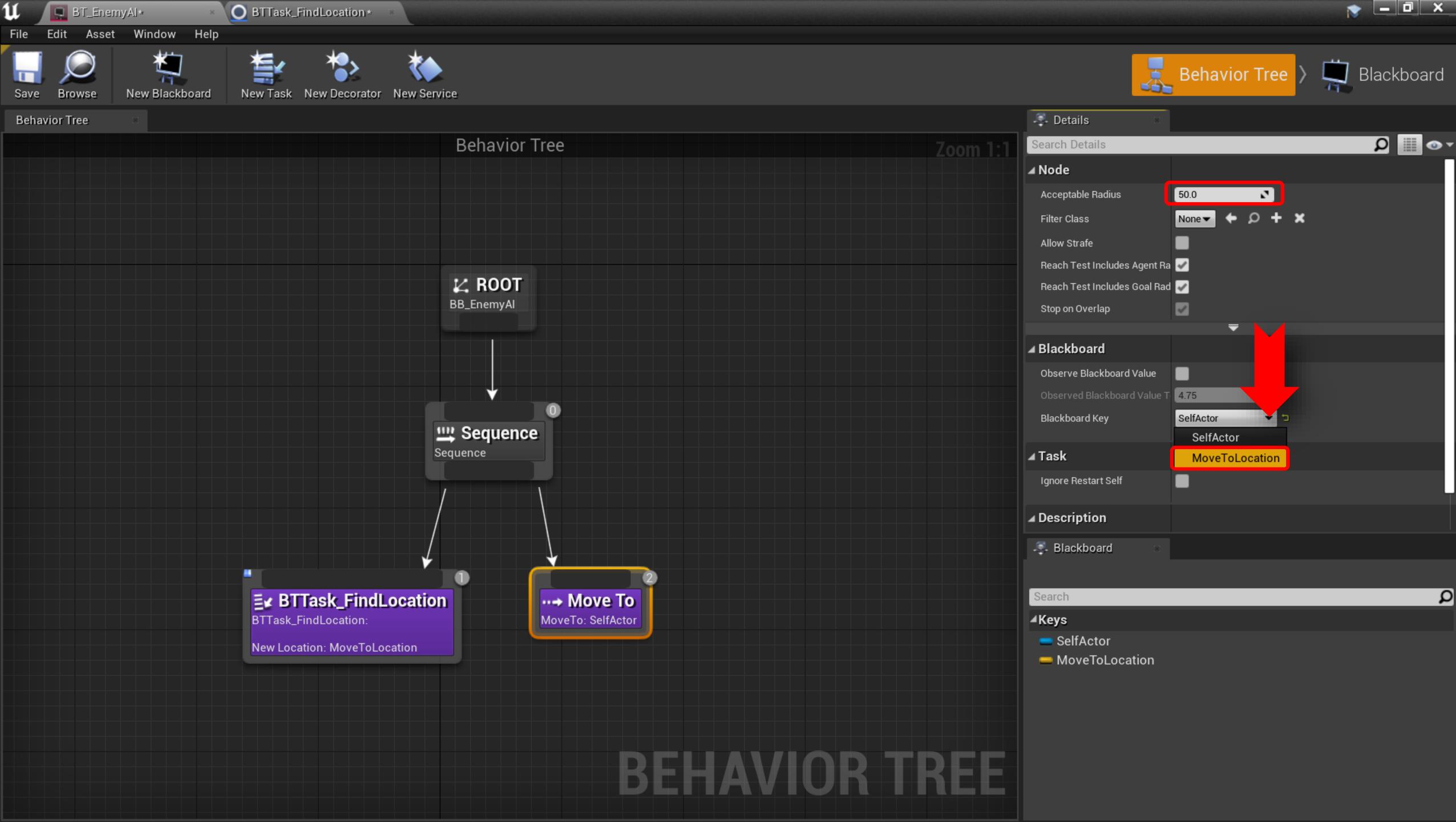
Finish with Result
Make Noise
Move Directly Toward
Move To
Play Animation
Play Sound
Push Pawn Action
Rotate to Face BBEntry
Run Behavior
Run Behavior Dynamic
Run EQSQuery
Set Tag Cooldown
Wait
Wait Blackboard Time

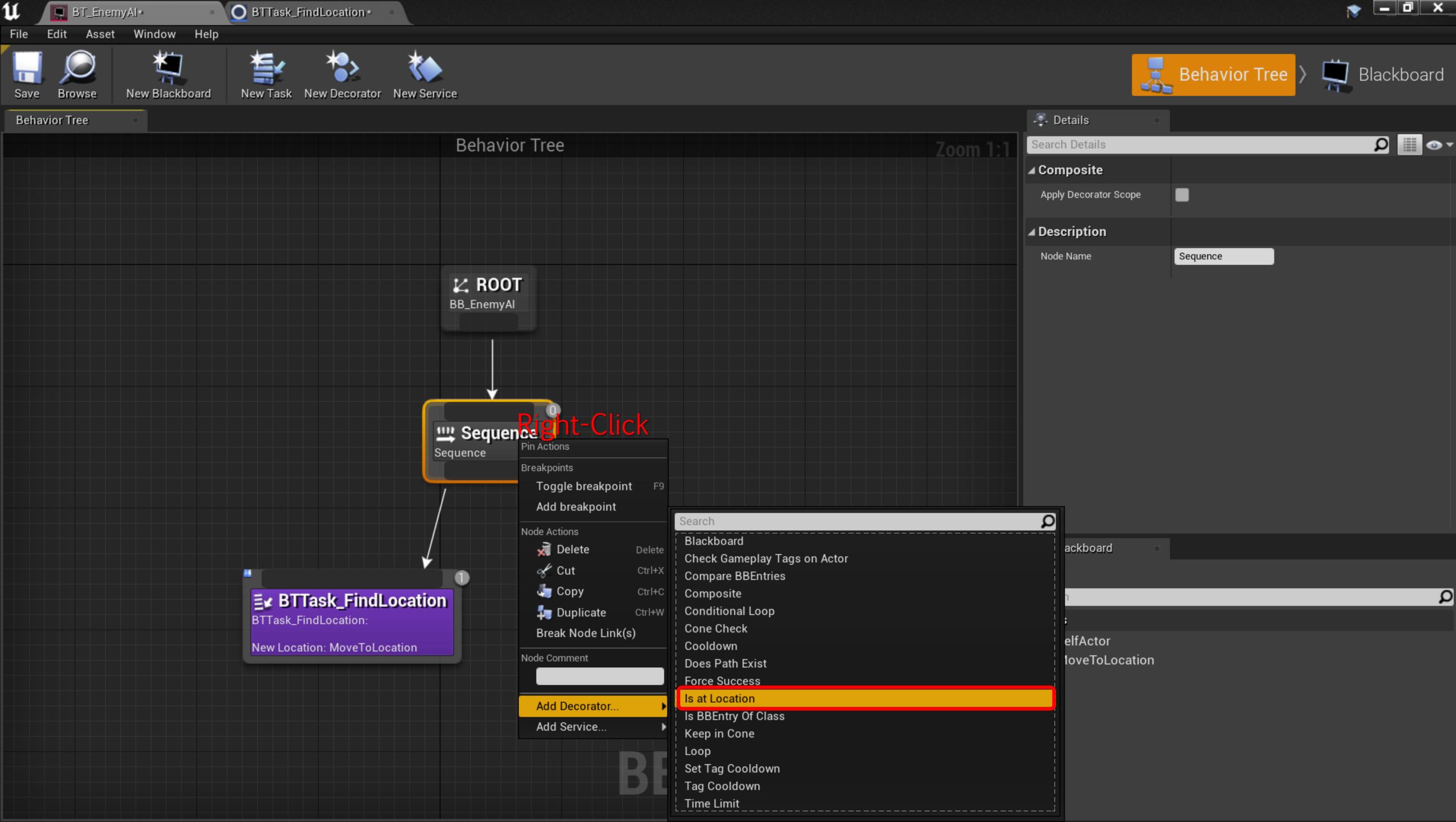
BEHAVIOR TREE

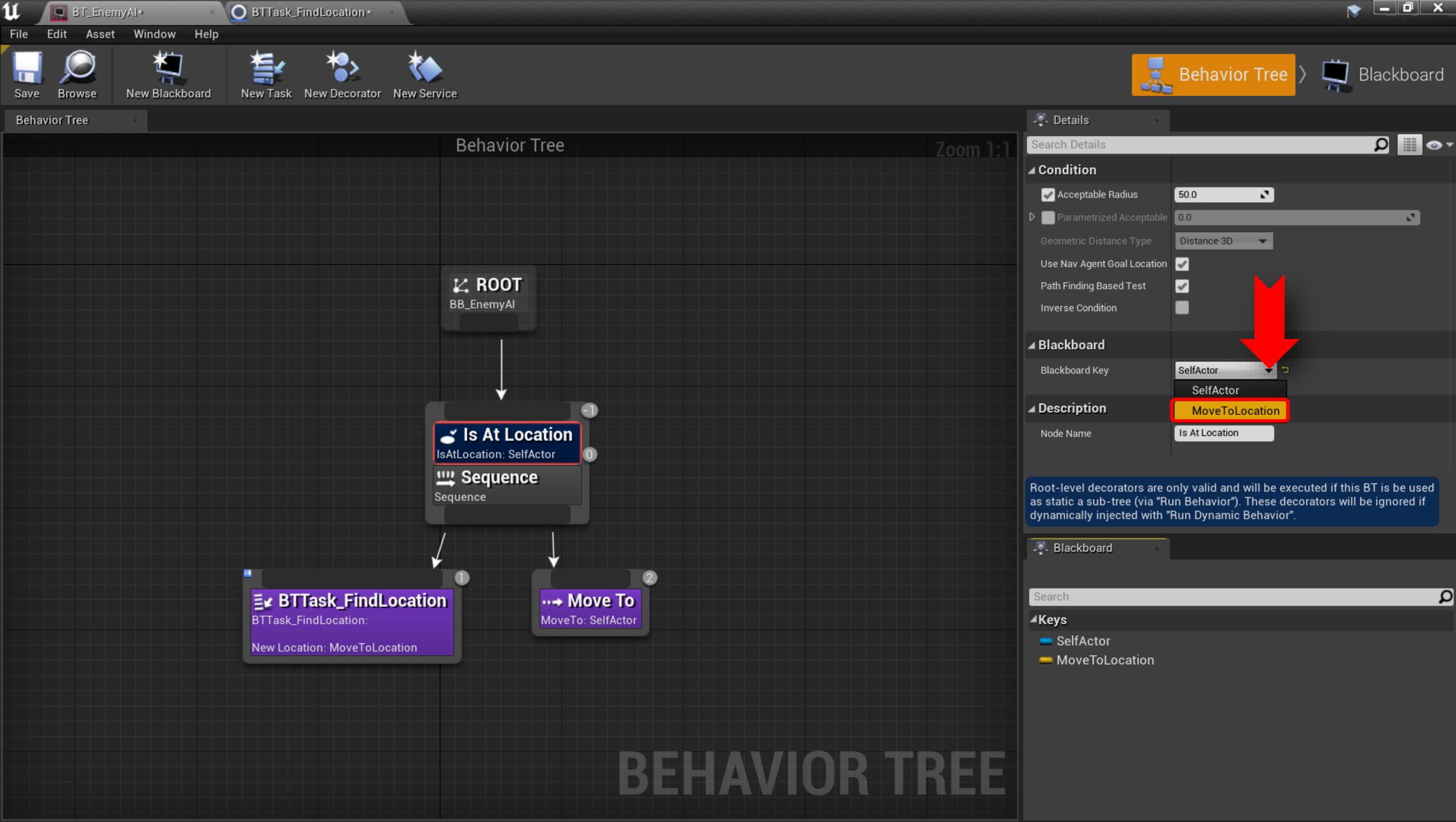


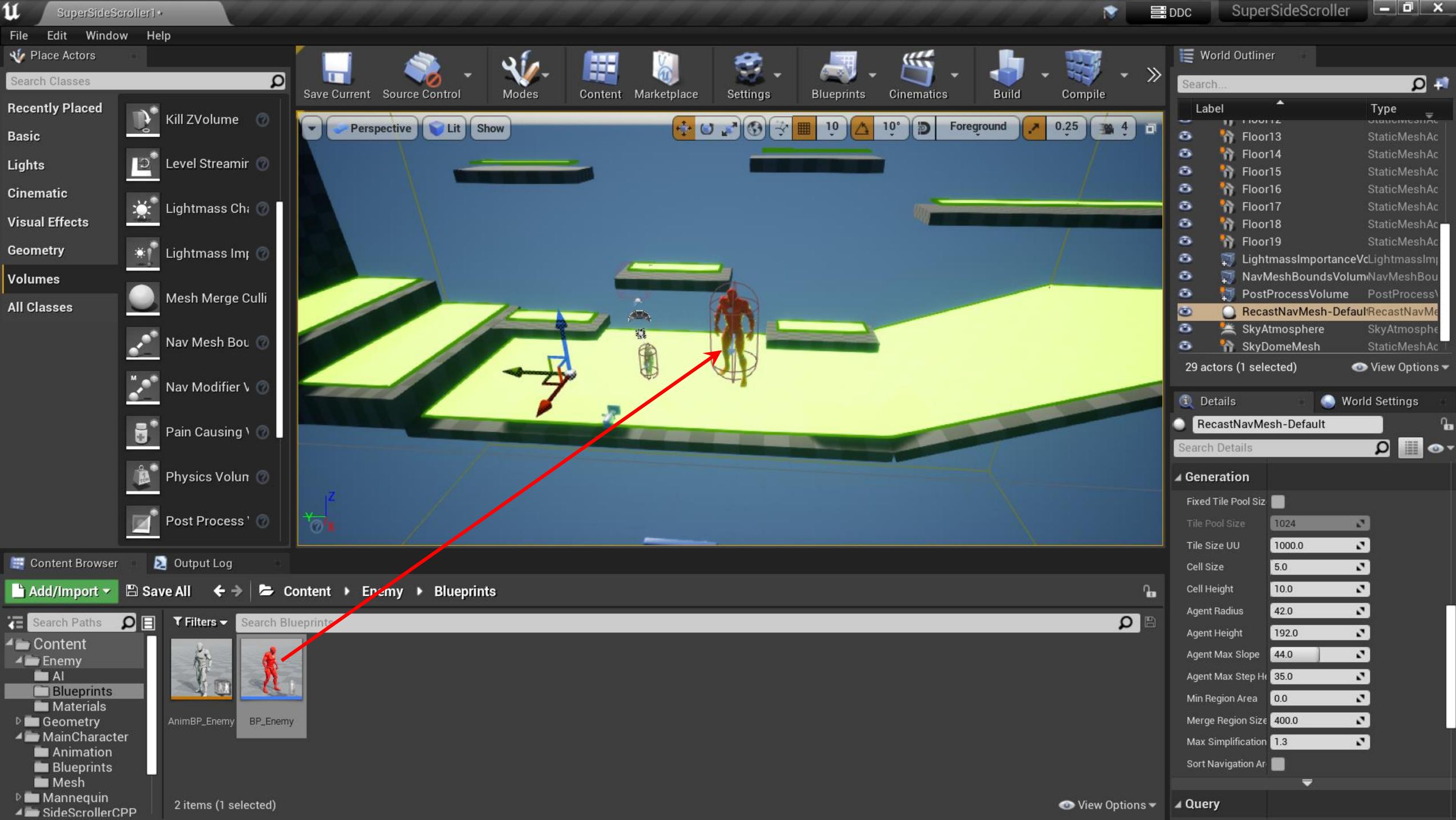
BEHAVIOR TREE

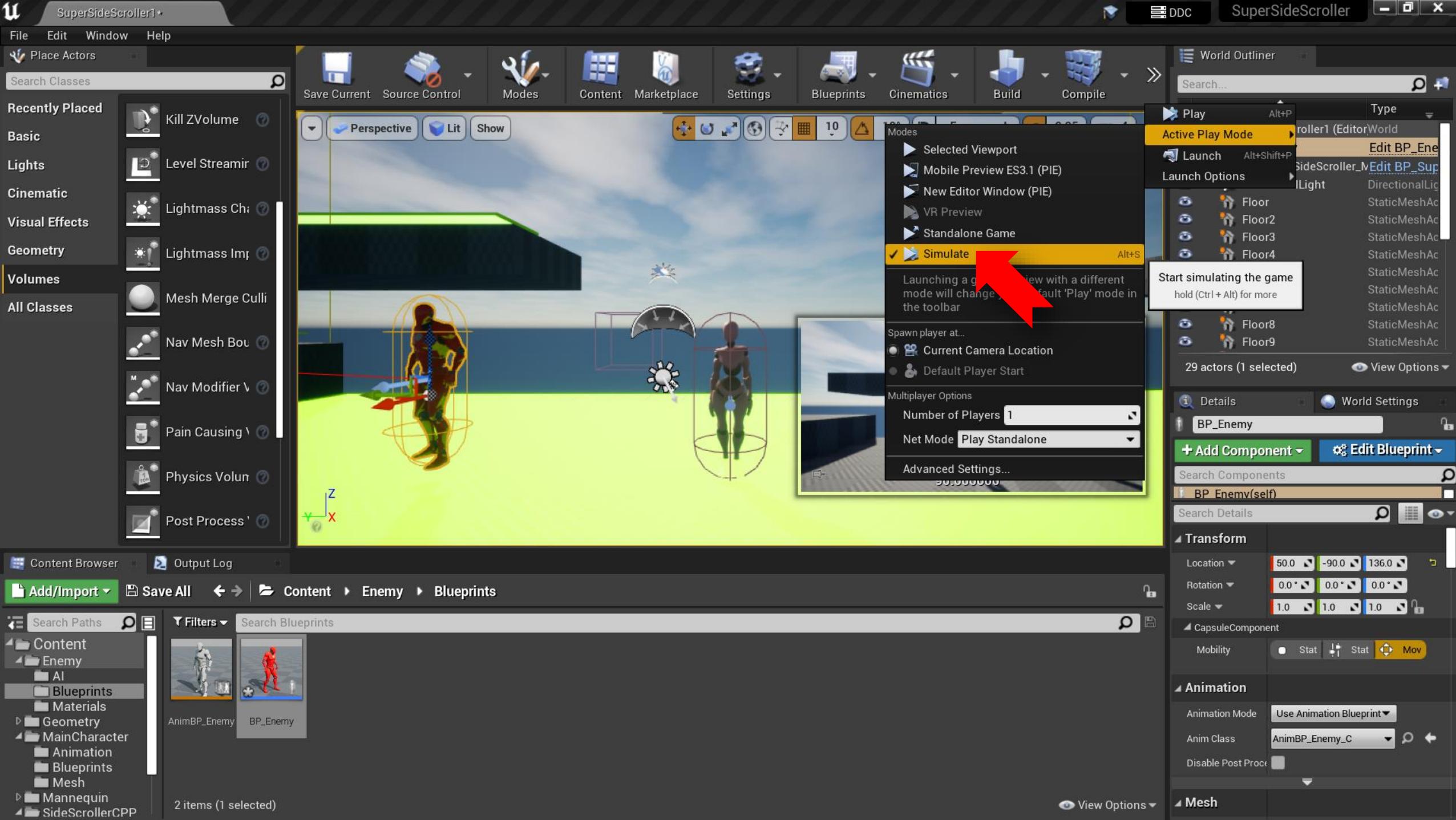


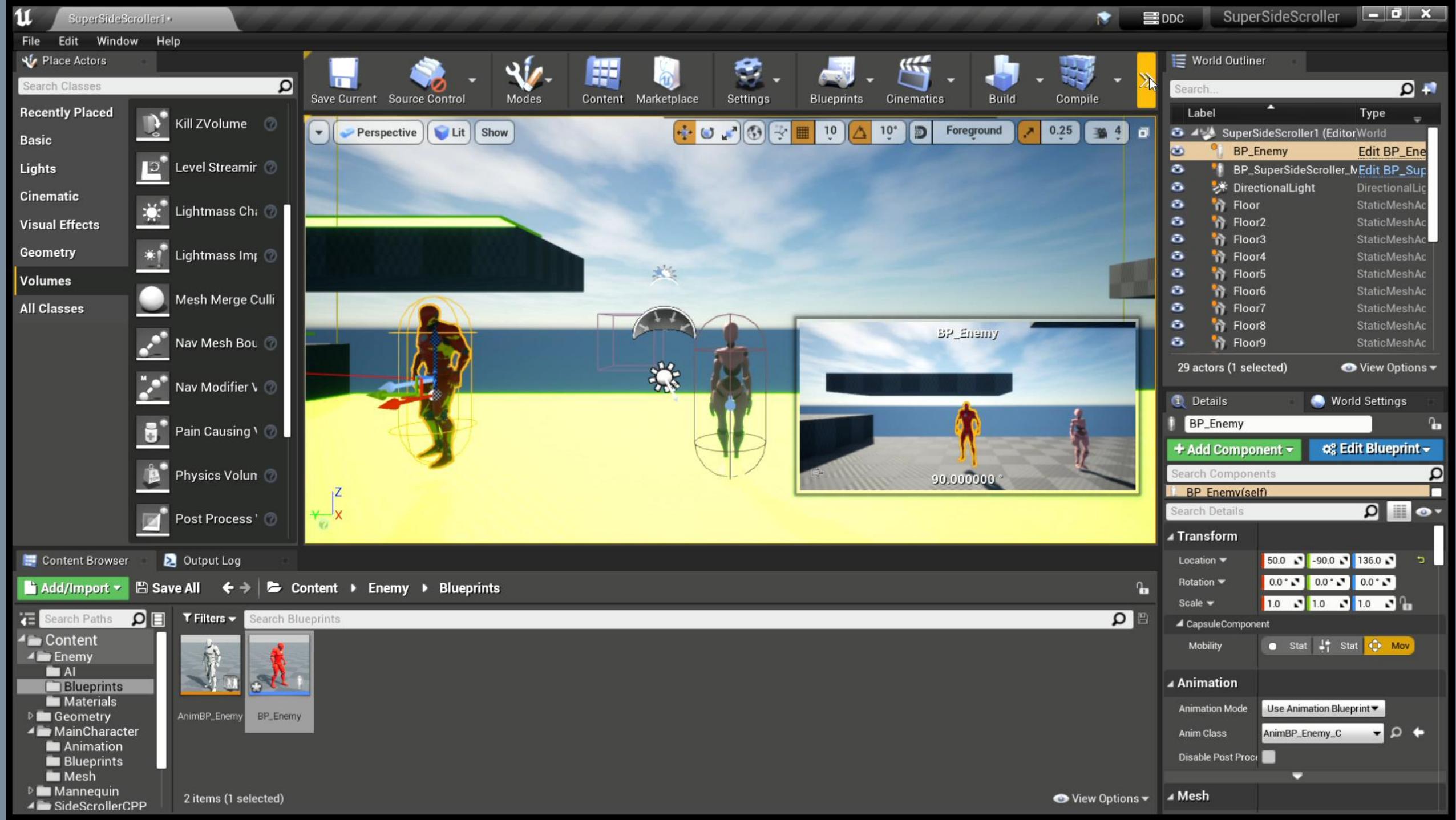














Activity 13.02: AI Moving to the Player Location

The screenshot shows the Unreal Engine Editor interface during the development of an AI system. The central viewports display a 3D scene with two humanoid characters: one in a red suit and one in a pink suit. A yellow capsule component is attached to the red character's back, representing an AI controller. A small blue dot on the ground indicates the target location. The right-hand panel, the Details View, shows the component properties for the selected 'BP_Enemy' actor. The Transform section lists Location (50.0, -90.0, 136.0), Rotation (0.0°, 0.0°, 0.0°), and Scale (1.0, 1.0, 1.0). The CapsuleComponent section includes Mobility settings (Stat, Stat, Mov). The Animation section specifies 'Use Animation Blueprint' and 'Anim Class AnimBP_Enemy_C'. The Mesh section is currently collapsed. The Content Browser at the bottom left lists assets like 'BB_EnemyAI', 'BP_AIController', 'BP_EnemyAI', and 'BTTask_Find_Location', with a red arrow pointing to the 'BTTask_Find_Location' icon.

Cinematic
Visual Effects
Geometry
Volumes
All Classes

Lightmass Ch:
Lightmass Imp:
Mesh Merge Culli
Nav Mesh Bou:
Nav Modifier V:
Pain Causing V:
Physics Volu:
Post Process

Content Browser Output Log

Add/Import Save All Content > Enemy > AI

Search Paths Filters Search AI

Content
Enemy
AI
Blueprints
Materials
Geometry
MainCharacter
Animation
Blueprints
Mesh
Mannequin
SideScrollerCPP

BB_EnemyAI BP_AIController BP_EnemyAI BTTask_Find_Location

4 items (1 selected)

DirectionalLight
Floor
Floor2
Floor3
Floor4
Floor5
Floor6
Floor7
Floor8
Floor9

29 actors (1 selected) View Options

Details World Settings

+ Add Component Edit Blueprint

Search Components

BP_Enemy(self)

Search Details

Transform

Location: 50.0, -90.0, 136.0
Rotation: 0.0°, 0.0°, 0.0°
Scale: 1.0, 1.0, 1.0

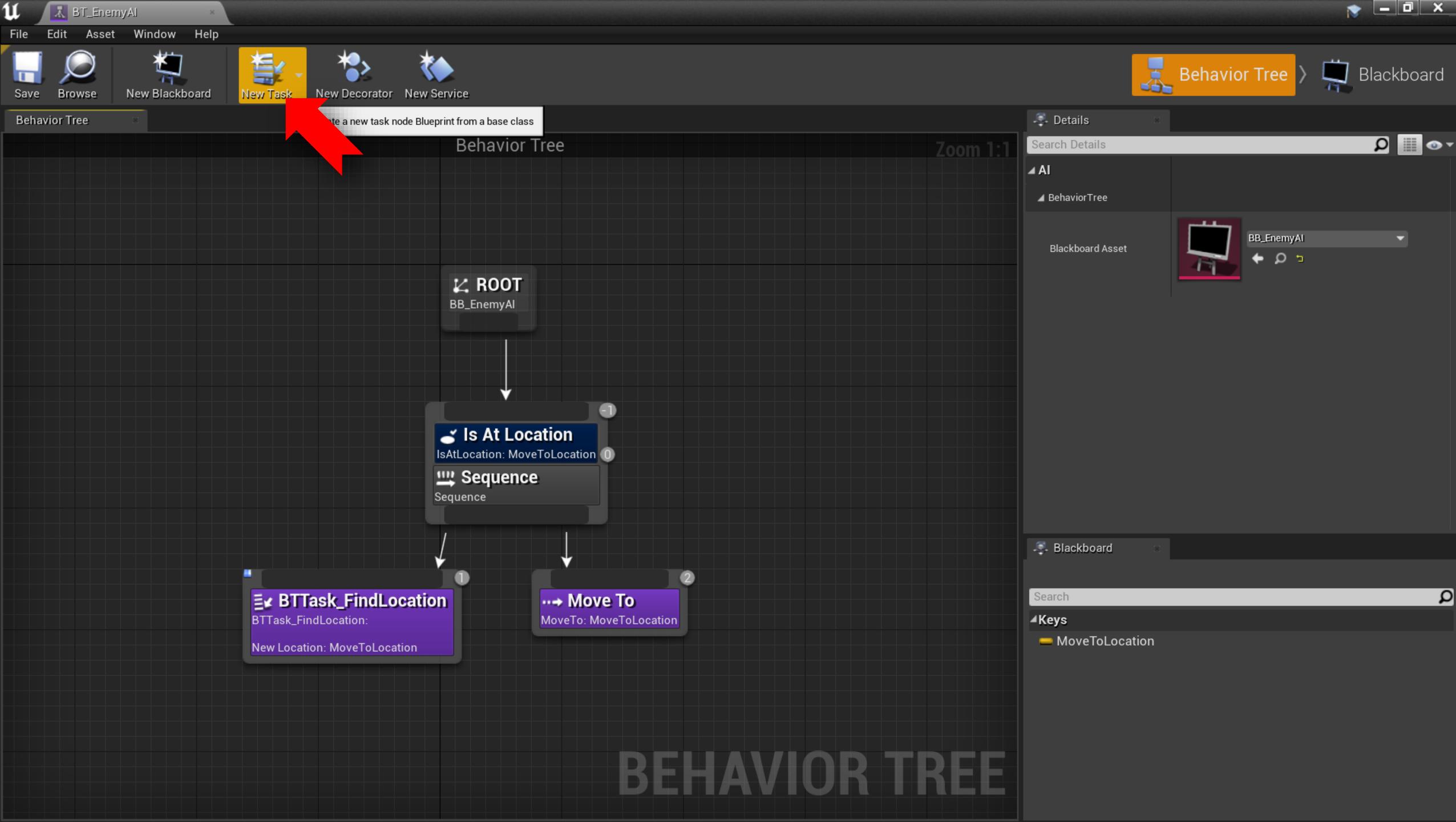
CapsuleComponent

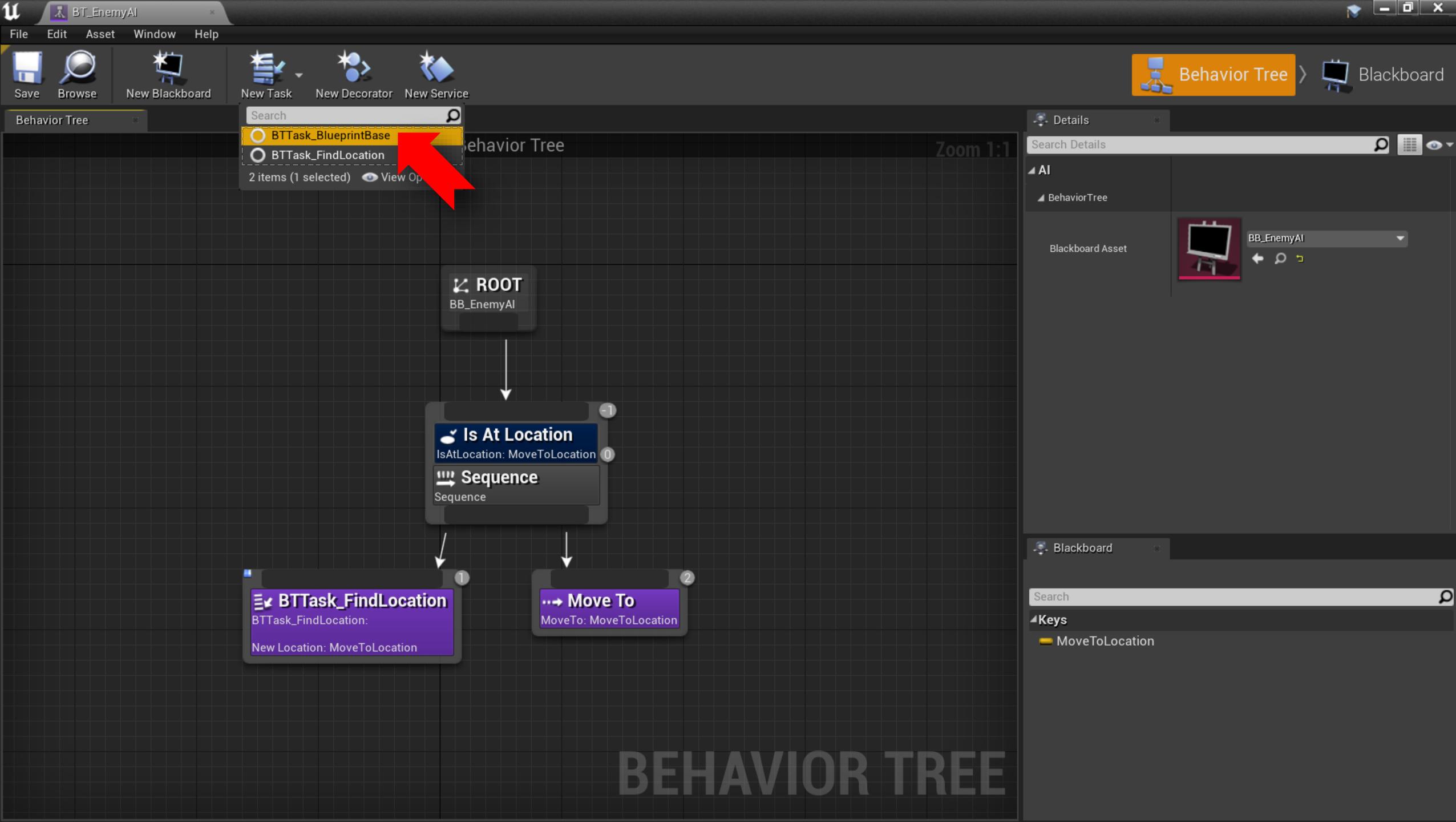
Mobility: Stat, Stat, Mov

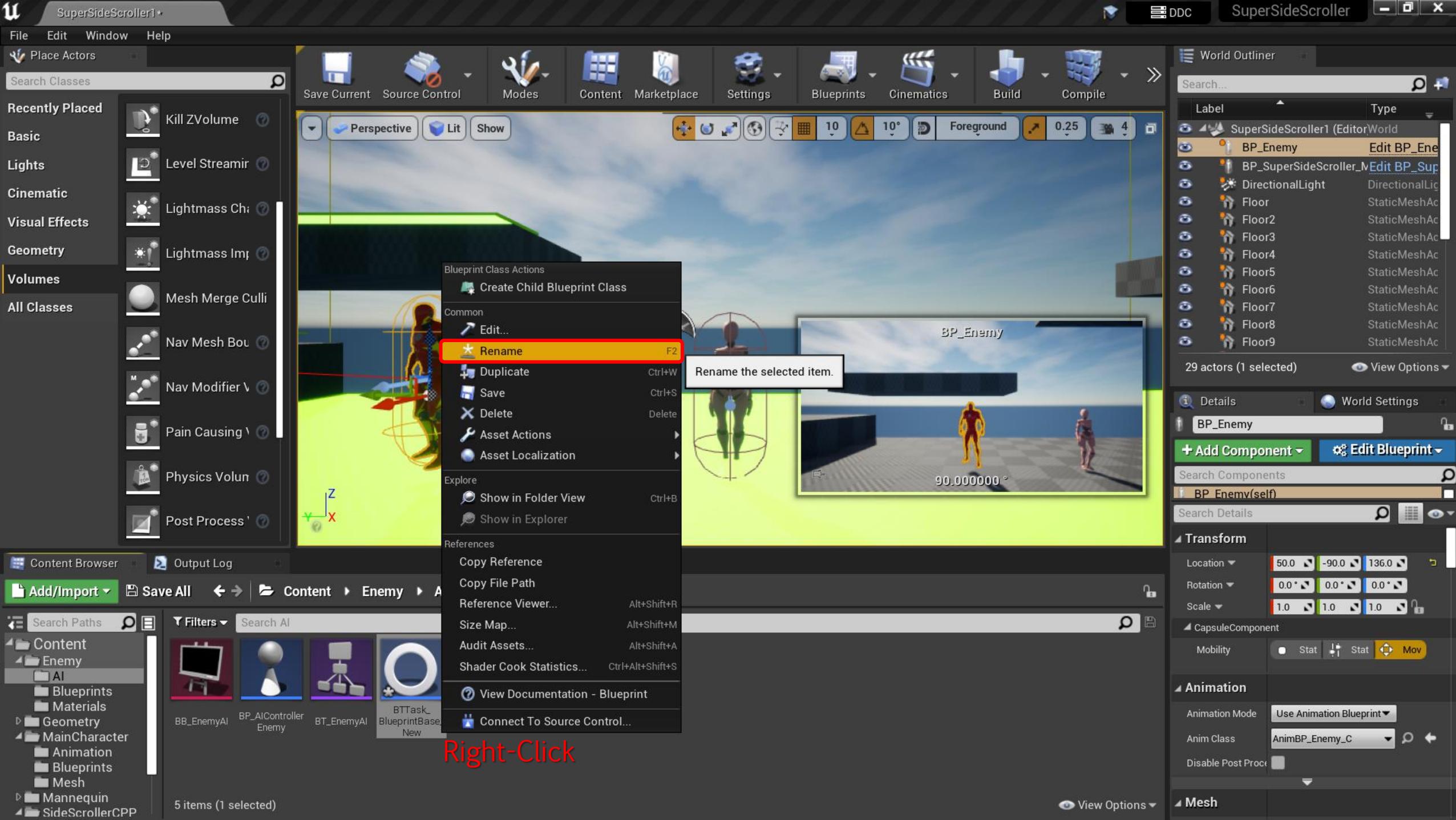
Animation

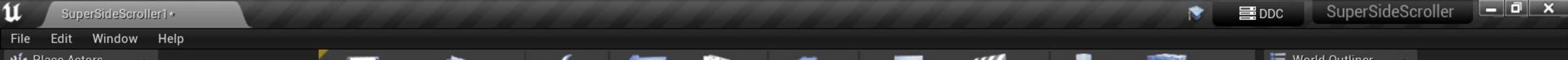
Animation Mode: Use Animation Blueprint
Anim Class: AnimBP_Enemy_C
Disable Post Proc

Mesh









File Edit Window Help

Place Actors

Search Classes

Recently Placed

Basic

Lights

Cinematic

Visual Effects

Geometry

Volumes

All Classes

Kill ZVolume

Level Streamir

Lightmass Ch:

Lightmass Imp

Mesh Merge Culli

Nav Mesh Bou

Nav Modifier V

Pain Causing \

Physics Volun

Post Process'

Save Current

Source Control

Modes

Content

Marketplace

Settings

Blueprints

Cinematics

Build

Compile

World Outliner

Search...



Label	Type
SuperSideScroller1 (Editor)World	
BP_Enemy	Edit BP_Ene
BP_SuperSideScroller_N	Edit BP_Sup
DirectionalLight	DirectionalLig
Floor	StaticMeshAc
Floor2	StaticMeshAc
Floor3	StaticMeshAc
Floor4	StaticMeshAc
Floor5	StaticMeshAc
Floor6	StaticMeshAc
Floor7	StaticMeshAc
Floor8	StaticMeshAc
Floor9	StaticMeshAc

29 actors (1 selected)

View Options

Details World Settings

BP_Enemy

+ Add Component

Edit Blueprint

Search Components

BP_Enemy(self)

Search Details

Transform

Location 50.0 -90.0 136.0

Rotation 0.0° 0.0° 0.0°

Scale 1.0 1.0 1.0

CapsuleComponent

Mobility Stat Stat Mov

Animation

Animation Mode Use Animation Blueprint

Anim Class AnimBP_Enemy_C

Disable Post Pro

Mesh



Add/Import Save All Content > Enemy > AI

Search Paths Filters Search AI

Content Enemy AI Blueprints Materials

Geometry MainCharacter Animation Blueprints Mesh

Mannequin SideScrollerCPP

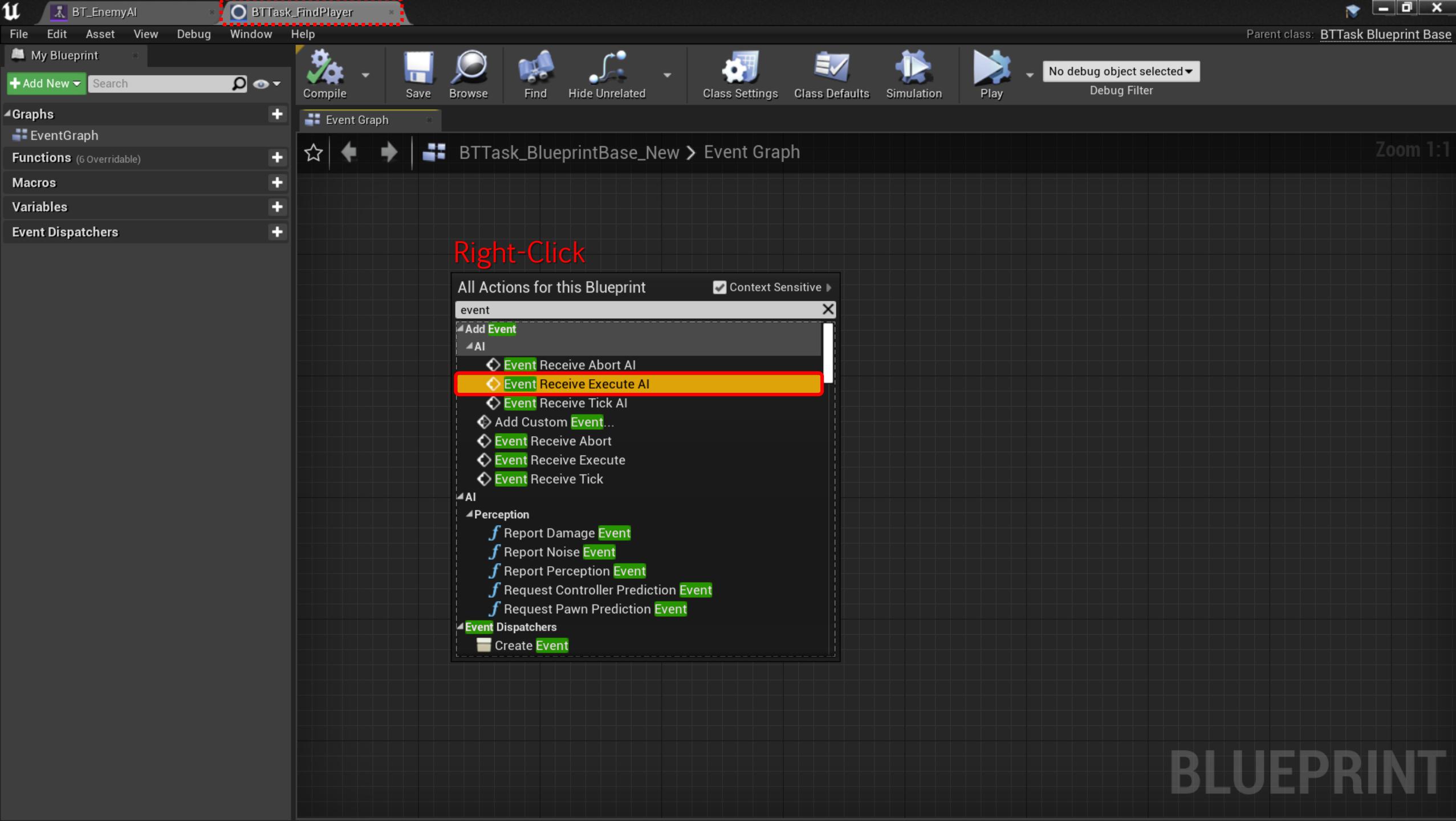


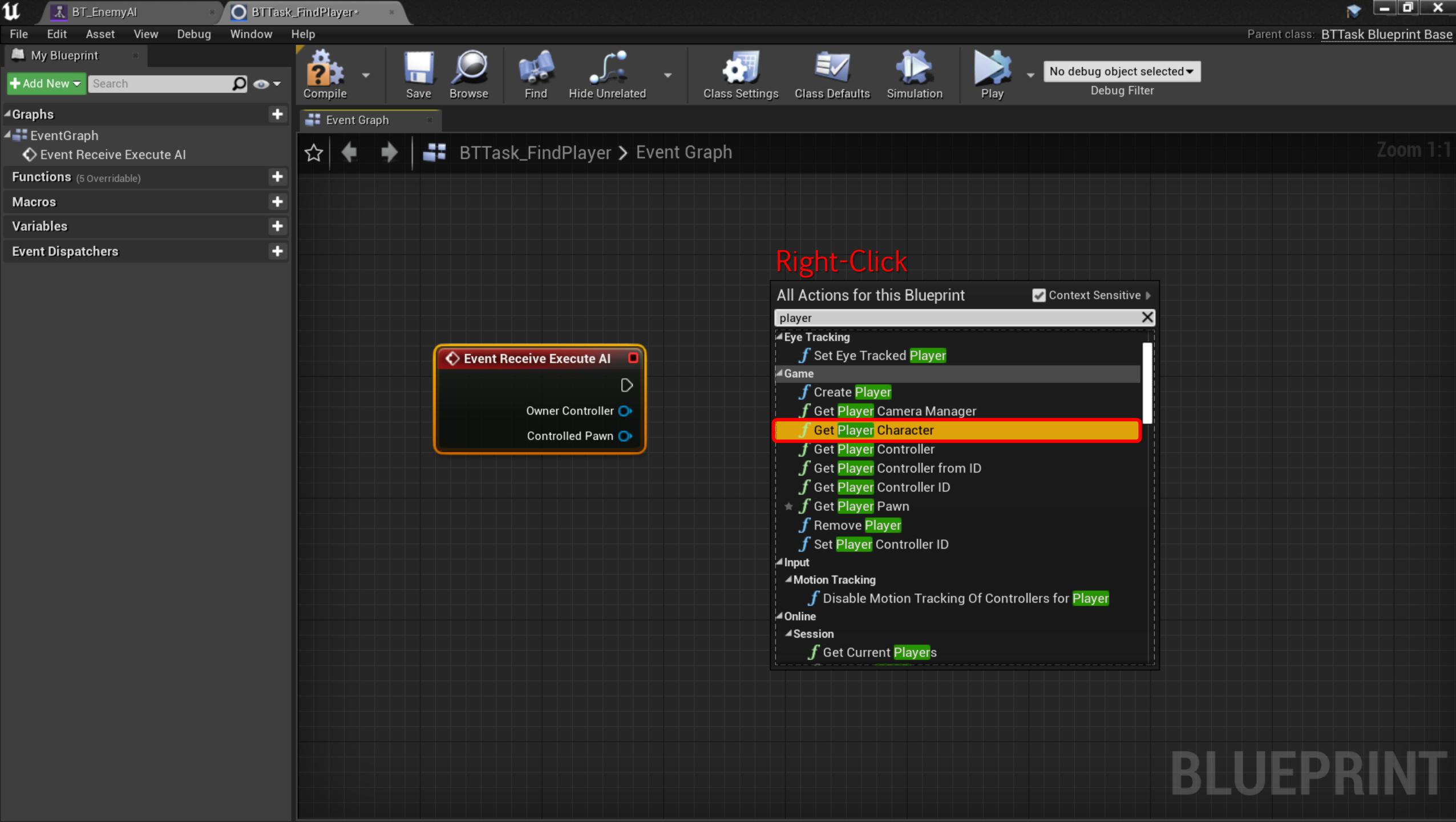
BB_EnemyAI BP_AIController Enemy BT_EnemyAI BTTask_Find Location

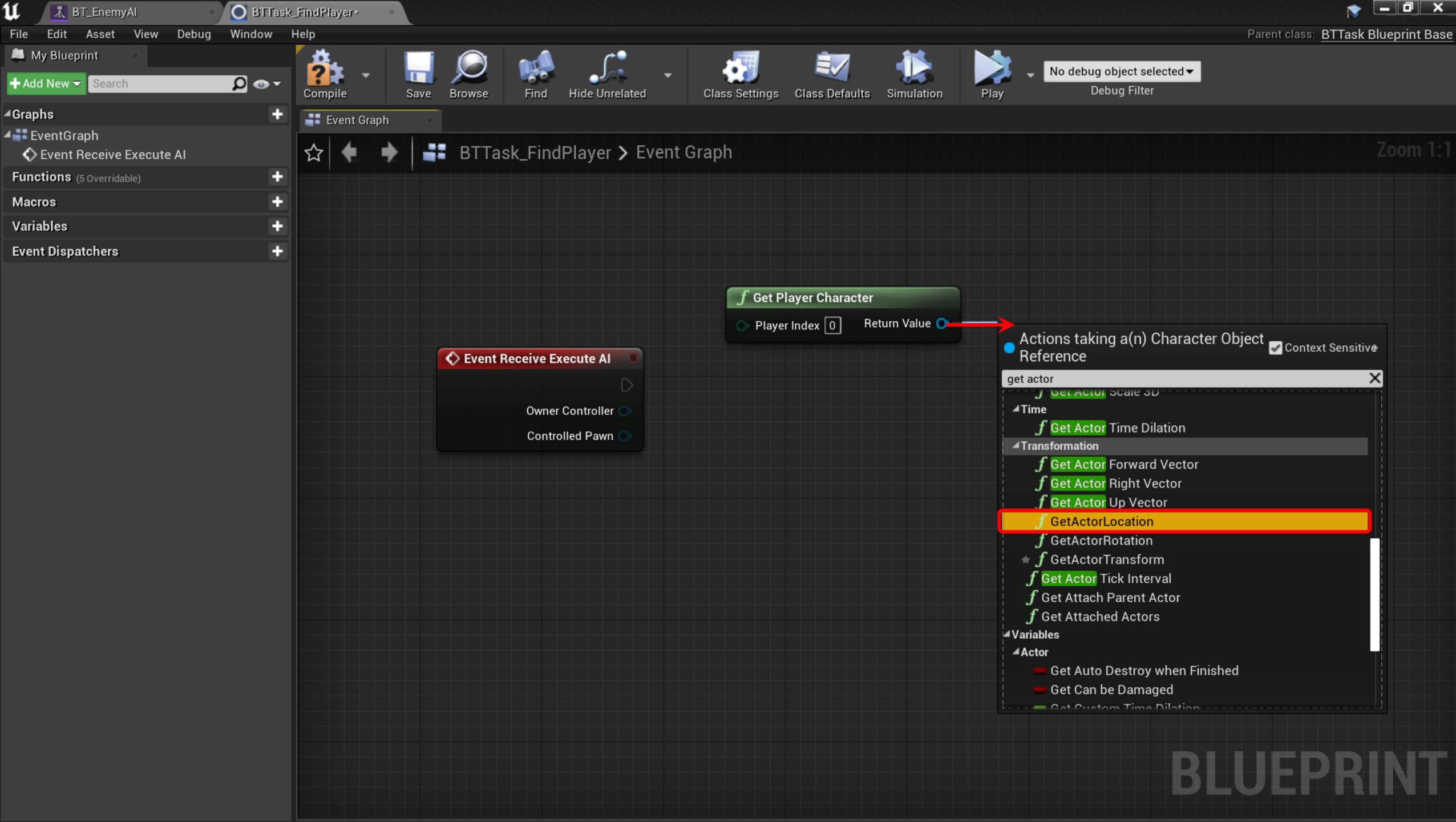
BTTTask_Find Player

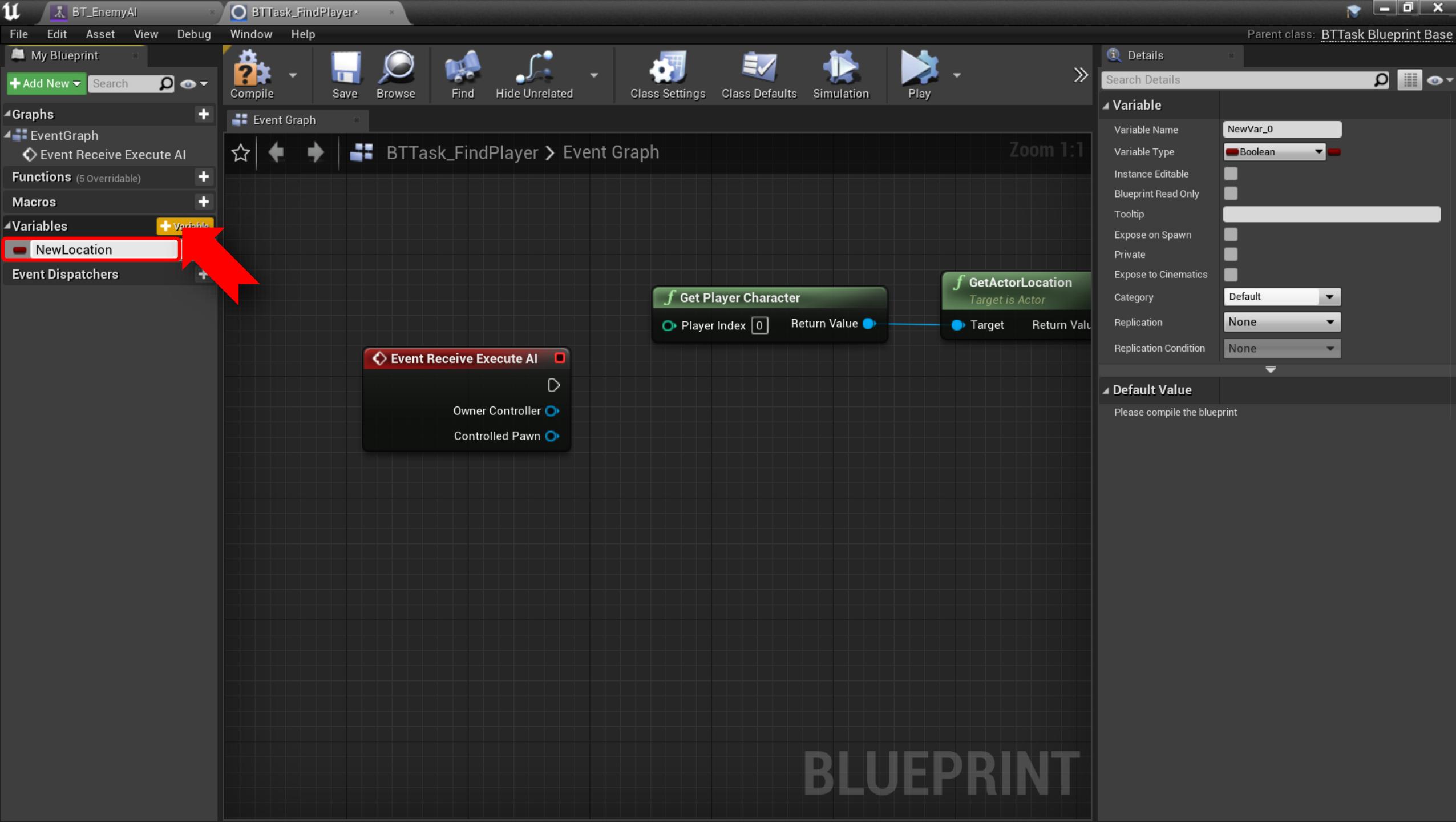
5 items (1 selected)

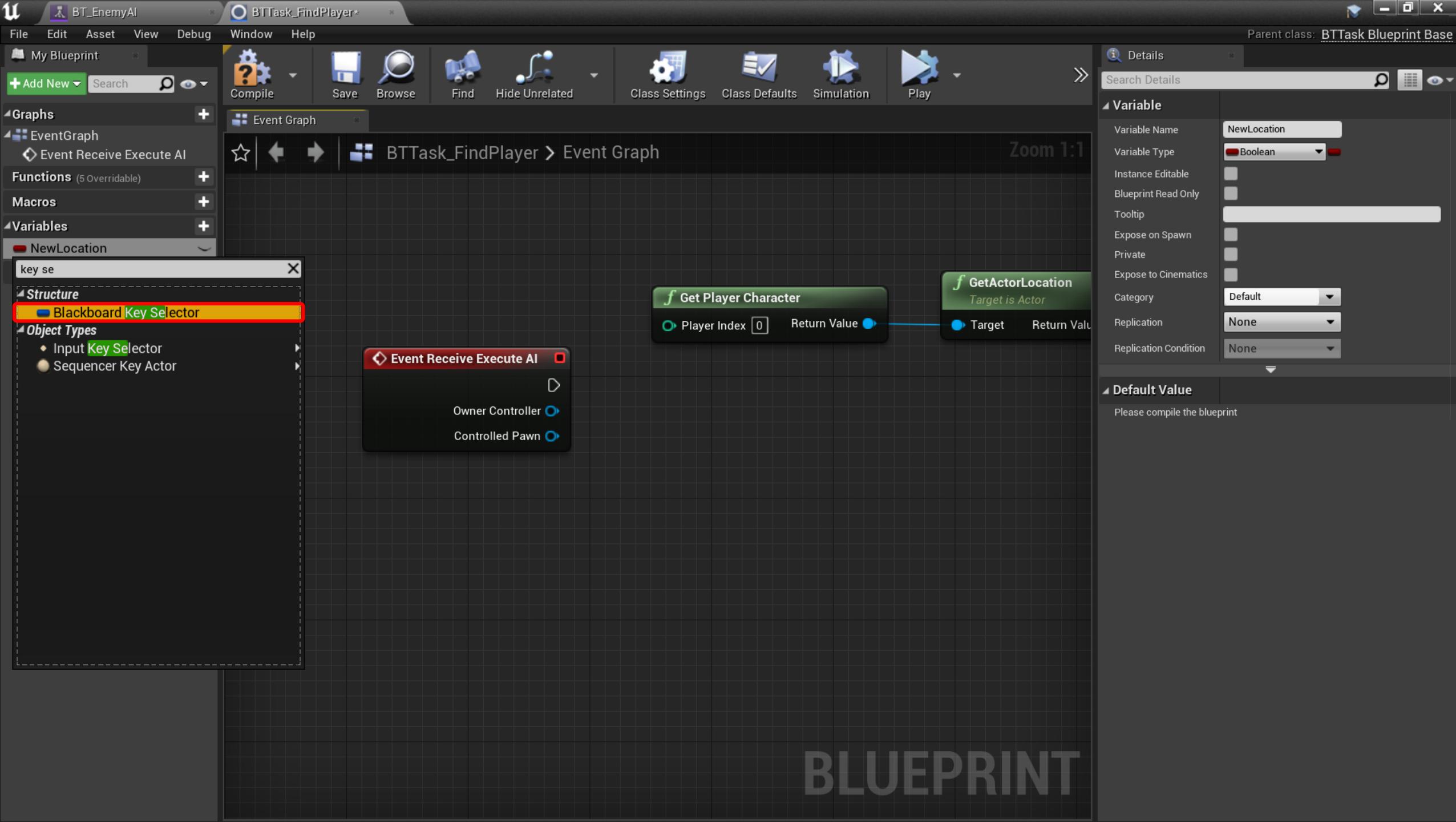
View Options

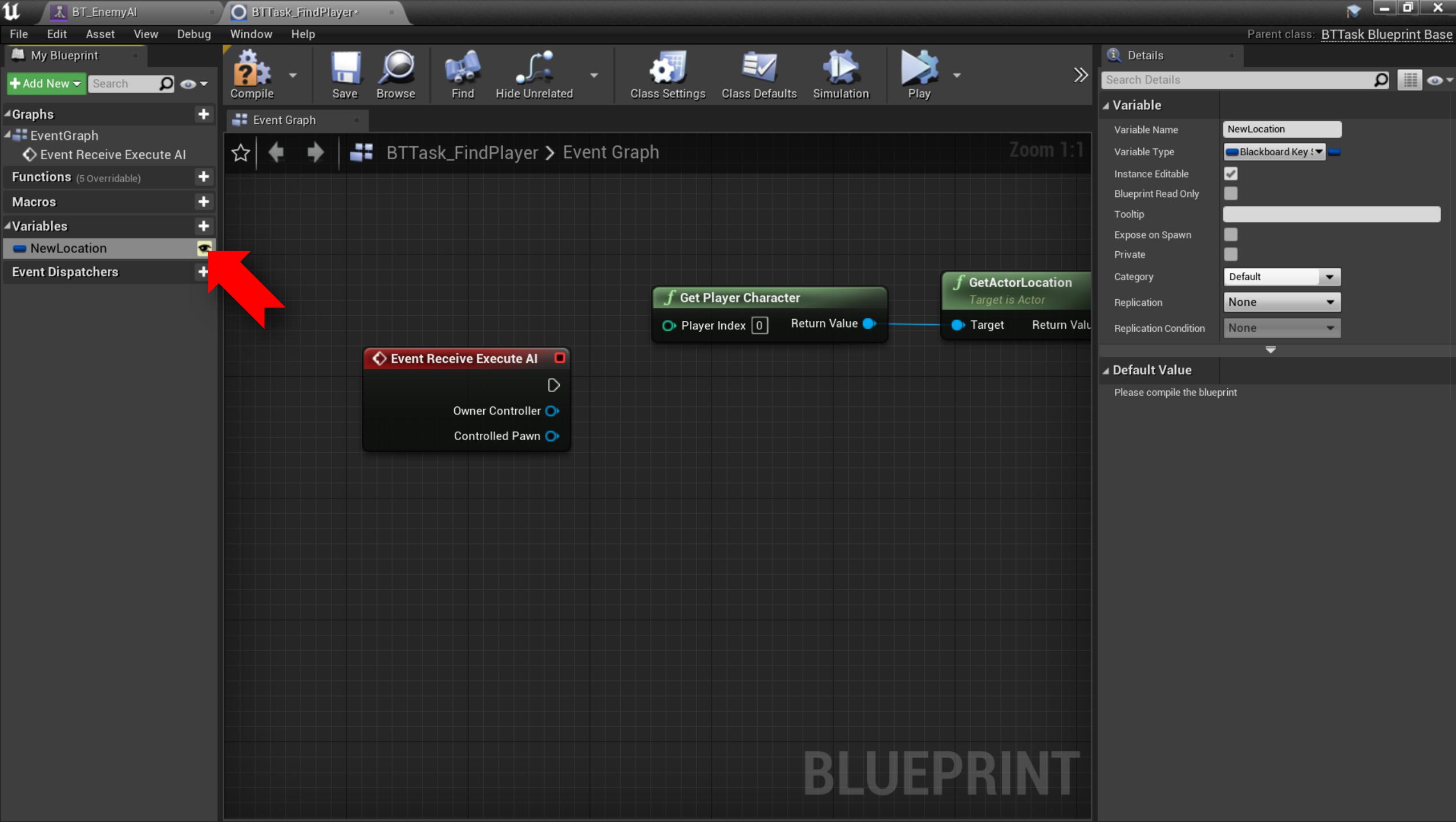


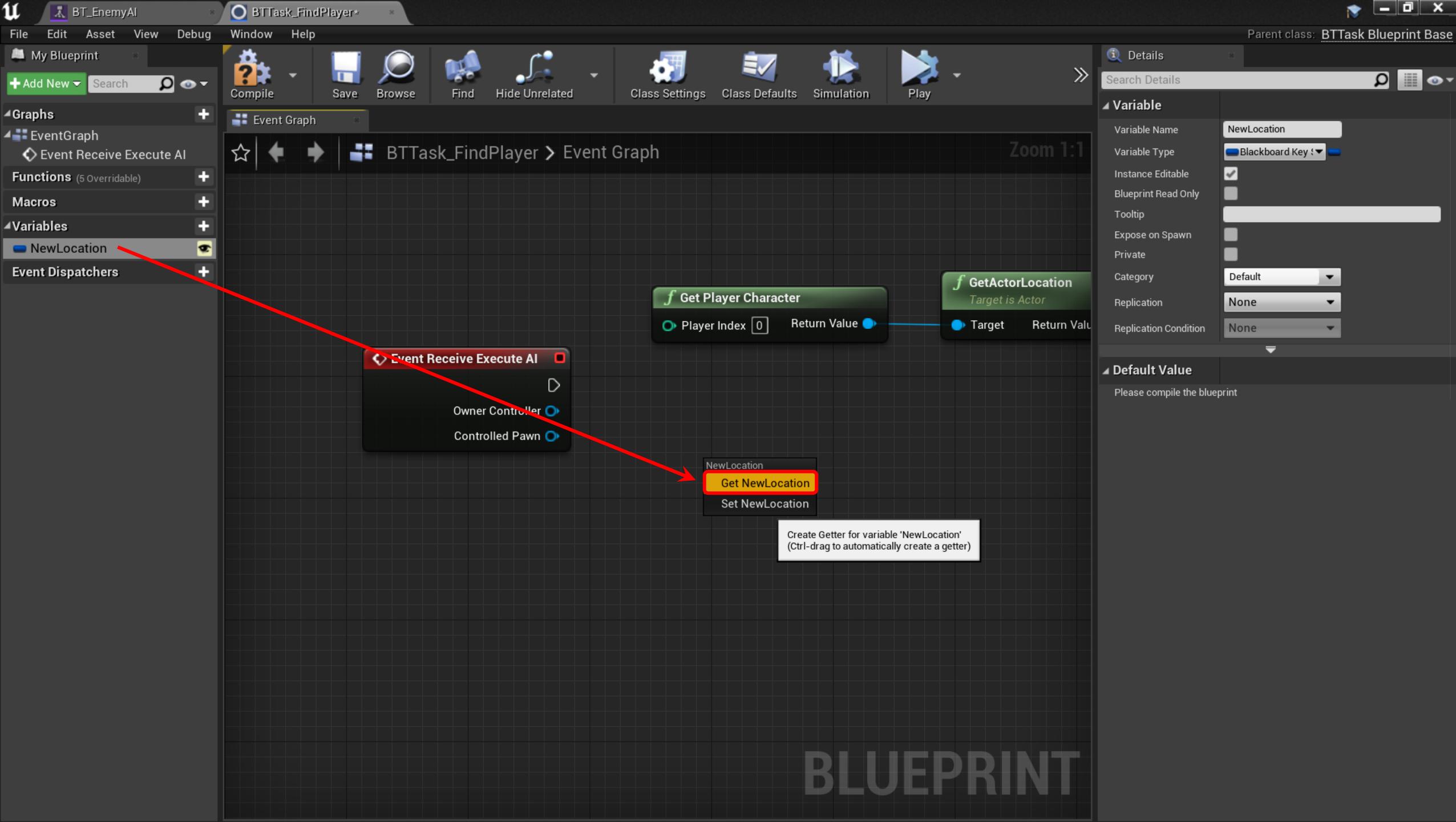


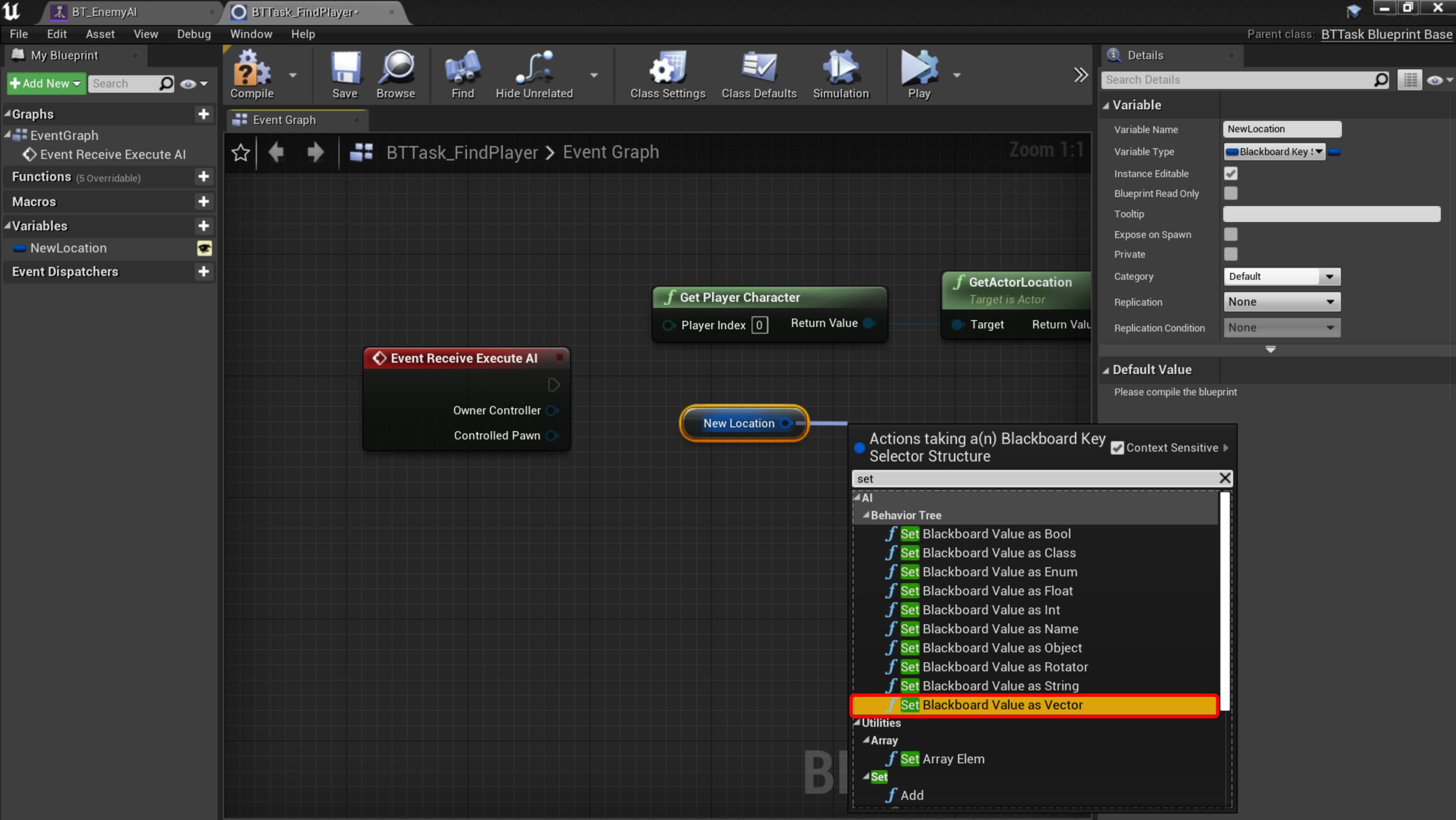


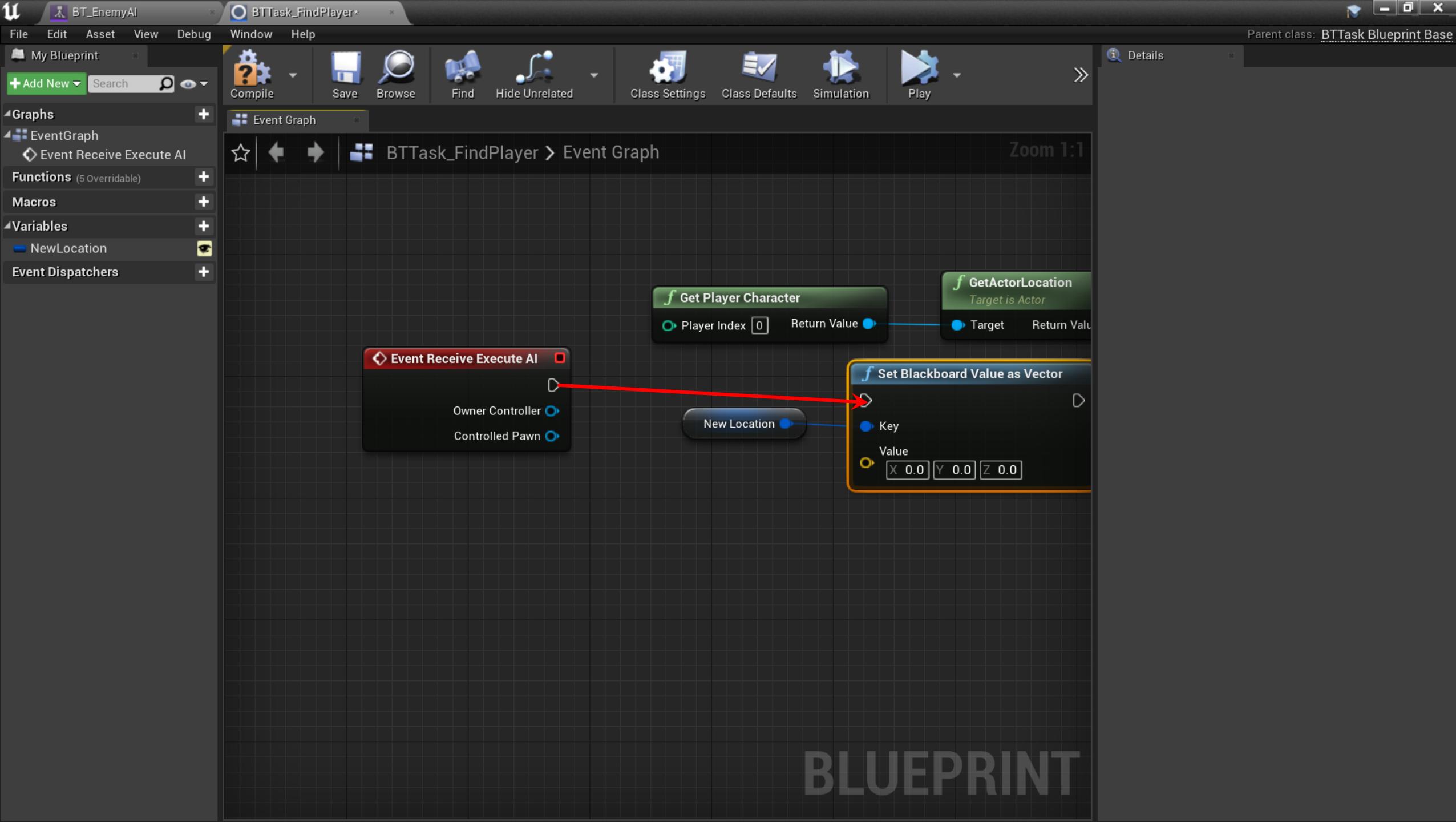


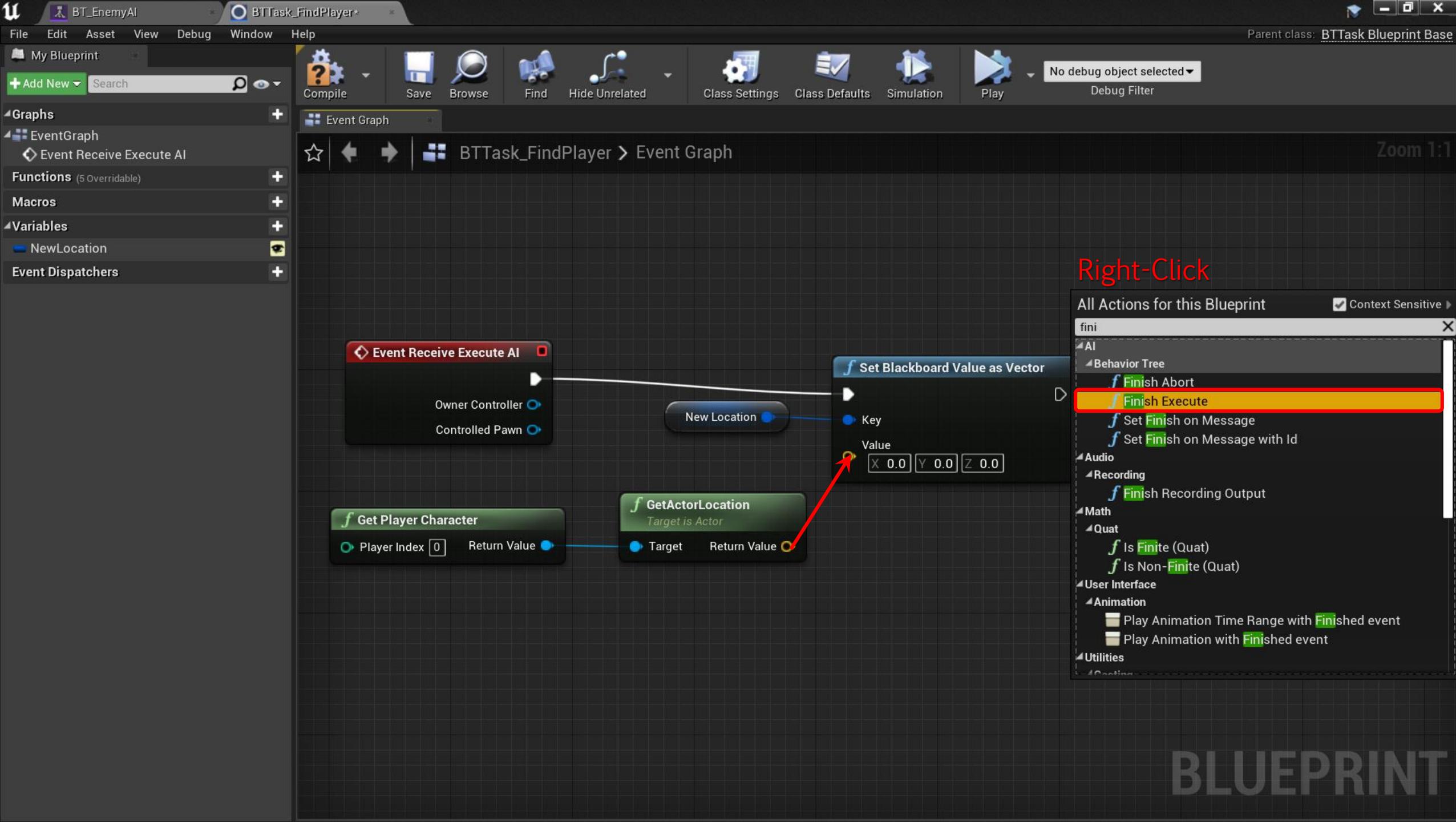


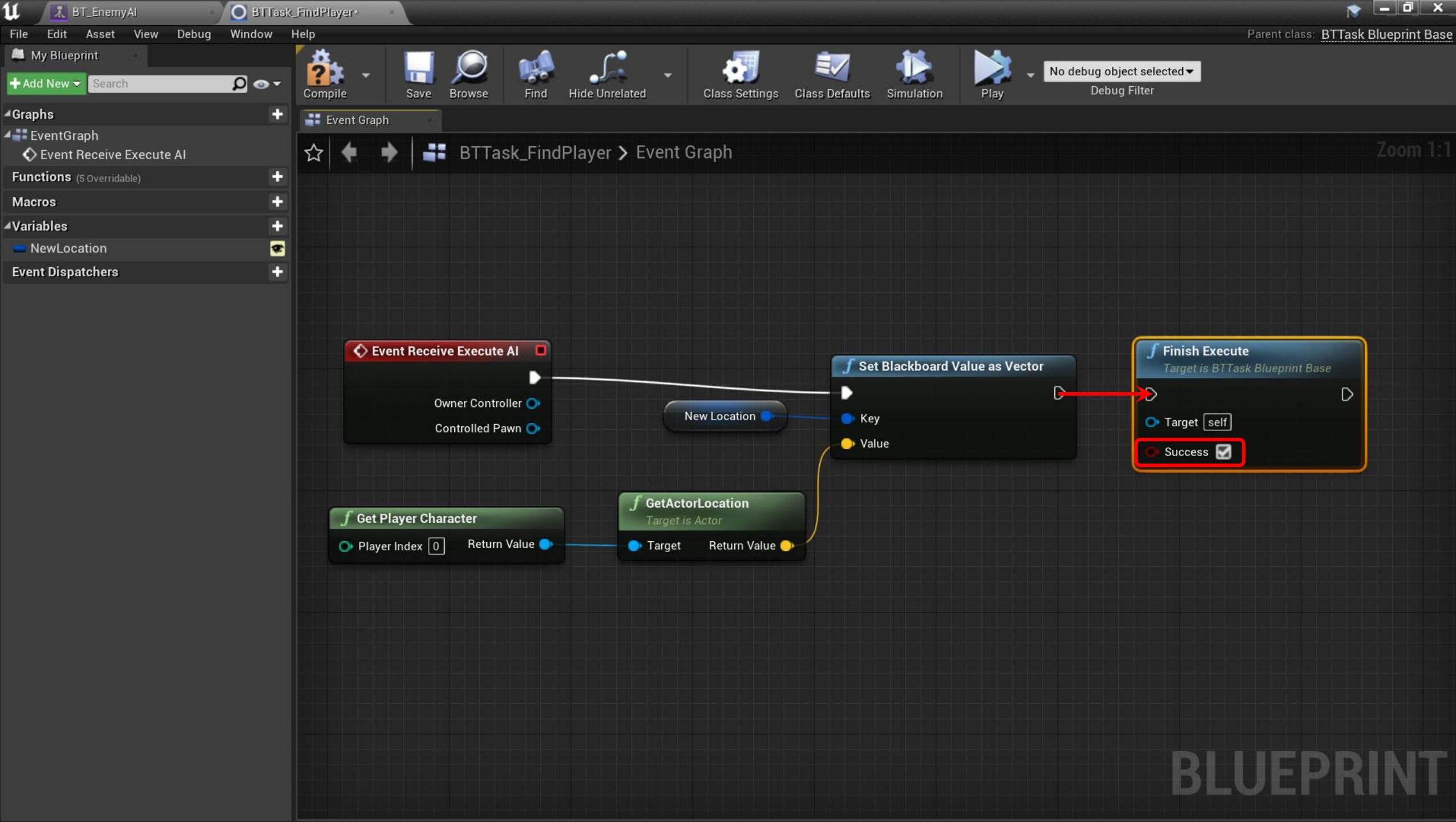


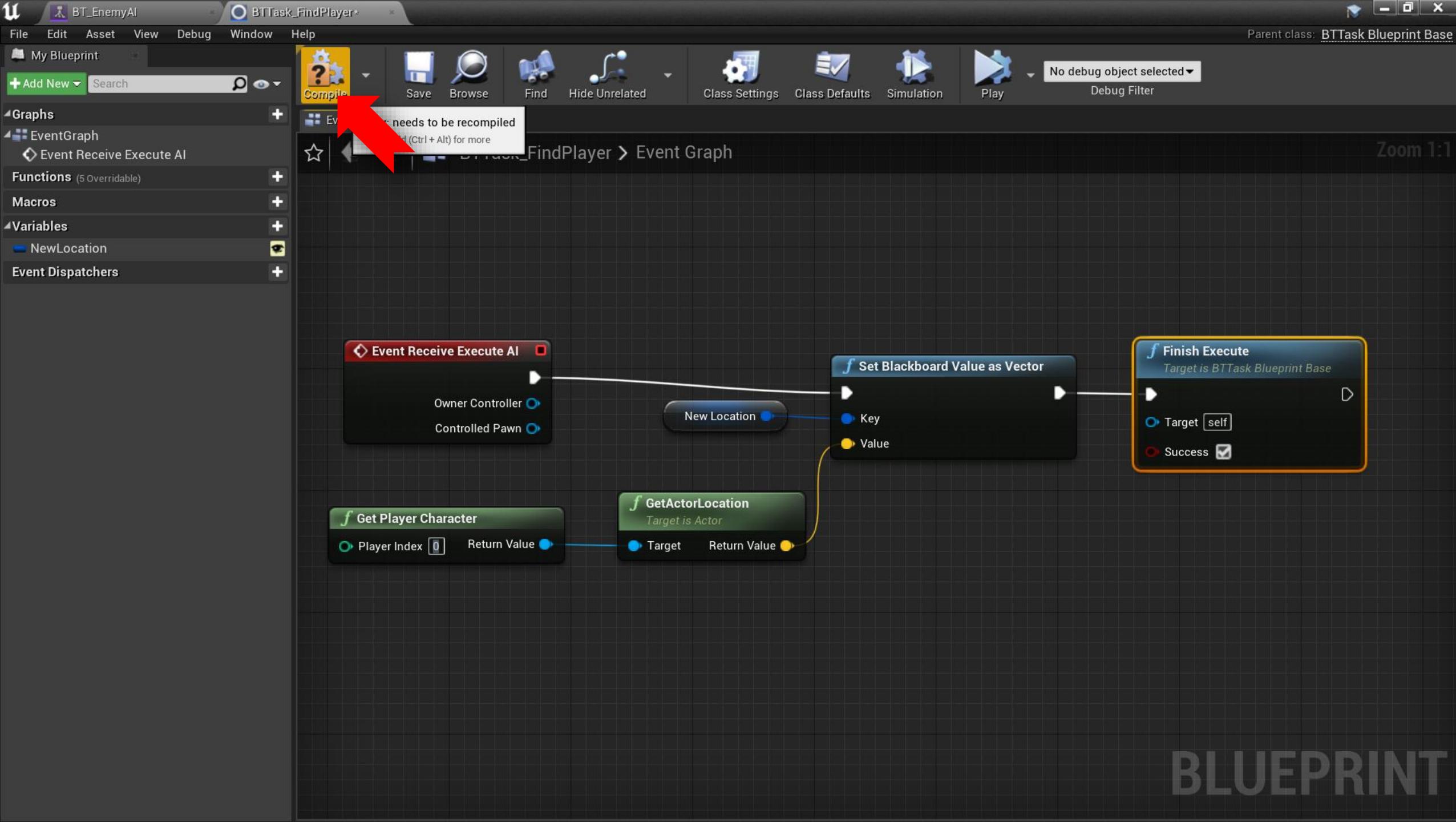


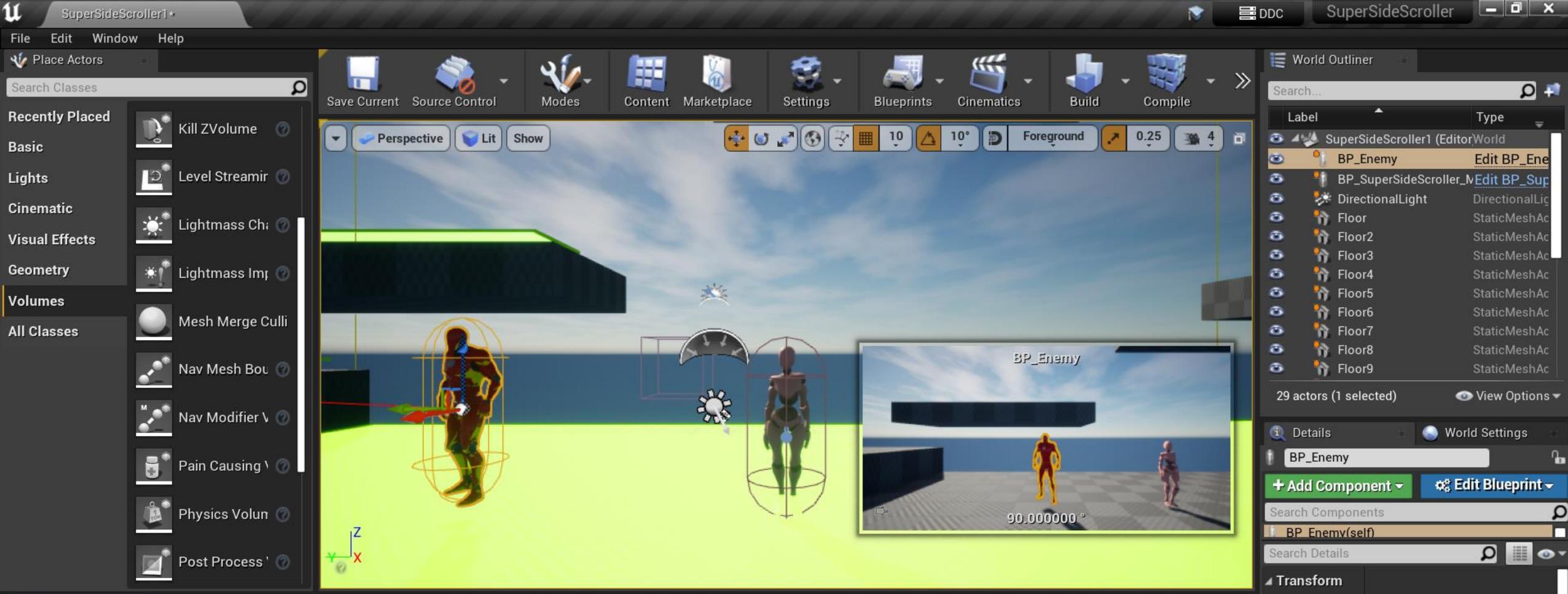




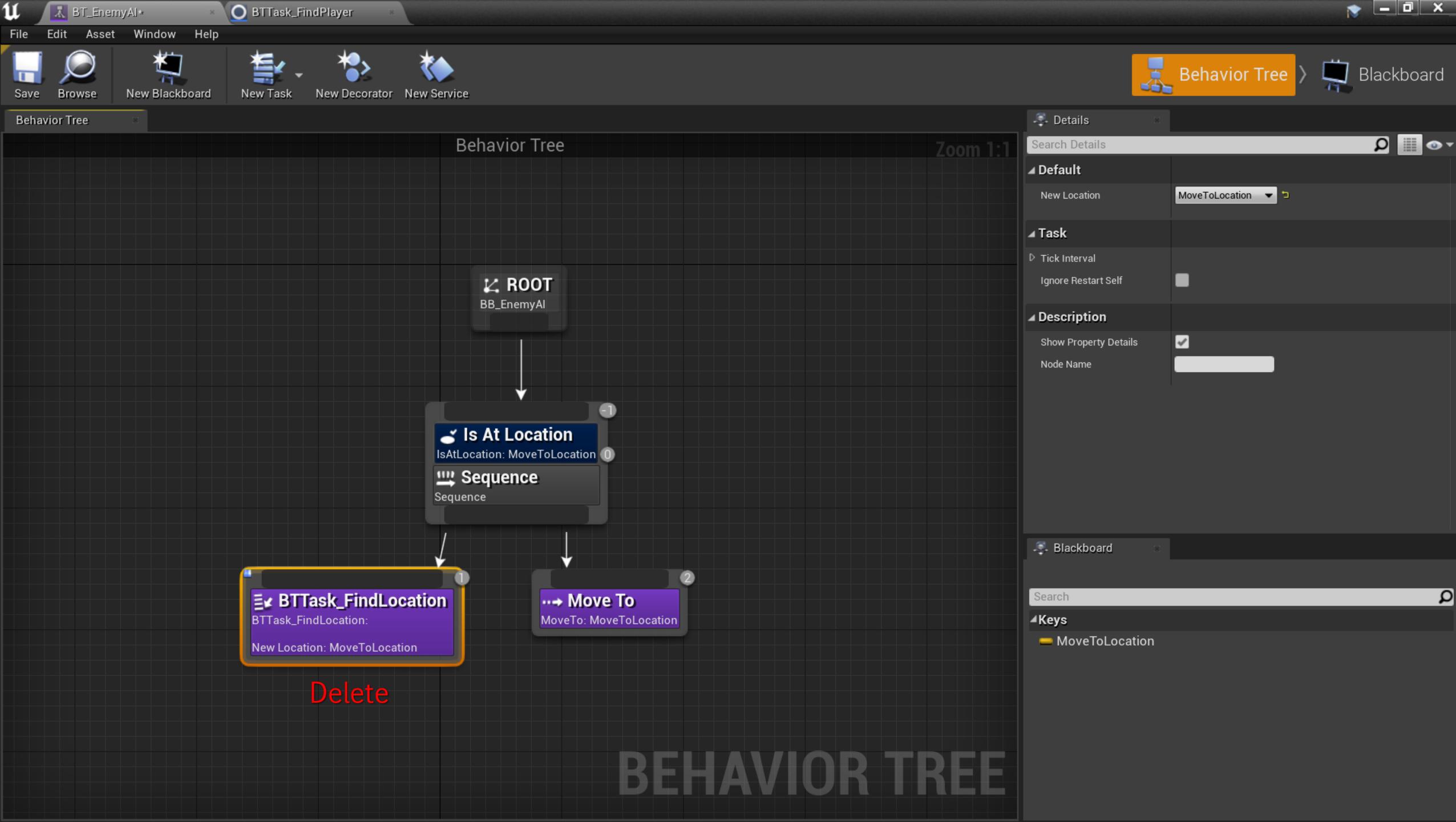


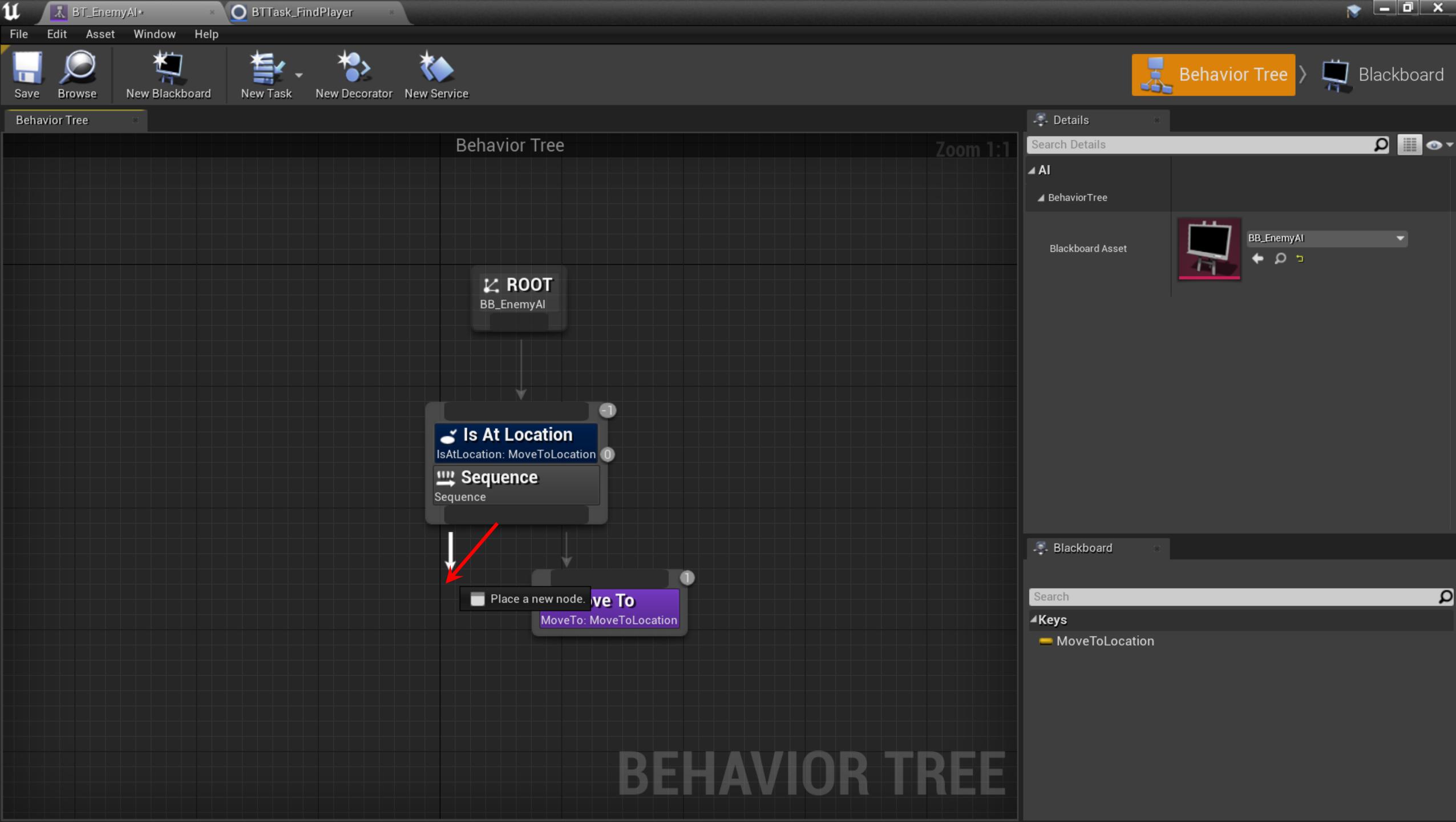






The screenshot shows the Content Browser interface. The top bar has tabs for Add/Import, Save All, and Content. The Content browser tree shows a hierarchy: Content > Enemy > AI. Under the AI folder, there are four items: BB_EnemyAI, BP_AIController, BT_EnemyAI, and BTTask_Find_Location. A red arrow points to the "BT_EnemyAI" icon. The bottom status bar indicates "5 items (1 selected)".





File Edit Asset Window Help

Save Browse New Blackboard New Task New Decorator New Service

Behavior Tree

Zoom 1:1

Search

Composites

Tasks

- BTTTask Find Location
- BTTTask Find Player**
- Finish with Result
- Make Noise
- Move Directly Toward
- Move To
- Play Animation
- Play Sound
- Push Pawn Action
- Rotate to Face BBEntry
- Run Behavior
- Run Behavior Dynamic
- Run EQSQuery
- Set Tag Cooldown
- Wait
- Wait Blackboard Time

...> Move To

MoveTo: MoveToLocation

Details

Search Details

AI

BehaviorTree

Blackboard Asset

BB_EnemyAI

Blackboard

Search

Keys

MoveToLocation

The screenshot shows the Behavior Tree Editor interface in the Unreal Engine. The main window displays a list of available tasks and composites. A specific task, "BTTTask Find Player", is highlighted with a red border. In the bottom left corner of the main window, there is a preview of a task node labeled "...> Move To" with the key "MoveTo: MoveToLocation". The right side of the screen features the "Details" panel, which is currently expanded to show the "AI" section. Within the AI section, the "BehaviorTree" asset is selected, and its "Blackboard Asset" is set to "BB_EnemyAI". Below the AI section, the "Blackboard" panel is also visible, showing a single key named "MoveToLocation". The overall title bar of the application is "BT_EnemyAI* BTTask_FindPlayer".

