Boss AI Toolkit

Drix Studios

Documentation v1.3.0

Features

- Boss phases and triggers.
- Boss Ability system.
- Boss blocking and dodging states.
- Status Effects and Crowd Control system.
- Wander and patrol behaviors.
- Collision shape traces such as sphere, cone, donut, and more.
- Ground Telegraphs.
- Directional hit reactions.
- Enemy Boss examples.
- Ability templates and examples.
- Comprehensive Animation Blueprints.
- Simple melee player combat system with blocking and dodging.
- Multiplayer support.

The Boss AI Toolkit is a simple to integrate and highly customizable boss fight creation system. Use it to create epic boss enemies for your game, whether it's an RPG or an FPS. Add different phases and attack patterns to your bosses using a flexible Ability system. It draws inspiration from games such as Dark Souls, Monster Hunter, Wolfenstein, and Final Fantasy XIV.

It was made with existing projects in mind, so you should be able to use your own player characters with it.

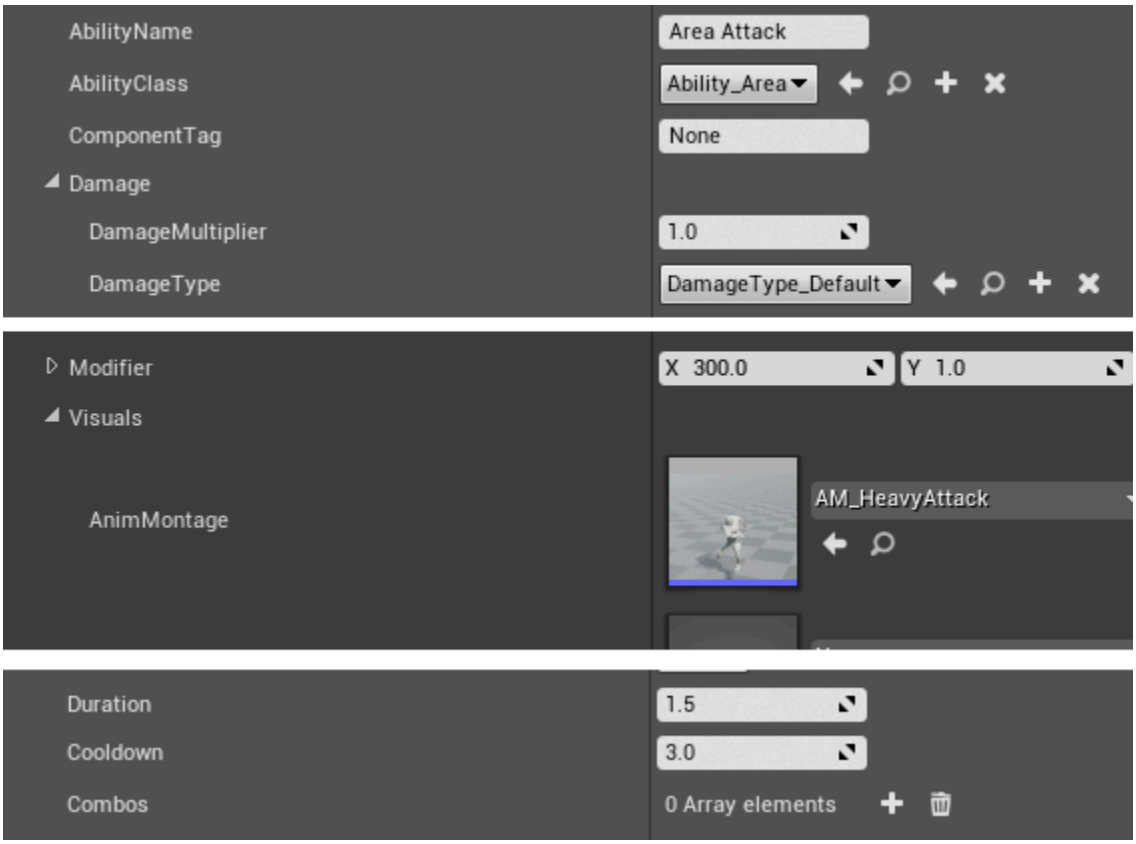
Getting Started

This guide assumes that you have basic knowledge of blueprints in Unreal Engine, as well as some basic knowledge in using the Editor.

1. **Migration of Boss AI Toolkit**
    a. Open the Boss AI Toolkit project.
    b. In the content browser, right click the BossAIToolkit folder and Migrate it.
    c. Click OK and find the Content folder of your own project.
    d. Now you can close the Toolkit project and go to your own project.
2. **Enabling EQS**
    a. Go to Settings -> Plugins.
    b. Enable the Environment Query Editor (Experimental)
3. **Navigation Mesh**
    a. Go to Settings -> Navigation Mesh -> Set Runtime Generation to “Dynamic”.

Creating A New Boss

1. **Create a Boss Character**
    a. Create a child blueprint of the “BP_Boss_Base” which already includes all the AI settings you need.
    b. Open the new blueprint and select the Boss Behavior component.
    c. Modify the settings as you see fit. They all have tooltips so you can easily understand what each property does.
2. **Create a New Phase**
    a. Open DT_SamplePhases and add a new row.
    b. Rename the row itself (Note: this is different from the Phase Name) and modify the other properties as you see fit.
    c. In the Boss Character blueprint, select the Boss Behavior component again.
    d. In the Phases array, set the PhaseID to be the same as the row name of the phase you just created.
3. **Add an Ability**
    a. Go back to the phase you just created in DT_SamplePhases.
    b. Add an element to the Abilities array.
    c. In order to create a basic circular AoE attack, just follow the settings below:



The other properties not shown above can be left on default.

The Ability System

1. **Animation-Driven Abilities**
    a. Most abilities depend on Anim Notifies in order to deal damage, trigger combos, execute effects, etc.
    b. These Notifies call different events in the Ability classes.
    c. Try opening one of the example bosses' animations to see how they work.

2. **Ability Blueprint Classes**
    a. All abilities need a class deriving from the "BP_Boss_Ability_Base".
    b. There are already a lot of templates in the Abilities folder. You can also create your own classes.

3. **Damage**
    a. Damage multiplier for both primary damage and status effect damage (if any).
    b. Damage type needs to be based on “BP_DamageType_Default” or should at least implement the BI_DamageType interface.
    c. Crowd Control type is also set here.

4. **Targeting**
    a. You can set what each ability targets (Enemy, ally, self, etc.)
    b. Set the targeting tags in the behavior component so the AI knows which tag is for an enemy or ally.
    c. Minimum and maximum distance is needed so the AI knows when to use the ability.

5. **Hitboxes**
    a. Hitboxes in your Boss AI character need to be tagged.
    b. You can then use the Component Tag property in the Ability to use that hitbox for that certain ability.
    c. Some use the Component Tag to look for sockets in the skeletal mesh instead. Some use the **Modifier** property to adjust shapes such as Spheres and Cones.

6. **Combos**
    a. Each ability has a Combo array where you can add sub-abilities to follow the original ability.
    b. If your animation doesn’t have the Notify_Combo, the combo will activate when the animation finishes playing.
    c. Enabling the Optional boolean in the ability means that combo will be ignored if the targeting requirements are not met.

7. **Execution Order**
    a. By default, abilities are executed randomly if they meet the targeting requirements.

b. In the Boss Behavior component, you can use the Ability Execution Order to control the order in which abilities are executed.

8. **Telegraphs**
    a. Enabling Show Telegraphs in the Boss Behavior will make some abilities show a decal that mimics the shape of the damage area. Some abilities don't have this (E.g. Direct damage and Projectiles)
    b. Enabling Force Show Telegraph will show that ability's telegraph even if Show Telegraphs on the Boss Behavior is disabled.

9. **Strafing During Abilities**
    a. Since 1.2.0, enabling the Allow Strafe boolean in the ability will allow the boss AI to move while executing that ability. This is useful for ranged AIs who want to move away from the player while still using abilities.
    b. Note that Desired Range in the Boss Behavior comp needs to be set to more than value of 0.

Ability Templates

The properties mentioned in the ability descriptions are from the F_BossAbility structs.

DAMAGE

1. **Area** - Deals damage in a sphere. Modifier X is the radius.

2. **Beam** - Deals damage in a line. Modifier X, Y, Z is the length, width, and height.

3. **Charge** - Deals damage as the boss moves forward.
    a. Max Distance is how far the charge is.
    b. Can use hitboxes via ComponentTag. If ComponentTag is empty, then Modifier X, Y, Z is the length, width, and height respectively.
    c. Animation needs the Notify_Execute to control charge timing and duration.

4. **Charge_Circular** - Deals damage as the boss moves behind the target in a circular manner.
    a. Same settings as Charge ability, except Modifier is used in another way.
    b. Modifier X is the distance behind the target actor where the boss lands.
    c. Modifier Y controls the radius of the circular movement.

5. **Cone** - Deals damage in a cone. Modifier X, Y, Z is the distance, min angle, max angle.

6. **Direct** - Deals damage to the target actor directly without any hitbox checks.

7. **Dive** - Jumps directly upwards before diving to the target, dealing damage in a sphere.
    a. Modifier X is the radius of the damage.
    b. Modifier Z is the height of the jump before the dive.
    c. Animation needs the Notify_Execute to start the jump and dive.

8. **Donut** - Deals damage in a donut shape. Modifier X and Y is the inner radius and outer radius respectively.

9. **Flamethrower** - Spawns fire projectiles that deal damage and apply Burn.
    a. Modifier X is the number of projectiles to spawn.
    b. ComponentTag is the socket name where the projectile is spawn.
    c. Repeat animation is false.

10. **Grab** - Grab the target actor and can deal damage while the target is grabbed.
    a. Uses hitboxes via ComponentTag to trace for a grab.
    b. The last ComponentTag is where the target is attached to.

    c. Crowd Control (if any) will be used when the target is released. E.g. if “Knock Down”, the target will be thrown away after the grab.
    d. Animation needs the Notify_Execute to do the grab. If no actor is grabbed in the first 0.25 seconds of the notify, the ability will stop and fail.

11. **Hitbox** - Deals damage using the hitboxes of the Boss AI that match the ComponentTag.

12. **Leap** - Jumps to target and slam down, dealing damage in a sphere. Modifier X is radius.
    a. Animation needs the Notify_Execute to control the start and end of jumping.

13. **Projectile** - Spawns projectiles that deal damage.
    a. Modifier X is the number of projectiles to spawn.
    b. ComponentTag is the socket name where the projectile is spawn.
    c. Repeat animation is true.

14. **Projectile_Circle** - Spawns projectiles in a circle or spiral pattern.
    a. Same settings as Projectile.
    b. Modifier Y is the direction and number of times the pattern circles around. E.g. a value of 3 means there will be 3 circles or spirals of projectiles.
    c. A longer Notify_Damage will make the patterns more noticeable.

15. **Projectile_Grid** - Spawns projectiles in a grid pattern.
    a. Modifier X is the number of columns.
    b. Modifier Y is the number of rows.
    c. Modifier Z is the space between projectiles in the grid.

16. **Projectile_Homing** - Just like the normal projectile but it follows the target.
    a. UseSocketRotation is true.

17. **RangedArea** - Deals damage in a sphere around the target actor or location.

18. **Wave_Ring** - Spawns a ring that gradually scales in size and deals damage when hit by it.
    a. Modifier X is the initial radius of the ring.
    b. Modifier Y is the final radius of the ring.
    c. Modifier Z controls how fast the ring scales up.

HEAL

1. **Heal_Self** - Heals the Boss AI itself. Heal amount is based on DamageMultiplier.
    a. Animation needs the Notify_Execute to start the heal.

2. **Heal_Self_Overtime** - Heals the Boss AI itself over a period of time. Heal amount is based on DamageMultiplier.
    a. Animation needs the Notify_Execute as that indicates the period of healing.

OTHERS

1. **DodgeAway** - Boss AI dodges in a random direction.

2. **Summon** - Spawn an actor with the same class as the SpawnClass.
    a. Modifier X is the number of actors to spawn.
    b. MaxDistance is the radius within which the actors can spawn.
    c. Animation needs the Notify_Execute to start the summoning.

3. **TweenTo** - Smoothly move the Boss AI to the target actor or location.
    a. ComponentTag is used to look for actors to move to. Note that actors must be added to the AI Storage as well.
    b. If ComponentTag is empty, then use Modifier as a location to move to.
    c. Duration controls how fast the move is.

Attributes

1. **Health**
    a. How much damage the AI can take before it dies.
    b. You can hide the health bar by using the “ShowHealthBar” boolean.

2. **Posture**
    a. How much damage the AI can take before it gets stunned/staggered.
    b. Posture damage is different from health damage by default (See “Custom Player” section)
    c. Stun duration can be adjusted too.

3. **Attack Power**
    a. How much damage the AI can deal using abilities. It is multiplied by the ability’s Damage Multiplier.
    b. Also affects status effects damage per tick.
    c. Also affects the healing amount of Heal Abilities by default.

Movement

1. **Movement Speed and Rotation Rate**
    a. Movement speed and rotation rate are adjusted depending on if the Boss AI is in combat or not. You can set them in the Boss Behavior component.
    b. Rotation rate when using an ability is also different.
    c. You can set if the AI rotates toward the target before moving.

2. **Out-Of-Combat Behavior**
    a. The Boss AI can do one of the following when not in-combat:
        i. Stationary
        ii. Wander around randomly
        iii. Patrol a spline
    b. You can set how far the AI can wander around.
    c. You can assign a patrol spline (BP_PatrolRoute)

3. **Movement Mode**
    a. In the Phases data table, you can set what Movement Mode that phase has.
    b. There is also a notify that changes movement modes. You can check the Shooter example boss for this.
    c. Minimum and Maximum Fly Height can be set in the Boss Behavior component.

4. **Maintaining Range (Staying away from Player)**
    a. Setting the Desired Range property to be more than 0 means that the boss AI will try to maintain that range between it and the target.

Hit Reactions

Hit reactions can be set in the Phases Data table (DT_SamplePhases by default). There are:

- 4 directional hit reactions
- 1 headshot hit reaction
- 1 block hit reaction

Blocking

1. **Can Block** - to enable boss blocking attacks/damage.
2. There are 2 ways for the AI to block an attack. You can only use one.
    a. **Blocking Angle** - The angle of blocking attacks, 0 is the center of the AI and blocks nothing. 90 is directly left and right. 180 is full block everywhere.
    b. **Blocker Tag** - When set, finds a component on the AI with this tag and uses that to block attacks. Make sure "**UseHitboxBlocker**" is enabled.

Dodging

As of version 1.3.0, dodge animations can now be assigned in the Phases Data table too.It will also make use of directional dodging. If you don't have multiple dodge animations, I recommend enabling "**Rotate to Dodge**" so that the AI faces towards the dodge location.

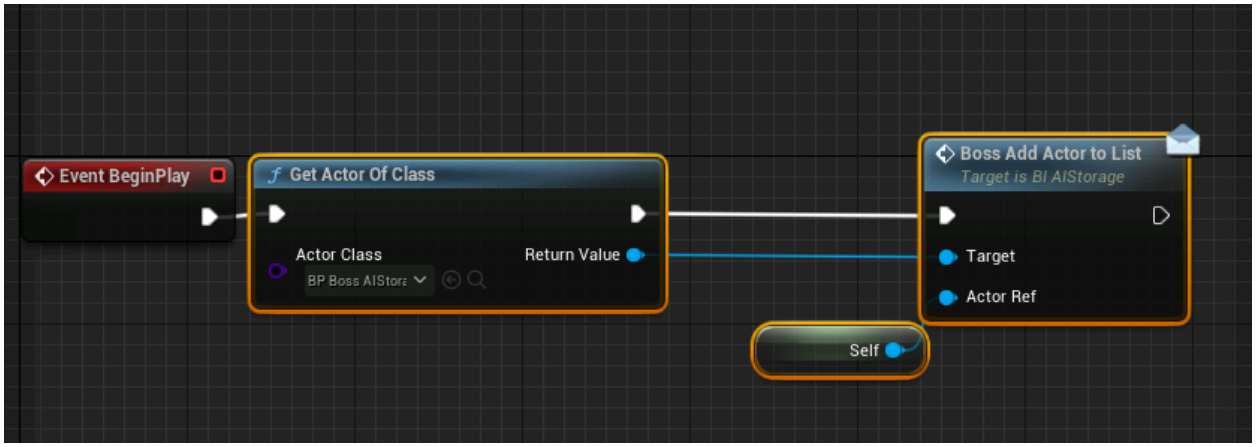
1. **Can Dodge** - to enable boss dodging of attacks.
2. **Dodge Customization** - there are multiple variables to be customized for the dodging. They all have detailed tooltips to help you out.

Friendly Fire

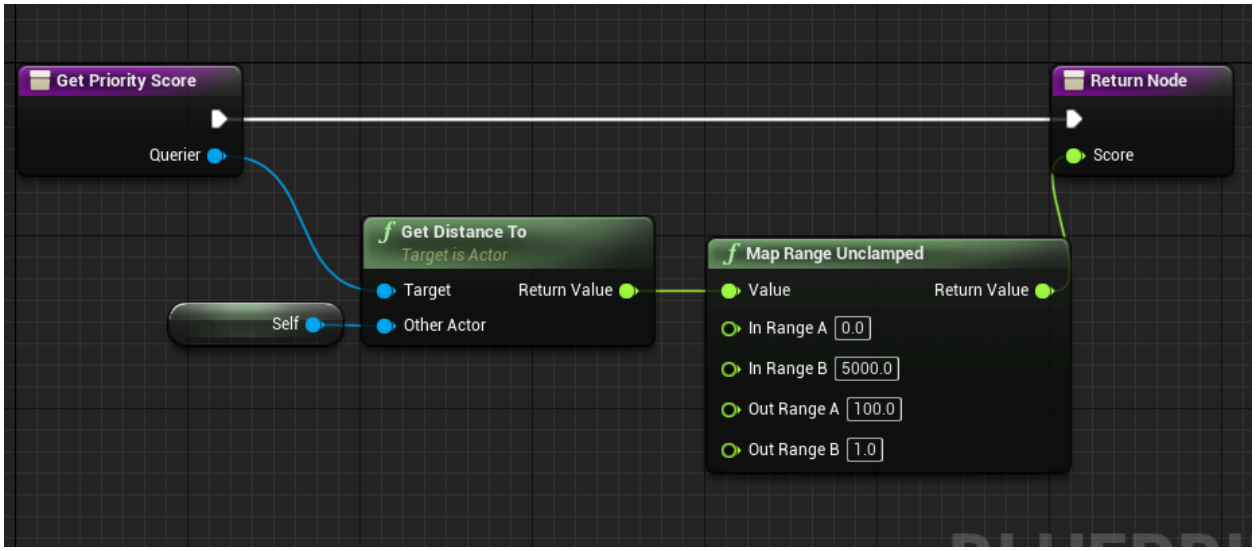
By default, the AI will damage other AIs. To disable this, uncheck "**Friendly Fire**" in the Boss Behavior component and make sure to add tags to the "**Target Tags Friendly**" array. All actors that have at least one of these tags will not be damaged if Friendly Fire is off.

Custom Player

1. **Make Boss Attack Your Player**
    a. In the Boss Behavior component, set the targeting tags so the AI knows which tag is for an enemy or ally. By default the AI attacks anyone with a “Player” tag.
    b. Add the same tag to your Player Character blueprint.
    c. If your game is Multiplayer, make sure to add the Player on login to the BP_Boss_AIStorage actor.



    d. In your Player, go to Class Settings and add the BI_CrowdControl interface to it.
    e. Implement the “Get Priority Score” function which allows the AI to score its potential targets. By default, we score it using distance to the boss AI.



2. **Status Effects and Crowd Control**
    a. Add the BPC_StatusEffects component to your Player. Add the events from it:
        i. OnEffectChanged
        ii. OnCrowdControlApplied

iii. OnCrowdControlRemoved

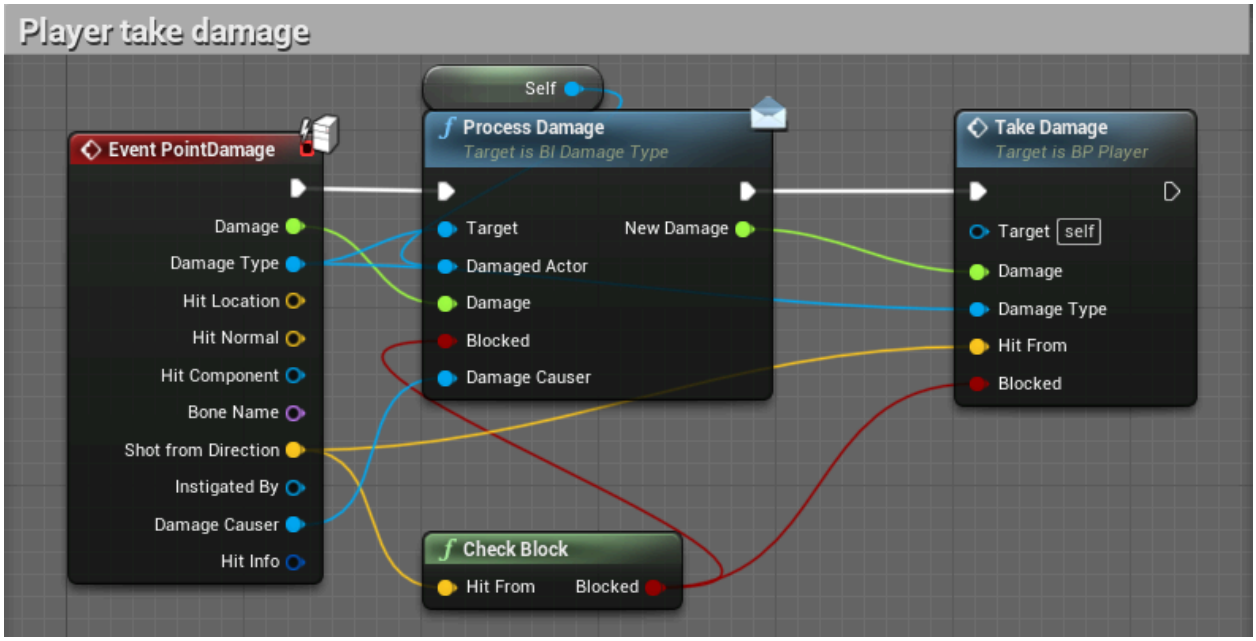
b. Implement the remaining functions and events from the interface BI_CrowdControl:
   i. Get Crowd Control State
   ii. Receive Crowd Control
   iii. Receive Debuff
   iv. Begin Grab, End Grab
   v. Is Grabbable
c. For ease of use, you can open BP_Player (the toolkit's player character) and just copy the code for the functions above.
d. NOTE: You also need to properly receive damage so that status effects work. See instructions on Receiving Damage.

3. Dealing Damage

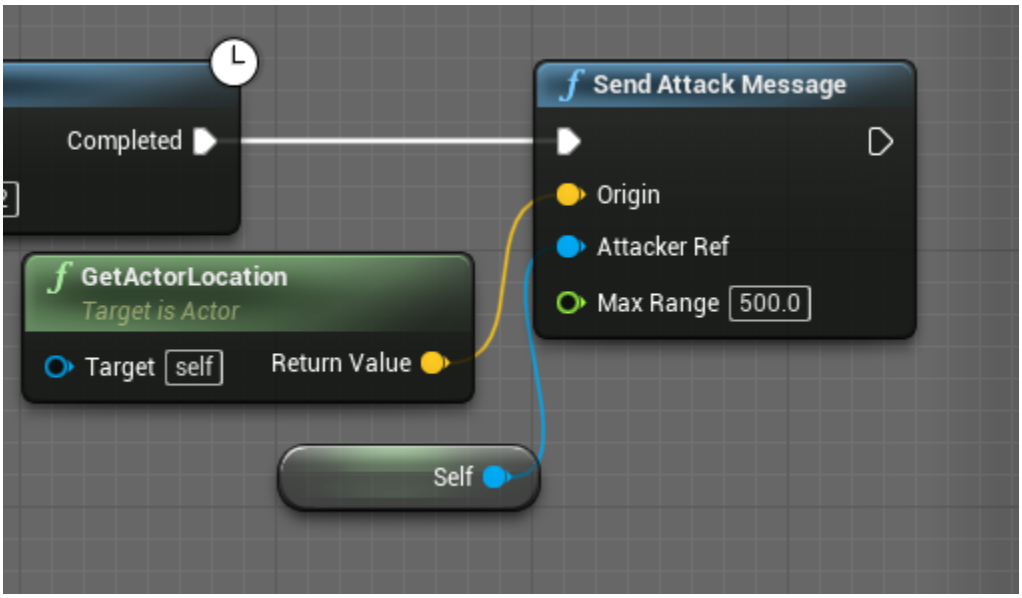
a. Get a reference to the Boss AI character. Ideally through collision or overlap.
b. Call "Apply Point Damage" and/or "Apply Radial Damage" when you overlap or collide with the boss. Set a Damage value and Damage Type class.
c. In your Player, go to Class Settings and add the BI_Ability interface to it.
d. Implement the "Get Status Effect Info" function in order to apply Status Effects with your attacks.
e. Implement the "Get Stagger Info" function in order to deal Posture damage.

4. Receiving Damage

a. Add the Event Point Damage and Event Radial Damage to your Player.
b. Drag the Damage Type pin and call Process Damage. This is so the Boss AI can apply status effects and crowd control based on the Damage Type.
c. Call whatever code you need to reduce your Player's health, etc.



5. **Telling Boss AI to Dodge**
    a. When your player attacks, call the function Send Attack Message in order to tell the AI that you are attacking it.
    b. In Boss Behavior comp, make sure “Before Hit” is in the Dodge Conditions.



Sounds

There are 2 ways to add sound to the boss abilities.

1. **Anim Montage** - You can directly add sounds to the anim montage of the ability. This gives you better control on the timing of each sound effect.
2. **BP Ability** - You can add sound to the different functions and events contained in the ability blueprint.

Events

The Boss Behavior component has a couple of events that can be added. Click the component inside the Boss BP and scroll down the details panel. You will see:

1. **On Phase Change** - called when the boss changes phases.
2. **On Phase Change End** - called when the boss finishes changing phases (I.E. finishes playing the intro sequence or animation)
3. **On Use Ability** - called when the boss starts and ability.
4. **On End Ability** - called when the boss finishes or cancels an ability (when interrupted).
5. **On Dodge** - called when the boss starts to dodge.
6. **On Boss Death** - called when the boss dies.

7. **On Combat State Changed** - called whenever the combat state changes.

Custom Status Effects

1. **Add Status Effect enum**
    a. Open E_BossDebuffs and add the name of your new status effect.

2. **Create Status Effect Object**
    a. Right click BP_Effect and click “Create Child Blueprint”.
    b. Name your new status effect actor and set its default variables like Icon, Particle effects, etc.

3. **Create New Damage Type**
    a. Duplicate BP_DamageType_Bleed.
    b. Open the duplicate and go to the “Process Damage” function. Change the call to Receive Debuff so the type is your new Enum.

4. **Connect the Enum with the Effect Object**
    a. Open BFL_Misc and go to the “Get Effect Class By Type” function. Set the Effect Object you made to the Enum you added.

5. **Customizing the Effect**
    a. If you want to change how damage is applied or calculated for the status effect, just override the “Tick Effect” function of the Effect Object you made. See BP_Effect for the default implementation.
    b. You can also override the event “Initialize Effect” to add whatever intro effects you want.

Version Changelog

Update v1.3.0

- NEW: Directional dodges for boss AI.
- NEW: Bullet Hell boss example.
- NEW: Friendly Fire toggle.
- NEW: Root crowd control which disables movement.
- Refactored crowd control code. They can now overlap with each other.
- Added multiple event dispatchers for the Boss Behavior component.
- Fixed an issue where Hit Results from Event Point Damage was missing some info.
- Improved flying AI behavior tree logic.
- Added minimum and maximum fly heights.
- Improved "On Spawn" combat trigger to be retriggered if the AI was reset.
- Fixed a bug where the grid projectile wasn't properly centered.
- Fixed an issue where abilities couldn't be interrupted/stopped.
- Fixed a bug that caused telegraphs to remain after death.
- Fixed a bug which made Charge and Leap abilities to "teleport" the Boss when briefly blocked by an actor.
- Fixed dodge sometimes being interrupted by an ability.
- Fixed a bug with Wave Ring where it wasn't visually replicated in multiplayer.
- Other minor bug fixes and improvements.

Update v1.2.1

- Fixed package error for 5.2 and above.
- Fixed ability execution order conflicting with Desired Range feature.

Update v1.2.0

- NEW: Projectile abilities (Grid, Circle, Spiral, etc.).
- NEW: Wave Ring ability.
- NEW: Dive ability and Circular Charge ability.
- NEW: Maintain Desired Range. Useful for purely ranged bosses.
- Improved combo system by adding optional combos.
- Added Force Show Telegraph option.
- Health Bar Visibility can now be controlled by distance or aggro.
- Added more event dispatchers (On Use Ability, On Dodge, and On Boss Death).
- Abilities can now be manually triggered by calling Activate Ability and inputting an index.
- Hitbox ability now rotates towards the actor itself by default.
- Fixed a bug where projectile spawn would be off by 1 count.
- Fixed an issue where the ability actor would be destroyed before all of its spawned projectiles were destroyed.
- Refactored some ability functions.
- Added Curve Assets for Charge, Dive, and Leap abilities.
- Strafing now gets a location from the target actor instead of the boss.
- Some minor fixes and adjustments.

Update v1.1.2

- Fixed an issue where Priority Scoring was unclamped and led to scoring bugs.
- Fixed an issue where boss HP wasn't removed on death.

- Fixed a bug for Unreal 5.1 where the FPS character has the mesh of the Third Person character.

Update v1.1.0

- NEW Grab attacks for bosses.
- NEW Sequencer trigger for phase changes.
- NEW FPS Player for testing shooter boss example.
- Improved the Charge Ability to have an option for continuous target tracking.
- Added Status Effects component to Boss Base. Some bosses can now be debuffed, crowd controlled, and grabbed.
- Added status effect icons to Boss's health bar.
- Added support for phase triggers with zero Health.
- Added Launch Strength property for Knock Back and Know Up crowd control states.
- Added Hit Type property in the Ability Damage struct.
- Added Stun Duration property for stunning the Boss.
- Added Boss VS Boss example map.
- Fixed a bug where bosses that were blocking or dodging always faced the 1st Player.
- Renamed the TakeDamage function to TakeDamageBoss so it doesn't conflict with AIBT.
- Fixed an issue where non-enemy targeting abilities would end the combat state if no target was found.
- Fixed a visual bug for staggered/stunned Bosses.
- Added a warning message when Damage Type is invalid.
- Other minor fixes and adjustments for the Player and Boss examples.

Update v1.0.1

- Added next phase trigger: Random.
- Triggering the next phase for the last phase in the array will now make the boss loop back to the 1st phase.
- Added enemy and ally distinction for Priority Score.
- If "Get Priority Score" isn't implemented, it will use distance to calculate the score instead.
- Fixed a bug with player dodge.
- Fixed some null pointer issues.