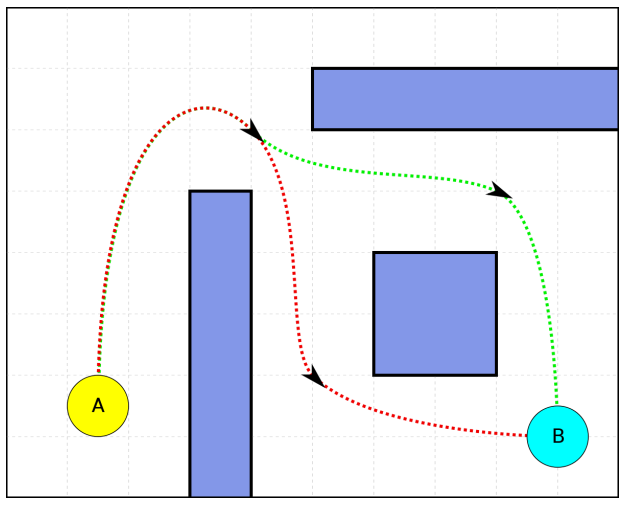
# COMP2007 - Game Development

## Week 7 - Code session

### Navigation

This system allows GameObjects to “pathfind” in a scene, or find a route around obstacles to reach a target destination



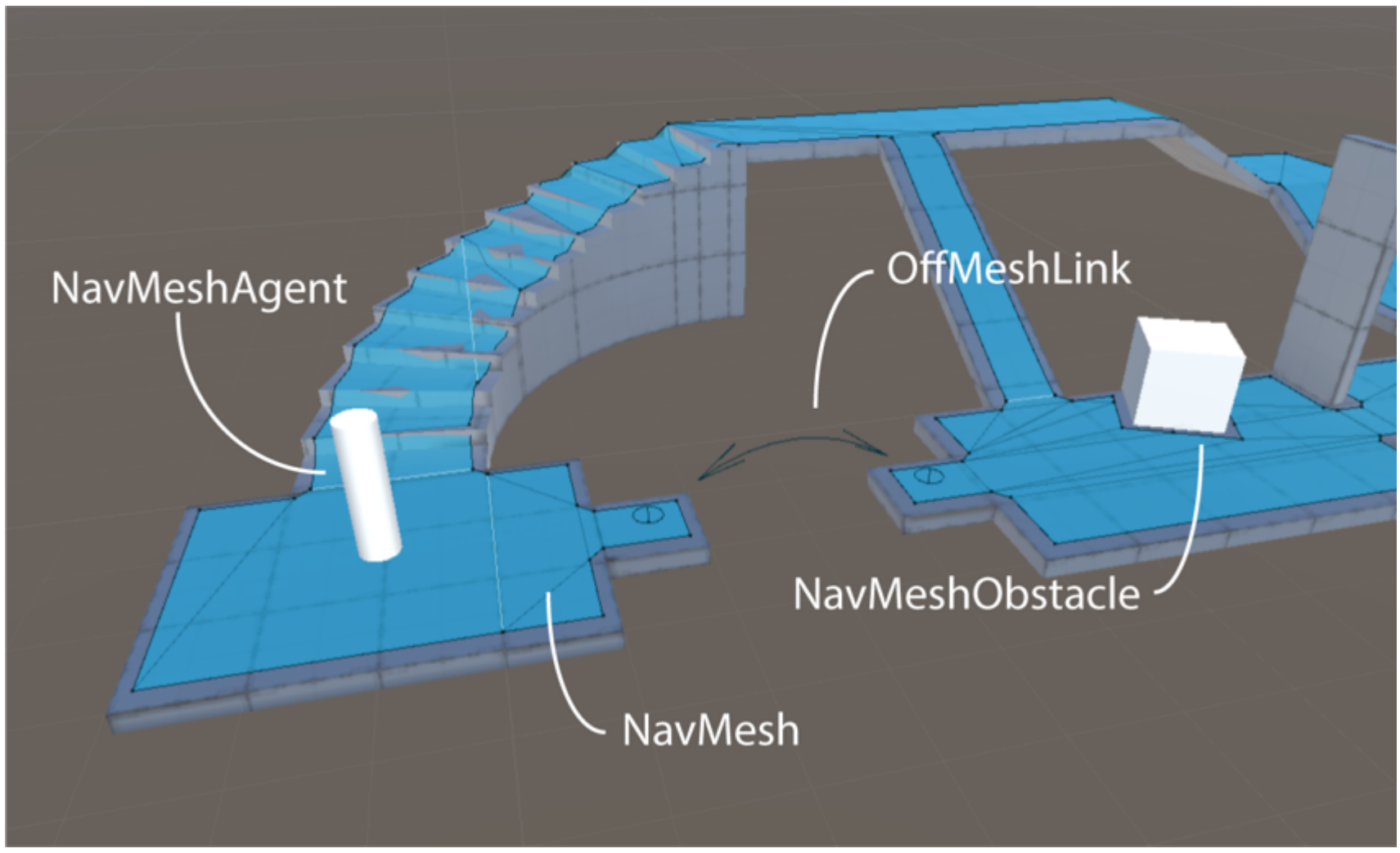

Navigation is often used for AI to find its way around a scene

- NPC character
- Enemy characters
- AI systems
- Ground vehicles

Navigation can be used in decision making for AI

- Chasing/avoiding other objects around obstacles
- Clear boundaries around levels that cannot be crossed
- Control over which GameObjects can navigate within an area

The 4 main parts to Unity Navigation




**NavMesh** (short for Navigation Mesh)

- A data structure which describes the walkable surfaces of the game world
- Allows GameObjects to find a path from one walkable location to another.
- The data structure is built, or baked, automatically from your level geometry.

**NavMesh Agent**

- A component to help Agents (characters) avoid each other while moving towards their goal.
- Agents reason about the game world using the NavMesh and they know how to avoid each other as well as moving obstacles.

**Off-Mesh Link**

- A component that incorporates navigation shortcuts which cannot be represented using a walkable surface.
    - e.g. jumping over a ditch or a fence, or opening a door before walking through it, can be all described as Off-mesh links.

**NavMesh Obstacle**

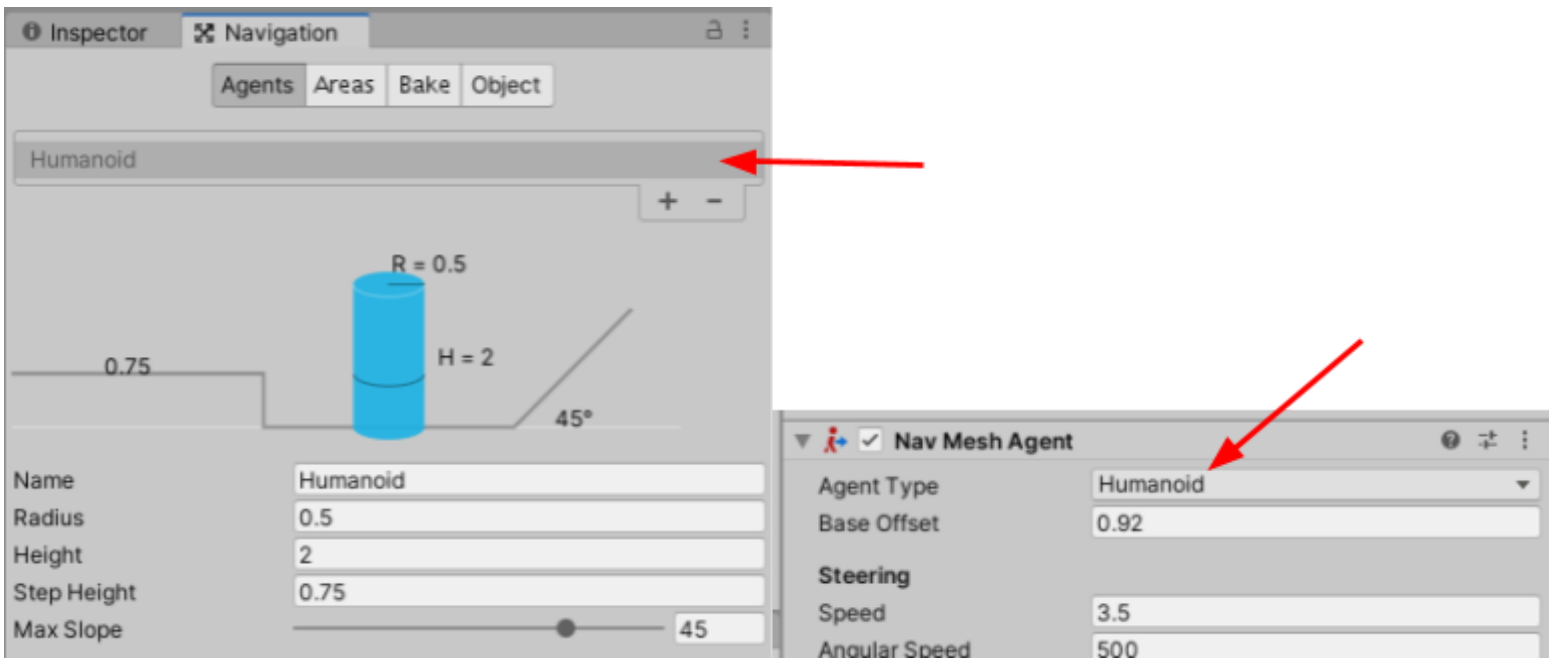
- A component that describes moving obstacles the agents should avoid while navigating the world.
- A barrel or a crate controlled by the physics system is a good example of an obstacle.
- While the obstacle is moving the agents do their best to avoid it, but once the obstacle becomes stationary it will carve a hole in the navmesh so that the agents can change their paths to steer around it, or if the stationary obstacle is blocking the path way, the agents can find a different route.

# Navigation Settings

In Window -> AI -> Navigation
This window sets up the navigation for the scene and any GameObjects within it.
The Navigation Mesh is baked here in the Bake Section

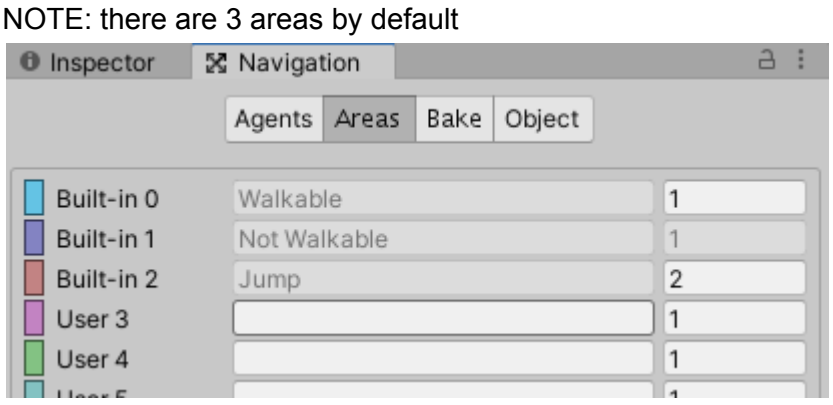
## Agents

Sets up any types of navigation agents
Setup any size of agent so they can fit between certain geometry or not
These agents can be applied to any NavMeshAgent component

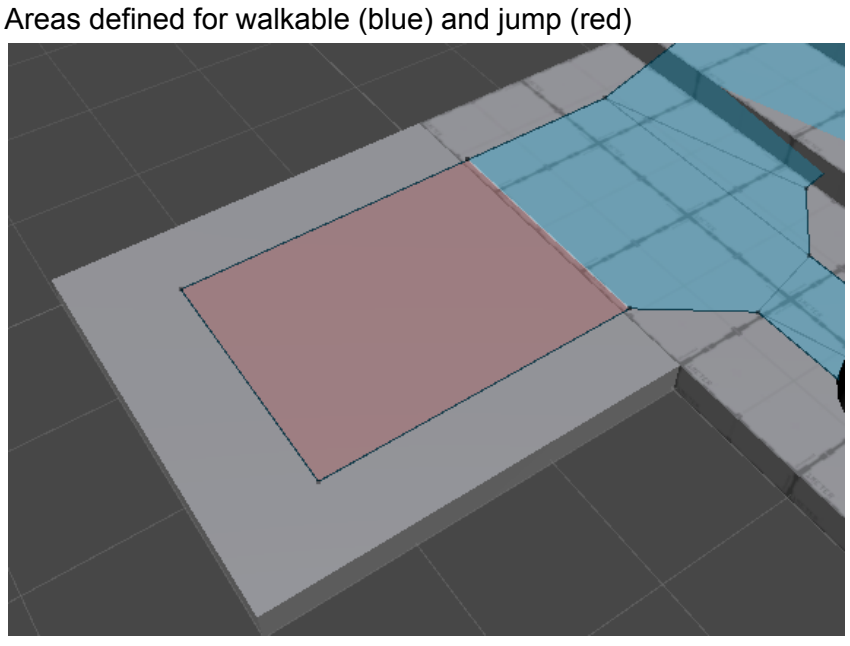



## Areas

Defines colour-coded areas that can be accessed or not by an agent
These areas appear in the scene view as the same colours
You can add custom area names with pre-dfeined colours
NOTE: there are 3 areas by default



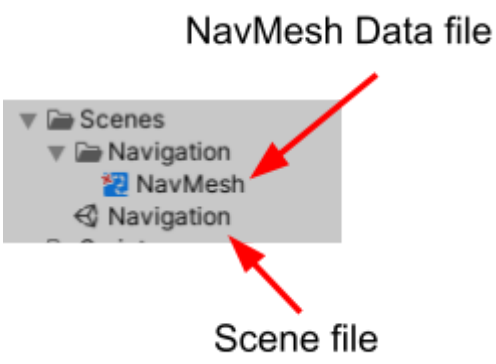

Areas defined for walkable (blue) and jump (red)



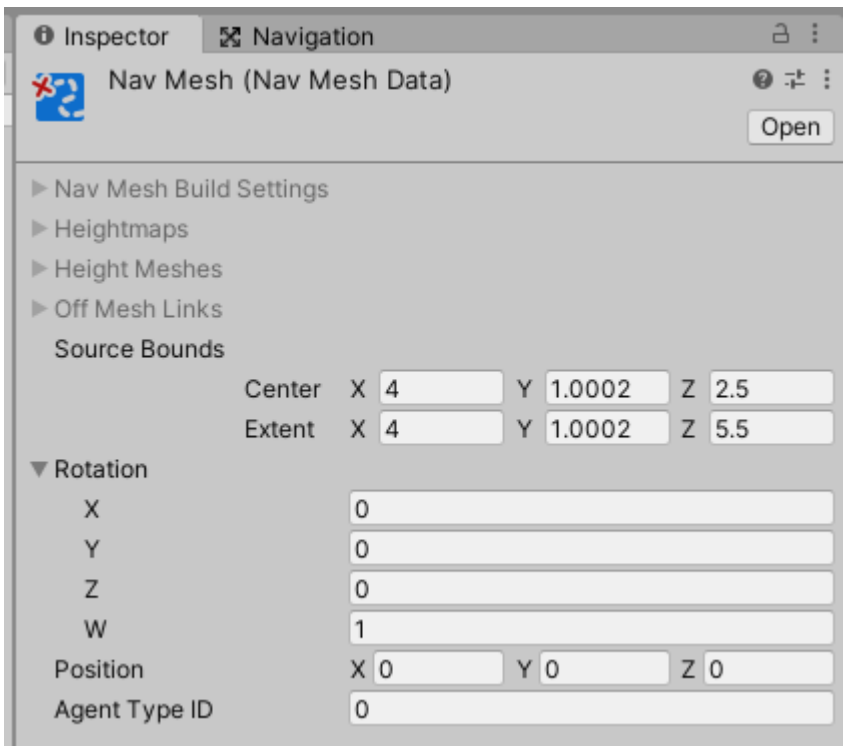
## Bake

This section allows you to “bake” your navmesh data for the scene

When you Bake your NavMesh, a NavMesh data file is created and storeed in a folder with the same name as your scene

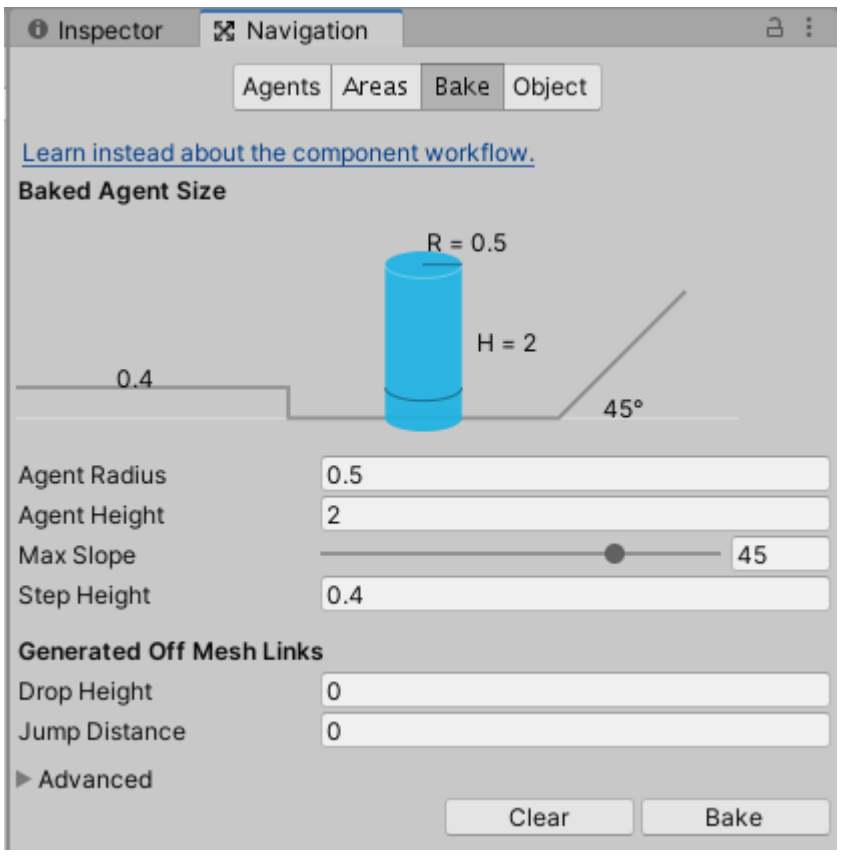



Here is the NavMesh Data file
NOTE: don’t touch the settings even though you can!

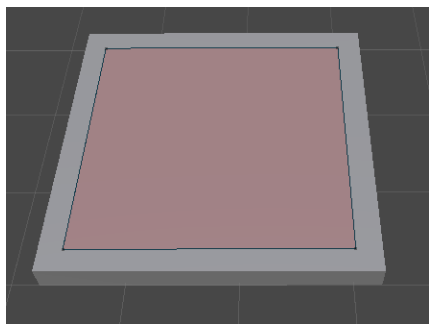



## The Bake section

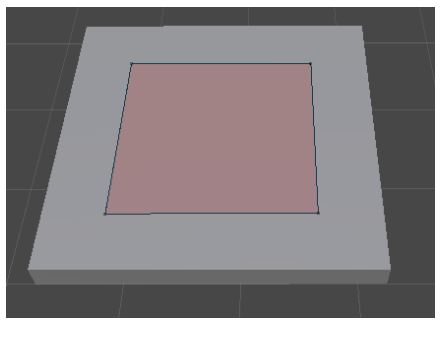
- The Bake button will create your NavMesh Data file
- The clear button will delete existing data
- Adjust the agent radius to increase the corner sizes



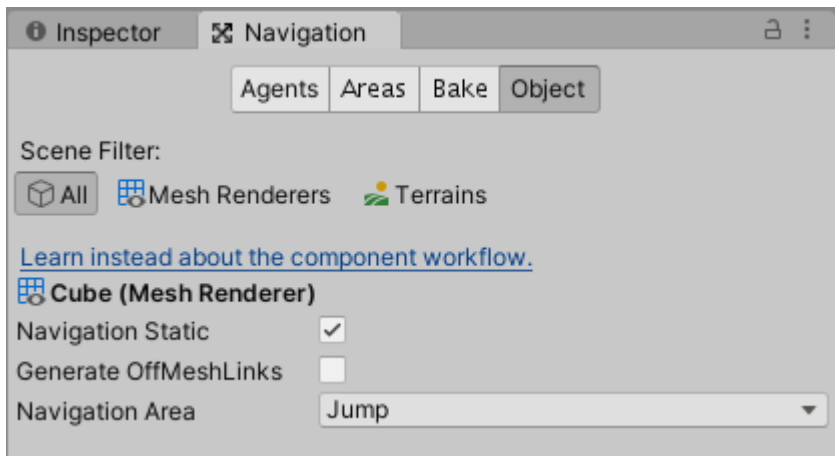
Radius of 0.1 - more space to move



Radius of 0.5 - less space to move



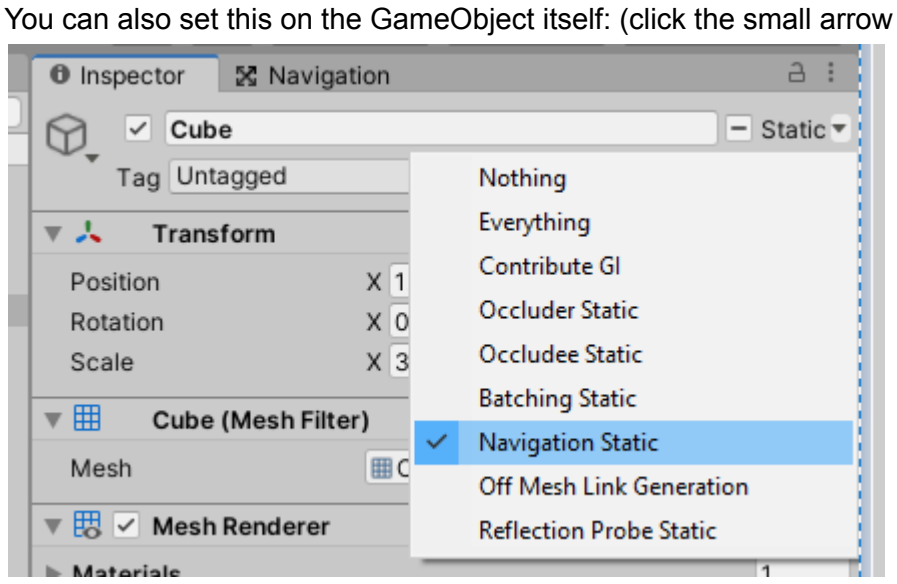
## Object settings




When a GameObject is selected, we can apply Navigation settings to it here
NOTE: the GameObject needs to have a MeshRenderer component to apply Navigation settings

### Navigation static

Tells the Navigation system that this GameObject (specifically the Mesh Renderer) will be part of the NavMesh Bake
You can also set this on the GameObject itself: (click the small arrow next to the static word to get the menu)



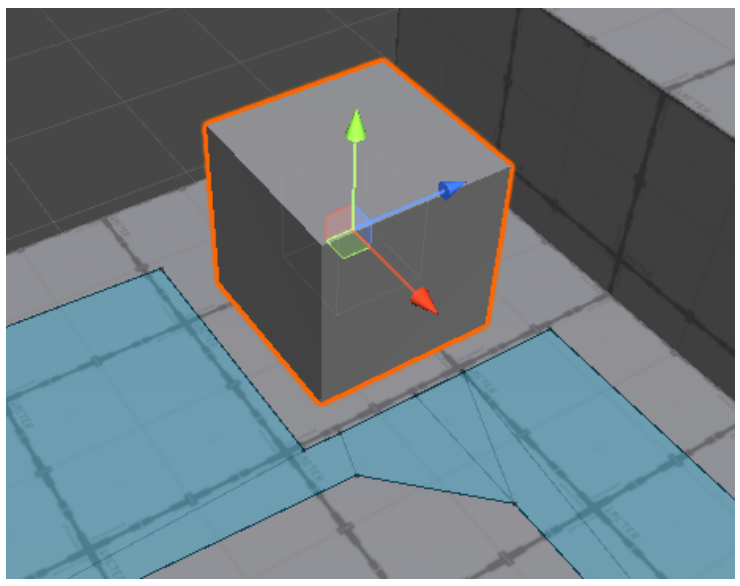

Generate off navmesh links
Generate links using any NavMeshLink components found nearby the Mesh Renderer

### Navigation area

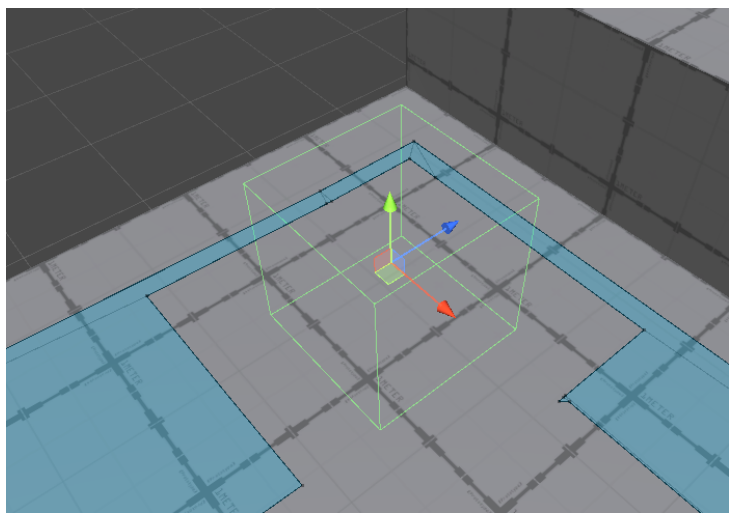
Define the areas this Mesh Renderer will use - this will colour the navmesh in the scene view to the area selected
NOTE: areas are defined in the Areas section

## NavMesh Obstacle component

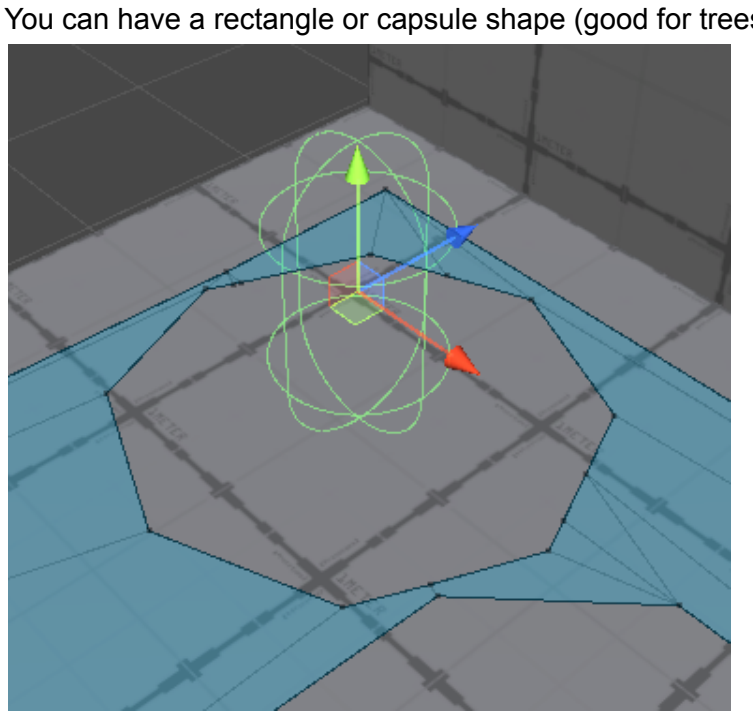
These will “Carve” a hole in the navmesh, acting like a obstacle to agents trying to pass by



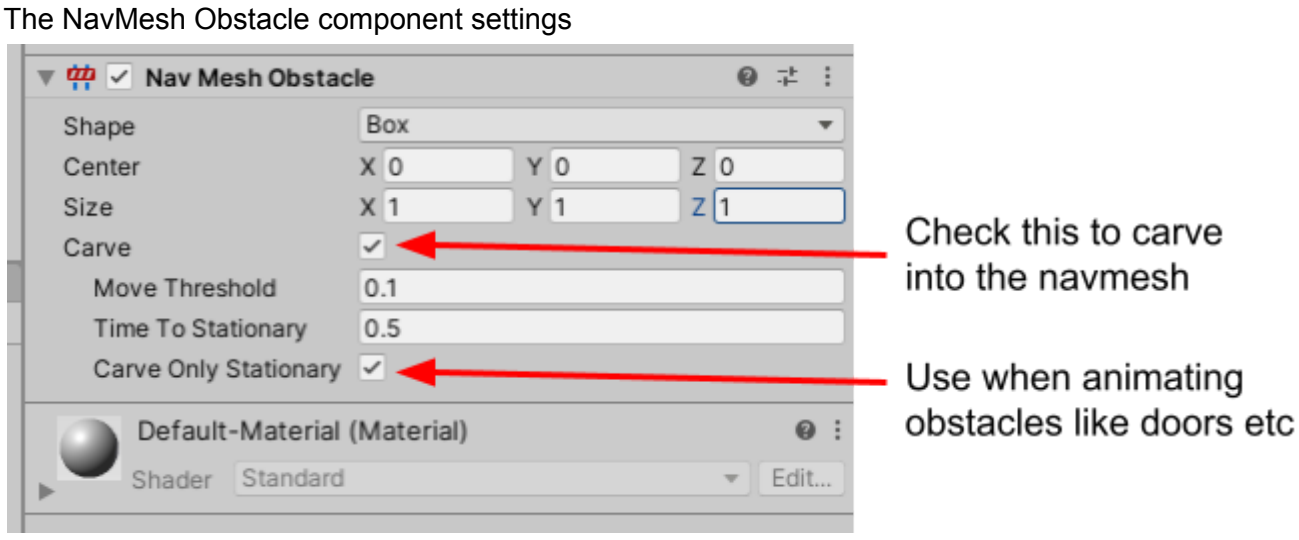
The debug carve area is green, looking like a collider



You can have a rectangle or capsule shape (good for trees, lamp posts etc)



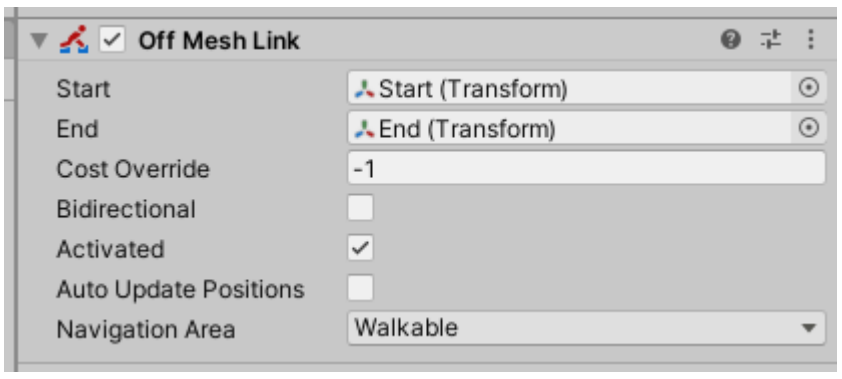
The NavMesh Obstacle component settings



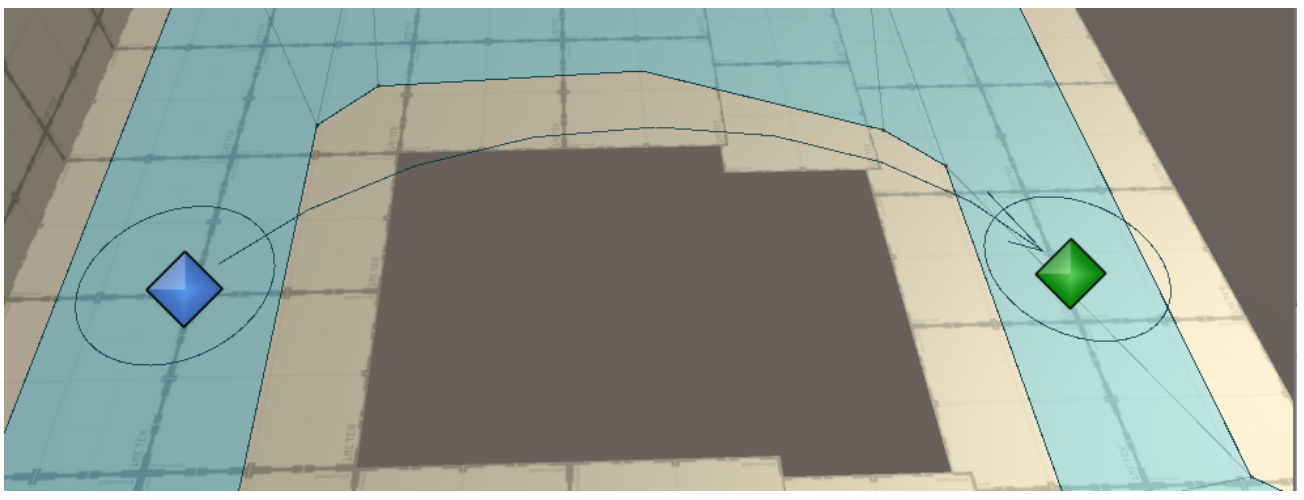
## Off-Navmesh links

These are two points that can act as a link between to parts of a navmesh
They can connect to navmeshes or to a part of the same navmesh

The Off Mesh Link component requires start and end GameObjects
Place the Off Mesh Link component on the same GameObject as the Mesh Renderer for your NavMesh Bake




A grey arrow connects the two points
Here a one directional arrow will only allow agents to go from blue to green
Set Bidirectional to True to go BOTH ways



# Navmesh building components

This is library of extra components and tools for doing more advanced work with navmeshes

LINK TO GITHUB - download the library here
https://github.com/Unity-Technologies/NavMeshComponents

## Navmesh surface component

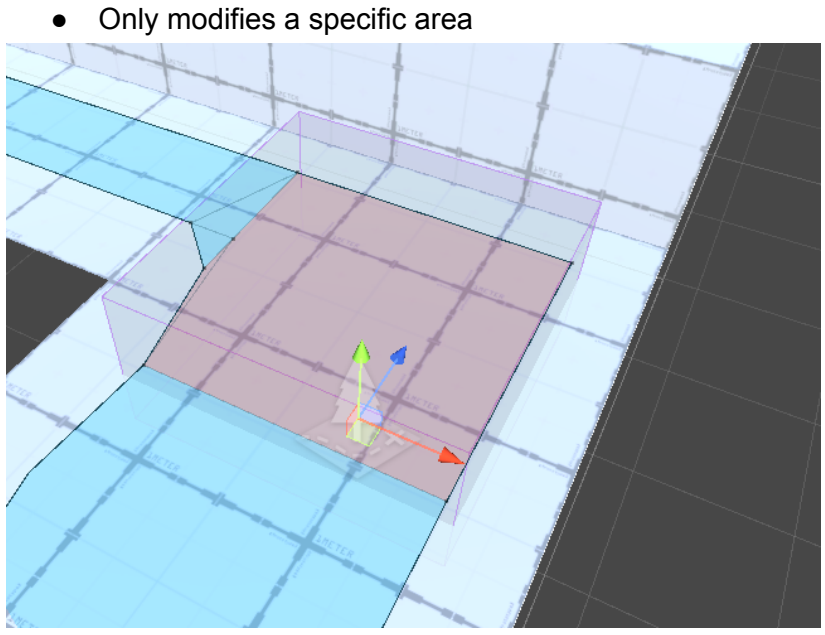
- Adds a navmesh to a specific gameobject or gameobject hierarchy
- The gameobject can be rotated to any angle and still maintain the navmesh local to its orientation
- Also they can be baked independently from the scene navmesh
- Multiple surface components can be applied for different agent sizes

## Navmesh modifier component

- Useful for applying settings to a navmesh generated at runtime
- Overrides or added navmesh settings to a gameobject:
    - Ignore from navmesh build
    - Override area type
    - Override agents to affect

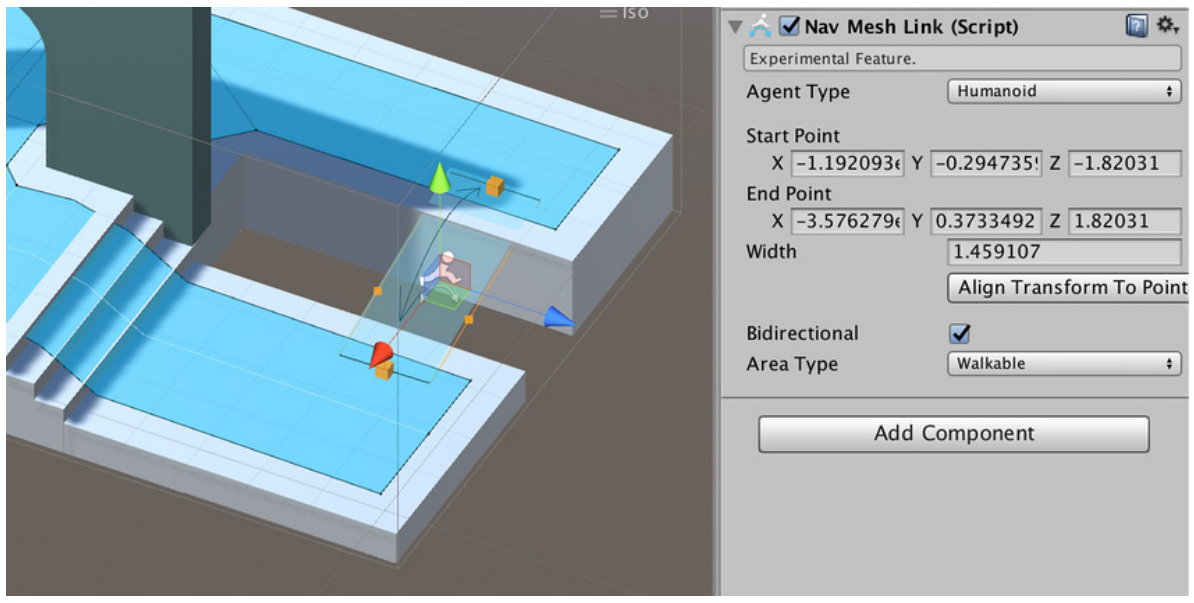
## Navmesh modifier volume component

- Changes the area type for a part of a mesh
- The mesh does not have to be a separate mesh renderer
- Only modifies a specific area



## Navmesh link

- Similar to the Off mesh link, this connects two navmeshes
- The Navmesh link will also align the agent to the connected navmesh, should it be at a different orientation

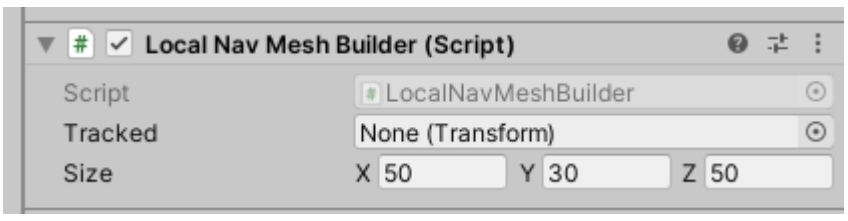


# Extra goodies

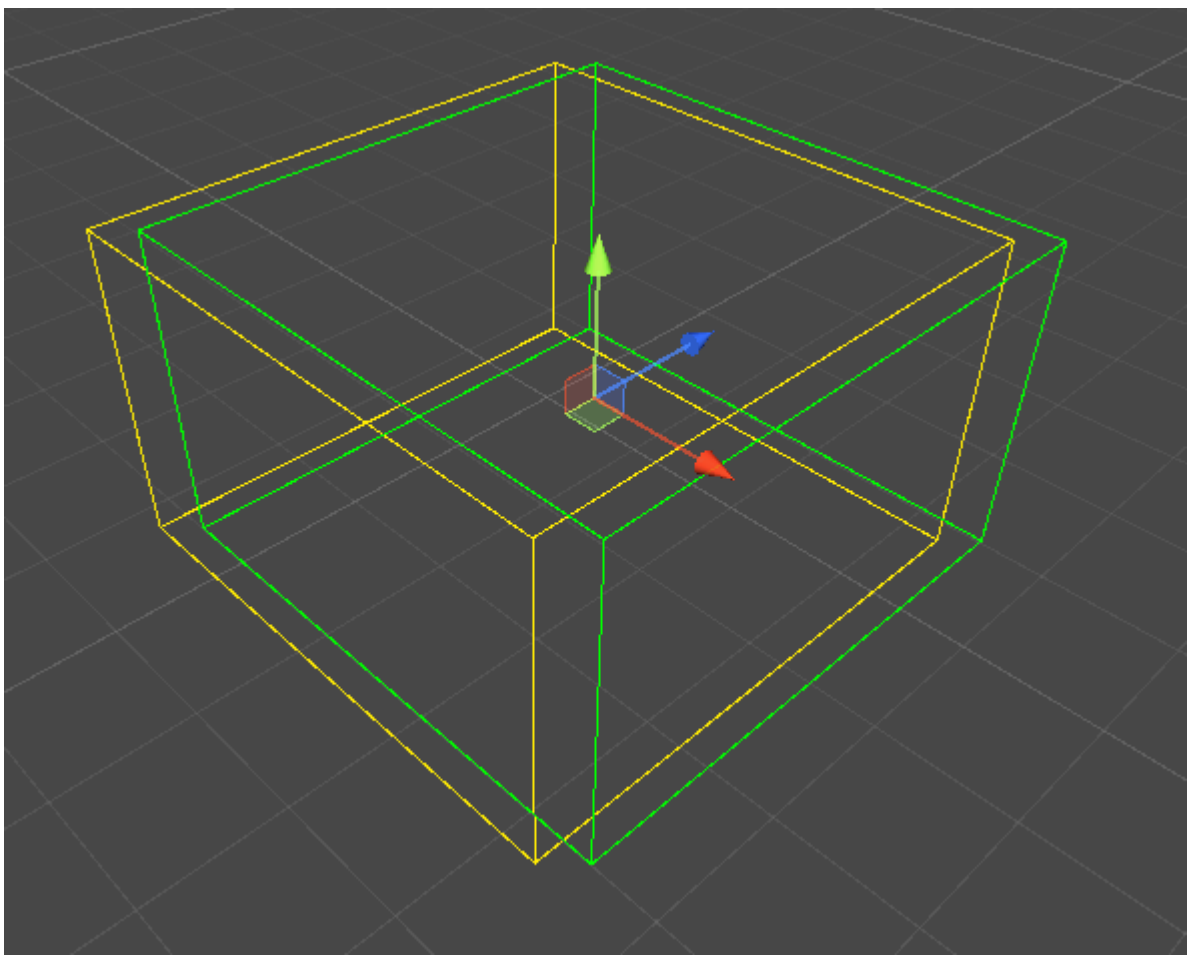
## Local navmesh builder component

This allows you to build a navmesh at runtime!
You can build only a certain portion of a larger level or all of a generated level

Track a transform to build the mesh around
You can build the navmesh around the player for example

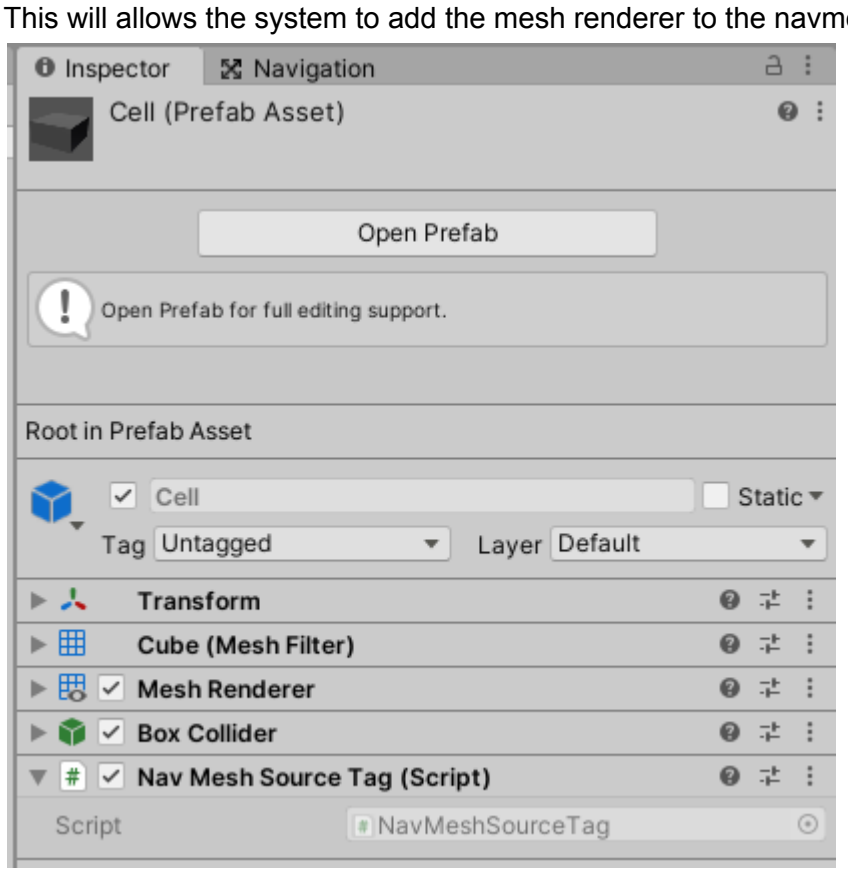



The green outline is the exact position of the area
The yellow outline is where the navmesh will be generated



Using the system
Use the **Navmesh Source Tag** component on any prefabs used to build the level geometry

This will allows the system to add the mesh renderer to the navmesh calculations



## Links

Navigation system in unity
https://docs.unity3d.com/2020.2/Documentation/Manual/nav-NavigationSystem.html

Inner workings of the navigation system
https://docs.unity3d.com/2020.2/Documentation/Manual/nav-InnerWorkings.html

Building a navmesh
https://docs.unity3d.com/2020.2/Documentation/Manual/nav-BuildingNavMesh.html

Navmesh agent
https://docs.unity3d.com/2020.2/Documentation/Manual/class-NavMeshAgent.html

Navmesh obstacle
https://docs.unity3d.com/2020.2/Documentation/Manual/class-NavMeshObstacle.html

Off navmesh link
https://docs.unity3d.com/2020.2/Documentation/Manual/class-OffMeshLink.html

Telling a navmesh agent to move
https://docs.unity3d.com/2020.2/Documentation/Manual/nav-MoveToDestination.html

Click to move
https://docs.unity3d.com/2020.2/Documentation/Manual/nav-MoveToClickPoint.html

Patrol points
https://docs.unity3d.com/2020.2/Documentation/Manual/nav-AgentPatrol.html

## Extra navmesh material

Navmesh building components
https://docs.unity3d.com/2020.2/Documentation/Manual/NavMesh-BuildingComponents.html

GitHub link to navmesh components
https://github.com/Unity-Technologies/NavMeshComponents

Navmesh surface
https://docs.unity3d.com/2020.2/Documentation/Manual/class-NavMeshSurface.html

Navmesh modifier
https://docs.unity3d.com/2020.2/Documentation/Manual/class-NavMeshModifier.html

Navmesh modifier volume
https://docs.unity3d.com/2020.2/Documentation/Manual/class-NavMesh-ModifierVolume.html

Navmesh link
https://docs.unity3d.com/2020.2/Documentation/Manual/class-NavMeshLink.html

Navmesh building components scripting guide
https://docs.unity3d.com/2020.2/Documentation/Manual/NavMesh-BuildingComponents-API.html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