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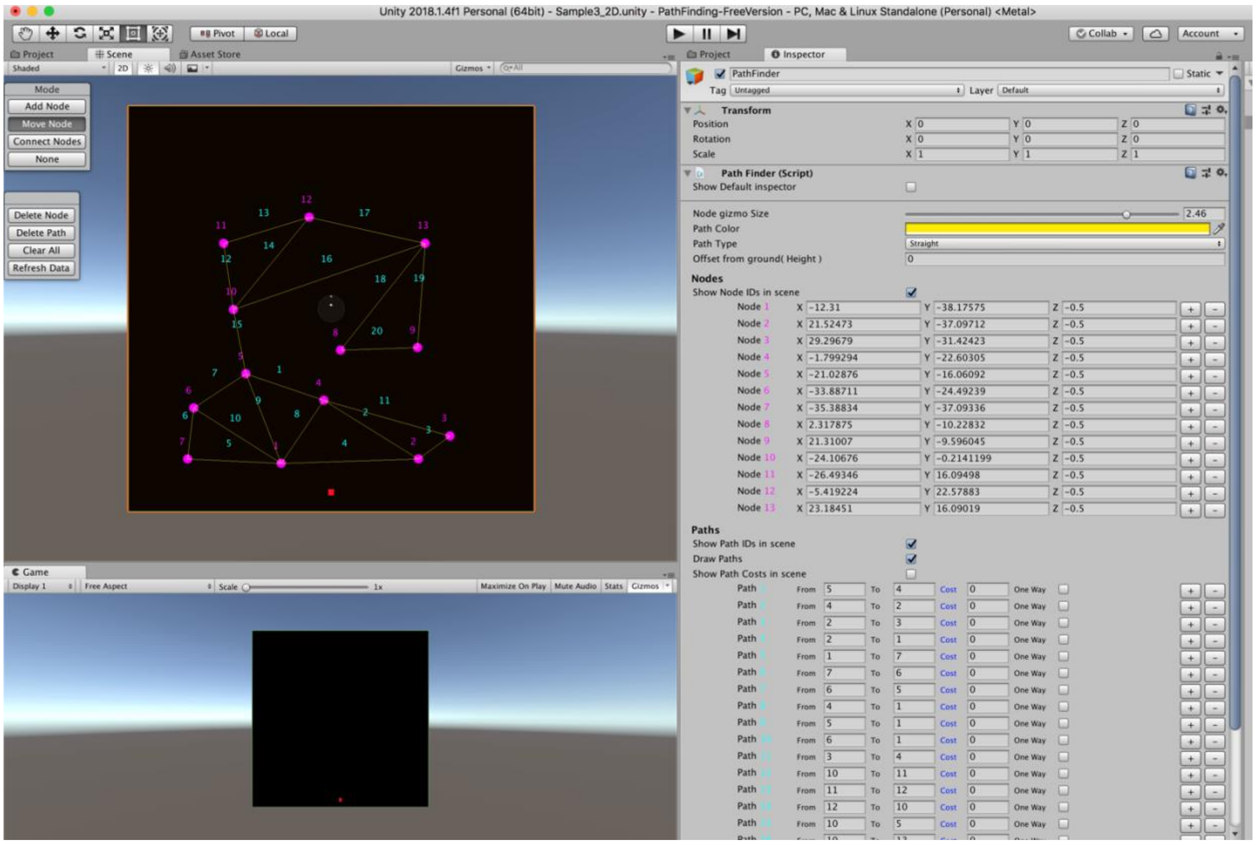
An Introduction

QPathFinder uses A* Path-finding Heuristic algorithm. This algorithm is best known for finding shortest path is minimal time.

Kindly Note, this plugin is not a grid based path finder, but a node based path finder.

You have to set up multiple Nodes and you inter-connect them like in the image below. Once you have that, this algorithm will provide the shortest path from one point on the ground* to another.

Ground* - is the collider on which we can add nodes.



PathFinder ☐ Static
Tag Untagged Layer Default

Transform

	X	Y	Z
Position	0	0	0
Rotation	0	0	0
Scale	1	1	1

Path Finder (Script)
Show Default inspector ☐

Node gizmo Size 2.46
Path Color 🟨
Path Type Straight
Offset from ground(Height) 0

Nodes
Show Node IDs in scene ✓

	X	Y	Z
Node 1	-12.31	-38.17575	-0.5
Node 2	21.52473	-37.09712	-0.5
Node 3	29.29679	-31.42423	-0.5
Node 4	-1.799294	-22.60305	-0.5
Node 5	-21.02876	-16.06092	-0.5
Node 6	-33.88711	-24.49239	-0.5
Node 7	-35.38834	-37.09336	-0.5
Node 8	2.317875	-10.22832	-0.5
Node 9	21.31007	-9.596045	-0.5
Node 10	-24.10676	-0.2141199	-0.5
Node 11	-26.49346	16.09498	-0.5
Node 12	-5.419224	22.57883	-0.5
Node 13	23.18451	16.09019	-0.5

Paths
Show Path IDs in scene ✓
Draw Paths ✓
Show Path Costs in scene ☐

	From	To	Cost	One Way
Path	5	4	0	☐
Path	4	2	0	☐
Path	2	3	0	☐
Path	2	1	0	☐
Path	1	7	0	☐
Path	7	6	0	☐
Path	6	5	0	☐
Path	4	1	0	☐
Path	5	1	0	☐
Path	6	1	0	☐
Path	3	4	0	☐
Path	10	11	0	☐
Path	11	12	0	☐
Path	12	10	0	☐
Path	10	5	0	☐

What are Nodes and Paths?

1. Nodes are like Junctions in real life. Each Node has a specific ID which is auto generated. You can find the IDs in Pink.
2. Path is a connection between 2 Nodes. Each Path has a specific ID, which is auto generated. You can find these IDs in Cyan.
   Note that Node ID with Path ID are different. They are also represented by different colors. Pink in the case of Nodes and Cyan for paths.

3. (Optional) Once you have the paths, you can give cost per each path. Path finding prefers to use paths with lower costs. Also, you can set few Paths as One-ways. The direction of the one way is *From* to *To*, in the inspector.

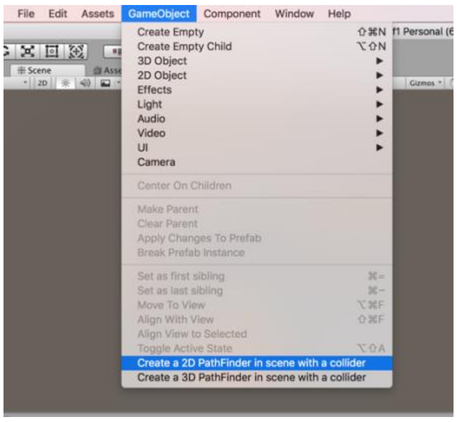
Note: Remember that Path finding takes two metrics in consideration before finding the shortest path

a. The costs you give for the *Path.*
b. The physical distance between the nodes.

How to create Nodes and Paths for 2D

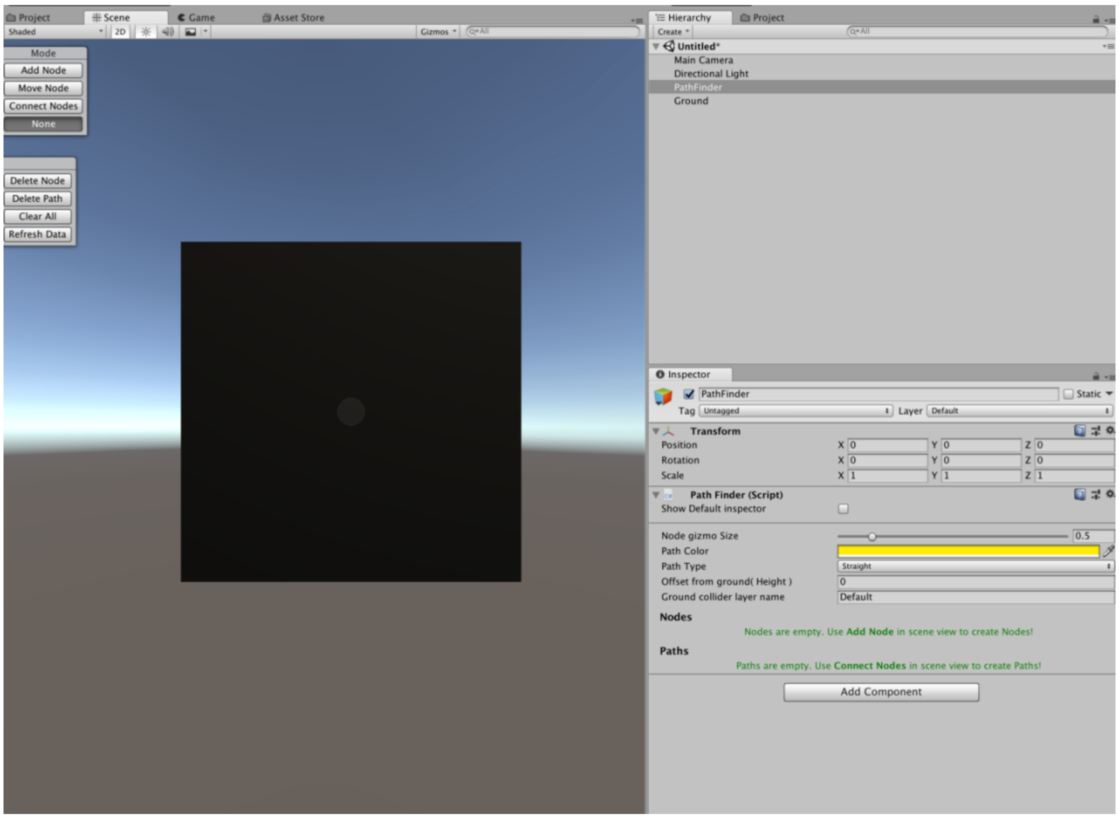
Step 1: Create Pathfinder

Create Pathfinder script and Ground colliders in the scene.



Step 2: Select Pathfinder

Select Pathfinder Gameobject in hierarchy. This brings ups the Pathfinder GUI on the scene view.

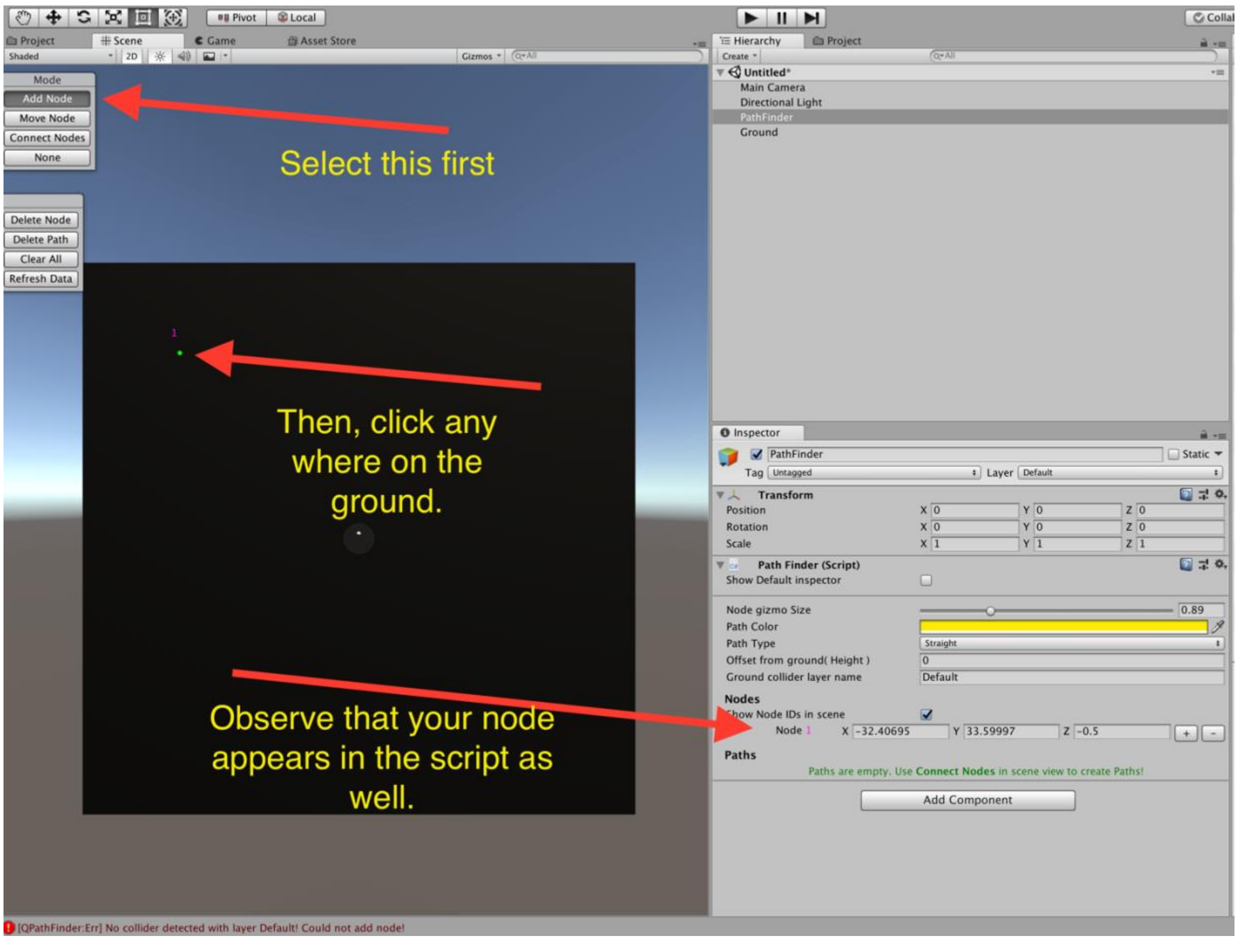


PathFinder
Static
Tag: Untagged
Layer: Default

Transform
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1

Path Finder (Script)
Show Default inspector ☐
Node gizmo Size 0.5
Path Color
Path Type Straight
Offset from ground(Height) 0
Ground collider layer name Default
Nodes
Nodes are empty. Use **Add Node** in scene view to create Nodes!
Paths
Paths are empty. Use **Connect Nodes** in scene view to create Paths!

Step 3: Create nodes

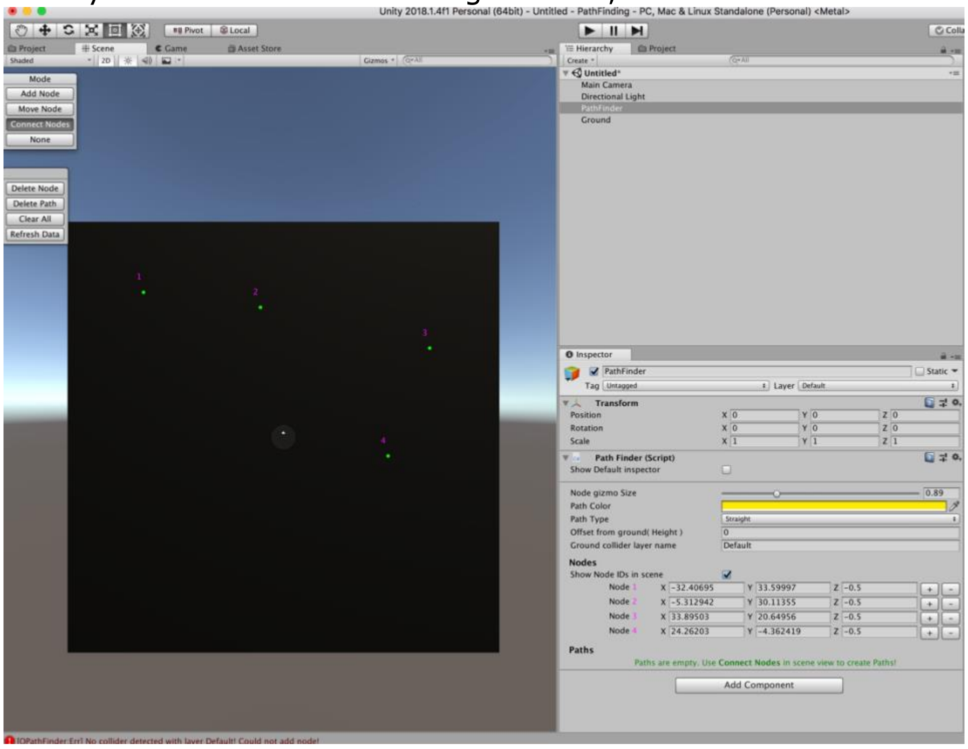


PathFinder
Tag Untagged Layer Default
Transform
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1
Path Finder (Script)
Show Default inspector
Node gizmo Size 0.89
Path Color
Path Type Straight
Offset from ground(Height) 0
Ground collider layer name Default
Nodes
Show Node IDs in scene ✓
Node 1 X -32.40695 Y 33.59997 Z -0.5
Paths
Paths are empty. Use **Connect Nodes** in scene view to create Paths!

[QPathFinder:Err] No collider detected with layer Default! Could not add node!

Repeat the process multiple times.

Then you would have something like this,



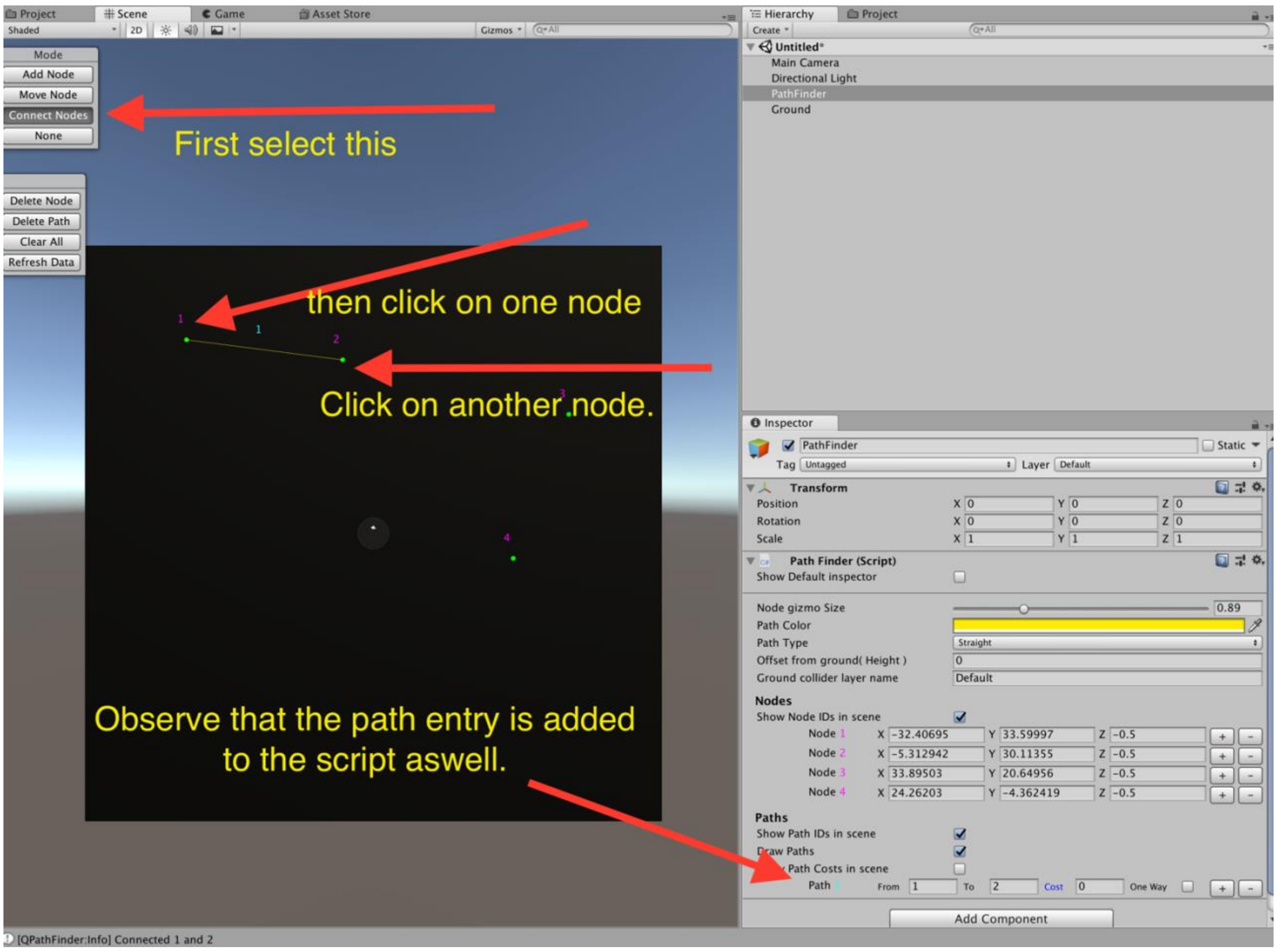
Unity 2018.1.4f1 Personal (64bit) - Untitled - PathFinding - PC, Mac & Linux Standalone (Personal) <Metal>

PathFinder
Tag Untagged Layer Default
Transform
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1
Path Finder (Script)
Show Default inspector
Node gizmo Size 0.89
Path Color
Path Type Straight
Offset from ground(Height) 0
Ground collider layer name Default
Nodes
Show Node IDs in scene ✓
Node 1 X -32.40695 Y 33.59997 Z -0.5
Node 2 X -5.312942 Y 30.11355 Z -0.5
Node 3 X 33.89503 Y 20.64956 Z -0.5
Node 4 X 24.26203 Y -4.362419 Z -0.5
Paths
Paths are empty. Use **Connect Nodes** in scene view to create Paths!

[QPathFinder:Err] No collider detected with layer Default! Could not add node!

Step 4: Create Paths (Connections)

This is a very important step, where u create paths between nodes.



```
PathFinder                          [ ] Static
Tag  Untagged                       Layer  Default

Transform
Position    X 0         Y 0          Z 0
Rotation    X 0         Y 0          Z 0
Scale       X 1         Y 1          Z 1

Path Finder (Script)
Show Default inspector              [ ]

Node gizmo Size                     0.89
Path Color
Path Type                           Straight
Offset from ground( Height )        0
Ground collider layer name          Default
Nodes
Show Node IDs in scene              [✓]
      Node 1   X -32.40695   Y 33.59997   Z -0.5   + -
      Node 2   X -5.312942   Y 30.11355   Z -0.5   + -
      Node 3   X 33.89503    Y 20.64956   Z -0.5   + -
      Node 4   X 24.26203    Y -4.362419  Z -0.5   + -
Paths
Show Path IDs in scene              [✓]
Draw Paths                          [✓]
Path Costs in scene                 [ ]
      Path     From 1   To 2   Cost 0   One Way [ ]   + -
```

```
[QPathFinder:Info] Connected 1 and 2
```

Step 5 (Optional): Enter costs for each path

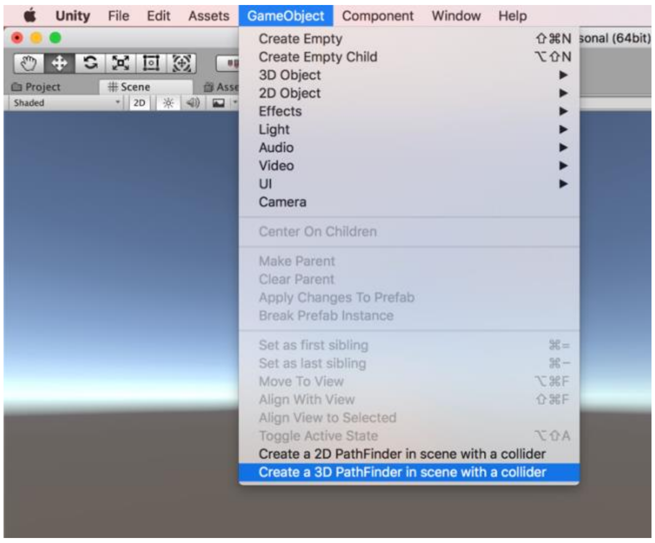
When u select Pathfinder Gameobject, you can Enter the cost for each path.

Or set few Paths are one-way. One-Ways go from *From* to *To* Nodes.

How to create Nodes and Paths for 3D

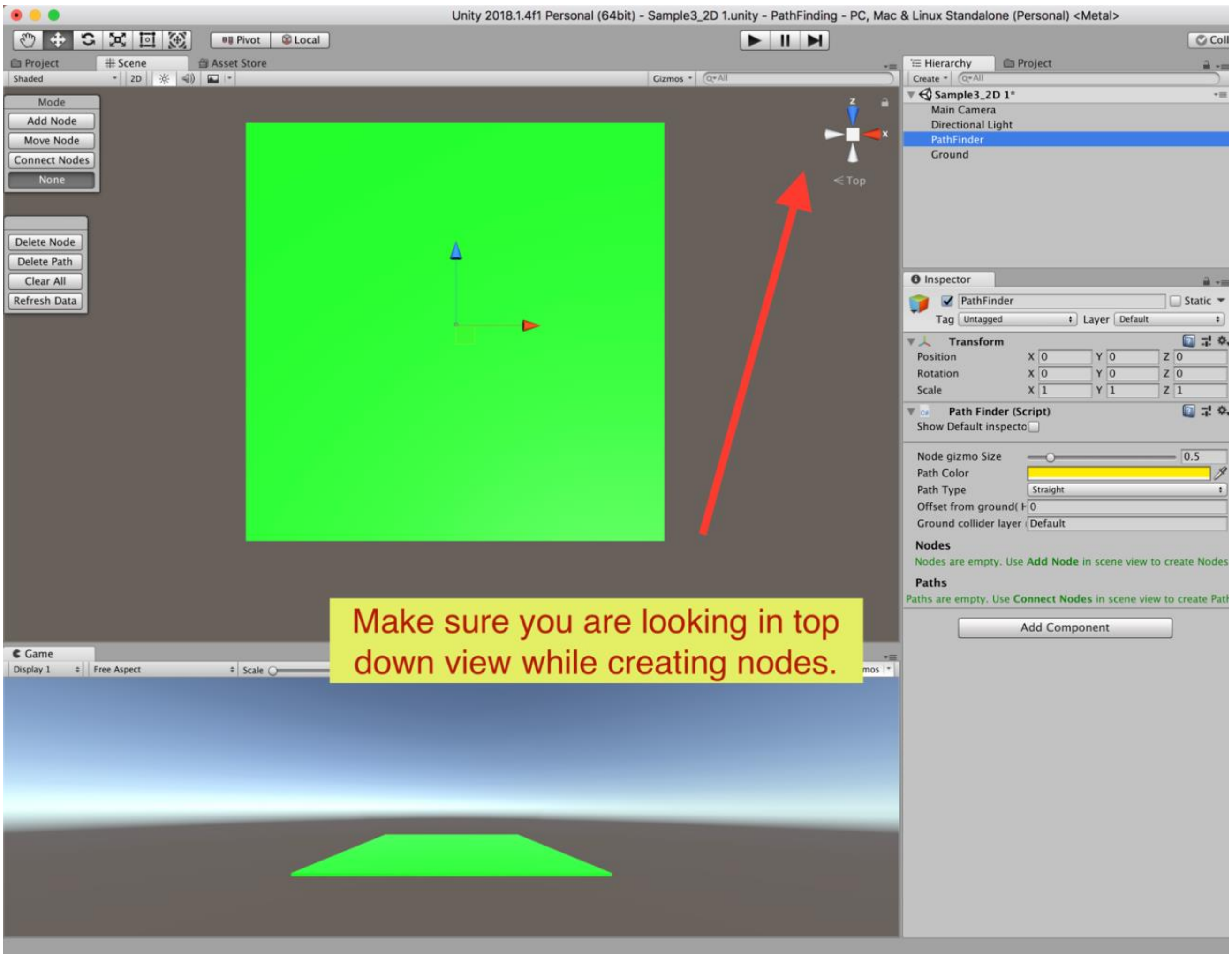
Step 1 : Create Pathfinder

Create Pathfinder gameobjects and ground collider.



Step 2: Select Pathfinder

Select *Pathfinder* Game object from the Hierarchy. This will show the Pathfinder GUI on the scene view.



Make sure you are looking in top down view while creating nodes.

PathFinder
Tag Untagged Layer Default
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1
Show Default inspector
Node gizmo Size 0.5
Path Color
Path Type Straight
Offset from ground(0
Ground collider layer Default
Nodes
Nodes are empty. Use **Add Node** in scene view to create Nodes
Paths
Paths are empty. Use **Connect Nodes** in scene view to create Path

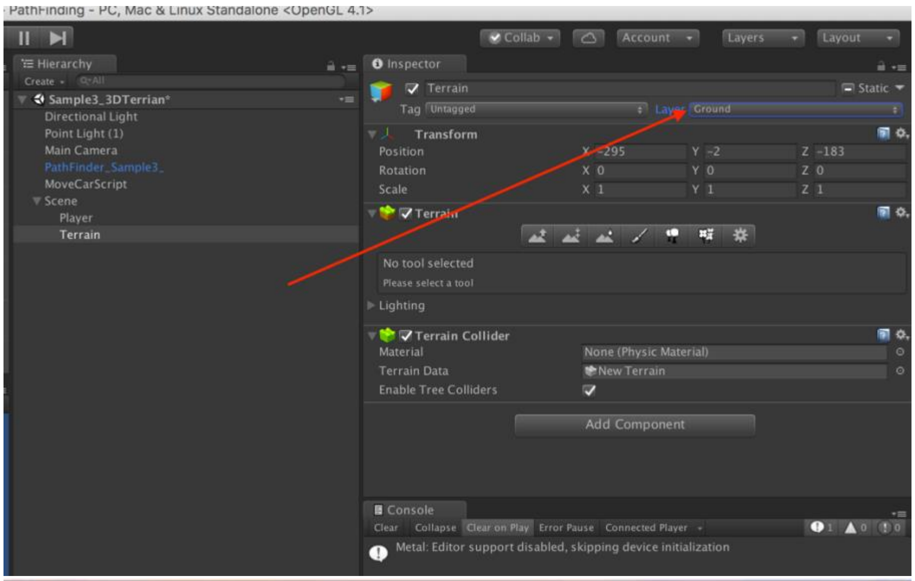
Step 3,4,5:

these steps are same as in 2D. Please refer to that. Go there.

Caution about 3D node creation:

1. Make sure you are in top-down view while adding nodes. This will make ensure that are placed where u tap.

2. The *Layer* of the ground collider should not be same as the *Layer* of the movable objects. Also, the *layer* of the ground collider should be entered in Pathfinder script.


PathFinding - PC, Mac & Linux Standalone <OpenGL 4.1>

Hierarchy: Sample3_3DTerrian* — Directional Light, Point Light (1), Main Camera, PathFinder_Sample3_, MoveCarScript, Scene — Player, Terrain

Inspector: Terrain — Tag Untagged — Layer Ground

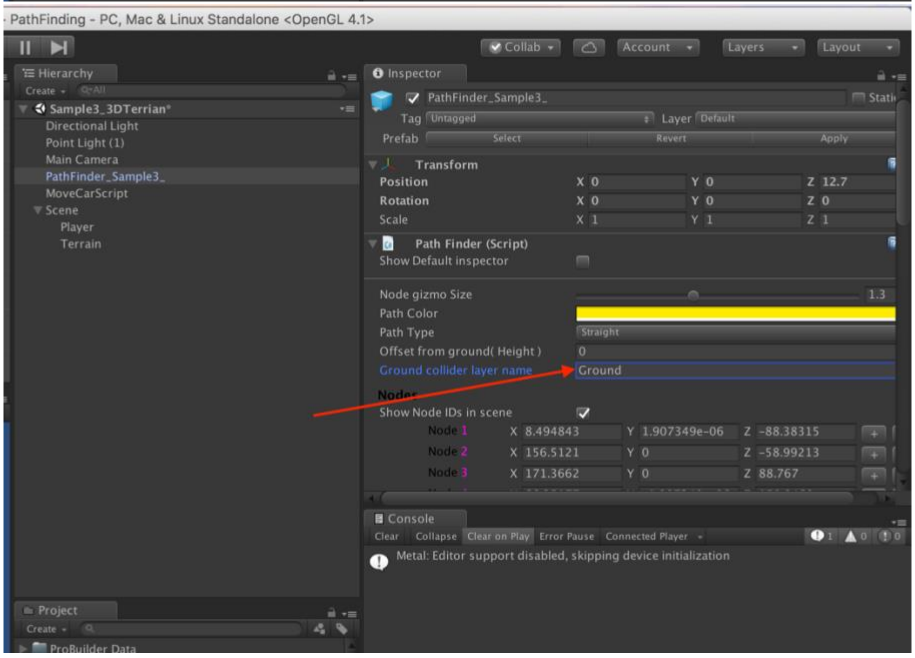
Transform — Position X -295 Y -2 Z -183 — Rotation X 0 Y 0 Z 0 — Scale X 1 Y 1 Z 1

Terrain — No tool selected — Please select a tool

Lighting

Terrain Collider — Material None (Physic Material) — Terrain Data New Terrain — Enable Tree Colliders ✓

Console: Metal: Editor support disabled, skipping device initialization


PathFinding - PC, Mac & Linux Standalone <OpenGL 4.1>

Hierarchy: Sample3_3DTerrian* — Directional Light, Point Light (1), Main Camera, PathFinder_Sample3_, MoveCarScript, Scene — Player, Terrain

Inspector: PathFinder_Sample3_ — Tag Untagged — Layer Default

Transform — Position X 0 Y 0 Z 12.7 — Rotation X 0 Y 0 Z 0 — Scale X 1 Y 1 Z 1

Path Finder (Script) — Show Default inspector

Node gizmo Size 1.3
Path Color
Path Type Straight
Offset from ground(Height) 0
Ground collider layer name Ground

Nodes
Show Node IDs in scene ✓

Node 1	X 8.494843	Y 1.907349e-06	Z -88.38315
Node 2	X 156.5121	Y 0	Z -58.99213
Node 3	X 171.3662	Y 0	Z 88.767

Console: Metal: Editor support disabled, skipping device initialization

Project: ProBuilder Data

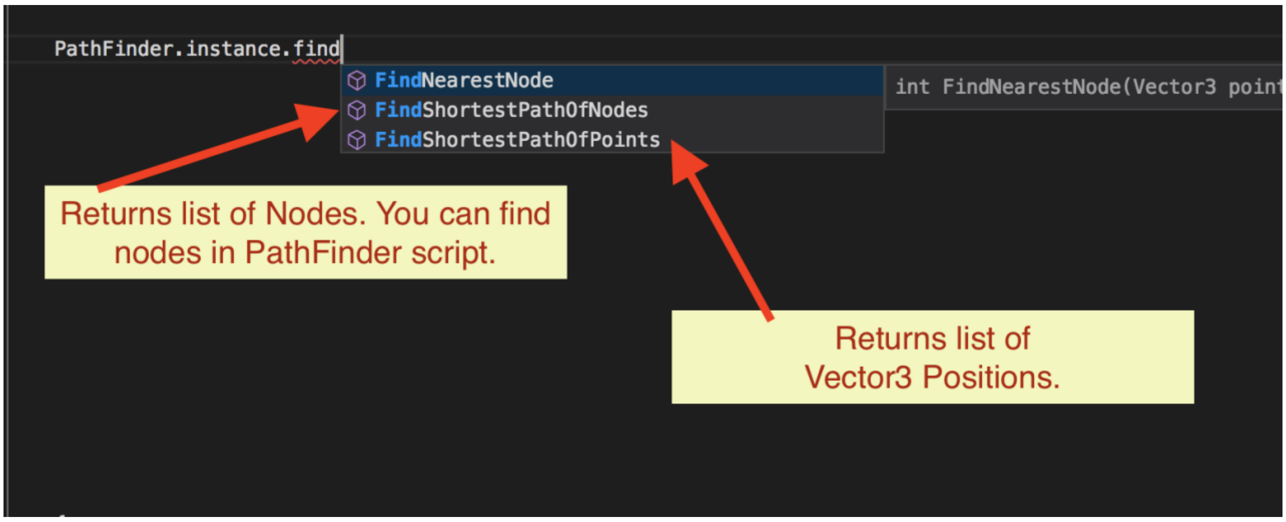
How to Trigger Pathfinder from code

Once you have created all Nodes and Paths. Use Pathfinder class to access all the methods necessary.

include namespace QPathFinder wherever needed.

```
using QPathFinder;
```

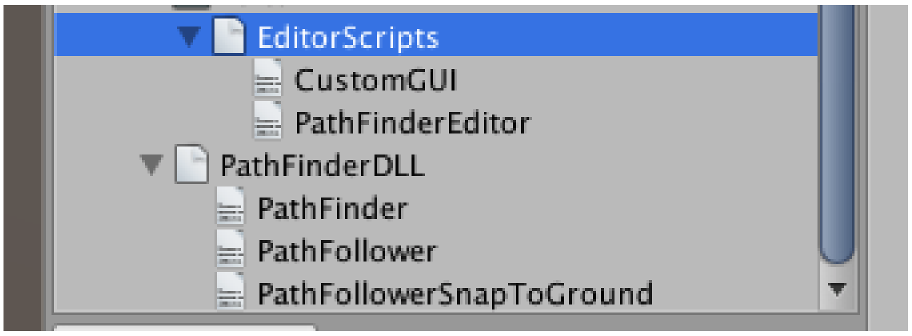
As long as you have Pathfinder script in the **scene**, you can access PathFinder.Instance directly from the code.



```
PathFinder.instance.find
```

FindNearestNode
FindShortestPathOfNodes
FindShortestPathOfPoints
int FindNearestNode(Vector3 point
Returns list of Nodes. You can find nodes in PathFinder script.
Returns list of Vector3 Positions.

Note for Free-Version users: As I had included DLLs instead of script files, you can expand the pathfinder DLL in unity and find the scripts there. You can attach them to gameobjects just like any other scripts.



There are 3 Methods to fetch the paths from PathFinder Class

1.

```
/// Finds shortest path between Nodes.
/// Once the path if found, it will return the path as List of nodes (not positions, but nodes. If you need positions, use
FindShortestPathOfPoints).
/// <returns> Returns list of **Nodes**</returns>
/// <param name="fromNodeID">Find the path from this node</param>
/// <param name="toNodeID">Find the path to this node</param>
/// <param name="executionType">Synchronous is immediate & locks the control till path is found and returns the path.
/// Asynchronous type runs in coroutines without locking the control. If you have more than 50 Nodes, Asynchronous is
recommended</param>
/// <param name="callback">Callback once the path is found</param>


public void FindShortestPathOfNodes ( int fromNodeID, int toNodeID, Execution executionType,
System.Action<List<Node>>  callback );
```

2.

```
/// Finds shortest path between Nodes.
/// Once the path is found, it will return the path as List of Positions (not Nodes, but vector3. If you need Nodes, use
FindShortestPathOfNodes).
/// <returns> Returns list of **Positions**</returns>
/// <param name="startNodeID">Find the path from this node</param>
/// <param name="endNodeID">Find the path to this node</param>
/// <param name="pathType">Path type. It can be a straight line or curved path</param>
/// <param name="executionType">Synchronous is immediate & locks the control till path is found and returns the path.
/// Asynchronous type runs in coroutines without locking the control. If you have more than 50 Nodes, Asynchronous is
recommended</param>
/// <param name="OnPathFound">Callback once the path is found</param>
```

public static void FindShortestPathOfPoints (this PathFinder manager, int startNodeID, int endNodeID, PathLineType pathType, Execution executionType, System.Action<List<Vector3>> OnPathFound);

3. (Overloaded method)

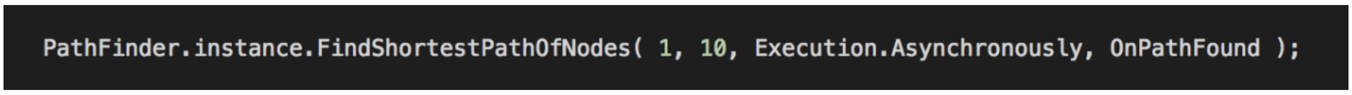
```
/// Finds shortest path between Nodes.
/// Once the path is found, it will return the path as List of Positions ( not Nodes, but vector3. If you need Nodes, use
FindShortestPathOfNodes).
/// <returns> Returns list of **Positions**</returns>
/// <param name="startNodeID">Find the path from this node</param>
/// <param name="endNodeID">Find the path to this node</param>
/// <param name="pathType">Path type. It can be a straight line or curved path</param>
/// <param name="executionType">Synchronous is immediate & locks the control till path is found and returns the path.
/// Asynchronous type runs in coroutines with out locking the control. If you have more than 50 Nodes, Asynchronous is
recommended</param>
/// <param name="searchMode"> This is still WIP. For now, Intermediate and Complex does a tad bit more calculations to make the
path even shorter</param>
/// <param name="OnPathFound">Callback once the path is found</param>
```

public static void FindShortestPathOfPoints (this PathFinder manager, Vector3 startPoint, Vector3 endPoint, PathLineType pathType, Execution executionType, SearchMode searchMode, System.Action<List<Vector3>> OnPathFound);

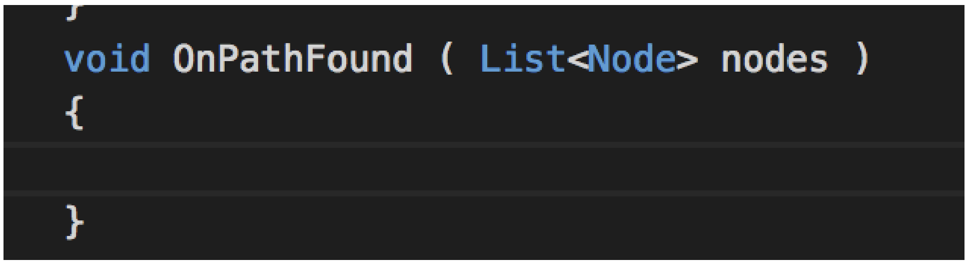
Note that some return list of Nodes and others return list of positions. Choose as you deem fit for your project.

Simple example

If I need to get shortest path from node 1 to 10, you can get it like this,



```
PathFinder.instance.FindShortestPathOfNodes( 1, 10, Execution.Asynchronously, OnPathFound );
```



```
void OnPathFound ( List<Node> nodes )
{

}
```

Once the result is found, callback will be called with list of nodes or positions (based on the method you use).

You can find more examples in the plugin under QPathFinder/Samples/Scripts.

How to traverse through the Path (Optional) :

Once we get the shortest path, we can choose to move a character across the path.

This is Optional. You can write your own path follower classes to move your character based on what your game needs. But I have included a sample pathFollower to do just the basics.

How to Trigger PathFollow from the code

1. To move an object along the list of positions.

```
/// <Summary>
/// This will move the game object through the positions specified.
/// </Summary>
/// <param name="transform">The object you want to move along the path</param>
/// <param name="points">List of positions along which the object is moved.</param>
/// <param name="moveSpeed">Movement speed</param>

public static PathFollower FollowPath( Transform transform, List<Vector3> points, float moveSpeed );
```

2. To move an object along list of positions, but also the object is snapped to the ground. In case of uneven terrains, you can use this.

```
/// <Summary>
/// This will move the game object through the points specified, Also, it will keep the gameobject snapped to the ground.
/// So if your Nodes are a little above the ground, your target will still move on the ground.
/// We are doing this by raycasting from above the player to the ground. At the ray cast hit position, we are snapping the player.
/// </Summary>
/// <param name="transform">The object you want to move along the path</param>
/// <param name="points">List of positions along which the object is moved.</param>
/// <param name="moveSpeed">Movement speed</param>
/// <param name="directionOfRayCast"> We use raycasting to find the ground position. If your ground is down, the ray has to go down, so use Vector3.down. </param>
/// <param name="offsetDistanceToFloatFromGround"> If you want your character to float a little above the ground, give the offset value here. More you give, character floats higher from the ground. </param>
/// <param name="groundGameObjectLayer">This is the ground Gameobject's layer. When we use raycast we target to hit this layer</param>
/// <param name="offsetDistanceFromPoint">this is to calculate the raycast origin, from where we shoot rays.
raycast origin is generally above the player, casting rays towards ground. For most cases, you can leave this as
default.</param>
/// <param name="maxDistanceForRayCast">this is the distance of ray from the raycast origin. For most cases you
can let this be default value. </param>


public static PathFollower FollowPathWithGroundSnap( Transform transform, List<Vector3> points, float
moveSpeed, Vector3 directionOfRayCast, float offsetDistanceToFloatFromGround, int
groundGameObjectLayer, float offsetDistanceFromPoint = 10, int maxDistanceForRayCast = 40 )
```

3. To stop a moving object.

```
/// <summary>
/// Stops the gameobject while moving along the path.
/// </summary>
/// <param name="transform">The gameobject which needs to stop moving</param>

public static void StopFollowing( Transform transform )
```

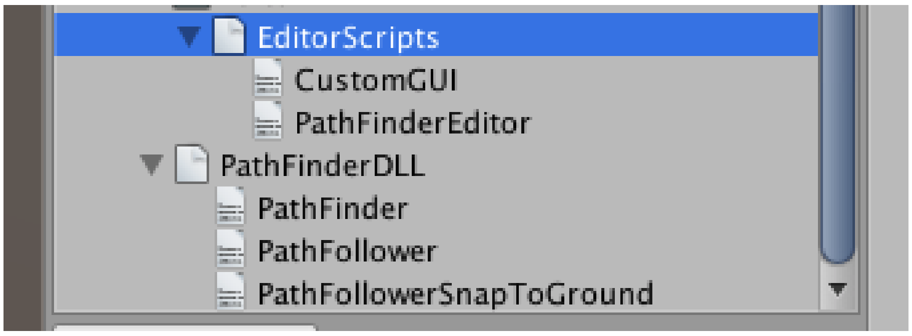
Note: All these Pathfollower methods are in PathFollowerUtility class. You can find more examples under QPathFinder/Samples/Scripts.

FAQ

To all the users using **Free-Version**

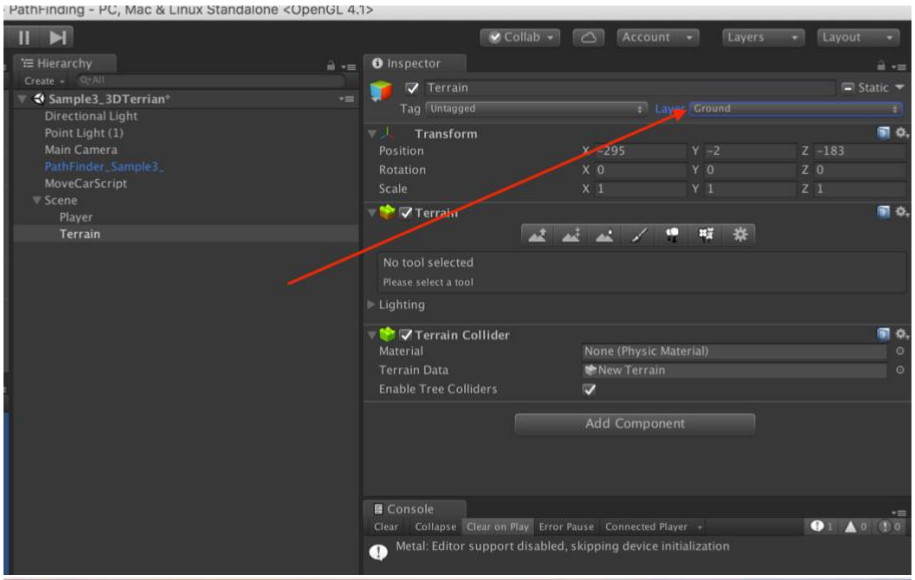
There is absolutely no difference between free-version and full-version except that I have provided dlls instead of source code. Other than that, you can do everything a full-version can do. There are no restrictions.

When you expand your DLL, you can find the class declarations there. You can drag these into scene just like any other script.



While trying to Create nodes, I am clicking on collider, but nodes are not created:

Make sure the collider name in PathFinder script and your collider layer name are the same.


PathFinding - PC, Mac & Linux Standalone <OpenGL 4.1>

Hierarchy: Sample3_3DTerrian*, Directional Light, Point Light (1), Main Camera, PathFinder_Sample3_, MoveCarScript, Scene, Player, Terrain

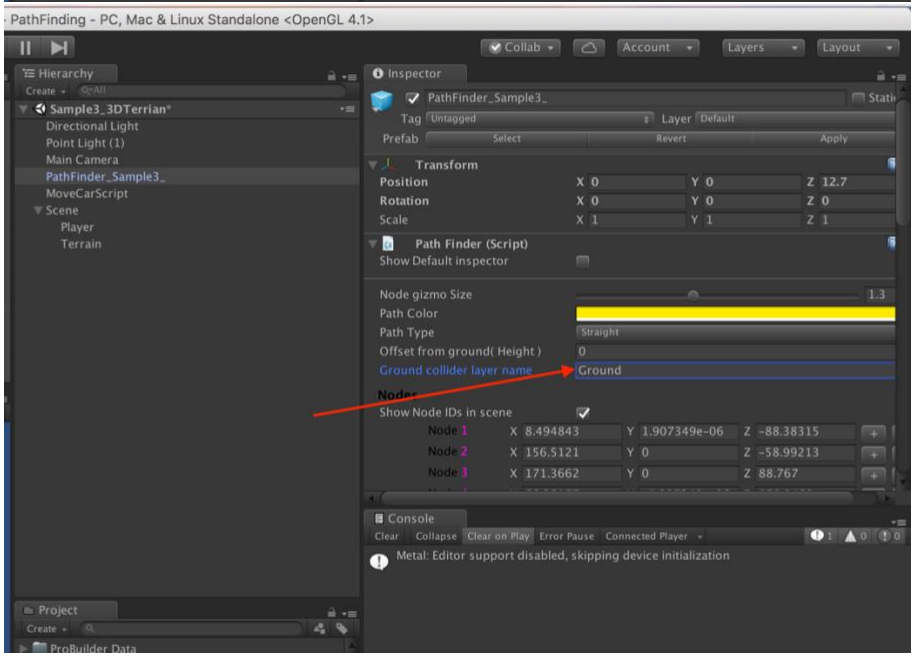
Inspector: Terrain — Tag: Untagged — Layer: Ground

Transform — Position: X -295, Y -2, Z -183; Rotation: X 0, Y 0, Z 0; Scale: X 1, Y 1, Z 1

Terrain — No tool selected. Please select a tool

Terrain Collider — Material: None (Physic Material); Terrain Data: New Terrain; Enable Tree Colliders: ✓

Console: Metal: Editor support disabled, skipping device initialization


PathFinding - PC, Mac & Linux Standalone <OpenGL 4.1>

Inspector: PathFinder_Sample3_ — Tag: Untagged — Layer: Default

Transform — Position: X 0, Y 0, Z 12.7; Rotation: X 0, Y 0, Z 0; Scale: X 1, Y 1, Z 1

Path Finder (Script) — Show Default inspector

Node gizmo Size: 1.3
Path Color
Path Type: Straight
Offset from ground(Height): 0
Ground collider layer name: Ground
Nodes
Show Node IDs in scene: ✓

Node 1	X 8.494843	Y 1.907349e-06	Z -88.38315
Node 2	X 156.5121	Y 0	Z -58.99213
Node 3	X 171.3662	Y 0	Z 88.767

Console: Metal: Editor support disabled, skipping device initialization

My object is not moving properly in 3D Terrian:

Make sure the collider name in PathFinder script and your collider layer name are the same. And its best if your ground collider has a different layer than your player. Eg: Ground can have a layer “Ground” and characters can have something else. The reason behind this is that we are doing raycasts to find the height of the ground and if there is any other game object with same layer, we will have trouble finding proper height.

Logging and other debugging

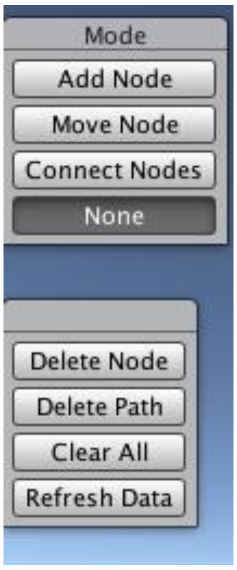
You can enable multiple levels of loggging, using these.

```
QPathFinder.Logger.SetLoggingLevel( debugLogLevel );
QPathFinder.Logger.SetDebugDrawLineDuration ( debugDrawLineDuration );
```

Note: When log level is set to "Info", you can also see Debug Lines drawn, which shows the shortest path choosen and other information using debug lines in scene view.

Make sure you have Gizmos turned on.

I cannot see Pathfinder GUI



If you cannot see the above GUI in your scene , make sure you select the pathfinder gameobject in your hierarchy.

If you do not have pathfinder in your hierarchy, refer here to create one.

If you have any other questions, please visit my website Veluri.in and drop a message with your email. I will get back to you.

Cheers and thanks for using this plugin,

Vijay Veluri