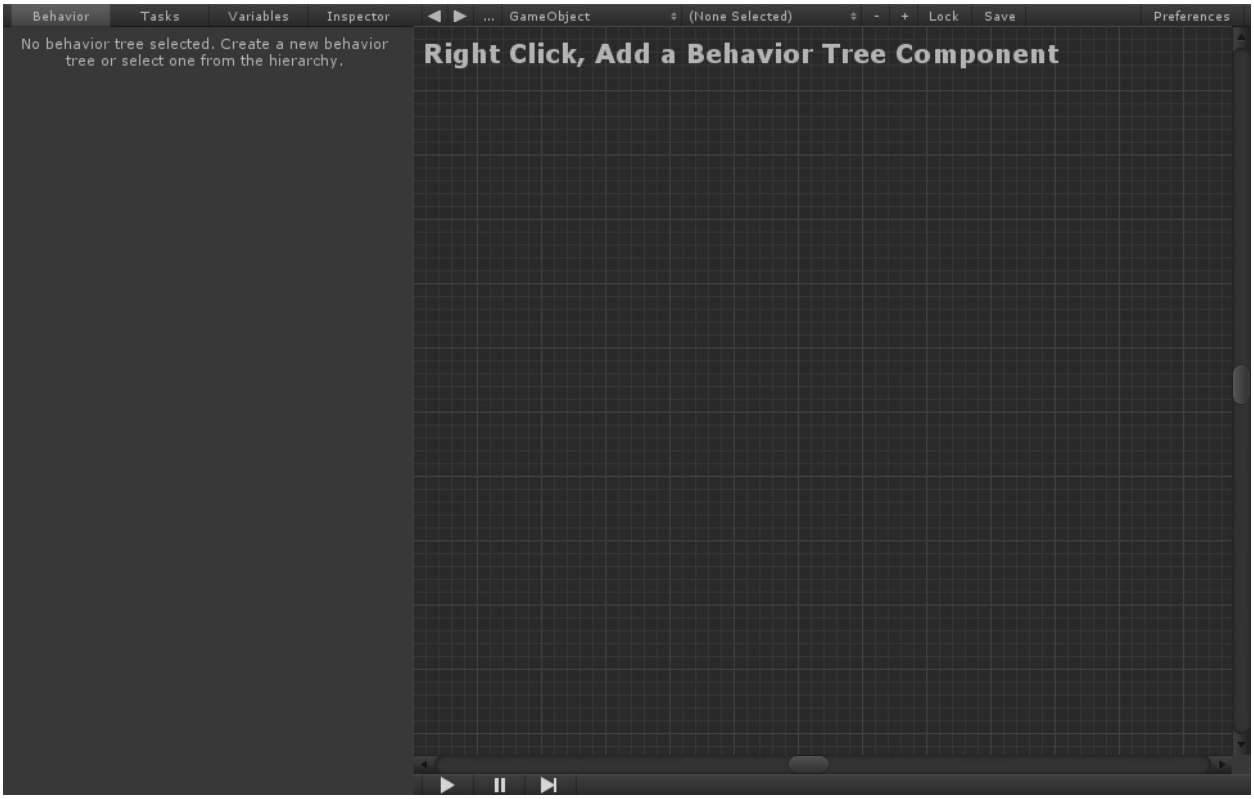
Thank you for your purchase! The most recent documentation can be found online. If you have any questions feel free to post on the forums or email support@opsive.com.

Overview

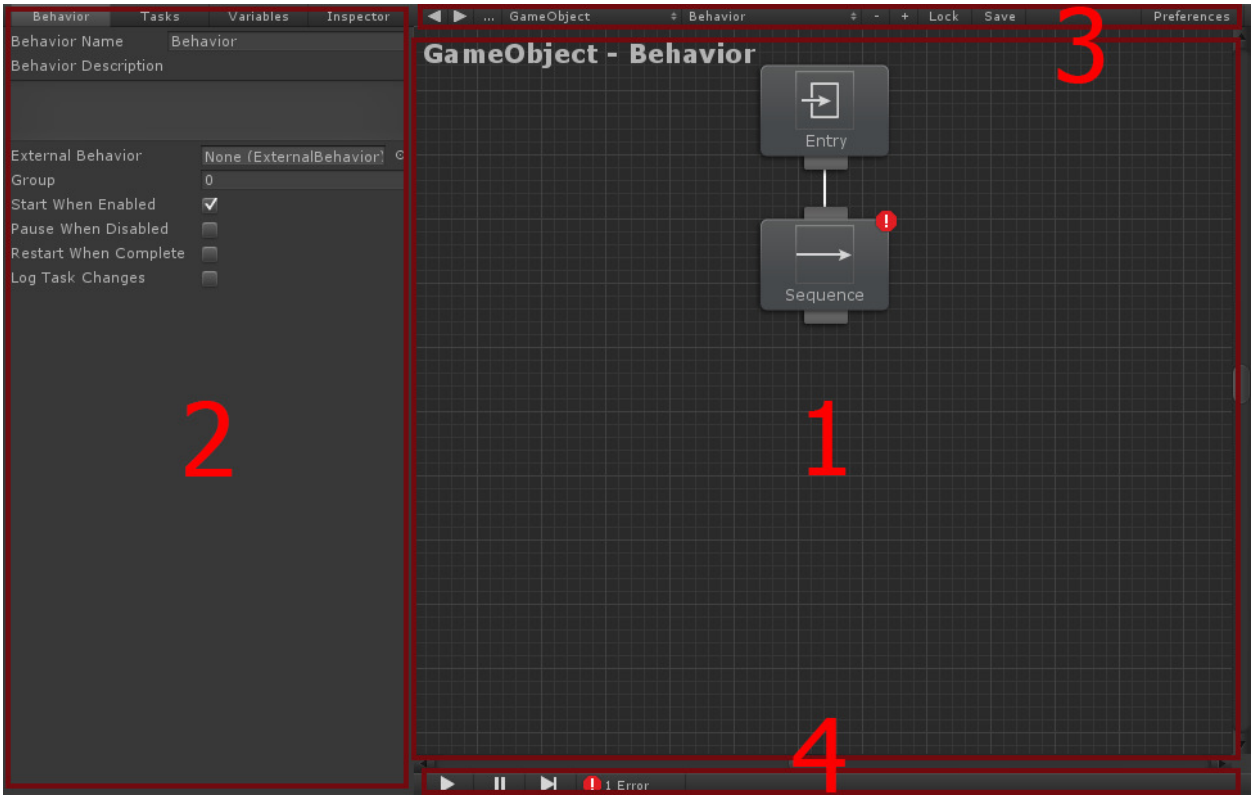
Behavior Designer is a behavior tree implementation designed for everyone - programmers, artists, designers. Behavior Designer offers a powerful API allowing you to easily create new tasks. it offers an intuitive visual editor with PlayMaker and uScript integration which makes it possible to create complex AIs without having to write a single line of code.

This guide is going to give a general overview of all aspects of Behavior Designer. If you don't know what behavior trees are take a look at our quick overview of behavior trees. With Behavior Designer you don't need to know how behavior trees are implemented but it is a good idea to know some of the key concepts such as the types of tasks (action, composite, conditional and decorator). You can watch the video version of this topic here.

When you first open Behavior Designer you'll be presented with the following window:

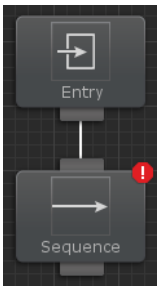


There are four sections within Behavior Designer. From the screenshot below, section 1 is the graph area. It is where you'll be creating the behavior trees. Section 2 is a properties panel. The properties panel is where you'll be editing the specific properties of a behavior tree, adding new tasks, creating new variables, or editing the parameters of a task. Section 3 is the behavior tree operations toolbar. You can use the drop down boxes to select existing behavior trees or add/remove behavior trees. The final section, section 4, is the debug toolbar. You can start/stop, step, and pause Unity within this panel. In addition, you'll see the number of errors that your tree has even before you start executing your tree.

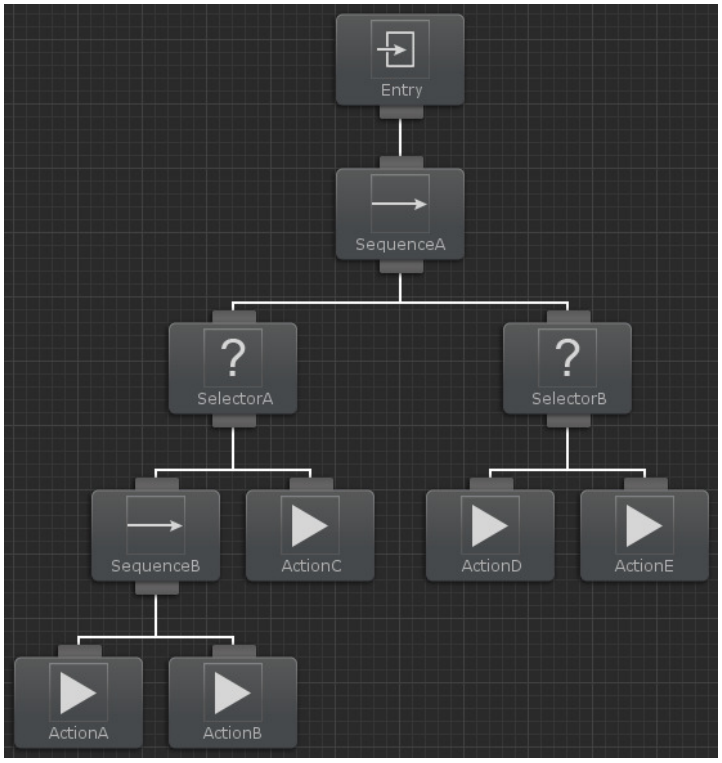


Section 1 is the main part of Behavior Designer that you'll be working in. Within this section you can create new tasks and arrange those tasks into a behavior tree. To start things off, you first need to add a Behavior Tree component. The Behavior Tree component will act as the manager of the behavior tree that you are just starting to create. You can create a new Behavior Tree component by right clicking within the graph area and clicking "Add Behavior Tree" or by clicking on the plus button next to "Lock" within the operations area of section 3.

Once a Behavior Tree has been added you can start adding tasks. Add a task by right clicking within the graph area or clicking on the "Tasks" tab within section 2, the properties panel. Once a task has been added you'll see the following:



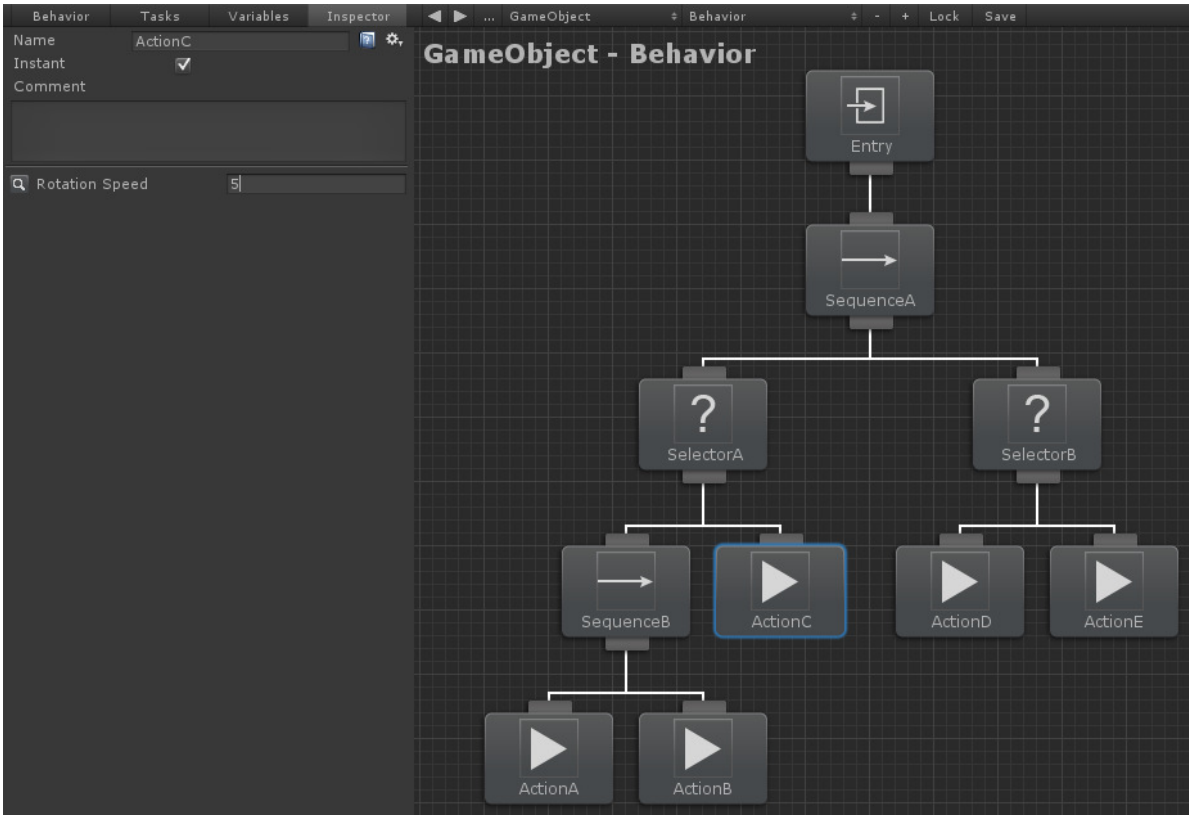
In addition to the task that you added, the entry task also gets added. The entry task acts as the root of the tree. That is the only purpose of the entry task. The sequence task has an error because it has no children. As soon as you add a child the error will go away. Now that we've added our first task lets add a few more:



You can connect the sequence and selector task by dragging from the bottom of the sequence task to the top of the selector task. Repeat this process for the rest of the tasks. If you make a mistake you can selection a connection and delete it with the delete key. You can also rearrange the tasks by clicking on a task and dragging it around.

Behavior Designer will execute the tasks in a depth first order. You can change the execution order of the tasks by dragging them to the left/right of their sibling. From the screenshot above, the tasks will be executed in the following order:

SequenceA, SelectorA, SequenceB, ActionA, ActionB, ActionC, SelectorB, ActionD, ActionE



Now that we have a basic behavior tree created, lets modify the parameters on one of the tasks. Select the ActionC node to bring up the Inspector within the properties panel. You can see here that we can rename the task, set the task to be instant, or enter a task comment. In addition, we can modify all public variables the task class contains. This includes assigning variables created within Behavior Designer. In our case the only public variable is the “Rotation Speed”. The value that we set the parameter to will be used within the behavior tree.

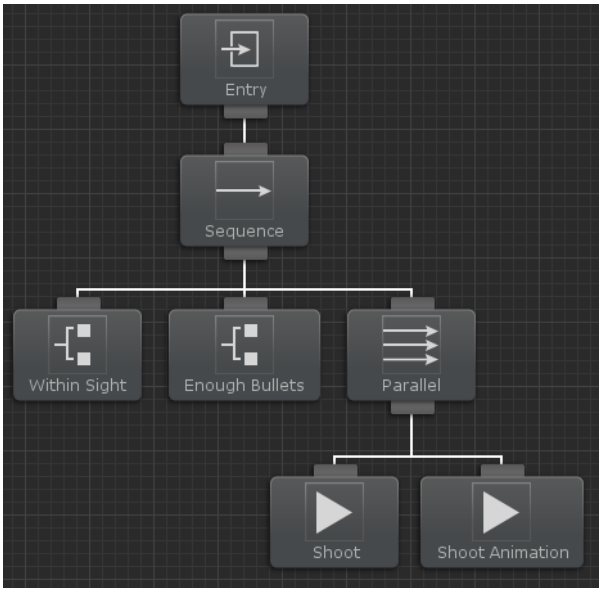
There are three other tabs within the properties panel: Variables, Tasks, and Behavior. The variables panel allows you to create variables that are shared between tasks. For more information take a look at the variables topic. The tasks panel lists all of the possible tasks that you can use. This is the same list as what is found when you right click and add a task. This list is created by searching for any class that is derived from the action, composite, conditional, or decorator task type. The last panel, the behavior panel, shows the inspector for the Behavior Tree component that you added when you first created a behavior tree. More details on what each option does can be found here.

The final section within the Behavior Designer window is the operations toolbar. The operations toolbar is mostly used for selecting behavior trees as well as adding/removing behavior trees. The arrows with the number 1 label will navigate between the behavior trees that you have opened. The drop down box with the number 2 label will list all of the behavior trees that are within the scene or the project. This means that it will include prefabs. The drop down box with the number 3 label will list any game object that has a behavior tree component added to it. This is also within the scene or project. Finally, the drop down box with the number 4 label will list any behavior trees that are attached to the game object that is selected from the number 3 drop down box.

The button with the number 5 label will remove the currently selected behavior tree. The button with the number 6 label will add a new behavior tree. The “Lock” button (number 7) will keep the active behavior tree selected even if you select a different game object within the hierarchy or project window. The “Save” button (number 8) will save the current behavior tree out as an asset. Finally, the “Preferences” button (number 9) will show any Behavior Designer preferences.

What is a Behavior Tree?

Behavior trees are a popular AI technique used in many games. Halo 2 was the first mainstream game to use behavior trees and they started to become more popular after a detailed description of how they were used in Halo 2 was released. Behavior trees are a combination of many different AI techniques: hierarchical state machines, scheduling, planning, and action execution. One of their main advantages is that they are easy to understand and can be created using a visual editor.



At the simplest level behavior trees are a collection of tasks. There are four different types of tasks: action, conditional, composite, and decorator. Action tasks are probably the easiest to understand in that they alter the state of the game in some way. Conditional tasks test some property of the game. For example, in the tree above the AI agent has two conditional tasks and two action tasks. The first two conditional tasks check to see if there is an enemy within sight of the agent and then ensures the agent has enough bullets to fire his weapon. If both of these conditions are true then the two action tasks will run. One of the action tasks shoots the weapon and the other task plays a shooting animation. The real power of behavior trees comes into play when you form different sub-trees. The two shooting actions could form one sub-tree. If one of the earlier conditional tasks fails then another sub-tree could be made that plays a different set of action tasks such as running away from the enemy. You can group sub-trees on top of each other to form a high level behavior.

Composite tasks are a parent task that hold a list of child tasks. From the above example, the composite tasks are labeled sequence and parallel. A sequence task runs each task once until all tasks have been run. It first runs the conditional task that checks to see if an enemy is within sight. If an enemy is within sight then it will run the conditional task that checks to see if the agent has any bullets left. If the agent has enough bullets then the parallel task will run that shoots the weapon and plays the shooting animation. Where a sequence task executes one child task at a time, a parallel task executes all of its children at the same time.

The final type of task is the decorator task. The decorator task is a parent task that can only have one child. Its function is to modify the behavior of the child task in some way. In the above example we didn’t use a decorator task but you may want to use one if you want to stop a task from running prematurely (called the interrupt task). For example, an agent could be performing a task such as collecting resources. It could then have an interrupt task that will stop the collection of resources if an enemy is nearby. Another example of a decorator task is one that reruns its child task x number of times or a decorator task that keeps running the child task until it completes successfully.

One of the major behavior tree topics that we have left out so far is the return status of a task. You may have a task that takes more than one frame to complete. For example, most animations aren't going to start and finish within just one frame. In addition, conditional tasks need a way to tell their parent task whether or not the condition was true so the parent task can decide if it should keep running its children. Both of these problems can be solved using a task status. A task is in one of three different states: running, success, or failure. In the first example the shoot animation task has a task status of running for as long as the shoot animation is playing. The conditional task of determining if an enemy is within sight will return success or failure within one frame.

Behavior Designer takes all of these concepts and packages it up in an easy to use interface with an API that is similar to Unity’s MonoBehaviour API. Behavior Designer

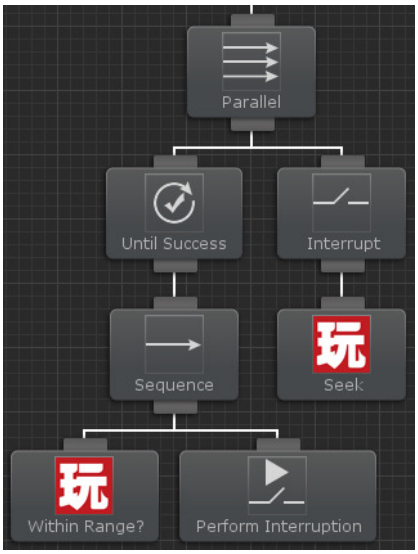
includes many composite and decorator classes within the standard installation. Action and conditional tasks are more game specific so not as many of those tasks are included but there are many examples within the sample projects. New tasks can be created by extending from one of the task types, or they can be created using PlayMaker or uScript. In addition, many videos have been created to make learning Behavior Designer as easy as possible.

For information on the implementation of a behavior tree, take a look at this AltDevBlog post.

Behavior Trees or Finite State Machines

On the Unity Forums SteveB asked an interesting question: why a behavior tree and why not a finite state machine (PlayMaker)? According to some, the age of finite state machines is over. We aren't going to go that far, but we are going to say that a finite state machine should not be the only AI technique that you use in your game. The true power comes when you combine both behavior trees and finite state machines together.

Before we continue, we want to point out that finite state machines are by no means required for behavior trees to work. Behavior trees work exceptionally well when used all by themselves. The CTF and RTS sample projects were created using only behavior trees. Behavior trees describe the *flow* of the AI whereas finite state machines can be used to describe the *function*.



Behavior trees have a few advantages over finite state machines: they provide lots of flexibility, are very powerful, and they are really easy to make changes to. But they definitely do not replace the functionality of finite state machines. This is why when you combine a behavior tree with a finite state machine, you can do some really cool things.

Lets first look at the first advantage: flexibility. With a finite state machine (such as PlayMaker), how do you run two different states at once? The only way we have figured it out is to create two separate finite state machines. With a behavior tree all that you need to do is add the parallel task and you are done - all child tasks will be running in parallel. With Behavior Designer, those child tasks could be a PlayMaker FSM and those FSMs will be running in parallel. In addition, lets say that you also have another task running in parallel and it detects a condition where it needs to stop the PlayMaker tasks from running. All you need to do for this situation is add an interrupt task and that task will be able to end the PlayMaker tasks immediately.

One more example of flexibility is the task guard task. In this example you have two different tasks that play a sound effect. The two different tasks are in two different branches of the behavior tree so they do not know about each other and could potentially play the sound effect at the same time. You don't want this to happen because it doesn't sound good. In this situation you can add a semaphore task (called a task guard in Behavior Designer) and it will only allow one sound effect to play at a time. When the first sound finishes playing the second one will start playing.

Another advantage of behavior trees are that they are powerful. That isn't to say that finite state machines aren't powerful, it is just that they are powerful in different ways. In our view behavior trees allow your AI to adopt to current game state easier than finite state machines do. It is easier to create a behavior tree that will adopt to all sorts of situations whereas it would take a lot of states and transitions with a finite state machine in order to have similar AI.

One final behavior tree advantage is that they are really easy to make changes to. One of the reasons behavior trees became so popular is because they are easy to create with a visual editor. If you want to change the state execution order with a finite state machine you have to change the transitions between states. With a behavior tree, all you have to do is drag the task. You don't really have to worry about transitions. Also, it is really easy to completely change how the AI reacts to different situations just by changing the tasks around or adding a new parent task to a branch of tasks.

Just like behavior trees have advantages over finite state machines, finite state machines have different advantages over behavior trees. This is why the true magic happens when you join a behavior tree with a finite state machine. You can use PlayMaker for all of the condition/action tasks and Behavior joining Behavior Designer with PlayMaker is where the true magic happens. You can use PlayMaker for all of the condition/action tasks and Behavior Designer for the composite/decorator tasks. With this setup you'd be playing off of each others strengths. The flexibility of a BT and the functionality of a finite state machine.

Installation

After Behavior Designer is imported you can access it from the Tools toolbar. If you will be writing your tasks in UnityScript you will need to make a minor directory change to enable the UnityScript class to see the C# classes.

You can access the runtime source code by extracting downloading and extracting the Runtime Source Code package located here. Before you extract this package ensure that you have deleted the runtime and editor assemblies otherwise you'll get a compile error.

Accessing UnityScript/Boo Tasks

Even though all of the Behavior Designer tasks are written in C#, tasks can also be written in UnityScript or Boo. Due to the order that Unity compiles scripts, you'll first need to rearrange the Behavior Designer directory. By default, Behavior Designer installs in the following locations:

```
/Behavior Designer/Editor/...
/Behavior Designer/Runtime/...
/Behavior Designer/Third Party/...
/Gizmos
```

The only change that you need to make is to move the Runtime and Third Party directories to a folder that gets compiled first, such as Plugins. You will then have the following directory structure:

```
/Behavior Designer/Editor/...
/Gizmos
/Plugins/Behavior Designer/Runtime/...
/Plugins/Behavior Designer/Third Party/...
```

You will then be able to inherit your UnityScript/Boo object from a Task subclass, just as you would in C#. For example, the following UnityScript task is inherited from Action:

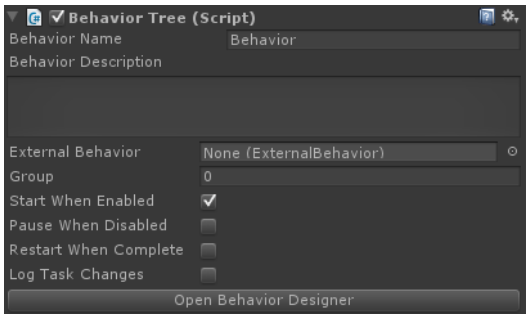
```
#pragma strict

class UnityScriptAction extends BehaviorDesigner.Runtime.Tasks.Action
{
    ...
}
```

If you have extracted the runtime source code you will need to make a similar change.

Compiling for the Windows Store/Phone

In order to compile Behavior Designer for the Windows Store and Windows Phone you must use the runtime source code instead of the compiled DLL. For instructions on how to extract the runtime source code take a look at the bottom of the installation topic. No compile settings need to be changed - Behavior Designer can compile with .Net Core enabled.

Behavior Tree Component



The behavior tree component stores your behavior tree and acts as the interface between Behavior Designer and the tasks. The following API is exposed for starting and stopping your behavior tree:

```
public void EnableBehavior();
public void DisableBehavior(bool pause = false);
```

You can find tasks using one of the following methods:

```
TaskType FindTask< TaskType >();
List< TaskType > FindTasks< TaskType >();
Task FindTaskWithName(string taskName);
List< Task > FindTasksWithName(string taskName);
```

The current execution status of the tree can be obtained by calling:

```
behaviorTree.ExecutionStatus;
```

A status of Running will be returned when the tree is running. When the tree finishes the execution status will be Success or Failure depending on the task results

The behavior tree component has the following properties:

Behavior Name
The name of the behavior tree

Behavior Description
Describes what the behavior tree does

External Behavior
A field to specify the external behavior tree that should be run when this behavior tree starts

Group
A numerical grouping of behavior trees. Can be used to easily find behavior trees. The CTF sample project shows an example of this

Start When Enabled
If true, the behavior tree will start running when the component is enabled

Pause When Disabled
If true, the behavior tree will pause when the component is disabled. If false, the behavior tree will end

Restart When Complete
If true, the behavior tree will restart from the beginning when it has completed execution. If false, the behavior tree will end

Log Task Changes
Used for debugging. If enabled, the behavior tree will output any time a task status changes, such as it starting or stopping

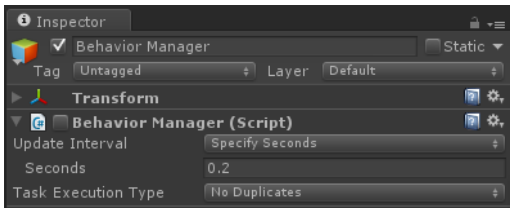
Creating a Behavior Tree from Script

In some circumstances you might want to create a behavior tree from script instead of directly relying on a prefab to contain the behavior tree for you. For example, you may have saved out an external behavior tree and want to load that tree in from a newly created behavior tree. This is possible by setting the externalBehavior variable on the behavior tree component:

```
using UnityEngine;
using BehaviorDesigner.Runtime;

public class CreateTree : MonoBehaviour
{
   public ExternalBehaviorTree behaviorTree;

   void Start () {
      var bt = gameObject.AddComponent();
      bt.ExternalBehavior = behaviorTree;
      bt.StartWhenEnabled = false;
   }
}
```

In this example the public variable behaviorTree contains a reference to your external behavior tree. When the newly created tree loads it will load the external behavior tree for all of its tasks. To prevent the tree from running immediately we set startWhenEnabled to false. The tree can then be started manually with bt.enableBehavior().

Behavior Manager



When a behavior tree runs it creates a new GameObject with a BehaviorManager component if it isn't already created. This component manages the execution of all of the behavior trees in your scene.

You can control how often the behavior trees tick by changing the update interval property. "Every Frame" will tick the behavior trees every frame within the Update loop. "Specify Seconds" allows you to tick the behavior trees a given number of seconds. The final option is "Manual" which will give you the control of when to tick the behavior trees. You can tick the behavior trees by calling tick:

```
BehaviorManager.instance.Tick();
```

In addition, if you want each behavior tree to have its own tick rate you can tick each behavior tree manually with:

```
BehaviorManager.instance.Tick(BehaviorTree);
```

Task Execution Type allows you to specify if the behavior tree should continue executing tasks until it hits an already executed task during that tick or if it should continue to execute the tasks until a maximum number of tasks have been executed during that tick. As an example, consider the following behavior tree:

The Repeater task is set to repeat 5 times. If the Task Execute Type is set to No Duplicates, the Play Sound task will only execute once during a single tick. If the Task Execution Type is set to Count, a maximum task execution count can be specified. If a value of 5 is specified then the Play Sound task will execute all 5 times in a single tick.

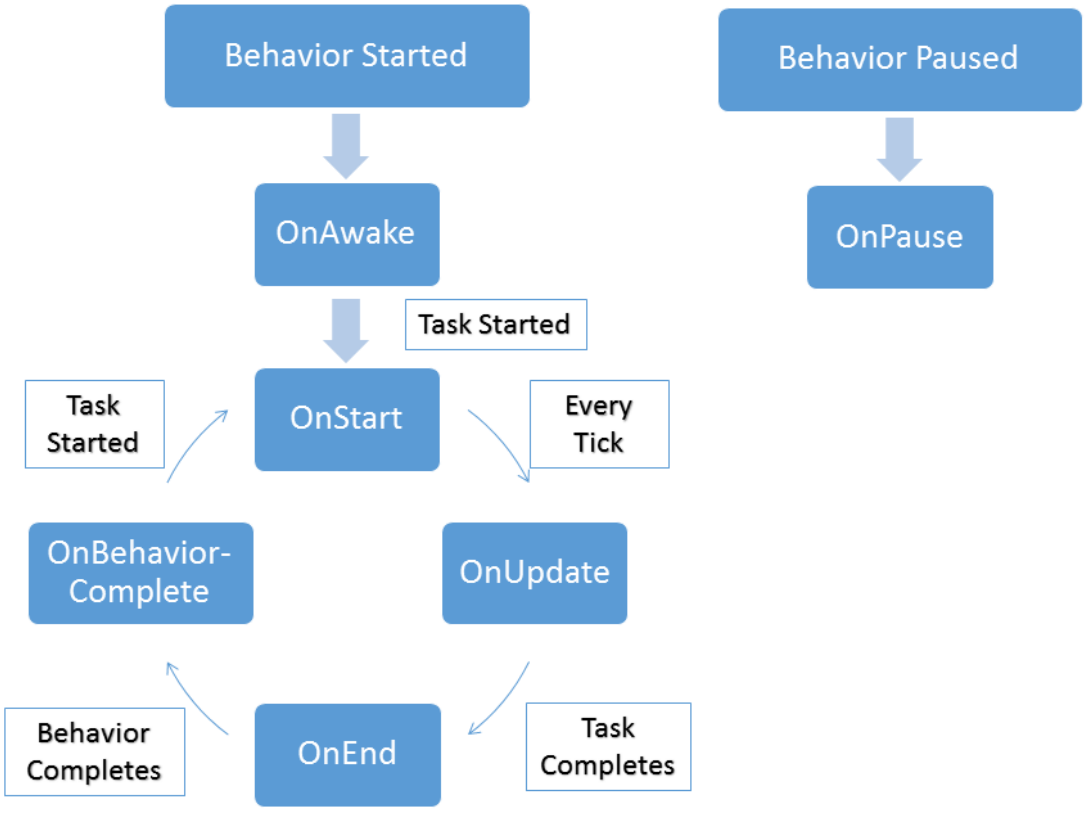
Tasks

At the highest level a behavior tree is a collection of tasks. Tasks have a similar API to Unity's MonoBehaviour so it should be really easy to get started writing your own tasks. The task class has the following API:

```
// OnAwake is called once when the behavior tree is enabled. Think of it as a constructor
public virtual void OnAwake();

// OnStart is called immediately before execution. It is used to setup any variables that need to be reset from the previous run
public virtual void OnStart();

// OnUpdate runs the actual task
public virtual TaskStatus OnUpdate();

// OnEnd is called after execution on a success or failure.
public virtual void OnEnd();

// OnPause is called when the behavior is paused and resumed
public virtual void OnPause(bool paused);

// The priority select will need to know this tasks priority of running
public virtual float GetPriority();

// OnBehaviorComplete is called after the behavior tree finishes executing
public virtual void OnBehaviorComplete();

// OnReset is called by the inspector to reset the public properties
public virtual void OnReset();

// Allow OnDrawGizmos to be called from the tasks
public virtual void OnDrawGizmos();

// Keep a reference to the behavior that owns this task
public Behavior Owner;
```

Tasks have three exposed properties: name, comment, and instant. Instant is the only property that isn't obvious in what it does. When a task returns success or fail it immediately moves onto the next task within the same update tick. If you uncheck the instant task it will now wait a update tick before the next task gets executed. This is an easy way to throttle the behavior tree.

The following flow chart is used when executing the task:



Parent Tasks

Parent Tasks are the composite and decorator tasks within the behavior tree. While the ParentTask API has no equivalent API to Unity's MonoBehaviour class, it is still pretty easy to determine what each method is used for.

```
// The maximum number of children a parent task can have. Will usually be 1 or int.MaxValue
public virtual int MaxChildren();

// Boolean value to determine if the current task is a parallel task
public virtual bool CanRunParallelChildren();
```

```
// The index of the currently active child
public virtual int CurrentChildIndex();

// Boolean value to determine if the current task can execute
public virtual bool CanExecute();

// Apply a decorator to the executed status
public virtual TaskStatus Decorate(TaskStatus status);

// Notifies the parent task that the child has been executed and has a status of childStatus
public virtual void OnChildExecuted(TaskStatus childStatus);

// Notifies the parent task that the child at index childIndex has been executed and has a status of childStatus
public virtual void OnChildExecuted(int childIndex, TaskStatus childStatus);

// Notifies the task that the child has started to run
public virtual void OnChildStarted();

// Notifies the parallel task that the child at index childIndex has started to run
public virtual void OnChildStarted(int childIndex);

// Some parent tasks need to be able to override the status, such as parallel tasks
public virtual TaskStatus OverrideStatus(TaskStatus status);

// The interrupt node will override the status if it has been interrupted.
public virtual TaskStatus OverrideStatus();

// Notifies the composite task that an conditional abort has been triggered and the child index should reset
public virtual void OnConditionalAbort(int childIndex);
```

Writing a New Conditional Task

This topic is divided into two parts. The first part describes writing a new conditional task, and the second part (available here) describes writing a new action task. The conditional task will determine if any objects are within sight and the action class will towards the object that is within sight. We will also be using variables for both of these tasks. We have also recorded a video on this topic and it is available here.

The first task that we will write is the Within Sight task. Since this task will not be changing game state and is just checking the status of the game this task will be derived from the Conditional task. Make sure you have the BehaviorDesigner.Runtime.Tasks namespace included:

```
using UnityEngine;
using BehaviorDesigner.Runtime.Tasks;

public class WithinSight : Conditional
{
}
```

We now need to create three public variables and one private variable:

```
using UnityEngine;
using BehaviorDesigner.Runtime;
using BehaviorDesigner.Runtime.Tasks;

public class WithinSight : Conditional
{
   public float fieldOfViewAngle;
   public string targetTag;
   public SharedTransform target;

   private Transform[] possibleTargets;
}
```

The fieldOfViewAngle is the field of view that the object can see. targetTag is the tag of the targets that the object can move towards. target is a shared variable which will be used by both the Within Sight and the Move Towards tasks. If you are using shared variables make sure you include the BehaviorDesigner.Runtime namespace. The final variable, possibleTargets, is a cache of all of the Transforms with the targetTag. If you take a look at the task API, you can see that we can create that cache within the the OnAwake or OnStart method. Since the list of possible transforms are not going to be changing as the Within Sight task is enabled/disabled we are going to do the caching within OnAwake:

```
   public override void OnAwake()
   {
      var targets = GameObject.FindGameObjectsWithTag(targetTag);
      possibleTargets = new Transform[targets.Length];
      for (int i = 0; i < targets.Length; ++i) {
         possibleTargets[i] = targets[i].transform;
      }
   }
```

This OnAwake method will find all of the GameObjects with the targetTag, then loop through them caching their transform in the possibleTargets array. The possibleTargets array is then used by the overridden OnUpdate method:

```
   public override TaskStatus OnUpdate()
   {
      for (int i = 0; i < possibleTargets.Length; ++i) {
         if (withinSight(possibleTargets[i], fieldOfViewAngle)) {
            target.Value = possibleTargets[i];
            return TaskStatus.Success;
         }
      }
      return TaskStatus.Failure;
   }
```

Every time the task is updated it checks to see if any of the possibleTargets are within sight. If one target is within sight it will set the target value and return success. Setting

this target value is key as this allows to Move Towards task to know what direction to move in. If there are no targets within sight then the task will return failure. The last part of this task is the withinSight method:

```
   public bool withinSight(Transform targetTransform, float fieldOfViewAngle)
   {
      Vector3 direction = targetTransform.position - transform.position;
      return Vector3.Angle(direction, transform.forward) < fieldOfViewAngle;
   }
```

This method first gets a direction vector between the current transform and the target transform. It will then compute the angle between the direction vector and the current forward vector to determine the angle. If that angle is less then fieldOfViewAngle then the target transform is within sight of the current transform. One thing to note is that unlike MonoBehaviour objects, all tasks already have all of the MonoBehaviour components cached so we do not need to precache the transform component.

That's it for the Within Sight task. Here's what the full task looks like:

```
using UnityEngine;
using BehaviorDesigner.Runtime;
using BehaviorDesigner.Runtime.Tasks;

public class WithinSight : Conditional
{
   // How wide of an angle the object can see
   public float fieldOfViewAngle;
   // The tag of the targets
   public string targetTag;
   // Set the target variable when a target has been found so the subsequent tasks know which object is the target
   public SharedTransform target;

   // A cache of all of the possible targets
   private Transform[] possibleTargets;

   public override void OnAwake()
   {
      // Cache all of the transforms that have a tag of targetTag
      var targets = GameObject.FindGameObjectsWithTag(targetTag);
      possibleTargets = new Transform[targets.Length];
      for (int i = 0; i < targets.Length; ++i) {
         possibleTargets[i] = targets[i].transform;
      }
   }

   public override TaskStatus OnUpdate()
   {
      // Return success if a target is within sight
      for (int i = 0; i < possibleTargets.Length; ++i) {
         if (withinSight(possibleTargets[i], fieldOfViewAngle)) {
            // Set the target so other tasks will know which transform is within sight
            target.Value = possibleTargets[i];
            return TaskStatus.Success;
         }
      }
      return TaskStatus.Failure;
   }

   // Returns true if targetTransform is within sight of current transform
   public bool withinSight(Transform targetTransform, float fieldOfViewAngle)
   {
      Vector3 direction = targetTransform.position - transform.position;
      // An object is within sight if the angle is less than field of view
      return Vector3.Angle(direction, transform.forward) < fieldOfViewAngle;
   }
}
```

Continue to the second part of this topic, writing the Move Towards task.

Writing a New Action Task

This topic is a continuation of the previous topic. It is recommended that you first take a look at the writing a new conditional task topic first.

The next task that we are going to write is the Move Towards task. Since this task is going to be changing the game state (moving an object from one position to another), we will derive the task from the Action class:

```
using UnityEngine;
using BehaviorDesigner.Runtime.Tasks;

public class MoveTowards : Action
{
}
```

This class will only need two variables: a way to set the speed and the transform of the object that we are targetting:

```
using UnityEngine;
using BehaviorDesigner.Runtime;
using BehaviorDesigner.Runtime.Tasks;

public class MoveTowards : Action
{
   public float speed = 0;
   public SharedTransform target;
}
```

The target variable is a SharedTransform and it will be set from the Within Sight task that will run just before the Move Towards task. To do the actual movement, we will need to override the OnUpdate method:

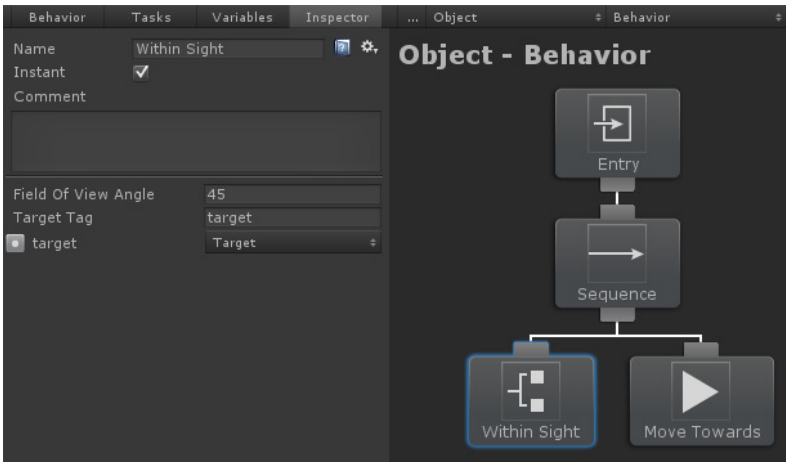
```
   public override TaskStatus OnUpdate()
   {
      if (Vector3.SqrMagnitude(transform.position - target.Value.position) < 0.1f) {
         return TaskStatus.Success;
      }
      transform.position = Vector3.MoveTowards(transform.position, target.Value.position, speed * Time.deltaTime);
      return TaskStatus.Running;
   }
```

When the OnUpdate method is run, it will check to see if the object has reached the target. If the object has reached the target then the task will success. If the target has not been reached yet the object will move towards the target at a speed specified by the speed variable. Since the object hasn't reached the target yet the task will return running.

That's the entire Move Towards task. The full task looks like:

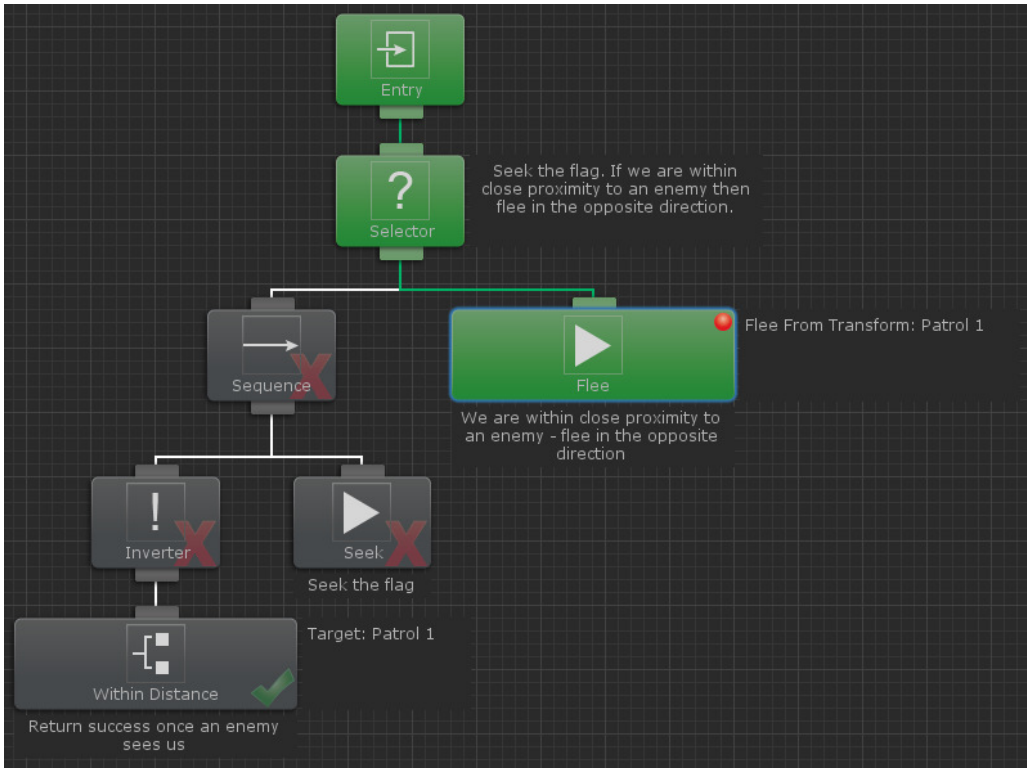
```
using UnityEngine;
using BehaviorDesigner.Runtime;
using BehaviorDesigner.Runtime.Tasks;

public class MoveTowards : Action
{
   // The speed of the object
   public float speed = 0;
   // The transform that the object is moving towards
   public SharedTransform target;

   public override TaskStatus OnUpdate()
   {
      // Return a task status of success once we've reached the target
      if (Vector3.SqrMagnitude(transform.position - target.Value.position) < 0.1f) {
         return TaskStatus.Success;
      }
      // We haven't reached the target yet so keep moving towards it
      transform.position = Vector3.MoveTowards(transform.position, target.Value.position, speed * Time.deltaTime);
      return TaskStatus.Running;
   }
}
```

Now that these two tasks are written, parent the tasks by a sequence task and set the variables within the task inspector. Make sure you've also created a new variable within Behavior Designer:



That's it! Create a few moving GameObjects within the scene assigned with the same tag as targetTag. When the game starts the object with the behavior tree attached with move towards whatever object first appears within its field of view. This was a pretty basic example and the tasks can get a lot more complicated depending on what you want them to do. All of the tasks within the sample projects are well commented so you should be able to pick it up from there. In addition, we have written some more documentation on the continuing topics such as variables, referencing tasks and task attributes.

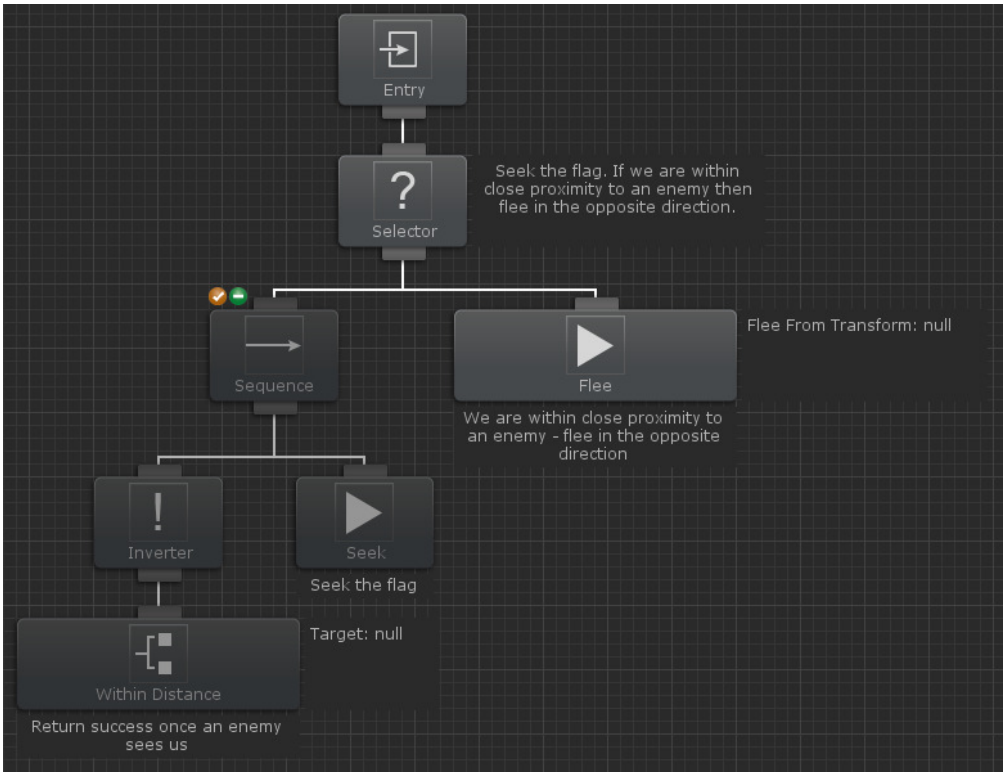
Debugging



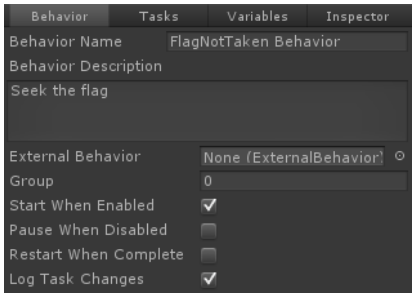
When a behavior tree is running you will see different tasks change colors between gray and green. When the task is green that means it is currently executing. When the task is gray it is not executing. After the task has executed it will have a check or x on the bottom right corner. If the task returned success then a check will be displayed. If it returned failure then an x will be displayed. While tasks are executing you can still change the values within the inspector and that change will be reflected in game.

Right clicking on a task will bring up a menu which allows you to set a breakpoint. If a breakpoint is set on a particular task then Behavior Designer will pause Unity whenever that task is activated. This is useful if you want to see when a particular task is executed.

When a task is selected you have the option of watching a variable within the graph by clicking on the magnifying glass to the left of the variable name. Watched variables are a good way to see the value of a particular variable without having to have the task inspector open. In the example above the variables "Fleed Distance" and "Flee From Transform" are being watched and appear to the right of the Flee task.



Sometimes you only want to focus on a certain set of tasks and prevent the rest from running. This is possible by disabling a set of tasks. Tasks can be disabled by hovering over the task and selecting the orange X on the top left of the task. Disabled tasks will not run and return success immediately. Disabled tasks appear in a darker color than the enabled tasks within the graph.



One more debugging option is to output to the console any time a task changes state. If “Log Task Changes” is enabled then you’ll see output to the log similar to the following:

```
GameObject - Behavior: Push task Sequence (index 0) at stack index 0
GameObject - Behavior: Push task Wait (index 1) at stack index 0
GameObject - Behavior: Pop task Wait (index 1) at stack index 0 with status Success
GameObject - Behavior: Push task Wait (index 2) at stack index 0
GameObject - Behavior: Pop task Wait (index 2) at stack index 0 with status Success
GameObject - Behavior: Pop task Sequence (index 0) at stack index 0 with status Success
Disabling GameObject - Behavior
```

These messages can be broken up into the following pieces:

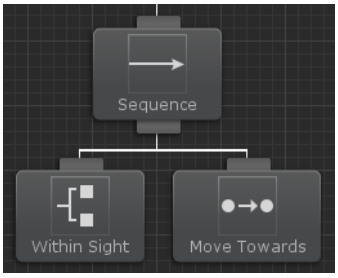
```
{game object name } - {behavior name}: {task change} {task type} (index {task index}) at stack index {stack index} {optional status}
```

{game object name} is the name of the game object that the behavior tree is attached to. {behavior name} is the name of the behavior tree. {task change} indicates the new status of the task. For example, a task will be pushed onto the stack when it starts executing and it will be popped when it is done executing . {task type} is the class type of the task. {task index} is the index of the task in a depth first search. {stack index} is the index of the stack that the task is being pushed to. If you have a parallel node then you’ll be using multiple stacks. {optional status} is any extra status for that particular change. The pop task will output the task status.

Variables

One of the advantages of behavior trees are that they are very flexible in that all of the tasks are loosely coupled - meaning one task doesn't depend on another task to operate. The drawback of this is that sometimes you need tasks to share information with each other. For example, you may have one task that is determine if a target is Within Sight. If the target is within sight you might have another task Move Towards the target. In this case the two tasks need to communicate with each other so the Move Towards task actually moves in the direction of the same object that the Within Sight task found. In traditional behavior tree implementations this is solved by coding a blackboard. With Behavior Designer it is a lot easier in that you can use variables.

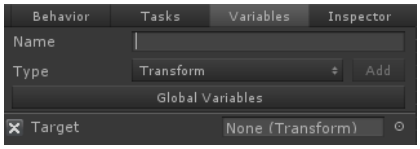
In our previous example we had two tasks: one that determined if the target is within sight and then the other task moves towards the target. This tree looks like:



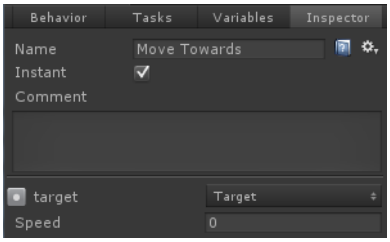
The code for both of these tasks is discussed in the Writing a New Task topic, but the part that deals with variables is in this variable declaration:

```
public SharedTransform target;
```

With the SharedTransform variable created, we can now create a new variable within Behavior Designer and assign that variable to the two tasks:



Switch to the task inspector and assign that variable to the two tasks:



And with that the two tasks can start to share information! You can get/set the value of the shared variable by accessing the Value property. For example, target.Value will return the transform object. When Within Sight runs it will assign the transform of the object that comes within sight to the Target variable. When Move Towards runs it will use that Target variable to determine what position to move towards.

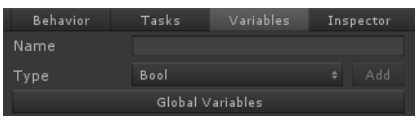
Behavior Designer supports both local and global variables. Global Variables are similar to local variables except any tree can reference the same variable. Variables can be referenced by non-Task derived classes by getting a reference to from the behavior tree.

The following shared variable types are included in the default Behavior Designer installation. If none of these types are suitable for your situation then you can create your own shared variable:

- SharedBool
- SharedColor
- SharedFloat
- SharedGameObject
- SharedGameObjectList
- SharedInt
- SharedMaterial
- SharedObject
- SharedObjectList
- SharedQuaternion
- SharedRect
- SharedString
- SharedTransform
- SharedTransformList
- SharedVector2
- SharedVector3
- SharedVector4

Global Variables

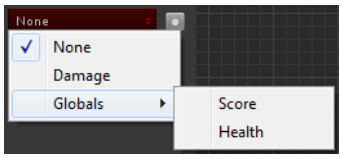
Global variables are similar to local variables except any behavior tree can access an instance of the same variable. To access global variables, navigate to the Window->Behavior Designer->Global Variables menu option or from within the Variables pane:



When a global variable is first added an asset file is created which stores all of the global variables. This file is created at /Behavior Designer/Resources

/BehaviorDesignerGlobalVariables.asset. You can move this file as long as it is still located in a Resources folder.

Global variables are assigned in a very similar way as local variables. In the task inspector, when you are assigning a global variable the global variables are located under the "Globals" menu item:



Global variables can also be accessed from non-Task derived objects.

Creating Shared Variables

New Shared Variables can be created if you don't want to use any of the built in types. To create a Shared Variable, subclass the SharedVariable type and implement the following methods. The keyword OBJECTTYPE should be replaced with the type of Shared Variable that you want to create.

```
[System.Serializable]
public class SharedOBJECTTYPE : SharedVariable
{
   public OBJECTTYPE Value { get { return mValue; } set { mValue = value; } }
   [SerializeField]
   private OBJECTTYPE mValue;

   public override object GetValue() { return mValue; }
   public override void SetValue(object value) { mValue = (OBJECTTYPE)value; }

   public override string ToString() { return mValue == null ? "null" : mValue.ToString(); }
}
```

It is important that the "Value" property exists. The variable inspector will show an error if the new Shared Variable is created incorrectly. Shared Variables can contain any type of object that your task can contain, including primitives, arrays, lists, custom objects, etc.

As an example, the following script will allow a custom class to be shared:

```
    [System.Serializable]
    public class CustomClass
    {
        public int myInt;
        public Object myObject;
    }

    [System.Serializable]
    public class SharedCustomClass : SharedVariable
    {
        public CustomClass Value { get { return mValue; } set { mValue = value; } }
        [SerializeField]
        private CustomClass mValue;

        public override object GetValue() { return mValue; }
        public override void SetValue(object value) { mValue = (CustomClass)value; }

        public override string ToString() { return (mValue == null ? "null" : mValue.ToString()); }
    }
```

Accessing Variables from non-Task Objects

Variables are normally referenced by assigning the variable name to the task field within the Behavior Designer inspector panel. Local variables can also be accessed by non-Task derived classes (such as MonoBehaviour) by calling the methods

```
behaviorTree.GetVariable("MyVariable");
behaviorTree.SetVariable("MyVariable", value);
behaviorTree.SetVariableValue("MyVariableName", value);
```

When setting a variable, if you want the tasks to automatically reference that variable then make sure a variable is created with that name ahead of time. The following code snippet shows an example of modifying a variable from a MonoBehaviour class:

```
using UnityEngine;
using BehaviorDesigner.Runtime;

public class AccessVariable : MonoBehaviour
{
   public BehaviorTree behaviorTree;

   public void Start()
   {
      var myIntVariable = (SharedInt)behaviorTree.GetVariable("MyVariable");
      myIntVariable.Value = 42;
   }
}
```

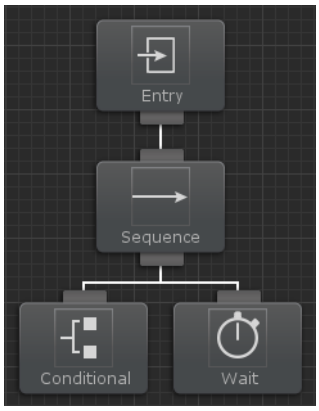
In the above example we are getting a reference to the variable named "MyVariable" within the Behavior Designer Variables pane. Also, as shown in the example, you can get and set the value of the variable with the SharedVariable.Value property.

Similarly, global variables can be accessed by getting a reference to the GlobalVariable instance:

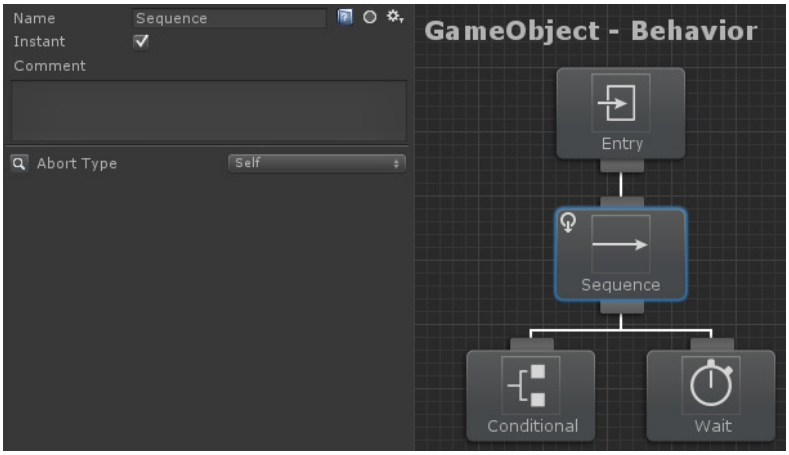
```
GlobalVariables.Instance.GetVariable("MyVariable");
GlobalVariables.Instance.SetVariable("MyVariable", value);
```

Conditional Aborts

Conditional aborts allow your behavior tree to dynamically respond to changes without having to clutter your behavior tree with many Interrupt/Perform Interrupt tasks. This feature is similar to the Observer Aborts in Unreal Engine 4. Most behavior tree implementations reevaluate the entire tree every tick. Conditional aborts are an optimization to prevent having to rerun the entire tree. As a basic example, consider the following tree:

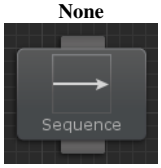


When this tree runs the Conditional task will return success and the Sequence task will start running the next child, the Wait task. The Wait task has a wait duration of 10 seconds. While the wait task is running, lets say that the conditional task changes changes state and now returns failure. If Conditional aborts are enabled, the Conditional task will issue an abort and stop the Wait task from running. The Conditional task will be reevaluated and the next task will run according to the standard behavior tree rules. Conditional aborts can be accessed from any Composite task:



There are four different abort types: None, Self, Lower Priority, and Both.

None

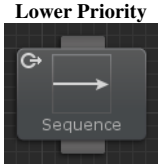


This is the default behavior. The Conditional task will not be reevaluated and no aborts will be issued.

Self

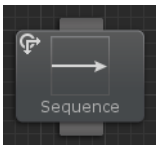
This is a self contained abort type. The Conditional task can only abort an Action task if they both have the same parent Composite task.

Lower Priority



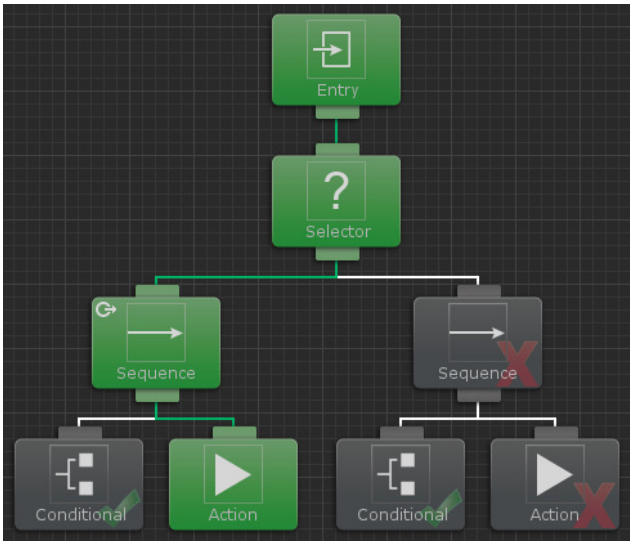
Behavior trees can be organized from more important tasks to least important. If a more important Conditional task changes status then can issue an abort that will stop the lower priority tasks from running.

Both



This abort type combines both self and lower priority

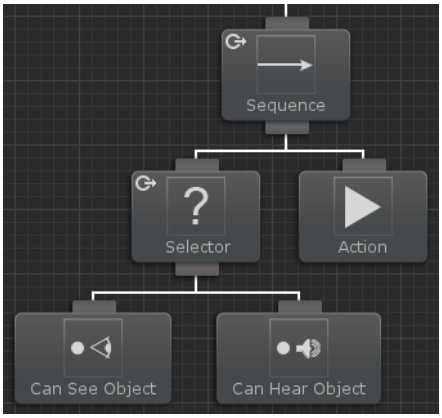
The following example will use the lower priority abort type:



In this example the parent Sequence task of the left branch has an abort type of lower priority. Lets say that the left branch fails and moves the tree onto the right branch due to the Selector parent task. While the right branch is running, the very first Conditional task changes status to success. Because the task status changed and the abort type was lower priority the Action task that is currently running gets aborted and the original Conditional task is rerun.

The conditional task's execution status will have a repeater icon around the success or failure status to indicate that it is being reevaluated by a conditional abort:

Conditional aborts can be nested beneath one another as well. For example, you may want to run a branch when one of two conditions succeed, but they both don't have to. In this example we will be using the Can See Object and Can Hear Object tasks. You want to run the action task when the object is either seen or heard. To do this, these two conditional tasks should be parented by a Selector with the lower priority abort type. The action task is then a sibling of the Selector task. A Sequence task is then parented to these two tasks because the action task should only run when either of the conditional tasks succeed. The Sequence task is set to a Lower Priority abort type so the two conditional tasks will continue to be reevaluated even when the tree is running a completely different branch.



The important thing to note with this tree is that the Selector task must have an abort type set to Self (or Both). If it does not have an abort type set then the two conditional tasks would not be reevaluated.

Events

The event system within Behavior Designer allows your behavior trees to easily react to changes. This event system can trigger an event via code or through behavior tree tasks.

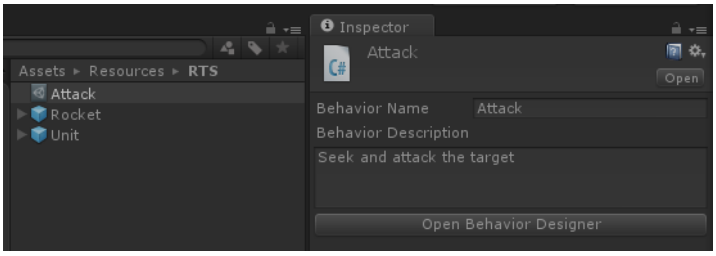
Events can be signaled through the behavior tree with the Send Event and the Has Received Event tasks. When an event should be signaled, the Send Event task should be used. The Has Received Event task is a conditional task and will return success as soon as the event has been received. An event name can be specified for both of these tasks.

In addition to being able to send events via the behavior tree, events can be sent through code. The BehaviorTree.SendEvent method will allow you to send an event to the specified behavior tree. For example:

```
var behaviorTree = GetComponent< BehaviorTree >();
behaviorTree.SendEvent("MyEvent");
```

In this example the "MyEvent" event will be sent to the behavior tree component. If the behavior tree contains the Has Received Event task then it will react accordingly.

External Behavior Trees



In some cases you may have a behavior tree that you want to run from multiple objects. For example, you could have a behavior tree that patrols a room. Instead of creating a separate behavior tree for each unit you can instead use an external behavior tree. An external behavior tree is referenced using the Behavior Tree Reference task. When the original behavior tree starts running it will load all of the tasks within the external behavior tree and act like they are its own. Furthermore, external behavior trees can inherit to make using external behavior trees even easier to use.

Referencing Tasks

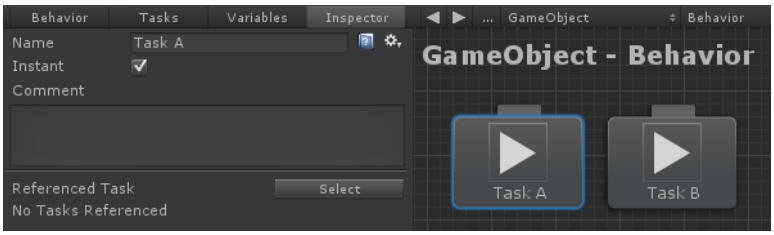
When writing a new task, in some cases it is necessary to access another task within that task. For example, TaskA may want to get the value of TaskB.SomeFloat. To accomplish this, TaskB needs to be referenced from TaskA. In this example TaskA looks like:

```
using UnityEngine;
using BehaviorDesigner.Runtime.Tasks;

public class TaskA : Action
{
   public TaskB referencedTask;

   public void OnAwake()
   {
      Debug.Log(referencedTask.SomeFloat);
   }
}
```

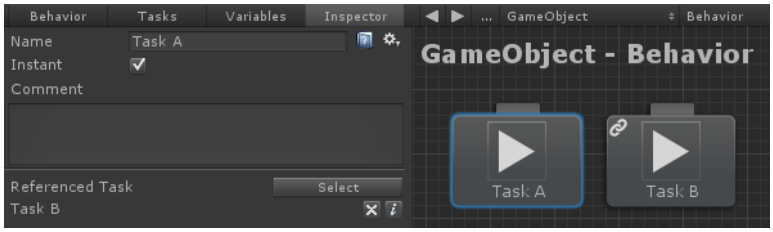
TaskB then looks like:

```
using UnityEngine;
using BehaviorDesigner.Runtime.Tasks;

public class TaskB : Action
{
   public float SomeFloat;
}
```

Add both of these tasks to your behavior tree within Behavior Tree and select TaskA.



Click the select button. You'll enter a link mode where you can select other tasks within the behavior tree. After you select Task B you'll see that Task B is linked as a referenced task:



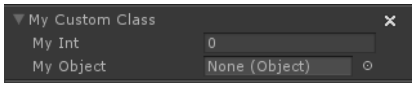
That is it. Now when you run the behavior tree TaskA will be able to output the value of TaskB's SomeFloat value. You can clear the reference by clicking on the “x” to the right of the referenced task name. If you click on the “i" then the linked task will highlight in orange:

Tasks can also be referenced using an array:

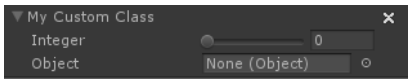
```
public class TaskA : Action
{
   public TaskB[] referencedTasks;
}
```

Object Drawers

Object Drawers are very similar to the Unity feature Property Drawers. Object drawers allow you to customize the look of different objects within the inspector. As an example, we will modify the Shared Custom Object example found in the Creating Your Own Shared Variable topic. With the default inspector, the SharedCustomClass variable looks like the following in the inspector:



For this example, we will limit the range of the integer between 0 and 10 using object drawers:



The following object drawer was used to accomplish this (this script goes in an Editor folder):

```
using UnityEngine;
using UnityEditor;
using BehaviorDesigner.Editor;

[CustomObjectDrawer(typeof(CustomClass))]
public class CustomClassDrawer : ObjectDrawer
{
   public override void OnGUI(GUIContent label)
   {
      var customClass = value as CustomClass;
      EditorGUILayout.BeginVertical();
      if (FieldInspector.DrawFoldout(customClass.GetHashCode(), label)) {
         EditorGUI.indentLevel++;
         customClass.myInt = EditorGUILayout.IntSlider("Integer", customClass.myInt, 0, 10);
         customClass.myObject = EditorGUILayout.ObjectField("Object", customClass.myObject, typeof(UnityEngine.Object), true);
         EditorGUI.indentLevel--;
      }
      EditorGUILayout.EndVertical();
   }
}
```

The only method that you need to override for object drawers to work is the OnGUI(GUIContent label) method. The label field is the name of the field that is being drawn. Just like property drawers, you can specify a object drawer by the class type or by attributes. The example above is using the class type method.

As another example, we will convert the Ranged Attribute used in Unity's example to a Object Drawer. First we need to create the attribute:

```
using UnityEngine;
using BehaviorDesigner.Runtime.Tasks;

public class RangeAttribute : ObjectDrawerAttribute
{
   public float min;
   public float max;

   public RangeAttribute(float min, float max)
   {
      this.min = min;
      this.max = max;
   }
}
```

Now that the attribute is created, we need to create the actual object drawer (this script goes in an Editor folder):

```
using UnityEngine;
using UnityEditor;
using BehaviorDesigner.Editor;

[CustomObjectDrawer(typeof(RangeAttribute))]
public class RangeDrawer : ObjectDrawer
{
   public override void OnGUI(GUIContent label)
   {
      var rangeAttribute = (RangeAttribute)attribute;
      value = EditorGUILayout.Slider(label, (float)value, rangeAttribute.min, rangeAttribute.max);
   }
}
```

Once both of these have been created, we can use it within a task:

```
using UnityEngine;
using BehaviorDesigner.Runtime;
using BehaviorDesigner.Runtime.Tasks;

public class NewAction : Action
```

```
{
   [Range(5, 10)]
   public float rangedFloat;
   public override TaskStatus OnUpdate()
   {
      Debug.Log(rangedFloat);
      return TaskStatus.Success;
   }
}
```

This will show up in the task inspector as:

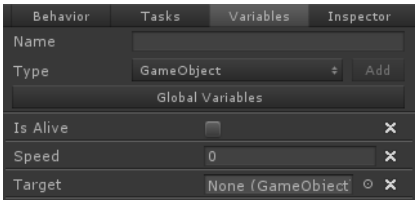
Variable Synchronizer

Shared Variables are great for sharing data across tasks and behavior trees. However, in some cases you want to share to same variables with non-behavior tree components. As an example, you may have a GUI Controller component which manages the GUI. This GUI Controller displays a GUI element indicating whether or not the agent being controlled by the behavior tree is alive. It does this by having a boolean which says whether or not the agent is alive:

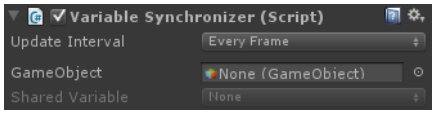
```
public bool isAlive { get; set; }
```

With the Variable Synchronizer component, you can automatically keep this boolean and the corresponding Shared Variable synchronized with each other.

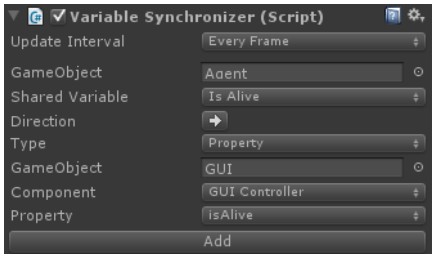
To setup the Variable Synchronizer, first make sure you have created the Shared Variables that you want to synchronize. For this example we created three Shared Variables:



Following that, add the Behavior Designer/Variable Synchronizer component to a GameObject.

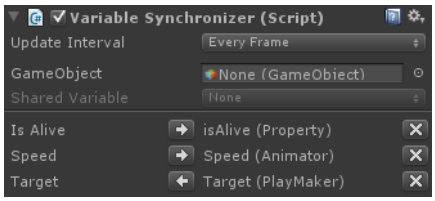


Next, start adding the Shared Variable that you want to keep synchronized. For this example we are going to add the Is Alive variable that was previously mentioned.



1. Specify the GameObject which contains the behavior tree that has the Shared Variable that you want to synchronize.
2. Select from the popup box which Shared Variable you want to use.
3. Specify a direction. If the arrow is pointing to the left then you are setting the Shared Variable value. If the arrow is pointing to the right then you are getting the Shared Variable value.
4. Specify the type of synchronization. Currently the following types are supported: Behavior Designer, Property, Animator, and PlayMaker.
5. The remaining steps will depend on the type of synchronization selected. In this example Property was selected so you'll need to select the component which contains the property that you want to synchronize with the Shared Variable.
6. Click Add.

Once added the Is Alive Shared Variable will set the isAlive property at an interval specified by Update interval. The following screenshot contains a few more synchronized variables:



- The Is Alive Shared Variable is setting the isAlive property.
- The Speed Share Variable is setting the Speed Animator parameter.
- The Target Shared Variable is being set by the Target PlayMaker variable.

Task Attributes

Behavior Designer exposes the following task attributes: HelpURL, TaskIcon, TaskCategory, TaskDescription, LinkedTask, and InheritedField.

If you open the task inspector panel you will see on the doc icon on the top right. This doc icon allows you to associate a help webpage with a task. You make this association with the HelpURL attribute:

```
[HelpURL("http://www.opsive.com/assets/BehaviorDesigner/documentation.php?id=27")]
public class Parallel : Composite
{
```

The HelpURL attribute takes one parameter which is the link to the webpage.

In addition to the HelpURL, a task can have the TaskIcon attribute:

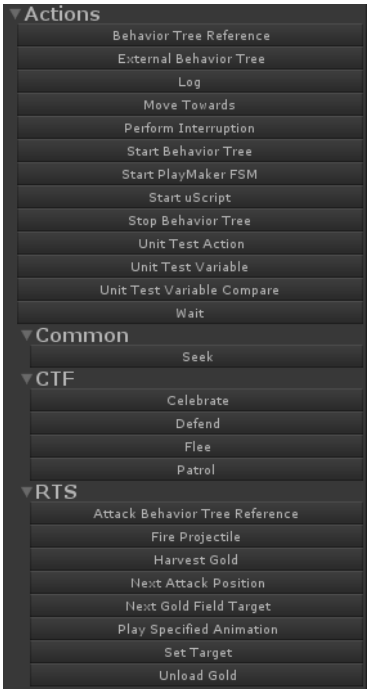
```
[TaskIcon("Assets/Path/To/{SkinColor}Icon.png")]
public class MyTask : Action
{
```

Task icons are shown within the behavior tree and are used to help visualize what a task does. Paths are relative to the root project folder. The keyword {SkinColor} will be replaced by the current Unity skin color, "Light" or "Dark".

Organization starts to become an issue as you create more and more tasks. For that you can use TaskCategory attribute:

```
[TaskCategory("Common")]
public class Seek : Action
{
```

This task will now be categorized under the common category:



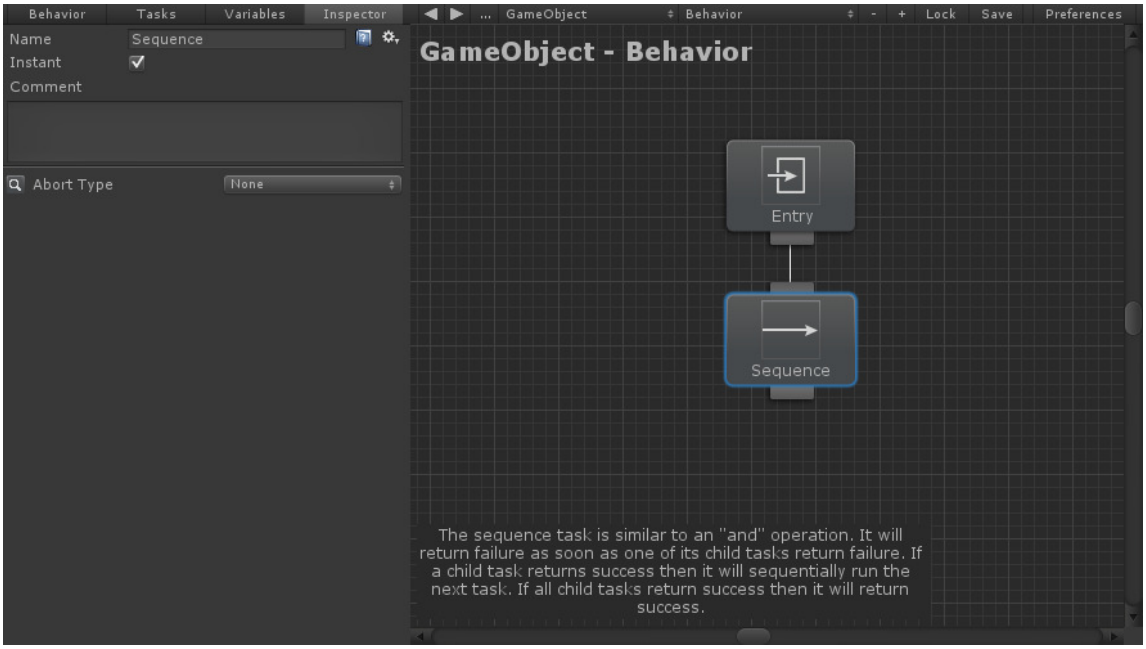
Categories may be nested by separating the category name with a slash:

```
[TaskCategory("RTS/Harvester")]
public class HarvestGold : Action
{
```

The TaskDescription attribute allows you to show your class-level comment within the graph view. For example, the sequence description starts out with:

```
[TaskDescription("The sequence task is similar to an \"and\" operation. ...")]
public class Sequence : Composite
{
```

This description will then be shown in the bottom left area of the graph:



Variables are great when you want to share information between tasks. However, you'll notice that there is no such thing as a "SharedTask". When you want a group of tasks to share the same tasks use the LinkedTask attribute. As an example, take a look at the task guard task. When you reference one task with the task guard, that same task will reference the original task guard task back. Linking tasks is not necessary, it is more of a convince attribute to make sure the fields have values that are synchronized. Add the following attribute to your field to enable task linking:

```
[LinkedTask]
public TaskGuard[] linkedTaskGuards = null;
```

To perform a link within the editor perform the same steps as referencing another task.

The InheritedField attribute is the last attribute exposed by Behavior Designer. Imagine a situation where you have a lot of external trees and the only thing that changes between them is one variable, such as the speed that the unit moves. In previous Behavior Designer versions you would have to create multiple behavior trees each with a different speed set or use a blackboard class. You can now add the InheritedField attribute to a variable and the value will be passed down from the external behavior tree task. In our move speed example, this will allow you to only have one external tree and change the move speed by changing the value on the external behavior tree task. The RTS sample project has an example of using the inherited field attribute.

```
[InheritedField]
public float moveSpeed;
```

Third Party Integrations

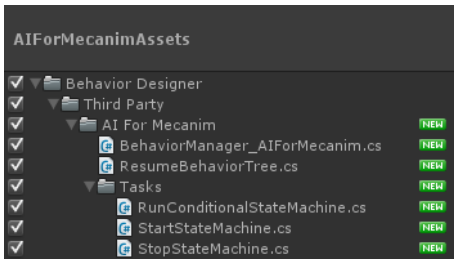
Behavior Designer includes many tasks which integrate with third party assets. For most of those integrations, no extra steps are required and they can be added to a behavior tree and then have their values assigned. However, the following integrations take a small amount of more work in order to fully work:

AI For Mecanim
Dialogue System
Motion Controller
PlayMaker
Realistic FPS
Third Person Controller
UFPS
uScript

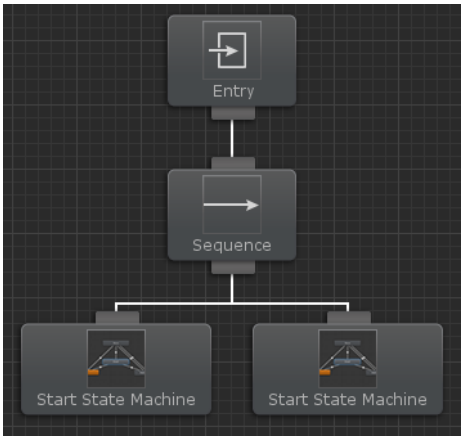
AI For Mecanim

AI For Mecanim allows you to create state machines with an interface similar to the mecanim animator interface. Behavior Designer is integrated with AI For Mecanim by allowing you to start and stop these state machines from within a behavior tree, as well as run a state machine as a conditional task. AI For Mecanim also includes a set of actions that allow you to start and stop a behavior tree from within the state machine. All of the AI For Mecanim integration files located on the integrations page.

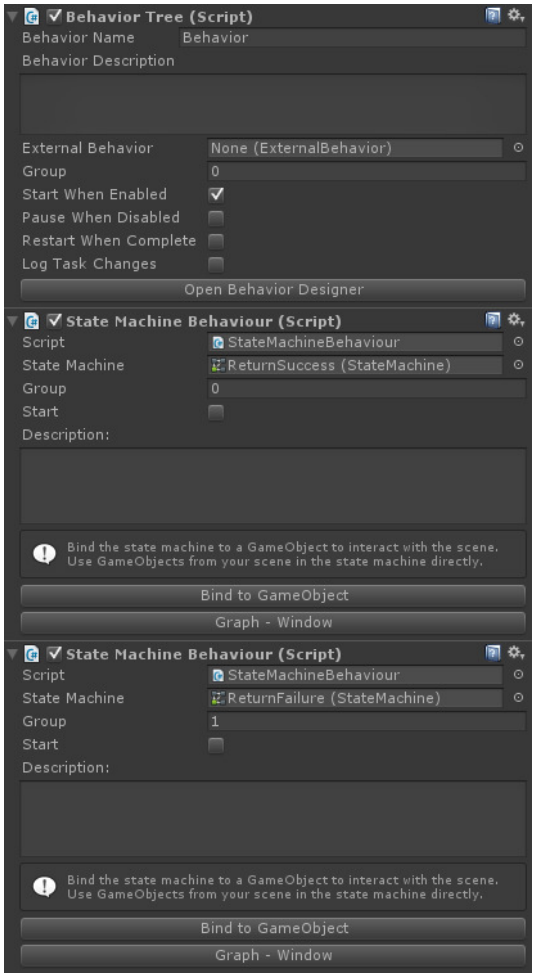
To get started, first make sure you have AI For Mecanim installed. Next, import AIForMecanimAssets.unitypackage:



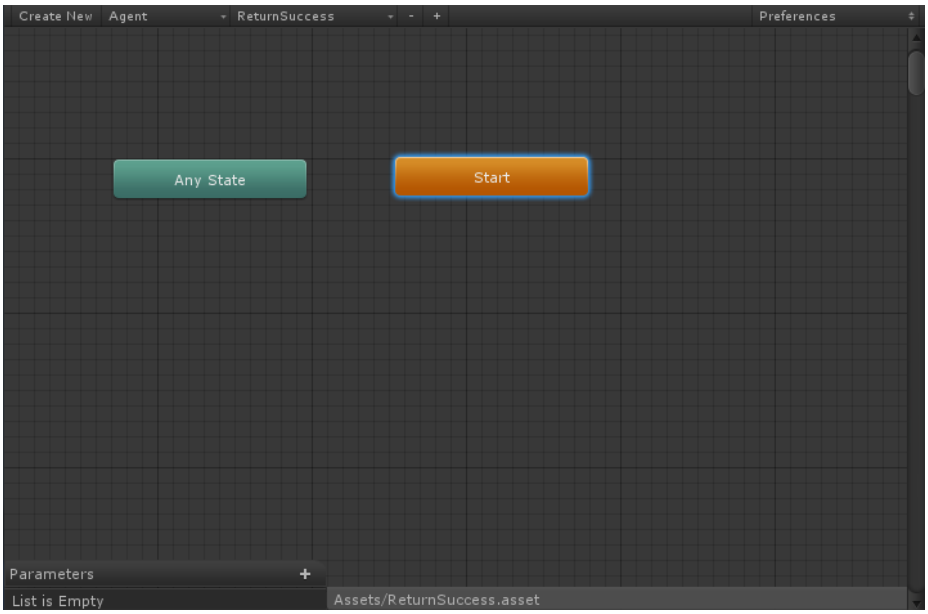
Once those files are imported you are ready to start creating behavior trees with AI For Mecanim! To get started, create a very basic tree with a sequence task who has two Start State Machine child tasks:



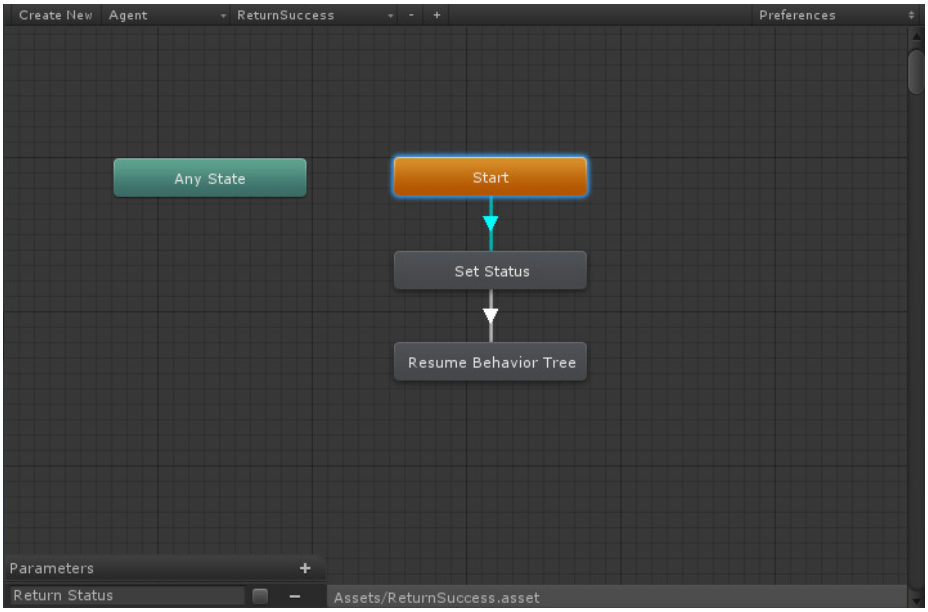
Next add two State Machine Behaviour components to the same GameObject that you added the behavior tree to. Since there are multiple State Machine Behaviours on the same GameObject ensure you have set the group number. In addition, assign the State Machine field to a new StateMachine and prevent the State Machine from starting when enabled.



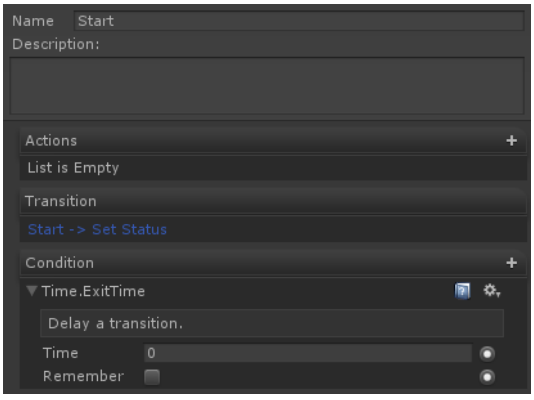
Open the AI For Mecanim editor and create a new state machine using one of the StateMachine objects that was just assigned to the State Machine Behaviour. Behavior Designer starts the state machine from the "Default" state so create a new state and ensure it is orange indicating that it is the default state.



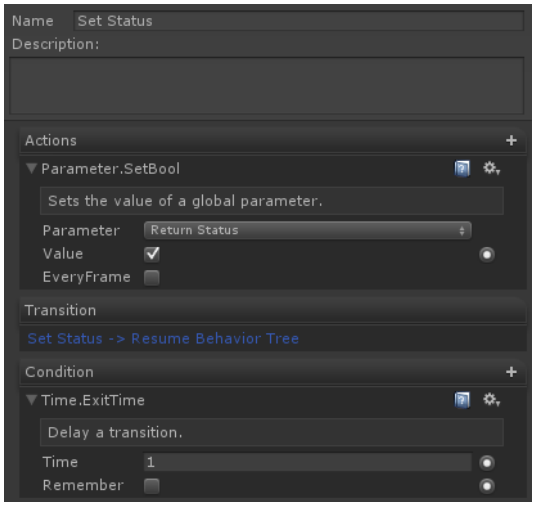
Create a new bool parameter (named Return Status) and two more states (named Set Status and Resume Behavior Tree). Add transitions from Start to Set Status and Set Status to Resume Behavior Tree. This state machine will simply set a bool to indicate the return status, wait a second, and finally resume the behavior tree.



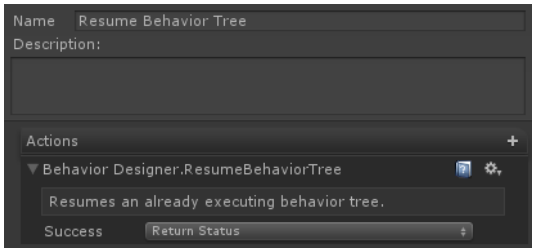
Select the Start state and view the State Inspector. For this state we only need to add a conditional which exits the state immediately.



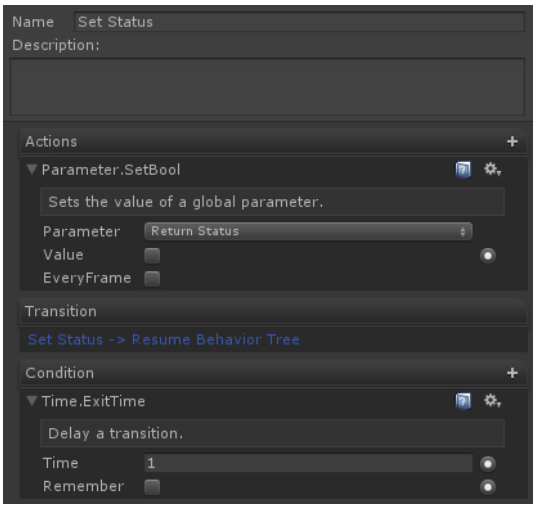
Select the Set Status state and view the State Inspector. Add the Parameter -> Set Bool action. This action will set the Return Status parameter to true. In addition, add a condition that exits the state after 1 second.



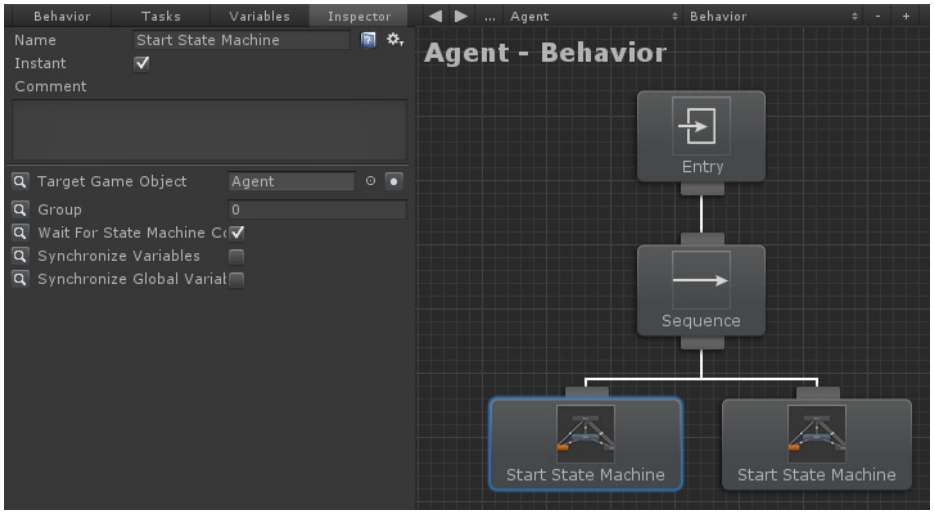
Select the Resume Behavior Tree state and view the State Inspector. Add the Behavior Designer -> Resume Behavior Tree action. Ensure you have set the Success variable to the Return Status parameter.



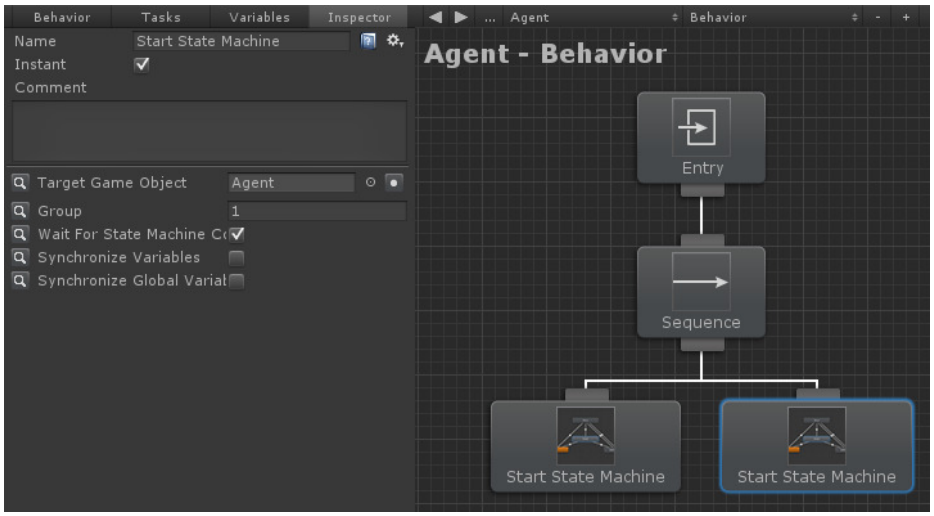
We are done setting up this state machine. Perform the same steps for the second state machine that we created earlier, only this time set the Return Status parameter to false within the Set Bool action.



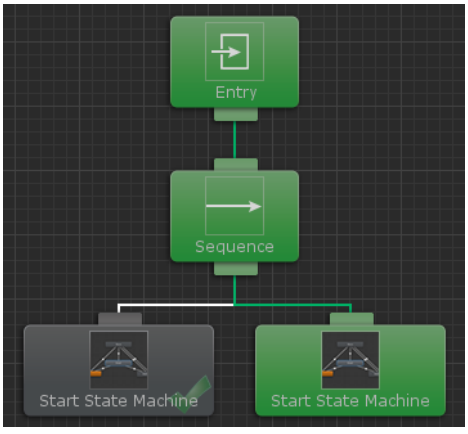
Open your behavior tree in Behavior Designer again and assign the Target Game Object and Group to point to the first state machine.



Set the fields of the second state machine task as well, making sure the group is set to 1.



We are now ready to run the behavior tree with AI For Mecanim integration! The first state machine's task will return success after 1 second because we set the Return Status parameter to true within the Set Status action. Similarly, the second state machine task will run for 1 second only this time it was return failure because the Return Status was set to false.

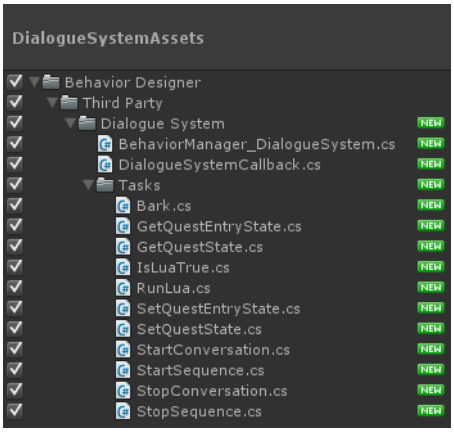


The behavior tree will never get to the second state machine if you were to swap the state machine tasks because the first state machine task returns failure.

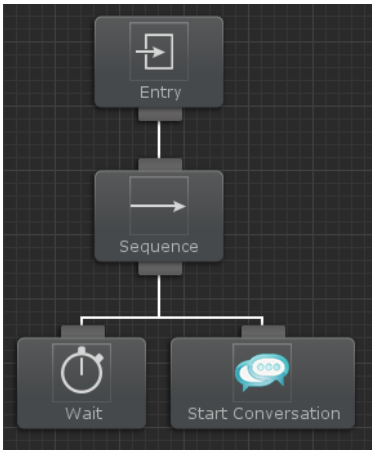
Dialogue System

The Dialogue System is a complete dialogue system for Unity. Behavior Designer is integrated with the Dialogue System by allowing you to manage conversations, barks, sequences, and quests within your behavior tree. Also, Dialogue System is integrated with Behavior Designer so it can synchronize variables with Lua and start/stop behavior trees with sequence commands. More information on this side of the integration can be found here. All of the Dialogue System integration files are located on the integrations page.

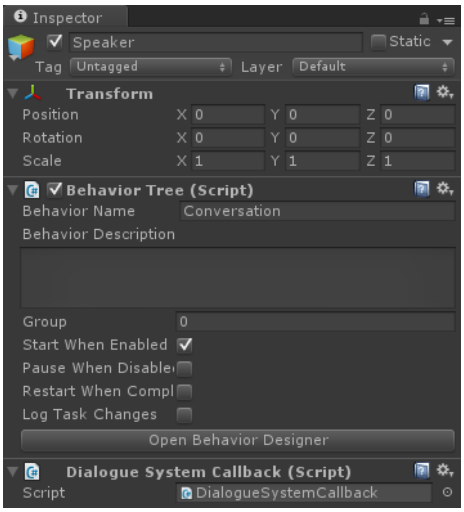
To get started, first make sure you have Dialogue System for Unity installed. Next, import DialogueSystemAssets.unitypackage:



Once those files are imported you are ready to start creating behavior trees with the Dialogue System! To get started, create a very basic tree with a sequence task which has a Wait task and a Start Conversation task:

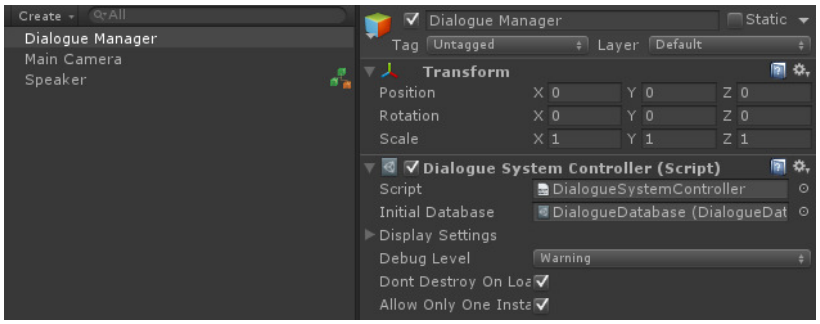


When the Dialogue System finishes with a conversation or sequence it will callback to Behavior Designer to let Behavior Designer know that it is done. In order for this to occur the Dialogue System Callback component must be added to the same GameObject that your behavior tree is on:

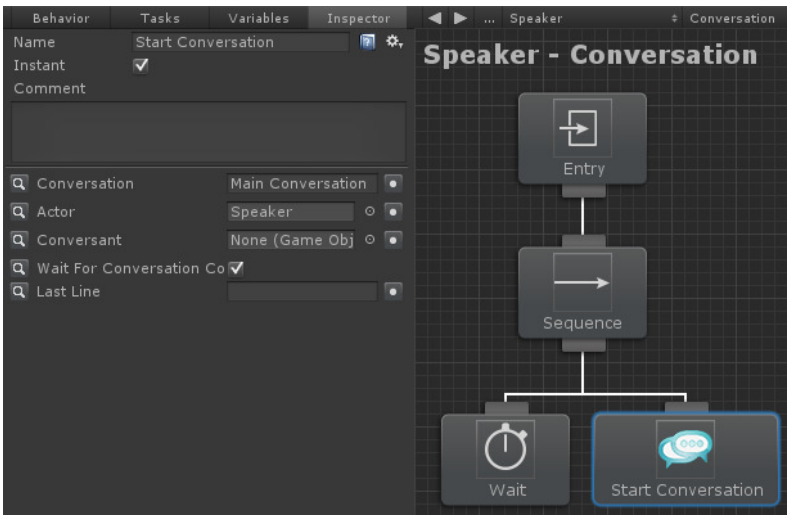


Now we are ready to start creating the actual conversion. Create a new Dialogue System Database and create a basic conversation:

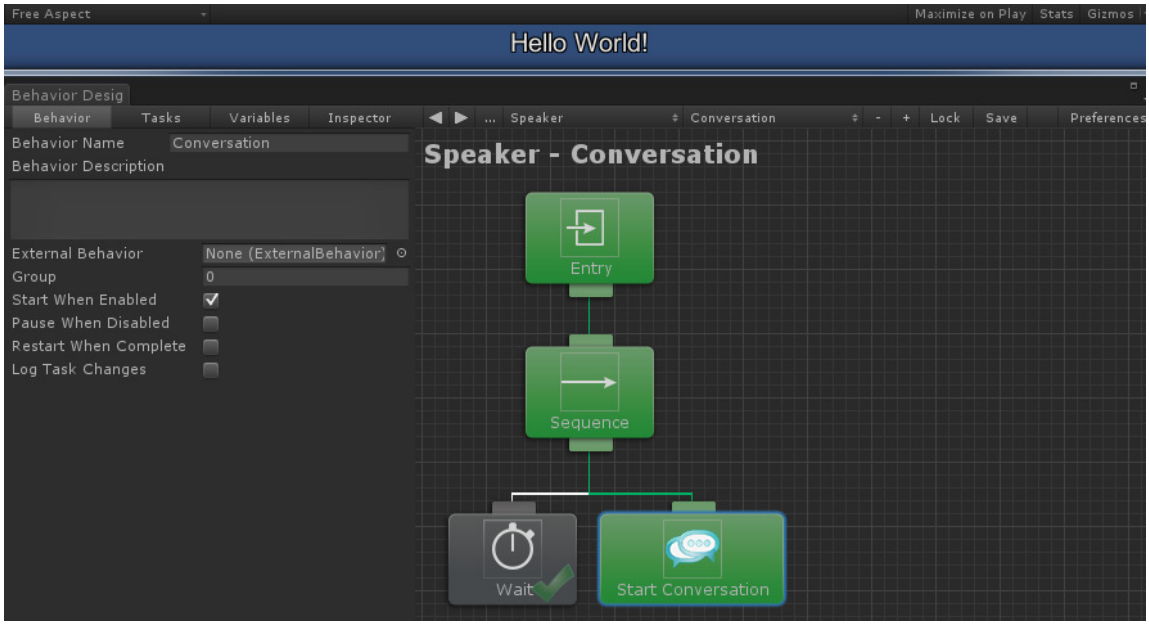
Make note of the conversation name because that will be needed later. Assign that database to the Dialogue System Controller:



The last step is to simply assign the values within the Start Conversation task. The only two values that are required are the conversation name and the actor GameObject:



Once those values have been assigned, hit play and you'll see the text "Hello World" appear at the top of the game screen:



This topic hardly scratches the surface for what is possible with Behavior Designer / Dialogue System integration. For a more complex example, take a look at the Dialogue System sample project.

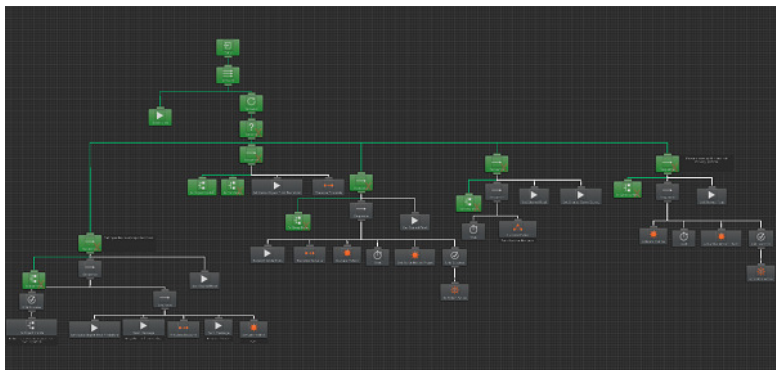
Motion Controller

Motion Controller allows you to add any type of motion to your character. With Behavior Designer integration, your agent will come alive by walking, running, jumping, and climbing as if they were controlled by another player.

We were contacted by Tim from ootii on integrating Motion Controller with Behavior Designer. Unlike other integrations, Tim wanted more than just task/script integration:

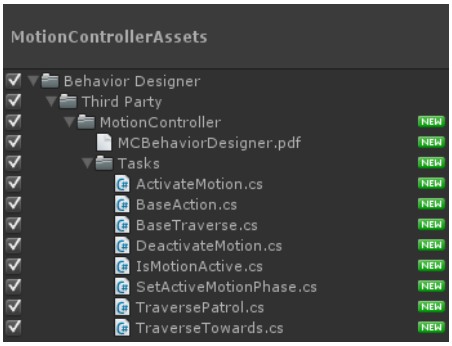
he wanted to create a complete tree that brings a character to life to really showcase the integration between the two assets. After a couple of months of work, we have that tree completed.

In the Goblin Life sample scene, you control a goblin. This goblin can move with the included Motion Controller actions such as walking, jumping, and climbing. This part isn't new. What is new is that your goblin character has many goblins surrounding him. All of these goblins are controlled by a behavior tree with tasks that are integrated with Motion Controller. This is a zoomed out view of that behavior tree:



Because some of the tasks use layers, we had to place the project in a zip file instead of the standard Unity package. Once you have downloaded this zip file *do not open* the GoblinLife scene yet. First import Motion Controller and Behavior Designer. Once those two packages are imported download the Motion Controller tasks on the integrations page.

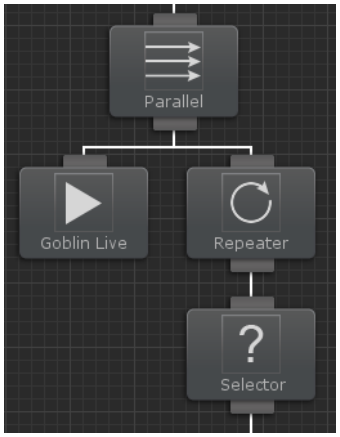
Import the Motion Controller Unity package. This package contains the Motion Controller tasks as well as a overview PDF which describes the integration.



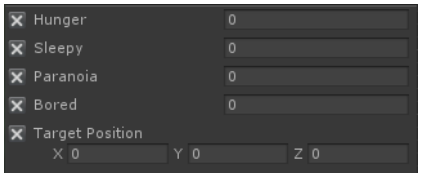
Once you have imported these three assets you can open the Goblin Life scene. If you accidentally opened the Goblin Life scene ahead of time it's no problem, just make sure you reload the scene before you hit play in Unity.

Once you play the scene you'll see that there are several activities that the goblins take part in. They can eat, sleep, patrol, and gamble when they become bored. This behavior tree makes use of conditional aborts, external behavior trees, and global variables.

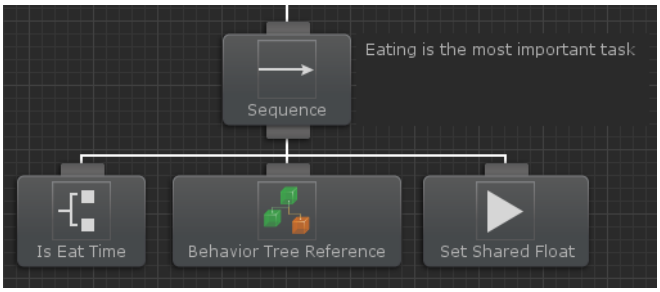
The root of the tree contains a parallel task which has two children: the Goblin Live task and a selector task which contains the various actions for the goblins.



The Goblin Live task updates Shared Variables in order to determine the current state of the goblin.

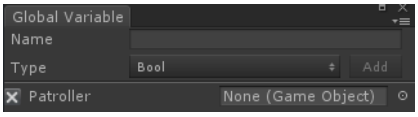


As an example, every tick the hunger variable will be updated by the Hunger Increase Rate. This causes the hunger variable to grow as time goes on, and the Is Eat Time task further down the tree will check to see if that hunger value is greater than a specified value.

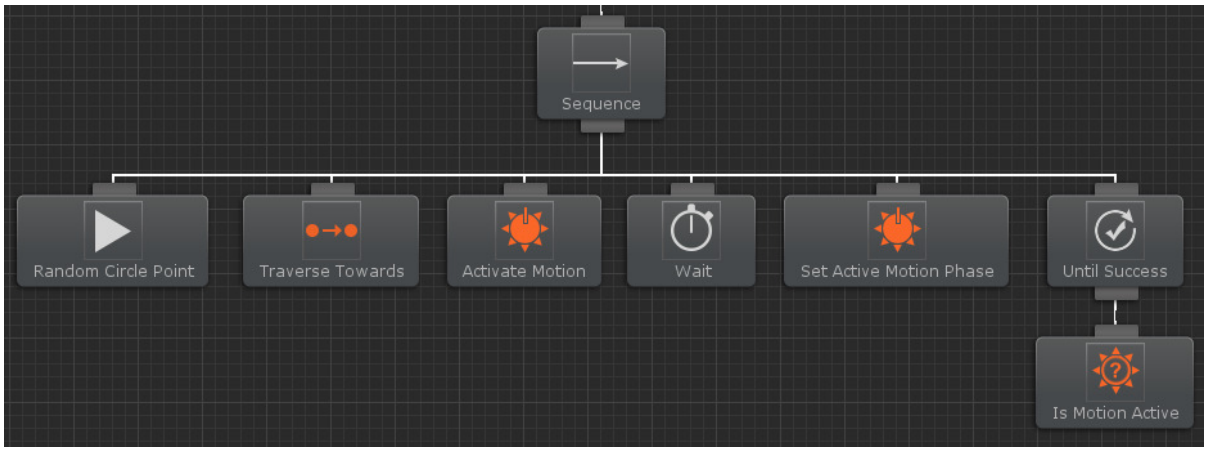


The sequence task has a lower priority conditional abort setup so when the hunger value is greater than the specified value it will abort whatever task is currently running and start the external tree within the behavior tree reference task. Once that external tree finishes executing the Set Shared Float task will reset the hunger value back to 0.

The Goblin Life tree contains four other branches similar to this one. They are arranged from highest priority to lowest priority: eat, sleep, patrol, move close to another goblin, and gamble. Each parent composite task of these branches have a conditional abort set the Lower Priority so that branch will always take priority over a lower branch. The only branch that is unique is the Patrol branch. The Patrol branch uses a global variable in order to determine if the goblin should go on patrol. If another goblin is on patrol then the current goblin should not start patrolling, and the global variable helps with this decision.



Within each branch is a set of Motion Controller actions that do the actual movement. For example, here is the Sleep branch:



These tasks are processed in the following order:

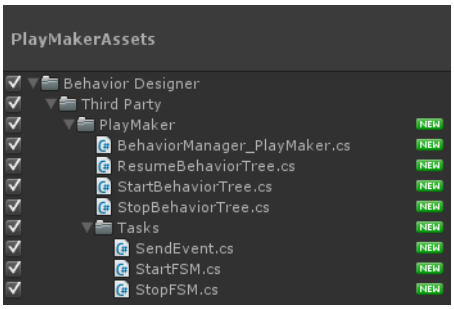
1. Random Circle Point finds a random location based on a center point and a radius.
2. Traverse Towards is a Motion Controller action that has the goblin walk towards the random location found earlier. If there's an obstacle in his way, he'll climb over it.
3. Activate Motion is a Motion Controller action that plays a specific motion. In this case, 'Lay Down and sleep'.
4. Wait for the goblin to finish sleeping.
5. Set Active Motion Phase is a Motion Controller action that progresses a motion forward. In this case, it's time to tell the goblin to wake up.
6. Waiting until the wake up portion of the motion finishes.
7. Is Motion Active is a condition we're check to see if we've finished waking up. Once we're done, #6 finishes successfully and the whole sequence is complete.

The rest of the branches are setup similarly. For a full listing of all of the Motion Controller tasks take a look at this topic.

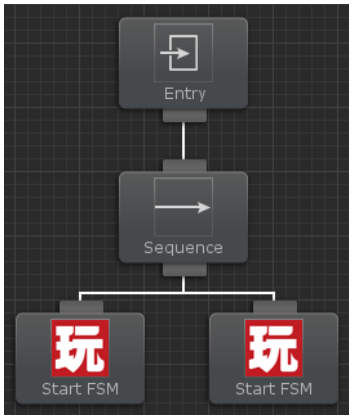
PlayMaker

PlayMaker is a popular visual scripting tool which allows you to easily create finite state machines. Behavior Designer integrates directly with PlayMaker by allowing PlayMaker to carry out the action or conditional tasks and then resume the behavior tree from where it left off. PlayMaker integration files are located on the integrations page because PlayMaker is not required for Behavior Designer to work.

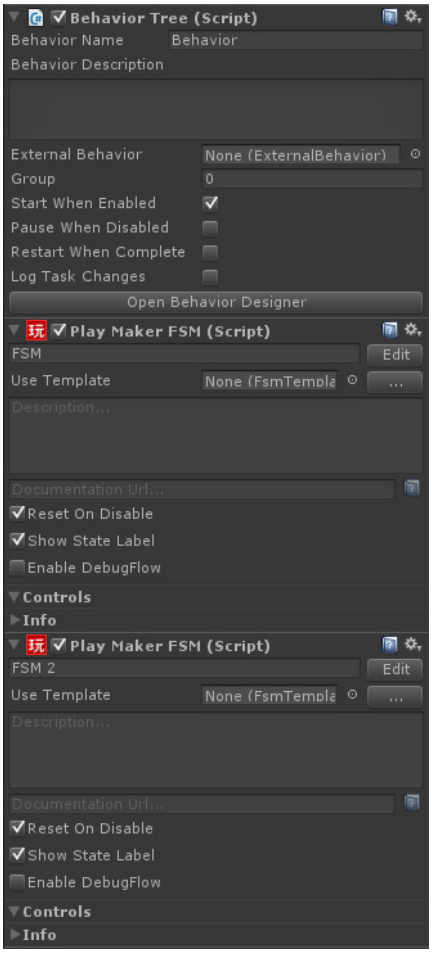
To get started, first make sure you have PlayMaker installed. Next, import PlayMakerAssets.unitypackage:



Once those files are imported you are ready to start creating behavior trees with PlayMaker! To get started, create a very basic tree with a sequence task who has two Start FSM child tasks:

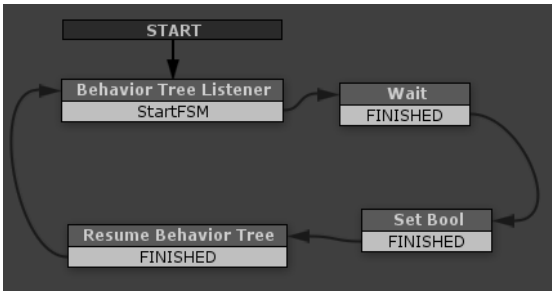


Next add two PlayMaker FSM components to the same game object that you added the behavior tree to.

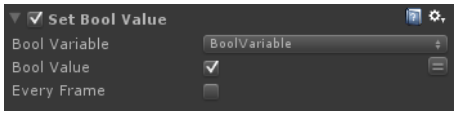


Open PlayMaker and start creating a new FSM. This FSM is going to be a simple FSM to show how Behavior Designer interacts with PlayMaker. For a more complicated FSM take a look at the FPS sample project. Behavior Designer starts the PlayMaker FSM by sending it an event. Create this event by adding a new state called "Behavior Tree Listener" and adding a new global event called "StartFSM". The event must be global otherwise Behavior Designer will never be able to start the FSM.

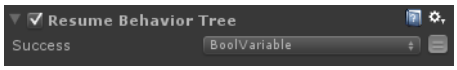
Add a transition from that event along with a wait state, a set bool state, and a resume behavior tree state. Make sure you transition from the Resume Behavior Tree state to the Behavior Tree Listener state so the FSM can be started again from Behavior Designer.



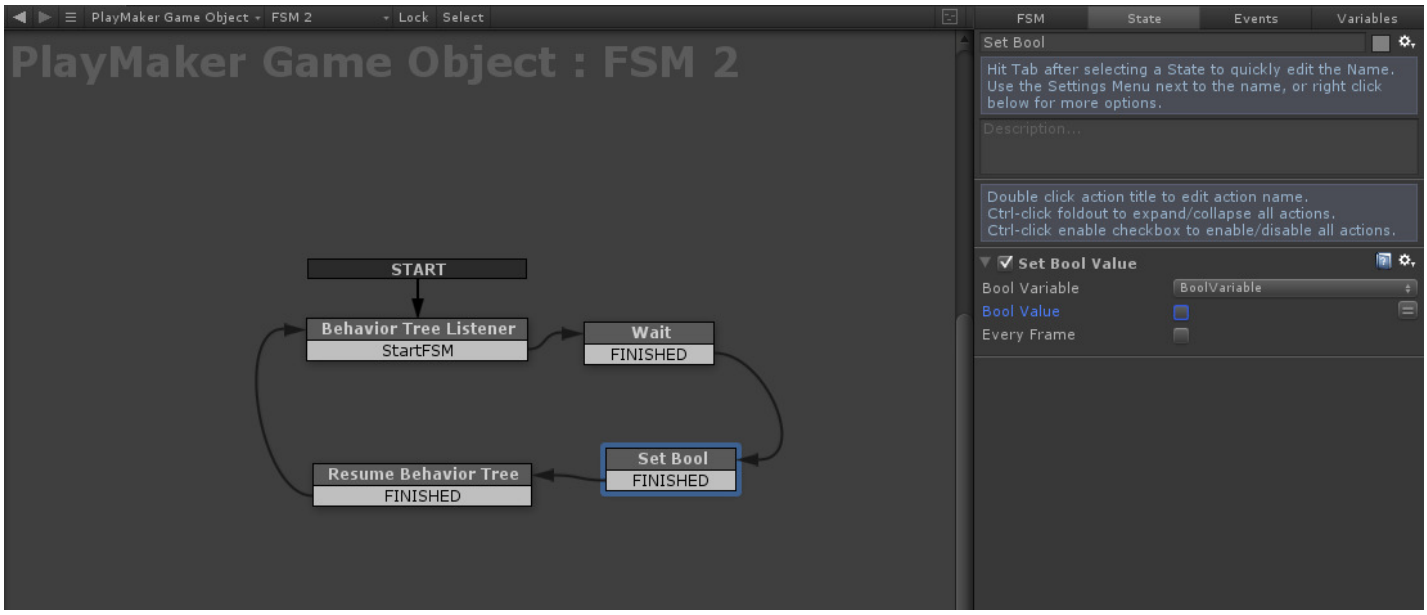
Create a new variable within the Set Bool state and set that value to true.



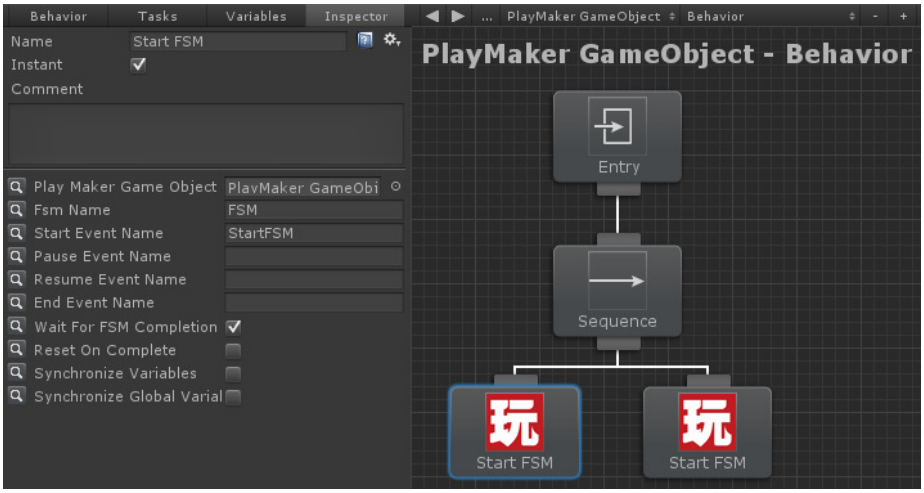
Then within the Resume Behavior Tree state we want to return success based off of that bool value:



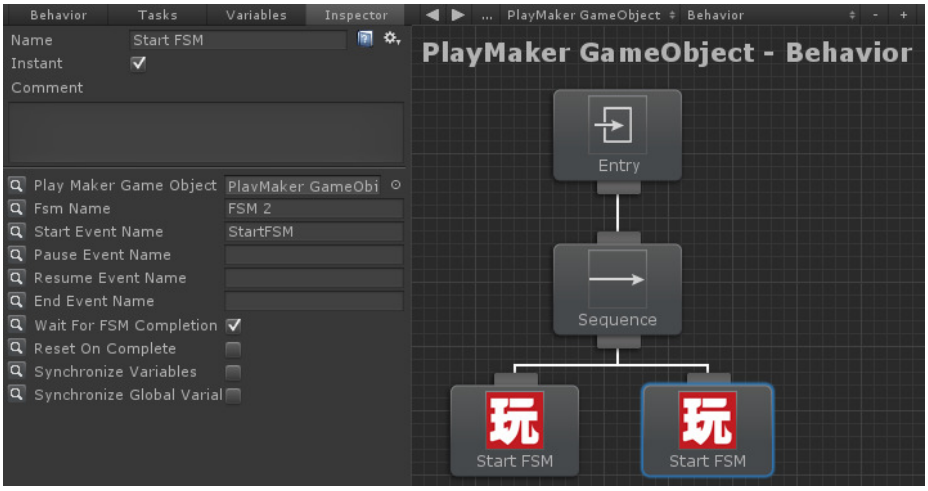
That's it for this FSM. Create the same states and variables for the second FSM that we created earlier. Do not set the bool variable to true for this FSM.



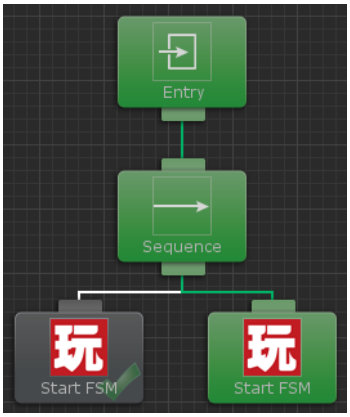
We are now done working in PlayMaker. Open your behavior tree back up within Behavior Designer. Select the left PlayMaker task and start assigning the values to the variables. PlayMaker Game Object is assigned to the game object that we added the PlayMaker FSM components to. FSM Name is the name of the PlayMaker FSM. Event name is the name of the global event that we created within PlayMaker.



Now we need to assign the values for the right PlayMaker task. The values should be the same as the left PlayMaker task except a different FSM Name.



That's it! When you hit play you'll see the first PlayMaker task run for a second and then the second PlayMaker task will start running.



If you were to swap the tasks so the second PlayMaker task runs before the first PlayMaker FSM, the behavior tree will never get to the first PlayMaker FSM because the second PlayMaker FSM returned failure and the sequence task stopped executing its children.

Realistic FPS

Realistic FPS Prefab gives you a quick way to implement the core FPS features quickly. The Behavior Designer integration with RFPS allows you to control the RFPS AI with a behavior tree. A few manual steps are required in order to allow Behavior Desogner to control the RFPS AI. The first step is to open the AI.cs file found in the RFPS package located within !RFPSP/Scripts/AI. Certain functions need to be made public to allow the behavior tree tasks to access the AI functions (such as Patrol, Stand Guard, Attack Player, etc). Change the following 6 methods in AI.cs from private to public:

From:

```
IEnumerator StandWatch (){
```

To:

```
public IEnumerator StandWatch (){
```

From:

```
IEnumerator Patrol (){
```

To:

```
public IEnumerator Patrol (){
```

From:

```
bool CanSeeTarget(){
```

To:

```
public bool CanSeeTarget(){
```

From:

```
IEnumerator Shoot (){
```

To:

```
public IEnumerator Shoot (){
```

From:

```
IEnumerator AttackPlayer (){
```

To:

```
public IEnumerator AttackPlayer (){
```

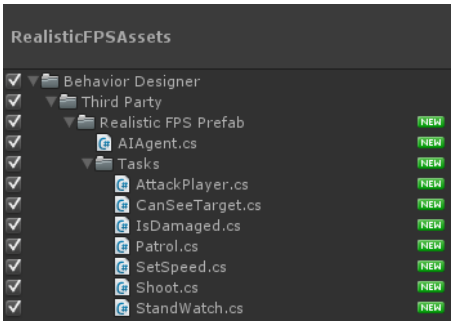
From:

```
void SetSpeed ( float speed  ){
```

To:

```
public void SetSpeed ( float speed  ){
```

The next step is to download the RFPS integration files from the integrations page. When you import this package the following will appear in the import dialogue:



Once the files have been imported the laststep is the replace the RFPS AI component with the AIAgent component found in Behavior Designer/Third Party/Realistic FPS Prefab:

The AIAgent component is a very small class which disables all of the AI functions from running. This will allow the behavior tree to directly control the AI.

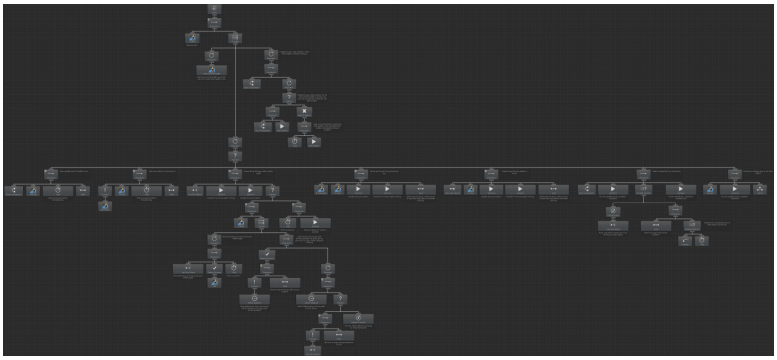
That's all that is required! The behavior tree is now able to control the Realistic FPS agent.

Third Person Controller

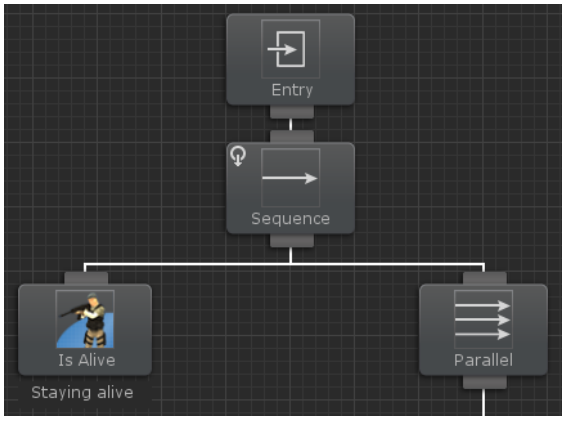
The Third Person Controller is the ultimate framework for any third person genre such as third person shooter, adventure, RPG, etc. Both Behavior Designer and the Movement Pack are integrated with the Third Person Controller allowing for realistic AI agents. The Third Person Controller tasks and sample project can be downloaded from the samples page and the Movement Pack integration files from the Movement Pack integrations page.

The Third Person Controller sample project contains a complete behavior tree that gives an example of how to create a realistic enemy agent with a behavior tree. This sample project can be played on the AI Demo page from the Third Person Controller webpage.

The goal of this behavior tree is to have the agent react when he sees, hears, or is shot by the player. In addition, the agent should go get health or ammo when he is running low. When the agent loses sight of the player he should search for the player at the last known position. When the agent is not aware of the player at all he should patrol a set of waypoints. This is a screenshot of the entire behavior tree (click to enlarge):



This tree looks complicated but it really is easy to understand once you break the tree up into the different branches. When the tree starts the Is Alive task is the very first task that runs.

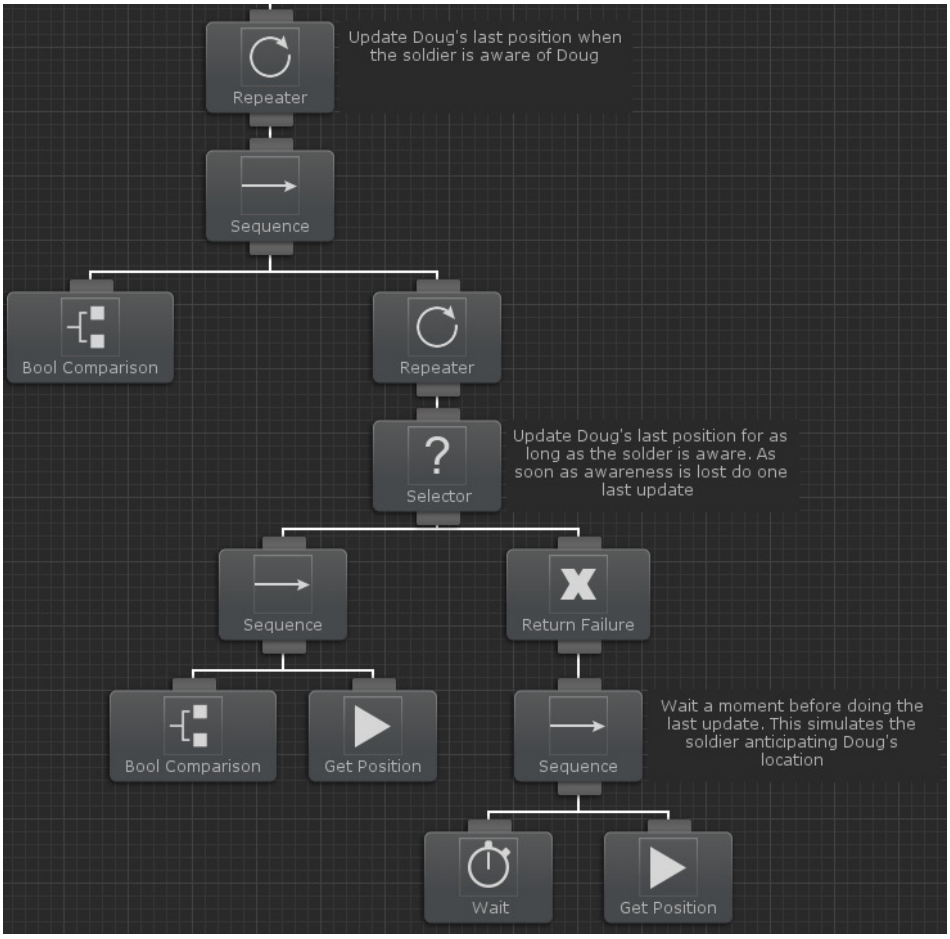


This task is parented by a Sequence task so the tree will continue execution one child at a time, from left to right. Conditional aborts are used on the Sequence task to reevaluate the Is Alive task every tick. This setup will stop the tree from executing when the agent dies.

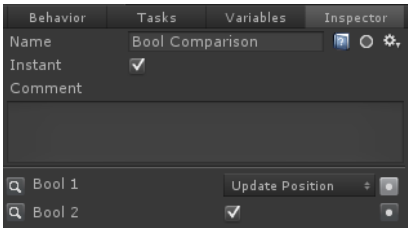
After Is Alive is done executing a Parallel task is used to run branches at once. The Get Health branch is the smallest branch that is run by this Parallel task:

A Repeater task is used to reevaluate the Get Health task every tick. This is done so the behavior tree will have the current health value of the agent every time the tree updates. This value is used by a different branch.

In addition to the Get Health branch, the Update Position branch is executed by the parent Parallel task:



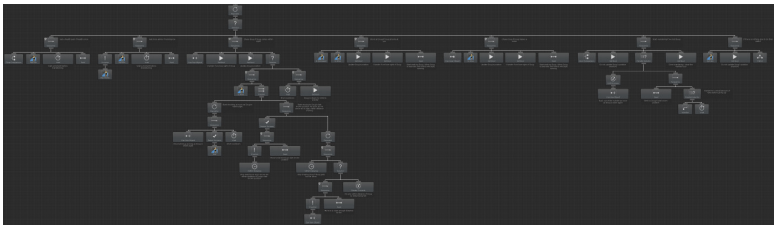
Similar to the Get Health task, the Update Position branch uses a Repeater task so the branch is executed every tick. The first action task that runs is a Bool Comparison task. This task will compare the Update Position Shared Variable with a true boolean value. When Update Position is equal to true the Bool Comparison task will return true and allow the parent Sequence task to run the next child (in this case the next child is another Repeater task).



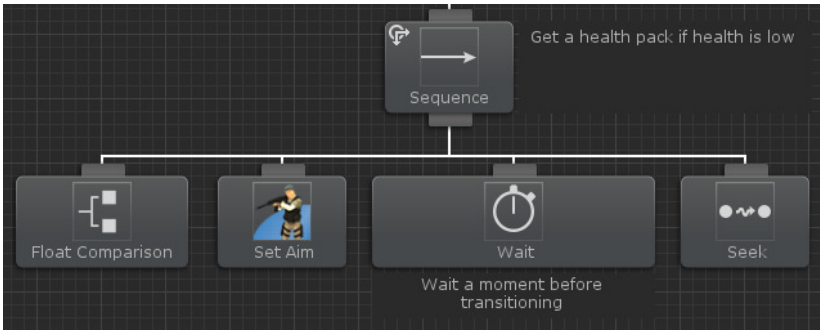
The Update Position variable is set to true when the agent starts to seek the player because of an event such as being able to see, hear, or is shot by the player. When this happens the Last Position Shared Variable should be updated to the player's position. The tasks under the second Repeater task do this update. A Selector task is used to parent the next set of branches. The position should only be updated for as long as the Update Position variable is true. The left branch under the Selector accomplishes this. Because the Selector is parented by a Repeater task this branch will be executed every tick for as long as Update Position is true. As soon as Update Position is set to false (because the agent lost sight of the player), the Bool Comparison task will return failure and the right branch will run.

This right branch uses two new tasks: the Return Failure task and Wait task. The very first action task that runs is the Wait task. When the agent loses sight of the player he will start to search for the player at the last known location. The Wait task along with the Get Position task simulates the agent anticipating the player's location a short amount of time after the agent loses sight of the player. This is useful for example when the player drops from a platform and the agent loses sight of the player. Before the player drops from the platform the last known location is on the platform so when the agent loses sight of the player he would search for the player on top of the platform. However, he should instead search for the player on the ground below the platform so this branch simulates that behavior. This branch is parented by the Return Failure task so the entire Update Position branch doesn't end. When the agent is done updating the position the tree should go back to the beginning and continuously check against the Bool Comparison task.

The final branch that executes under the Parallel task can be considered the heart of the tree and provides the actual functionality for the agent (click to enlarge):

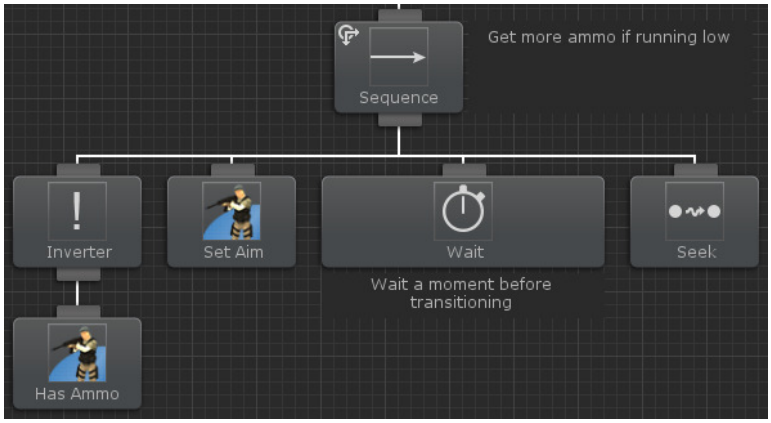


Similar to the other two branches, this branch is parented by a Repeater task so it will continue to be reevaluated even if a child branch returns success. The Selector task is a child of the Repeater task to allow the next child branch to run if the previous child branch returns failure. This brings up an important point in designing your behavior tree - since behavior trees are executed in depth first search order, the behavior tree should be designed with the highest priority branches on the left followed by the lower priority branches to the right. In this tree the highest priority branch is to get health if running low or to get ammo if running low. The lowest priority branch is to patrol. Conditional aborts are used so the conditional tasks are reevaluated every tick. This allows the agent to seek for a health pack if his health is low even though the patrol task is running, for example. The Health branch is the furthest on the left because it is the most important:



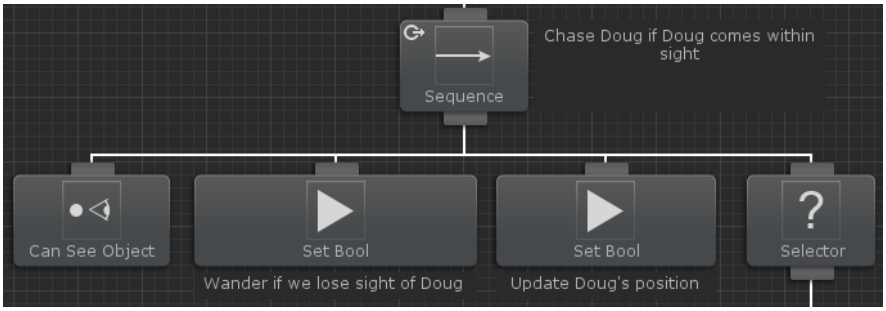
The Float Comparison task compares the Current Health Shared Variable with another float to determine if the agent is running low on health. When the agent is low on health the Set Aim task will run which will put the agent in a non-aiming state. The agent is only aiming when he is firing on the player so this task isn't necessary in all cases but it doesn't hurt to run. Following the Set Aim task, the Wait task will wait a small amount of time to make the transition smoother between the agent's last active task and the current task. The Seek task is then used to move the agent to the health pack. As soon as the agent picks up the health pack this branch will return failure because of the original Float Comparison task and a Both conditional abort set on the parent Sequence task.

If the agent does not need health the next highest priority item is to get ammo if the agent is out of ammo. This branch is setup very similarly to the Health branch:

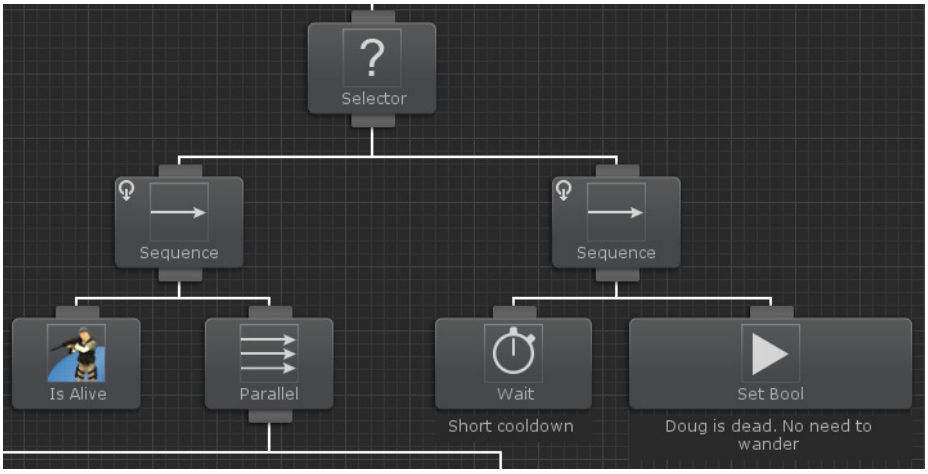


The Has Ammo conditional task is reevaluated every tick to determine if the agent has ammo. This task is parented by an Inverter task because this branch should only execute when Has Ammo returns failure, rather than success. In most cases the agent is going to have ammo so Has Ammo will return success. However, this branch should only run when the agent does not have ammo so an Inverter task is needed to flip the failure task status to success. The rest of the tasks are the same as the Health branch, with the only difference being that the Seek task will seek the ammo location instead of the health pack location

The next branch is where all of the main action occurs. This branch will attack the player if the player is within sight and distance. Before this can happen the agent must first be able to see the player:

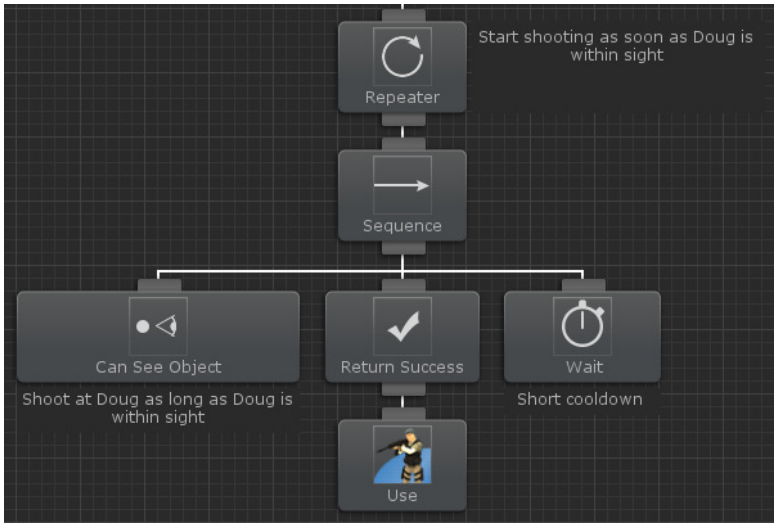


A Lower Priority Conditional Abort is used to allow the Can See Object task to be reevaluated every tick. When the agent can see the player the Wander Shared Variable will be set to true to allow the agent to start wandering if the agent loses sight of the player. This branch will be described later on. Similarly, the Update Position bool is enabled to allow the position to be updated within the Update Position branch. This branch has already been described and is parented to the main Parallel task. A Selector task is then used to start executing the tasks within the Attack branch:



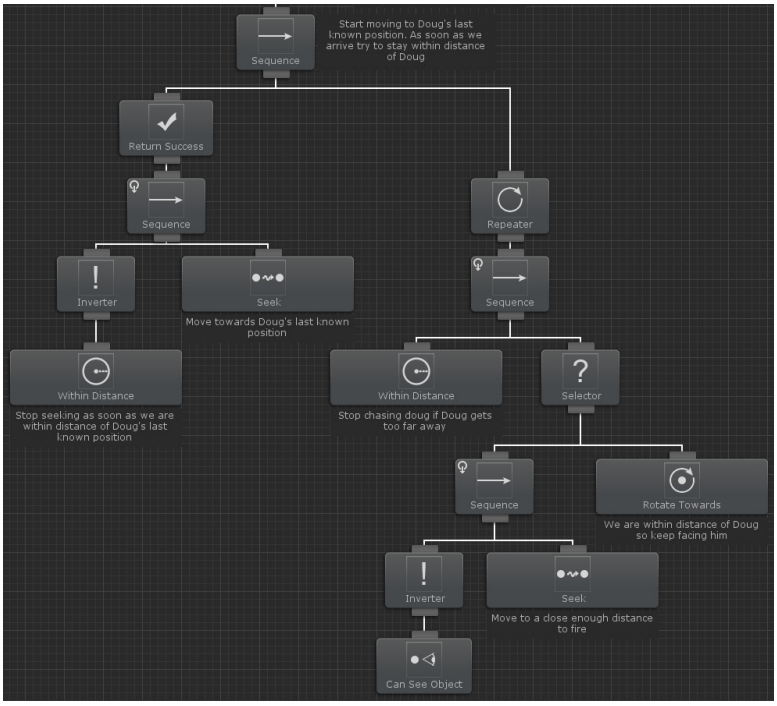
The player can only be attacked if they are alive. The first task that is executed is the Is Alive task to check the health of the player. A Self Conditional Abort is used to allow this task to be reevaluated every tick. If the player is alive a Parallel task is then run to allow the agent to do the actual attacking. If the player dies the Is Alive task will return failure and the Parallel branch will stop running. As soon as this happens the right branch will run which will prevent the agent from needing to wander. A task that prevents the agent from updating the position is not needed because that is set in a different branch.

There are two branches under the Parallel task. The left branch will do the actual firing of the agent's weapon:

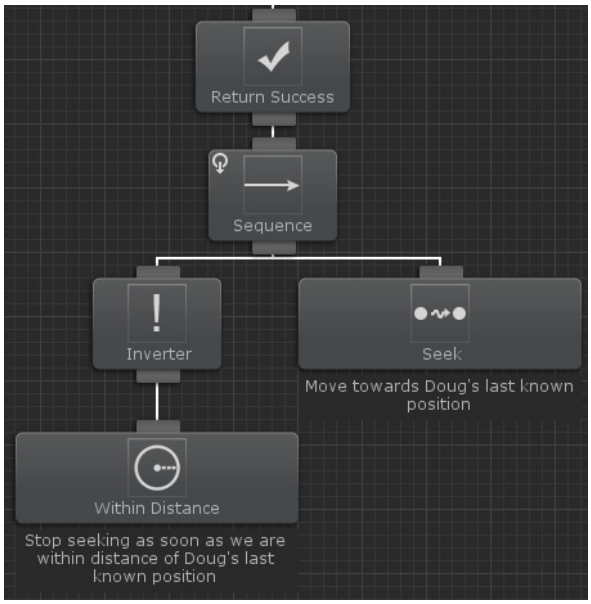


The agent will Use the weapon when the Can See Object task returns success. The Return Success task is used because the Use task may return failure and the following Wait task should always be executed. This prevents the agent from trying to fire his weapon every time the tree is ticked. No Conditional Aborts are needed because of the top Repeater task. This Repeater task is used to continue to execute this branch for as long as the other reevaluating conditional tasks allow it to run.

The right branch controls the actual movement of the agent. This branch ensures the agent is near and is looking at the player so the agent will successfully hit the player when he fires (click to enlarge).

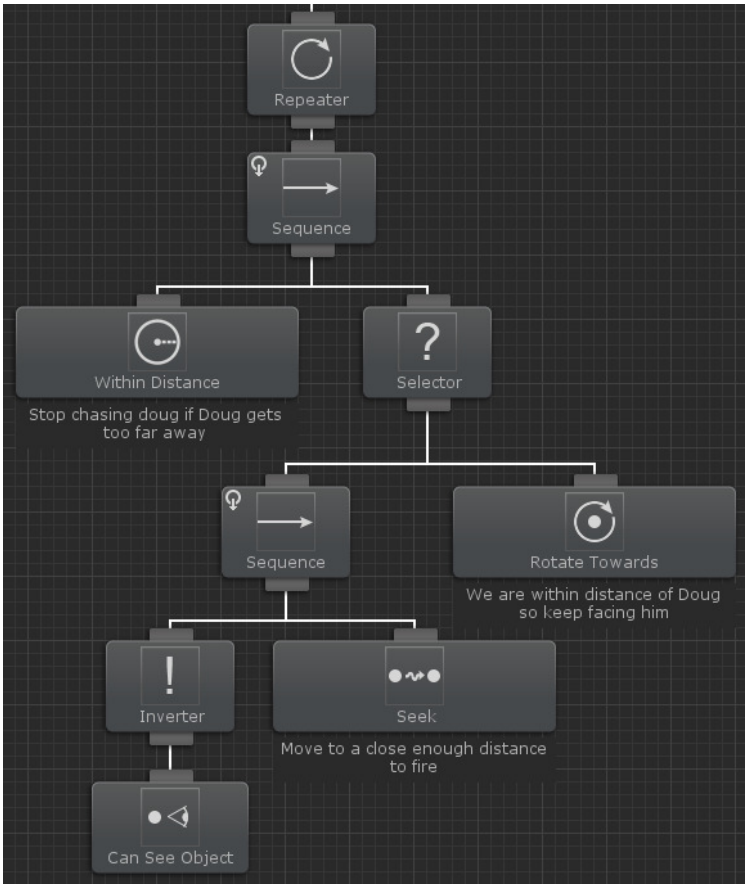


Unlike previous similar branches, this branch is parented by a Sequence task instead of a Selector branch. When the agent first sees the player he should Seek the player's Last Position until he is Within Distance. When the agent is within distance he should then only Seek the player's Last Position when the player is out of sight. The following branch will do the initial Seek to get the agent within firing distance of the player:



A Self Conditional Abort is used to stop the Seek task from running when the Within Distance task returns success. When the agent initially has to move towards the player, he may not be close enough to the player so the Within Distance task is going to return failure. The Inverter task is then used so the Seek task will only run when the Within Distance task returns failure, or the agent is not close to the player. Remember that we are not actually Seeking the player, instead we are seeking the position of the Last Position variable which is being updated in a higher level branch.

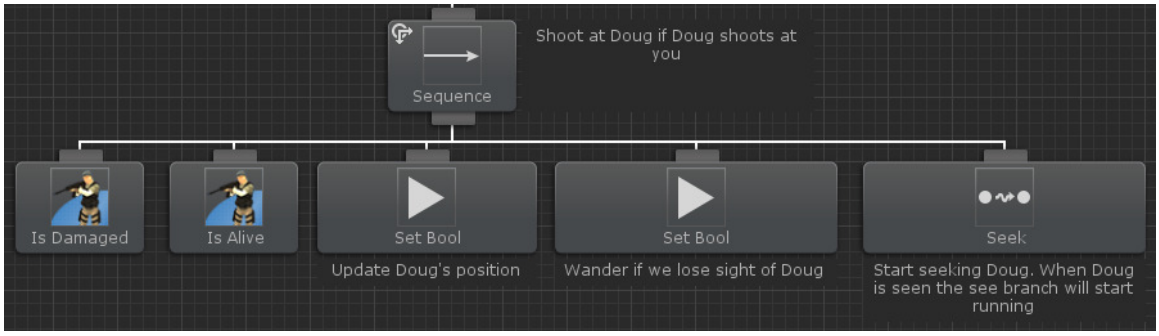
Once the agent is within distance of the player he will need to keep the player in sight so when he fires he will successfully hit the player:



The Within Distance task is used again to stop the agent from seeking the player's Last Position. This task uses a larger distance than the previously described Within Distance task and the Can See Object task within this screenshot. This allows a small buffer zone where the agent will continue to seek the player and stop seeking if the distance becomes too far. For example, this Within Distance task can check to see if the player is within a distance of 20 units. The Can See Object task can then have a value of 10 so the agent will seek the player any distance between 10 and 20 units.

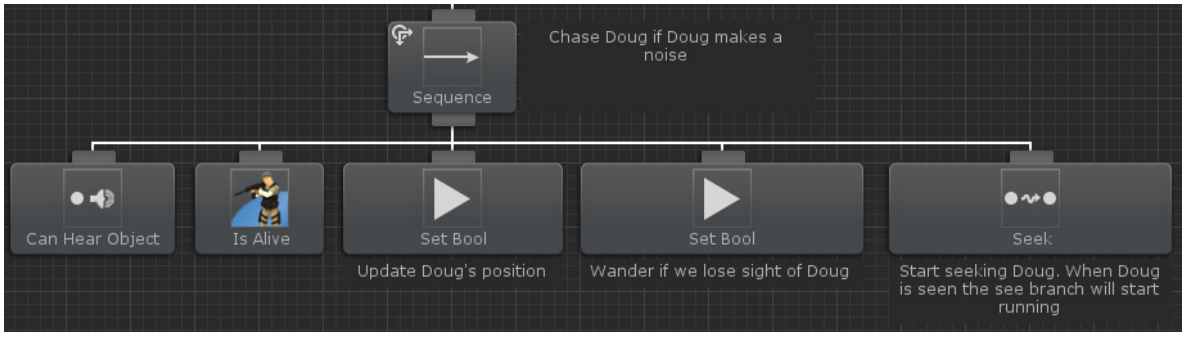
For as long as the Within Distance task returns true the right Can See Object branch will run. This is done using a Self Conditional Abort on the top Sequence task. A Selector task is then used to have the agent Seek the player's Last Position if the player is not within sight or distance. If the player is within sight and distance the Rotate Towards task keeps the agent facing the player.

This Attack branch provides the most visible agent functionality and while it branch looks complicated it can be broken down and explained really easily. The remaining branches have significantly less tasks than this attack branch. The next highest priority branch is a branch that will react to the agent taking damage from being shot at:



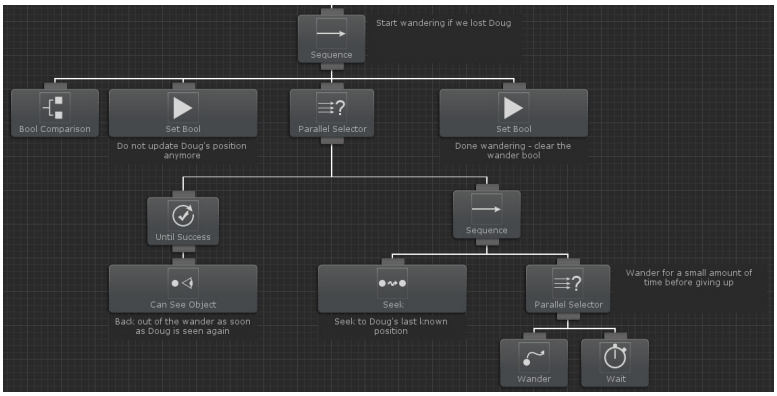
The Is Damaged task will return success when the agent takes damage. In this example scene the agent will take damage when the player shoots at the agent. A Both Conditional Abort is used to allow the Is Damaged task to stop the lower priority tasks from running if the agent takes damage. If the agent does take damage the Is Alive task will then check to see if the player is alive. In most cases this task won't be necessary but the player may have shot a projectile at the agent and died shortly after from something else, such as a different agent killing the player. Following the Is Alive check, the Update Position and Wander Shared Variables are set to true. This is similar to the variables being set to true within the higher priority See branch. After these variables are set to true the agent will then start to Seek the player's Last Position. No more tasks are needed for this branch because eventually the agent will see the player and the See branch will take over with its Lower Priority Conditional Abort.

In addition to reacting if the agent takes damage, the agent should also react if the agent hears a sound coming from the player. This could include footsteps or a weapon firing:



This branch is setup very similarly to the Damaged branch. The only difference being the first conditional task is Can Hear Object instead of Is Damaged. Can Hear Object will return success as soon as it hears a sound coming from the player within a specified distance. When this task returns success the Is Alive task will then run. In this case the Is Alive task is more useful than within the Damaged branch because the agent may hear the player dying and should not start to Seek the player if the player is dead. The Update Position and Wander variables are then set to true and the Seek task takes over. When the agent can see the player the See branch will stop the Seek task from running.

If the agent recently saw the player but the player is no longer within distance/sight of the agent then the agent will start to search for the player. The Wander Shared Variable is used by this branch (click to enlarge):

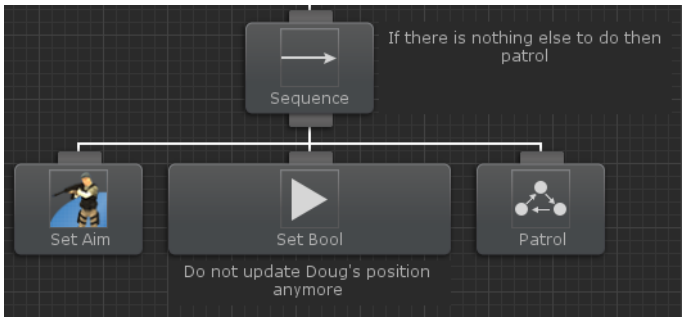


The Bool Comparison task is used to check to see if the Wander Shared Variable is set to true. Notice that unlike the previous branches, this branch does not have a Conditional Abort set because it is not needed. Wander is never going to be set to true by a lower priority branch so there is not a case where this branch can ever interrupt a lower priority branch. The first task that runs after Bool Comparison returns success is a task that sets the Update Position Shared Variable to false. This will prevent the Last Position from updating to the player's position so the agent cannot cheat to know where the player is.

The Parallel Selector task is then used to run both child branches at the same time. The Selector version of the Parallel task is used to stop the branch from running if one of the child branches returns success. It may look incorrect that another Can See Object task is used. After all, the See branch has a Lower Priority Conditional Abort set so it should interrupt this Wander branch if the player comes within sight. This is true but it hides an important detail of Conditional Aborts: Conditional Aborts are triggered when task execution status changes, not only when the conditional task returns success. Because of the way the Attack branch is setup it is possible for the agent to continue to see the player but not be within the Attack branch because the player is no longer within distance. In this case the Can See Object task is going to continue to return success while the Wander task is running. The Can See Object task within the Wander branch prevents the agent from wandering when the player can be seen. The Until Success task will return a status of running until the child task returns success. This allows the Parallel Selector task to keep running its children.

The right branch of the top Parallel Selector contains a Sequence task that will first Seek to the Last Position of the player. As soon as the agent arrives at that position another Parallel Selector task is used to run both the Wander task and Wait task. The Wander task always returns a status of running so the Wait task will stop the agent from wandering after a specified amount of time. As soon as the agent gets done wandering or can see the player the Set Bool task is run which will set Wander to false. Another higher priority branch can set the Wander value to true again.

The final branch within this tree is a small branch that will patrol the area if there is nothing else to do:



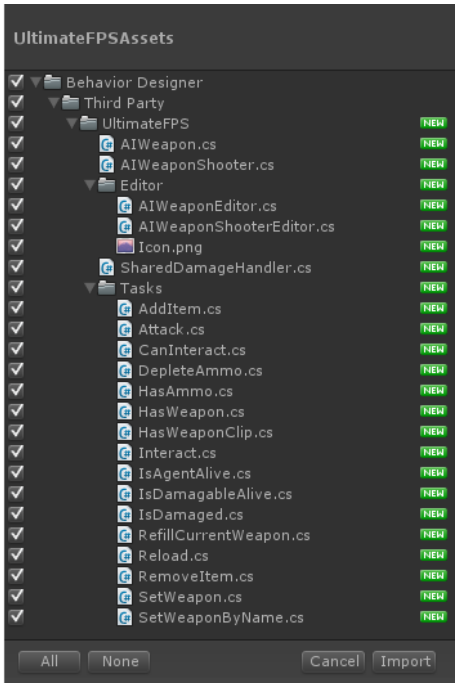
This branch does not have any conditional tasks because it is the lowest priority branch and should run if there are no higher priority branches to run. The first task will stop the agent from aiming, and the second task will set the Update Position Shared Variable to false to prevent the player's Last Position from updating. These tasks may not always be necessary depending on the previous branch that was run. The final task will Patrol a set of waypoints and will always return a status of running.

This tree was put together to give a complete example on how to design a behavior tree. Since behavior trees are so flexible there are many ways to accomplish this same behavior.

UFPS

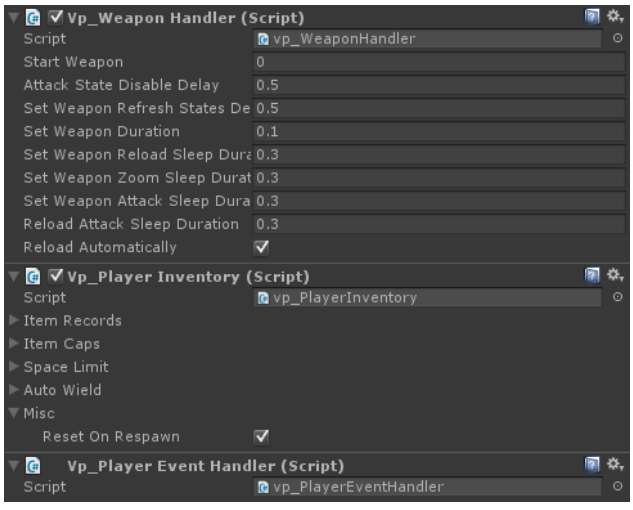
Ultimate FPS is a FPS asset which allows you to get a first person shooter up and running quickly. It has many features which manages the camera, weapons, inventory, and a lot more. Behavior Designer includes tasks which allow you to add the UFPS controls on an AI agent. Because UFPS is not specifically designed to be placed on an AI agent there is some extra setup required. UFPS integration files are located on the integrations page because Behavior Designer doesn't require UFPS to work.

To get started, first make sure you have UFPS installed. Next, import UltimateFPSAssets.unitypackage:

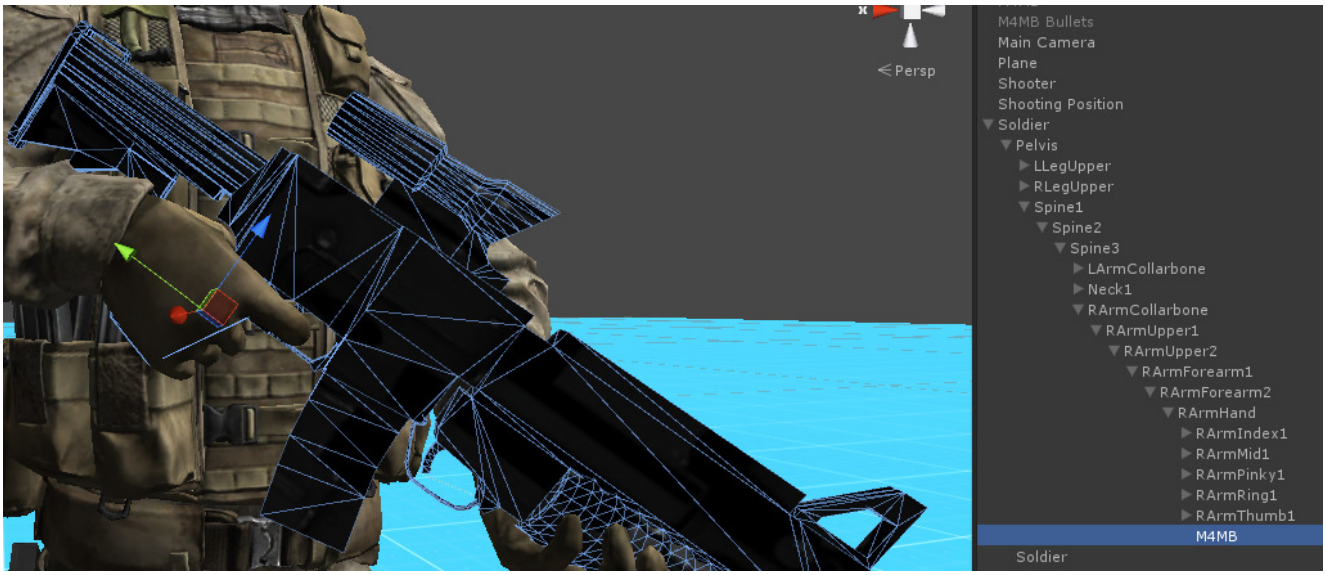


In this example our AI agent will be the soldier found in the Unity Bootcamp sample project. Add the following components to your agent:

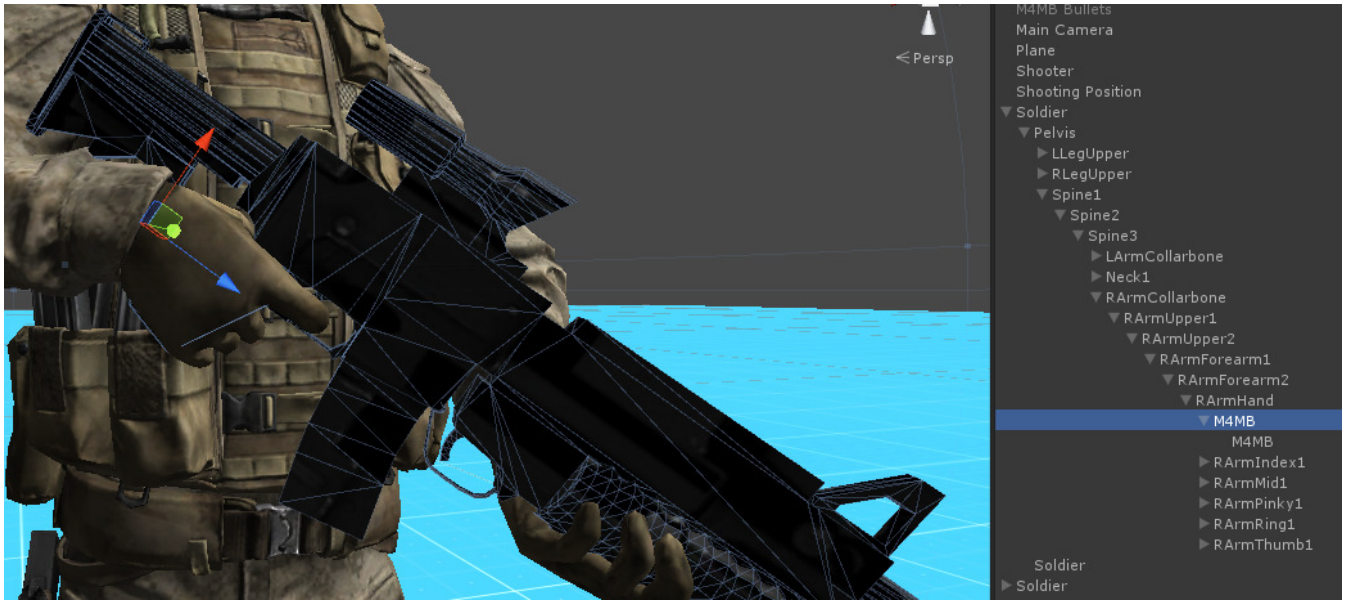
vp_WeaponHandler
vp_PlayerInventory
vp_PlayerEventHandler



It is now time to add a weapon. Add the weapon to the solder's hand GameObject within the hierarchy window. In our case the M4 assault rifle has already been added to the solder. Take a look at the position handle within the scene.

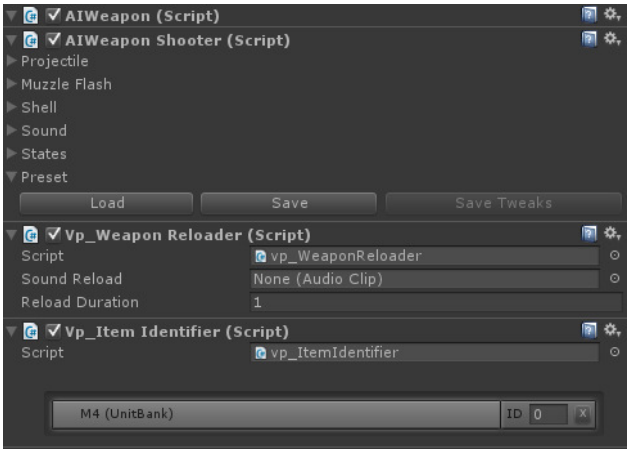


If the blue arrow (the forward vector) is facing in the same direction as the weapon then you do not have to perform the next step. When the UFPS tasks goes to aim the weapon they need to know which direction is forward. If the weapon's forward direction is not it's 'actual' forward direction then we need to add a parent GameObject which corrects this:



A parent GameObject (also called M4MB) has been added and now you can see that the blue arrow is facing in the same direction as the weapon. Once this is complete we can start adding the weapon components. The following components need to be added to the weapon's parent GameObject (or the original GameObject if no parent is needed):

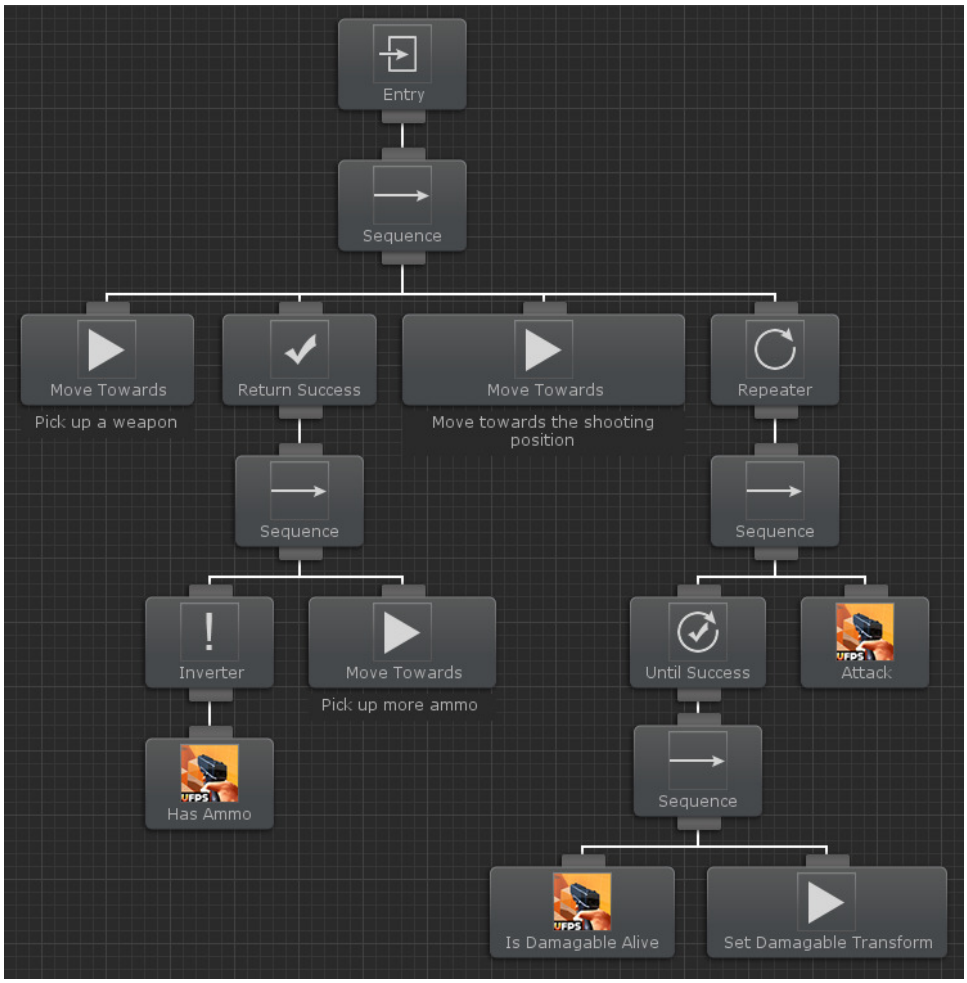
AIWeapon
AIWeaponShooter
vp_WeaponReloader
vp_ItemIdentifier



The last two components are standard UFPS and should already be familiar to you. The AIWeapon component is derived from vp_Weapon and it is basically there to prevent the vp_Weapon component from updating the position/rotation of the weapon. Since the AI is not in first person view we do not want UFPS managing the position of the weapon. This should be done with animations instead. AIWeaponShooter is derived from vp_Shooter and it is the script that actually shoots the weapon.

This is the only extra setup required. The rest of the steps (such as setting up the inventory) are similar to a standard UFPS setup which you can refer to from the UFPS manual.

In the UFPS sample scene we created the following behavior tree:

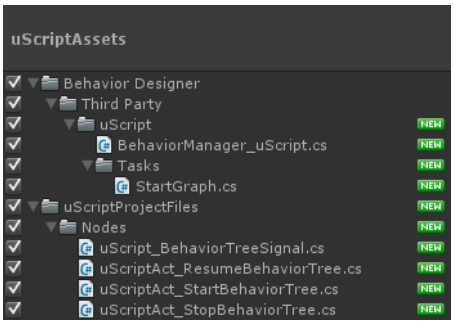


This behavior tree will have the soldier shoot at a target, reload, and pickup more bullets when necessary.

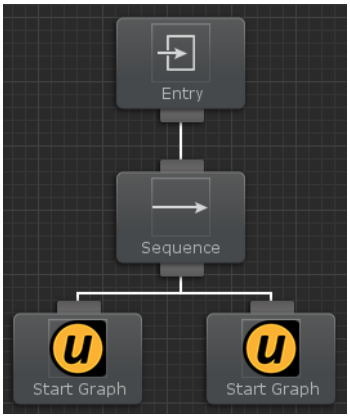
uScript

uScript is a popular visual scripting tool which allows you to create complicated setups without needing to write a single line of code. Behavior Designer integrates directly with uScript by allowing uScript to carry out the action or conditional tasks and then resume the behavior tree from where it left off. uScript integration files are located on the integrations page because uScript is not required for Behavior Designer to work.

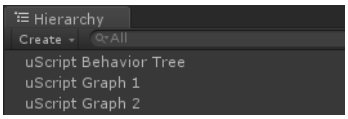
To get started, first make sure you have uScript installed. Next, import uScriptAssets.unitypackage:



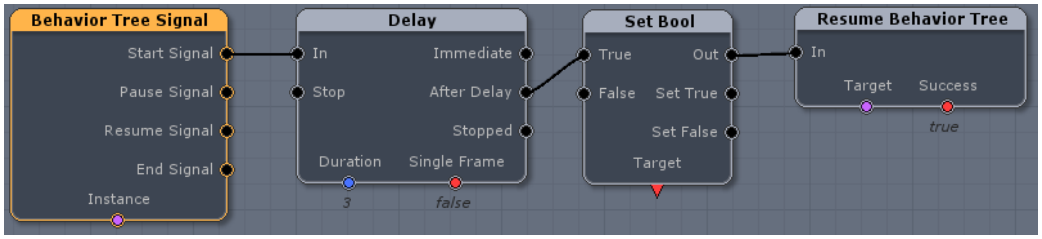
Once those files are imported you are ready to start creating behavior trees with uScript! To get started, create a very basic tree with a sequence task who has two Start Graph child tasks:



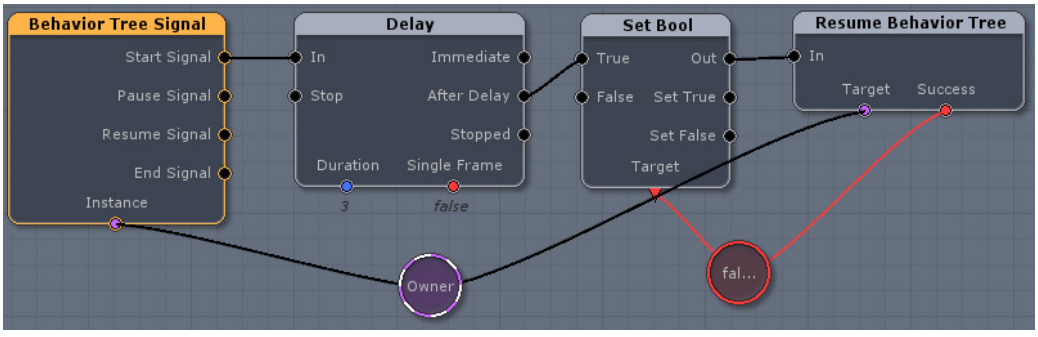
Now we need to create two GameObjects which will hold the compiled uScript graph:



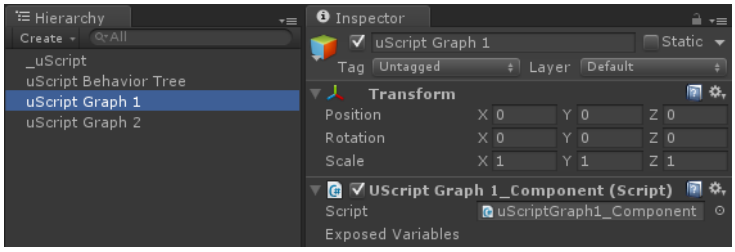
Open uScript and start creating a new graph. Add the Behavior Tree Signal node, located under Events/Signals. When Behavior Designer wants to start executing a uScript graph it will start from this node. This node contains four events – Start Signal, Pause Signal, Resume Signal, and End Signal. Start Signal is used when the behavior tree task starts running. Pause Signal gets called when the behavior tree is paused, and the Resume Signal gets called when the behavior tree resumes from being paused. Finally, End Signal gets called when the uScript task ends. For our graph we are only going to create a few nodes, the uScript sample project shows a more complicated uScript graph. Create a node which has a delay of 3 seconds, sets a bool, then resumes the behavior tree. The Resume Behavior Tree node is located under Actions/Behavior Designer:



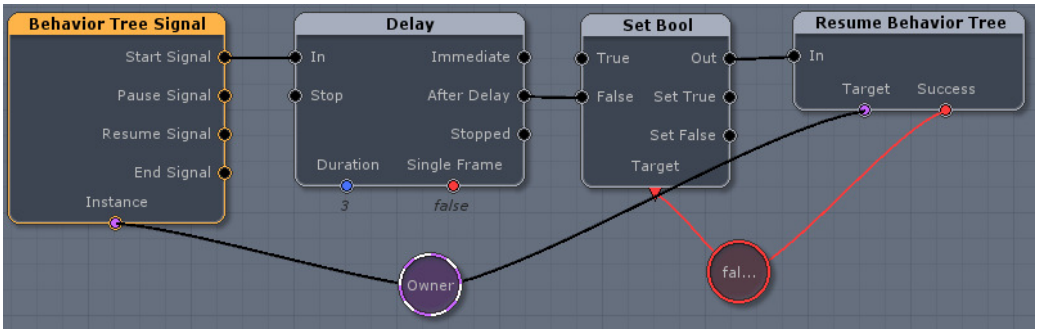
Now we need to create a Owner GameObject and bool variable.



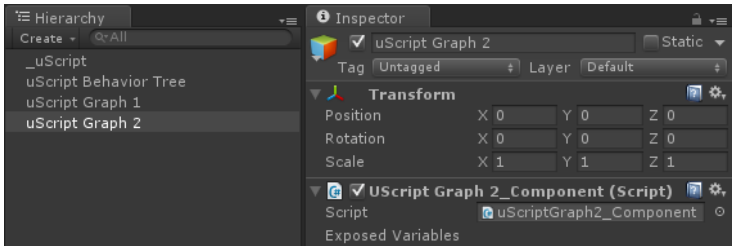
Save the uScript graph and assign the component to your first uScript graph GameObject. Answer no if uScript asks if you want to assign the component to the master GameObject.



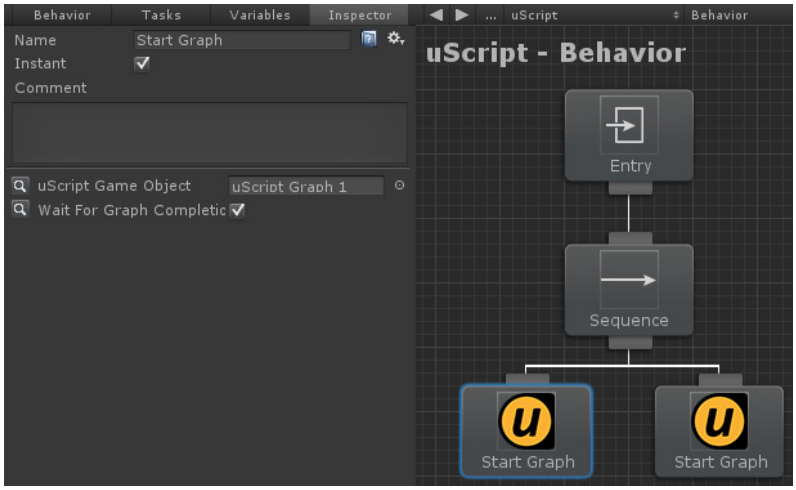
Create one more uScript graph. Make it the same as the last graph except set the bool to false:



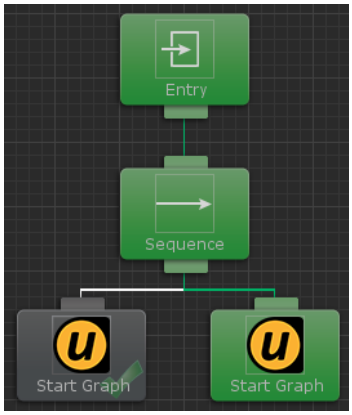
Finally save that graph and assign the component to the second uScript GameObject:



We're almost done. The only thing left to do is to assign the correct uScript GameObject to the tasks within Behavior Designer. Open your behavior tree within Behavior Designer again. Click on the left uScript task and assign the uScript GameObject to your first uScript graph GameObject.



Do the same for the right uScript task, only assign the uScript GameObject to your second uScript graph GameObject. That's it! When you hit play you'll see the first uScript task run for three seconds, followed by the second uScript task.



If you were to swap the tasks so the second uScript graph runs before the first uScript graph, the behavior tree will never get to the first uScript graph because the second uScript graph returned failure and the sequence task stopped executing its children.

Task List

A collection of tasks form a behavior tree. Behavior Designer includes the tasks listed below with its default installation. For more tasks take a look at the sample projects or the Movement Pack.

Actions

- Behavior Tree Reference
- Idle
- Log
- Perform Interruption
- Restart Behavior Tree
- Send Event
- Start Behavior
- Stop Behavior
- Wait
- Invoke Method
- Get Field Value
- Get Property Value
- Set Field Value
- Set Property Value

Composites

- Sequence
- Selector
- Parallel
- Parallel Selector
- Priority Selector
- Random Selector
- Random Sequence
- Selector Evaluator

Conditionals

- Random Probability
- Compare Field Value
- Compare Property Value
- Has Received Event
- Physics

Decorators

- Conditional Evaluator
- Interrupt
- Inverter
- Repeater
- Return Failure
- Return Success
- Task Guard
- Until Failure
- Until Success

Basic Tasks

- Animation

- Animator
- AudioSource
- Behaviour
- BoxCollider
- BoxCollider2D
- CapsuleCollider
- CharacterController
- CircleCollider2D
- Debug
- GameObject
- Input
- Light
- Math
- Particle System
- Physics
- Physics2D
- Player Prefs
- Quaternion
- Renderer
- Rigidbody
- Rigidbody2D
- String
- SharedVariable
- SphereCollider
- Transform
- Vector2
- Vector3

Third Party

- 2D Toolkit
- Adventure Creator
- AI For Mecanim
- Anti-Cheat Toolkit
- Camera Path Animator
- Cinema Director
- Control Freak
- Core GameKit
- Curvy
- Dialogue System
- DOTween
- Final IK
- Glow Effect
- LeanTween
- Master Audio
- Motion Controller
- NGUI
- Particle Playground
- PlayMaker
- Pool Boss
- Pool Manager
- Realistic FPS Prefab
- SECTR
- Simple Waypoint System
- Third Person Controller
- Trigger Event Pro
- uFrame
- Ultimate FPS
- Uni2D
- UniStorm
- uScript
- uSequencer
- Vectrosity

Entry Task

Actions

Action tasks alter the state of the game. For example, an action task might consist of playing an animation or shooting a weapon.

Behavior Designer includes the following actions with its default installation. For more action examples take a look at sample projects.

Behavior Tree Reference

The Behavior Tree Reference task allows you to run another behavior tree within the current behavior tree. You can create this behavior tree by saving the tree as an external behavior tree. One use for this is that if you have an unit that plays a series of tasks to attack. You may want the unit to attack at different points within the behavior tree, and you want that attack to always be the same. Instead of copying and pasting the same tasks over and over you can just use an external behavior and then the tasks are always guaranteed to be the same. This example is demonstrated in the RTS sample project located on the samples page.

The GetExternalBehaviors method allows you to override it so you can provide an external behavior tree array that is determined at runtime.

Idle

Returns a TaskStatus of running. Will only stop when interrupted or a conditional abort is triggered.

Log

Log is a simple task which will output the specified text and return success. It can be used for debugging.

text
Text to output to the log.

logError
Is this text an error?

Perform Interruption

Perform the actual interruption. This will immediately stop the specified tasks from running and will return success or failure depending on the value of interrupt success.

interruptTasks
The list of tasks to interrupt. Can be any number of tasks.

interruptSuccess
When we interrupt the task should we return a task status of success?

Restart Behavior Tree

Restarts a behavior tree, returns success after it has been restarted.

behavior
The behavior tree that we want to start. If null use the current behavior

Send Event

Sends an event to the behavior tree, returns success after sending the event.

targetGameObject
The GameObject of the behavior tree that should have the event sent to it. If null use the current behavior

eventName
The event to send

Start Behavior

Start a new behavior tree and return success after it has been started.

behavior
The behavior that we want to start. If null use the current behavior.

Stop Behavior

Pause or disable a behavior tree and return success after it has been stopped.

behavior
The behavior that we want to stop. If null use the current behavior.

pauseBehavior
Should the behavior be paused or completely disabled.

Wait

Wait a specified amount of time. The task will return running until the task is done waiting. It will return success after the wait time has elapsed.

waitTime
The amount of time to wait.

Invoke Method

Invokes the specified method with the specified parameters. Can optionally store the return value. Returns success if the method was invoked.

targetGameObject
The GameObject to invoke the method on

componentName
The component to invoke the method on

methodName
The name of the method

parameter1
The first parameter of the method

parameter2
The second parameter of the method

parameter3
The third parameter of the method

parameter4
The fourth parameter of the method

storeResult
Store the result of the invoke call

Get Field Value

Gets the value from the field specified. Returns success if the field was retrieved.

targetGameObject
The GameObject to get the field on

componentName
The component to get the field on

fieldName
The name of the field

fieldValue
The value of the field

Get Property Value

Gets the value from the property specified. Returns success if the property was retrieved.

targetGameObject
The GameObject to get the property of

componentName
The component to get the property of

propertyName
The name of the property

propertyValue
The value of the property

Set Field Value

Sets the field to the value specified. Returns success if the field was set.

targetGameObject

The GameObject to setthe field on

componentName
The component to set the field on

fieldName
The name of the field

fieldValue
The value to set

Set Property Value

Sets the property to the value specified. Returns success if the property was set.

targetGameObject
The GameObject to setthe property of

componentName
The component to set the property of

propertyName
The name of the property

propertyValue
The value to set

Composites

Composite tasks are parent tasks that hold a list of child tasks. For example, one composite task may loop through the child tasks sequentially while another task may run all of its child tasks at once. The return status of the composite tasks depends on its children.

Behavior Designer includes the following composites with its default installation. For more composite examples take a look at sample projects.

Every composite task holds the property which specifies if conditional aborts should be used.

Sequence
Selector
Parallel
Parallel Selector
Priority Selector
Random Selector
Random Sequence
Selector Evaluator

Sequence

The sequence task is similar to an "and" operation. It will return failure as soon as one of its child tasks return failure. If a child task returns success then it will sequentially run the next task. If all child tasks return success then it will return success.

Selector

The selector task is similar to an "or" operation. It will return success as soon as one of its child tasks return success. If a child task returns failure then it will sequentially

run the next task. If no child task returns success then it will return failure.

Parallel

Similar to the sequence task, the parallel task will run each child task until a child task returns failure. The difference is that the parallel task will run all of its children tasks simultaneously versus running each task one at a time. Like the sequence class, the parallel task will return success once all of its children tasks have return success. If one tasks returns failure the parallel task will end all of the child tasks and return failure.

Parallel Selector

Similar to the selector task, the parallel selector task will return success as soon as a child task returns success. The difference is that the parallel task will run all of its children tasks simultaneously versus running each task one at a time. If one tasks returns success the parallel selector task will end all of the child tasks and return success. If every child task returns failure then the parallel selector task will return failure.

Priority Selector

Similar to the selector task, the priority selector task will return success as soon as a child task returns success. Instead of running the tasks sequentially from left to right within the tree, the priority selector will ask the task what its priority is to determine the order. The higher priority tasks have a higher chance at being run first.

Random Selector

Similar to the selector task, the random selector task will return success as soon as a child task returns success. The difference is that the random selector class will run its children in a random order. The selector task is deterministic in that it will always run the tasks from left to right within the tree. The random selector task shuffles the child tasks up and then begins execution in a random order. Other than that the random selector class is the same as the selector class. It will continue running tasks until a task completes successfully. If no child tasks return success then it will return failure.

seed
Seed the random number generator to make things easier to debug.

useSeed
Do we want to use the seed?

Random Sequence

Similar to the sequence task, the random sequence task will return success as soon as every child task returns success. The difference is that the random sequence class will run its children in a random order. The sequence task is deterministic in that it will always run the tasks from left to right within the tree. The random sequence task shuffles the child tasks up and then begins execution in a random order. Other than that the random sequence class is the same as the sequence class. It will stop running tasks as soon as a single task ends in failure. On a task failure it will stop executing all of the child tasks and return failure. If no child returns failure then it will return success.

seed
Seed the random number generator to make things easier to debug.

useSeed
Do we want to use the seed?

Selector Evaluator

The selector evaluator is a selector task which reevaluates its children every tick. It will run the lowest priority child which returns a task status of running. This is done each tick. If a higher priority child is running and the next frame a lower priority child wants to run it will interrupt the higher priority child. The selector evaluator will return success as soon as the first child returns success otherwise it will keep trying higher priority children. This task mimics the conditional abort functionality except the child tasks don't always have to be conditional tasks

Conditionals

Conditional tasks test some property of the game. For example, a condition might be to check if an object is within sight or determine if the player is still alive.

Behavior Designer includes the following conditionals with its default installation. For more conditional examples take a look at sample projects.

Random Probability
Compare Field Value
Compare Property Value
Has Received Event
Physics

Random Probability

The random probability task will return success when the random probability is above the succeed probability. It will otherwise return failure.

successProbability
The chance that the task will return success.

seed
Seed the random number generator to make things easier to debug.

useSeed
Do we want to use the seed?

Compare Field Value

Compares the field value to the value specified. Returns success if the values are the same.

targetGameObject
The GameObject to setthe field on

componentName
The component to set the field on

fieldName
The name of the field

compareValue
The value to compare to

Compare Property Value

Compares the property value to the value specified. Returns success if the values are the same.

targetGameObject
The GameObject to setthe property of

componentName
The component to set the property of

propertyName
The name of the property

compareValue
The value to compare to

Has Received Event

Returns success as soon as the event specified by eventName has been received.

eventName
The name of the event to receive

Physics

The following tasks are included in the conditional physics category:

Has Entered Collision
Has Entered Collision2D
Has Entered Trigger
Has Entered Trigger2D
Has Exited Collision
Has Exited Collision2D
Has Exited Trigger
Has Exited Trigger2D

Decorators

The decorator task is a wrapper task that can only have one child. The decorator task will modify the behavior of the child task in some way. For example, the decorator task may keep running the child task until it returns with a status of success or it may invert the return status of the child.

Behavior Designer includes the following decorators with its default installation. For more decorator examples take a look at sample projects.

Conditional Evaluator
Interrupt
Inverter
Repeater
Return Failure
Return Success
Task Guard
Until Failure
Until Success

Conditional Evaluator

Evaluates the specified conditional task. If the conditional task returns success then the child task is run and the child status is returned. If the conditional task does not return success then the child task is not run and a failure status is immediately returned. The conditional task is only evaluated once at the start.

reevaluate
Should the conditional task be reevaluated every tick?

conditionalTask
The conditional task to evaluate

Interrupt

The interrupt task will stop all child tasks from running if it is interrupted. The interruption can be triggered by the perform interruption task. The interrupt task will keep running its child until this interruption is called. If no interruption happens and the child task completed its execution the interrupt task will return the value assigned by the child task.

Inverter

The inverter task will invert the return value of the child task after it has finished executing. If the child returns success, the inverter task will return failure. If the child returns failure, the inverter task will return success.

Repeater

The repeater task will repeat execution of its child task until the child task has been run a specified number of times. It has the option of continuing to execute the child task even if the child task returns a failure.

count
The number of times to repeat the execution of its child task.

repeatForever
Allows the repeater to repeat forever.

endOnFailure
Should the task return if the child task returns a failure.

Return Failure

The return failure task will always return failure except when the child task is running.

Return Success

The return success task will always return success except when the child task is running.

Task Guard

The task guard task is similar to a semaphore in multithreaded programming. The task guard task is there to ensure a limited resource is not being overused. For example, you may place a task guard above a task that plays an animation. Elsewhere within your behavior tree you may also have another task that plays a different animation but uses the same bones for that animation. Because of this you don't want that animation to play twice at the same time. Placing a task guard will let you specify how many times a particular task can be accessed at the same time. In the previous animation task example you would specify an access count of 1. With this setup the animation task can be only controlled by one task at a time. If the first task is playing the animation and a second task wants to control the animation as well, it will either have to wait or skip over the task completely.

maxTaskAccessCount
The number of times the child tasks can be accessed by parallel tasks at once. Marked as SynchronizeField to synchronize the value between any linked tasks.

linkedTaskGuards
The linked tasks that also guard a task. If the task guard is not linked against any other tasks it doesn't have much purpose. Marked as LinkedTask to ensure all tasks linked are linked to the same set of tasks.

waitUntilTaskAvailable
If true the task will wait until the child task is available. If false then any unavailable child tasks will be skipped over.

Until Failure

The until failure task will keep executing its child task until the child task returns failure.

Until Success

The until success task will keep executing its child task until the child task returns success.

Basic Tasks

Behavior Designer includes a large number of tasks to accomplish basic operations, such as getting the velocity of a Rigidbody or playing a Mecanim state. The following categories of tasks are included:

Animation
Animator
AudioSource
Behaviour
BoxCollider
BoxCollider2D
CapsuleCollider
CharacterController
CircleCollider2D
Debug
GameObject
Input
Light
Math
Particle System
Physics
Physics2D
Player Prefs
Quaternion
Renderer
Rigidbody
Rigidbody2D
String
SharedVariable
SphereCollider
Transform
Vector2
Vector3

Animation

The following tasks are included in the Animation category:

Blend
CrossFade
CrossFadeQueued
GetAnimatePhysics
IsPlaying
Play
PlayQueued
Rewind
Sample
SetAnimatePhysics
SetWrapMode
Stop

Animator

The following tasks are included in the Animator category:

CrossFade
GetApplyRootMotion
GetBoolParameter
GetDeltaPosition
GetDeltaRotation
GetFloatParameter
GetGravityWeight
GetIntegerParameter
GetLayerWeight
GetSpeed
InterruptMatchTarget
IsInTransition
IsParameterControlledByCurve
MatchTarget
Play
SetApplyRootMotion
SetBoolParameter
SetFloatParameter
SetIntegerParameter
SetLayerWeight
SetLookAtPosition
SetLookAtWeight
SetSpeed
SetTrigger
StartPlayback
StartRecording
StopPlayback
StopRecording

AudioSource

The following tasks are included in the AudioSource category:

GetIgnoreListenerPause
GetIgnoreListenerVolume
GetLoop
GetMaxDistance
GetMinDistance
GetMute
GetPan
GetPanLevel
GetPitch
GetSpeed
GetPriority
GetSpread
GetTime
GetTimeSamples
GetVolume
IsPlaying
Pause
Play
PlayDelayed
PlayOneShot
PlayScheduled
SetIgnoreListenerPause
SetIgnoreListenerVolume

SetLoop
SetMaxDistance
SetMinDistance
SetMute
SetPan
SetPanLevel
SetPitch
SetPriority
SetRolloffMode
SetScheduledEndTime
SetScheduledStartTime
SetSpread
SetTime
SetVelocityUpdateMode
SetVolume
Stop

Behaviour

The following tasks are included in the Behaviour category:

GetIsEnabled
IsEnabled
SetIsEnabled

BoxCollider

The following tasks are included in the BoxCollider category:

GetCenter
GetSize
SetCenter
SetSize

BoxCollider2D

The following tasks are included in the BoxCollider2D category. These tasks first need to be extracted from the BasicTasks2D Unity Package.

GetCenter
GetSize
SetCenter
SetSize

CapsuleCollider

The following tasks are included in the CapsuleCollider category:

GetCenter
GetDirection
GetHeight
GetRadius
SetCenter
SetDirection
SetHeight
SetRadius

CharacterController

The following tasks are included in the CharacterController category:

GetCenter
GetHeight
GetRadius
GetSlopeLimit
GetStepOffset
GetVelocity
IsGrounded
Move
SetCenter
SetHeight
SetRadius
SetSlopeLimit

SetStepOffset
SimpleMove

CircleCollider2D

The following tasks are included in the CircleCollider2D category. These tasks first need to be extracted from the BasicTasks2D Unity Package.

GetCenter
GetRadius
SetCenter
SetRadius

Debug

The following tasks are included in the Debug category:

DrawLine
DrawRay
LogValue

GameObject

The following tasks are included in the GameObject category:

ActiveInHierarchy
ActiveSelf
CompareTag
Destroy
DestroyImmediate
Find
FindWithTag
GetComponent
GetTag
SendMessage
SetActive
SetTag

Input

The following tasks are included in the Input category:

GetAcceleration
GetAxis
GetAxisRaw
GetButton
GetKey
IsButtonDown
IsButtonUp
IsKeyDown
IsKeyUp

Light

The following tasks are included in the Light category:

GetColor
GetCookieSize
GetIntensity
GetRange
GetShadowBias
GetShadowSoftness
GetShadowSoftnessFade
GetShadowStrength
GetSpotAngle
SetColor
SetCookieSize
SetCullingMask
SetIntensity
SetRange
SetShadowBias
SetShadows
SetShadowSoftness

SetShadowSoftnessFade
SetShadowStrength
SetSpotAngle
SetType

Math

The following tasks are included in the Math category:

BoolComparison
BoolOperator
FloatComparison
FloatOperator
IntComparison
IntOperator
RandomBool
RandomFloat
RandomInt
SetBool
SetFloat
SetInt

Particle System

The following tasks are included in the Particle System category:

Clear
GetDuration
GetEmissionRate
GetEnableEmission
GetGravityModifier
GetLoop
GetMaxParticles
GetParticleCount
GetPlaybackSpeed
GetTime
IsAlive
IsPaused
IsPlaying
IsStopped
Pause
Play
SetEmissionRate
SetEnableEmission
SetGravityModifier
SetLoop
SetMaxParticles
SetPlaybackSpeed
SetStartColor
SetStartDelay
StartStartLifetime
SetStartRotation
SetStartSize
SetStartSpeed
SetTime
Simulate
Stop

Physics

The following tasks are included in the Physics category:

Linecast
Raycast
Spherecast

Physics2D

The following tasks are included in the Physics2D category:

Circlecast
Linecast
Raycast

Player Prefs

The following tasks are included in the Player Prefs category:

DeleteAll
DeleteKey
GetFloat
GetInt
GetString
HasKey
Save
SetFloat
SetInt
SetString

Quaternion

The following tasks are included in the Quaternion category:

Angle
AngleAxis
Dot
Euler
FromToRotation
Identity
Inverse
Lerp
LookRotation
RotateTowards
Slerp

Renderer

The following task is included in the Renderer category:

IsVisible

Rigidbody

The following task is included in the Rigidbodycategory:

AddExplosionForce
AddForce
AddForceAtPosition
AddRelativeForce
AddRelativeTorque
AddTorque
GetAngularDrag
GetAngularVelocity
GetCenterOfMass
GetDrag
GetFreezeRotation
GetIsKinematic
GetMass
GetPosition
GetRotation
GetUseGravity
GetVelocity
IsKinematic
IsSleeping
MovePosition
MoveRotation
SetAngularDrag
SetAngularVelocity
SetCenterOfMass
SetConstraints
SetDrag
SetFreezeRotation
SetIsKinematic
SetMass
SetPosition
SetRotation

SetUseGravity
SetVelocity
Sleep
UseGravity
WakeUp

Rigidbody2D

The following tasks are included in the Rigidbody2D category. These tasks first need to be extracted from the BasicTasks2D Unity Package.

AddForce
AddForceAtPosition
AddTorque
GetAngularDrag
GetAngularVelocity
GetDrag
GetFixedAngle
GetGravityScale
GetIsKinematic
GetMass
GetVelocity
IsKinematic
IsSleeping
SetAngularDrag
SetAngularVelocity
SetDrag
SetFixedAngle
SetGravityScale
SetIsKinematic
SetMass
SetVelocity
Sleep
WakeUp

String

The following tasks are included in the String category:

BuildString
Format
GetLength
GetRandomString
GetSubstring
IsNullOrEMpty
Replace
SetString

SharedVariable

The following tasks are included in the SharedVariable category:

CompareSharedBool
CompareSharedColor
CompareSharedFloat
CompareSharedGameObject
CompareSharedGameObjectList
CompareSharedInt
CompareSharedObject
CompareSharedObjectList
CompareSharedQuaternion
CompareSharedRect
CompareSharedString
CompareSharedTransform
CompareSharedTransformList
CompareSharedVector2
CompareSharedVector3
CompareSharedVector4
SetSharedBool
SetSharedColor
SetSharedFloat
SetSharedGameObject
SetSharedGameObjectList
SetSharedInt

SetSharedObject
SetSharedObjectList
SetSharedQuaternion
SetSharedRect
SetSharedString
SetSharedTransform
SetSharedTransformList
SetSharedVector2
SetSharedVector3
SetSharedVector4
SharedGameObjectToTransform
SharedTransformToGameObject

SphereCollider

The following tasks are included in the SphereCollider category:

GetCenter
GetRadius
SetCenter
SetRadius

Transform

The following tasks are included in the Transform category:

Find
FindChild
GetChild
GetChildCount
GetEulerAngles
GetLocalEulerAngles
GetLocalPosition
GetLocalRotation
GetLocalScale
GetParent
GetPosition
GetRotation
IsChildOf
LookAt
Rotate
RotateAround
SetEulerAngles
SetLocalEulerAngles
SetLocalRotation
SetLocalScale
SetParent
SetPosition
SetRotation
Translate

Vector2

The following tasks are included in the Vector2 cateogry:

ClampMagnitude
Distance
Dot
GetMagnitude
GetRightVector
GetSqrMagnitude
GetUpVector
GetVector3
GetXY
Lerp
MoveTowards
Multiply
Normalize
Operator
SetValue
SetXY

Vector3

The following tasks are included in the Vector3 cateogry:

ClampMagnitude
Distance
Dot
GetForwardVector
GetMagnitude
GetRightVector
GetSqrMagnitude
GetUpVector
GetVector2
GetXYZ
Lerp
MoveTowards
Multiply
Normalize
Operator
RotateTowards
SetValue
SetXYZ

Third Party

Behavior Designer contains tasks for the following third party assets:

2D Toolkit
Adventure Creator
AI For Mecanim
Anti-Cheat Toolkit
Camera Path Animator
Cinema Director
Control Freak
Core GameKit
Curvy
Dialogue System
DOTween
Final IK
Glow Effect
LeanTween
Master Audio
Motion Controller
NGUI
Particle Playground
PlayMaker
Pool Boss
Pool Manager
Realistic FPS Prefab
SECTR
Simple Waypoint System
Third Person Controller
Trigger Event Pro
uFrame
Ultimate FPS
Uni2D
UniStorm
uScript
uSequencer
Vectrosity

2D Toolkit

The following tasks are included in the 2D Toolkit integration:

Get Sprite Color
Get Sprite ID
Get TextMesh Anchor
Get TextMesh Colors

Get TextMesh Font
Get TextMesh Inline Styling
Get TextMesh Max Chars
Get TextMesh Num Drawn Characters
Get TextMesh Properties
Get TextMesh Scale
Get TextMesh Text
Get TextMesh Texture Gradient
Is Playing
Is TextMesh Inline Styling Available
Make Sprite Pixel Perfect
Make TextMesh Pixel Perfect
Pause Animation
Play Animation
Resume Animation
Set Animation Frame Rate
Set Sprite Color
Set Sprite ID
Set Sprite Scale
Set TextMesh Anchor
Set TextMesh Colors
Set TextMesh Font
Set TextMesh Inline Styling
Set TextMesh Max Chars
Set TextMesh Properties
Set TextMesh Scale
Set TextMesh Text
Set TextMesh Texture Gradient
Stop Animation

Adventure Creator

The following tasks are included in the Adventure Creator integration:

Synchronize Bool
Synchronize Float
Synchronize Int
Synchronize String

AI For Mecanim

The following tasks are included in the AI For Mecanim integration:

Start State Machine
Stop State Machine
Run State Machine

Anti-Cheat Toolkit

The following tasks are included with the Anti-Cheat Toolkit integration:

Detectors/Injection Detected (doc)
Detectors/Obscured Cheating Detected (doc)
Detectors/Speed Hack Detected (doc)
Obscured Prefs/Altered
Obscured Prefs/Delete All
Obscured Prefs/Delete Key
Obscured Prefs/Get Bool

Obscured Prefs/Get Color
Obscured Prefs/Get Float
Obscured Prefs/Get Int
Obscured Prefs/Get Quaternion
Obscured Prefs/Get String
Obscured Prefs/Get Vector2
Obscured Prefs/Get Vector3
Obscured Prefs/Has Key
Obscured Prefs/Save
Obscured Prefs/Set Bool
Obscured Prefs/Set Color
Obscured Prefs/Set Float
Obscured Prefs/Set Int
Obscured Prefs/Set New Crypto Key
Obscured Prefs/Set Quaternion
Obscured Prefs/Set String
Obscured Prefs/Set Vector2
Obscured Prefs/Set Vector3

Camera Path Animator

The following tasks are included with the Camera Path Animator integration:

Get Path Speed
Pause
Play
Seek
Set Animation Mode
Set Orientation Mode
Set Path Speed/Stop

Cinema Director

The following tasks are included with the Cinema Director integration:

Pause
Play
Skip
Stop

Control Freak

The following tasks are included with the Control Freak integration:

Get Axis
Get Axis Raw
Get Axis Vector
Get Button
Get Key
Is Button Down
Is Button Up
Is Key Down
Is Key Up

Core GameKit

The following tasks are included in the Core GameKit integration:

Add Float
Add Int
Attack Or Hit Points Add
Attack Or Hit Points Mod
Despawn
Despawn All Prefabs
Despawn Killable
Despawn Prefabs of Type
Destroy
End Triggered Wave
End Wave
Get Current Hit Points
Get Float
Get Int
Goto Wave
Is Tiggered Wave Spawning
Kill All Prefabs
Kill Prefabs of Type
Multiply Float
Multiply Int
Pause Wave
Prefab Despawned Count
Prefab Is In Pool
Prefab Spawned Count
Prefab Total Count
Prefab Type Count In Pool
Restart Wave
Resume Wave
Set Float
Set Int
Spawn From Pool
Spawn One
Take Damage
Temporary Invincibility

Curvy

The following tasks are included with the Curvy integration:

Align To Spline
Create Spline
Delete Control Points
Follow Spline
Get Control Points
Get Nearest Point
Get Segment Value
Get Value
Is Initialized
Move Along Spline
Set Clone Builder Source
Set Control Points

Dialogue System

The following tasks are included with Dialogue System integration:

Bark
Get Quest Entry State
Get Quest State
Is Lua True
Run Lua
Set Quest Entry State
Set Quest State
Start Sequence
Stop Conversation
Stop Sequence

DOTween

The following tasks are included with the DOTween integration:

Color To
Local Move
Local Move X
Local Move Y
Local Move Z
Local Rotate
Look At
Move
Move X
Move Y
Move Z
Rotate
Scale
Scale X
Scale Y
Scale Z
Float To
Init
Int To
Kill
Pause
Play
Rect To
Set Delay
Set Easy
String To
Toggle Pause
Vector2 To
Vector3 To
Vector4 To

Final IK

The following tasks are included in the Final IK integration:

Aim IK
Biped IK
CCD IK
FABR IK
FABR IK Root
FABR IK Root Chain
FBB IK Body
FBB IK Limb
FBB IK Settings
IK Execution Order
Limb IK
Look At IK
Pause Interaction

Resume Interaction
Start Interaction
Stop Interaction
Trigonometric IK

Glow Effect

The following tasks are included with the Glow Effect integration:

Get Blur Iterations
Get Blur Spread
Get Glow Color Multiplier
Get Glow Strength
Set Blur Iterations
Set Blur Spread
Set Glow Color Multiplier
Set Glow Strength

LeanTween

The following tasks are included with the LeanTween integration:

Alpha
Cancel
Cancel All
Color
Color Value
Float Value
Init
Int Value
Move
Move Local
Move Spline
Move Spline Local
Move X
Move Y
Move Z
Pause
Pause All
Resume
Resume All
Rotate
Rotate Around
Rotate Around Local
Rotate Local
Rotate X
Rotate Y
Rotate Z
Scale
Scale X
Scale Y
Scale Z
Set Delay
Set Ease
Vector2 Value
Vector3 Value

Master Audio

The following tasks are included in the Master Audio integration:

Add Ducking Group
Change Variation Pitch
Fade Bus
Fade Group
Fade Out All Of Sound Group
Fade Playlist
Fire Custom Event
Get Current Playlist Clip Name
Mute Bus
Mute Everything
Mute Group
Mute Playlist
Next Playlist Clip
Pause Bus
Pause Everything
Pause Group
Pause Mixer
Pause Playlist
Play Playlist By Clip Name
Play Random Playlist Clip
Play Sound
Remove Ducking Group
Set Bus Volume
Set Group Volume
Set Master Volume
Set Playlist Volume
Solo Bus
Solo Group
Start Playlist By Name
Stop All Of Sound
Stop Bus
Stop Everything
Stop Mixer
Stop Playlist
Stop Transform Sound
Toggle Ducking
Toggle Group Mute
Toggle Group Solo
Toggle Playlist Mute
Unmute Bus
Unmute Everything
Unmute Group
Unmute Playlist
Unpause Bus
Unpause Everything
Unpause Group
Unpause Mixer
Unpause Playlist
Unsolo Bus
Unsolo Group

Motion Controller

The following tasks are included with the Motion Controller integration:

Activate Motion
Deactivate Motion
Set Active Motion Phase
Is Motion Active
Traverse Towards
Traverse Patrol

NGUI

The following tasks are included in the NGUI integration:

Button Is Enabled
Get Label Text
Get Scroll Bar Value
Get Slider Value
Get Widget Alpha
Get Widget Color
Set Button Is Enabled
Set Label Text
Set Scroll Bar Value
Set Slider Value
Set Sprite
Set Widget Alpha
Set Widget Color
Set Widget Enabled
Simulate Click
Widget Enabled

Particle Playground

The following tasks are included with the Particle Playground integration:

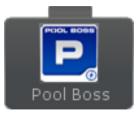
Destroy
Emit
Get Particles
Is Particle Event
Set Alpha
Set Color
Set Lifetime
Set Material
Set Particle Count
Set Size
Translate

PlayMaker

PlayMaker integration details can be found on the PlayMaker Integration topic. The following tasks are included with the PlayMaker integration:

Broadcast Event
Run Conditional FSM
Send Event
Start FSM
Stop FSM
Synchronize Bool
Synchronize Color
Synchronize Float
Synchronize GameObject
Synchronize Int
Synchronize Object
Synchronize Quaternion
Synchronize Rect
Synchronize String
Synchronize Vector2
Synchronize Vector3

Pool Boss



The following tasks are included with the Pool Boss integration:

Despawn
Despawn All Prefabs
Despawn Prefabs Of Type
Is In Pool
Item Despawned Count
Item Spawned Count
Item Total Count
Prefab Count
Spawn

Pool Manager

The following tasks are included in the PoolManager integration:

Check If Prefab Pool Exists
Create Pool
Create Prefab Pool
Despawn
Destroy All Pools
Destroy Pool
Get Pool Group
Get Pool Instances Count
Get Pools Count
Spawn

Realistic FPS Prefab

The following tasks are included with the Realistic FPS Prefab integration:

Attack Player
Can See Target
Is Damaged
Patrol
Set Speed
Shoot
Stand Watch

SECTR

The follwoing tasks are included with the SCTR integration:

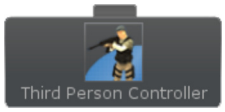
Audio/Start Stop Source
Audio/Play Music
Audio/Play Audio Cue
Audio/Change Audio Bus
Audio/Add Ambience
Core/Open Door
Core/Set Portal Flags
Stream/Load Sector
Vis/Enable Culling

Simple Waypoint System

The following tasks are included in the Simple Waypoint System integration:

Chase Speed
Get Waypoint of Path
Pause Movement
Resume Movement
Set Delay at Waypoint
Set Path
Set Waypoint of Path
Start Movement
Stop Movement
Update Bezier Path

Third Person Controller



The Third Person Controller sample project contains a complete behavior tree which uses the Third Person Controller tasks. This tree is described in detail on this page. The following tasks are included with the Third Person Controller integration:

Action
Has Ammo
Has Current Item
Is Alive
Is Damaged
Move
Reload
Set Aim
Switch Item
Use

Trigger Event Pro

The following tasks are included with the Trigger Event Pro integration:

Event Fire Controller/Has Event Trigger Spawned
Event Fire Controller/Has Firedd
Event Fire Controller/Has Idle Updated
Event Fire Controller/Has Pre Fired
Event Fire Controller/Has Started
Event Fire Controller/Has Stopped
Event Fire Controller/Has Target Updated
Event Fire Controller/Has Updated
Event Trigger/Has Been Sorted
Event Trigger/Has Fired
Event Trigger/Has Fired Updated
Event Trigger/Has Hit Target
Event Trigger/Has Listen Started
Event Trigger/Has Listen Updated
Event Trigger/Has New Target Been Detected
Event Trigger/Has Targets Changed
Targetable/Is DetectedTargetable/Is HitTargetable/Is Not Detected

uFrame

The following task is included with the uFrame integration. The Variable Synchronizer can also synchronize uFrame properties. Get it contact with us if you think any other uFrame tasks are appropriate.

Synchronize Property

Ultimate FPS

The following tasks are included with the UFPS integration:

Add Item
Attack
Can Interact
Deplete Ammo
Has Ammo
Has Weapon
Has Weapon Clip
Interact
Is Agent Alive
Is Damagable Alive
Is Damaged
Refill Current Weapon
Reload
Remove Item
Set Weapon
Set Weapon By Name

Uni2D

The following tasks are included with the Uni2D integration:

Animation/Get Frame Index
Animation/Get Frame Rate
Animation/Get Normalized Time
Animation/Get Speed
Animation/Get Time
Animation/Pause
Animation/Play By Index
Animation/Play By Name
Animation/Play Current
Animation/Resume
Animation/Set Frame Index
Animation/Set Frame Rate
Animation/Set Normalized Time
Animation/Set Speed
Animation/Set Time
Animation/Set Wrap Mode
Animation/Stop
Sprite/Get Sorting Layer ID
Sprite/Get Sorting Layer Name
Sprite/Get Sorting Order
Sprite/Get Vertex Color
Sprite/Is Kinematic
Sprite/Is Trigger
Sprite/Set Is Kinematic
Sprite/Set Is Trigger
Sprite/Set Sorting Layer ID
Sprite/Set Sorting Layer Name
Sprite/Set Sorting Order

Sprite/Set Vertex Color

UniStorm

The following tasks are included with the UniStorm integration:

Get Day Length
Get Days
Get Fog Density
Get Fog End Distance
Get Fog Start Distance
Get Hours
Get Max Sun Intensity
Get Minutes
Get Months
Get Stormy Fog Distance
Get Stormy Fog Start
Get Sun Angle
Get Temperature
Get Weather Forcaster
Get Years
Is Time Stopped
Set Day Length
Set Fog Density
Set Fog End Distance
Set Fog Start Distance
Set Max Sun Intensity
Set Stormy Fog Distance
Set Stormy Fog Start
Set Sun Angle
Stop Time

uScript

uScript integration details can be found in the uScript Integration topic. The following tasks are included with uScript integration:

Start Graph
Run Conditional Graph

uSequencer

The following tasks are included in the uSequencer integration:

Is Sequence Playing
Pause Sequence
Play Sequence From Time
Play Sequence
Set Sequence Time
Stop Sequence

Vectrosity

The following tasks are included with the Vectrosity integration:

Destroy
Make Circle
Make Cube
Make Curve
Make Ellipse
Make Rect
Make Spline
Make Test
Set Color
Set Line
Set Line 3D
Set Ray
Set Ray 3D
Set Width

Entry Task

The entry task is a task that is used for display purposes within Behavior Designer to indicate the root of the tree. It is not a real task and cannot be used within the behavior tree.

Support

We are here to help! If you have any questions/problems/suggestions please don't hesitate to ask. You can email us at support@opsive.com or post on the forum.