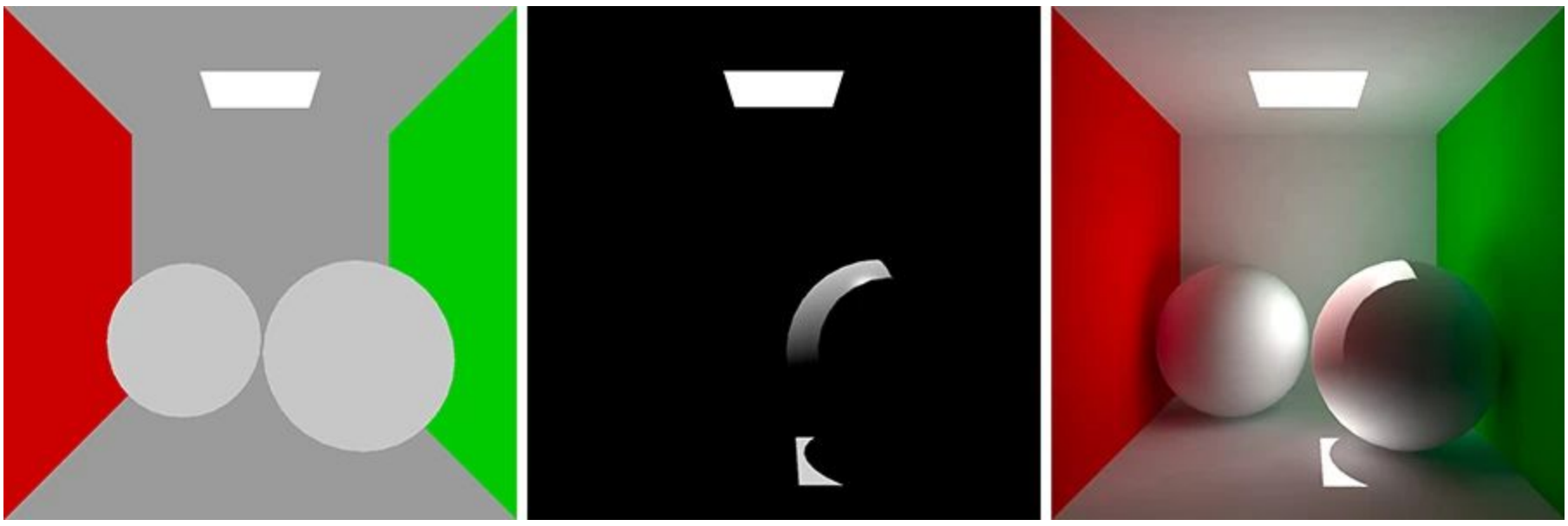
COMP2007 - Game Development

Lighting in Unity

Direct and indirect lighting

Direct light hits a surface once, and is then reflected
Indirect light is all other light that is ultimately reflected

Left: no lighting
Middle: direct lighting only
Right: indirect lighting only



Real time and baked lighting

Real-time lighting is when Unity calculates lighting at runtime

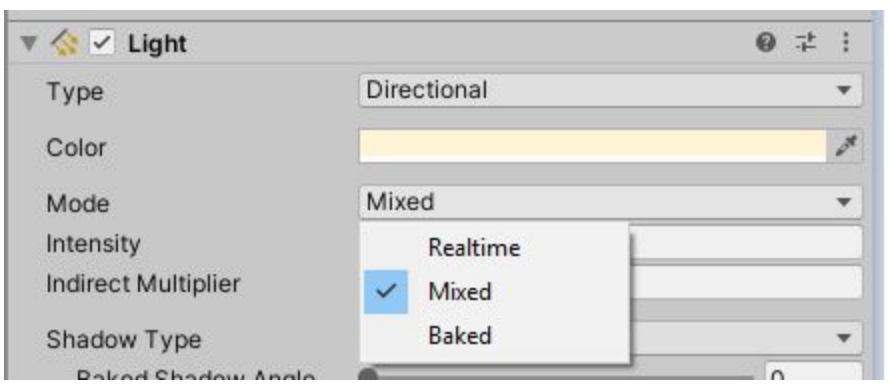
- Can be very performance intensive with lots of geometry in a scene
- Can do things like day/night cycles easily or other dynamic effects

Baked lighting (or pre-computed) is when Unity performs lighting calculations in advance and saves the results as lighting data, which is then applied at runtime

- Much better performance than real time
- Best choice for static lit scenes like levels etc in action games

We can use real-time lighting, baked lighting, or a mix of the two (called **mixed lighting**).

A Light component lighting mode options



Global illumination (GI)

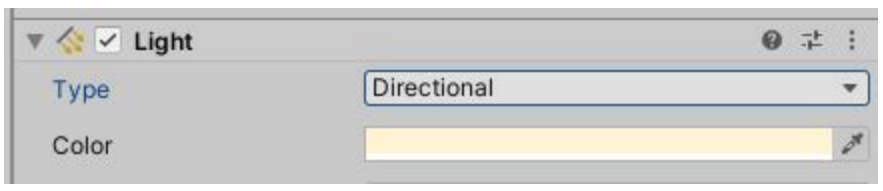
Global illumination is a group of techniques that model both direct and indirect lighting to provide realistic lighting results

Light sources

Light component

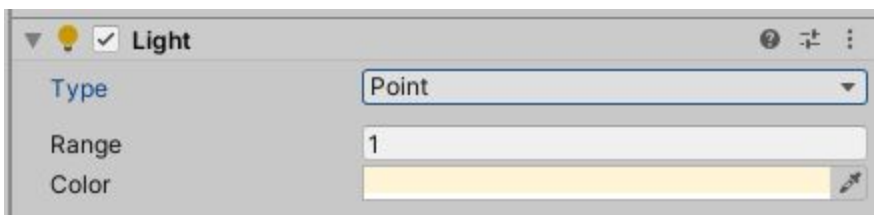
Directional light

- A simple, central light, like the sun/moon
- All light points in one direction over everything

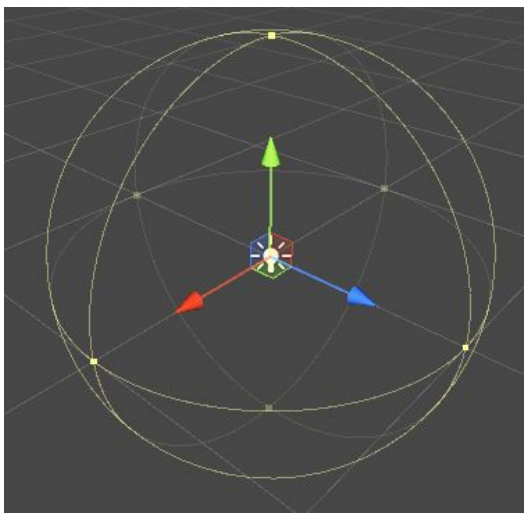


Point light

- Emits light from a point in 3D space
- Anything within the range may have light applied to it

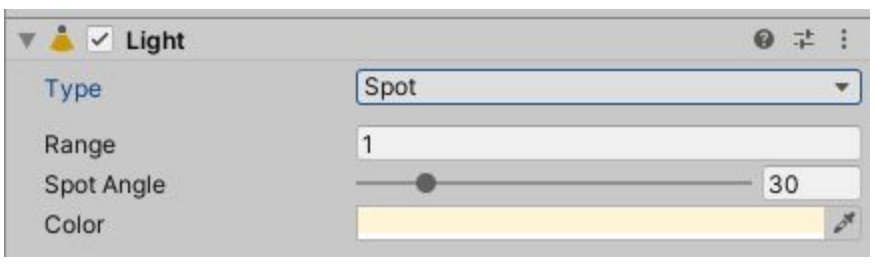


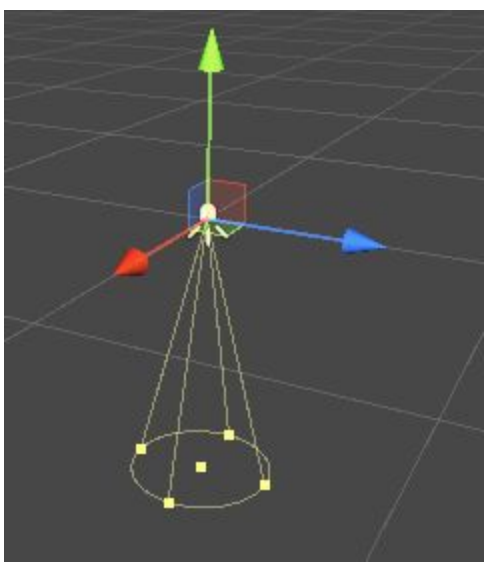
A point light has a sphere of range to light meshes



Spot light

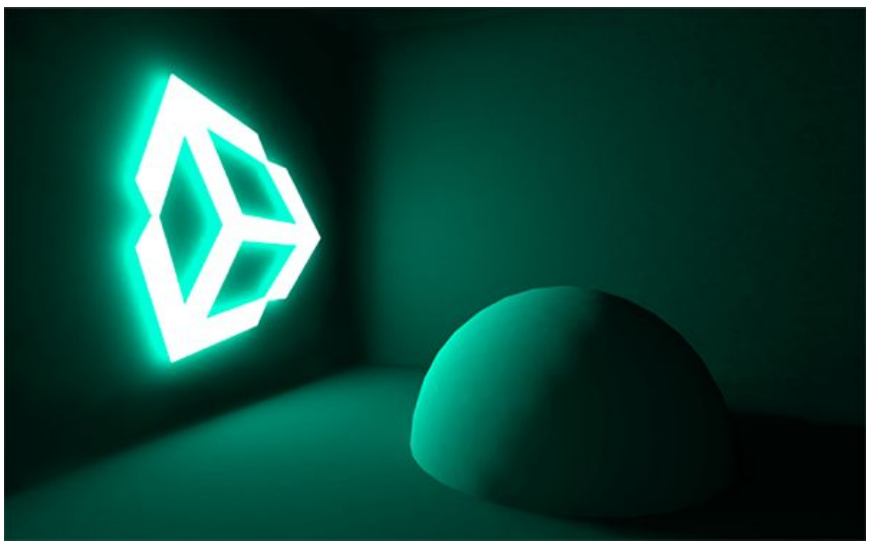
- Emits a cone of light in a direction
- Anything within the angle of the cone may be lit





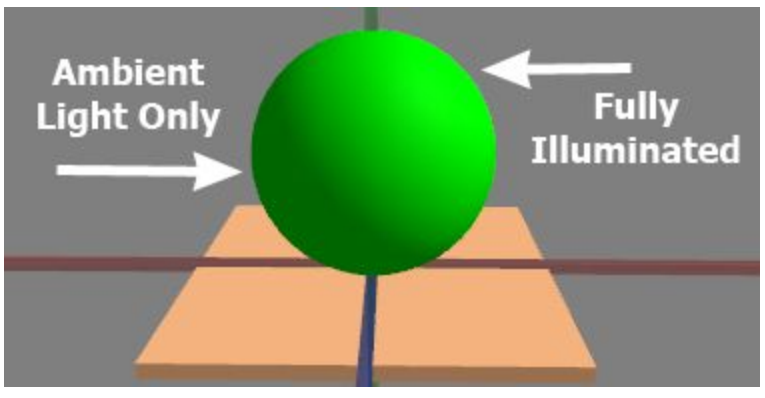
Emissive materials

An emissive material is a material that can emit light from certain pixels
This is most common in neon effects in games



Ambient light

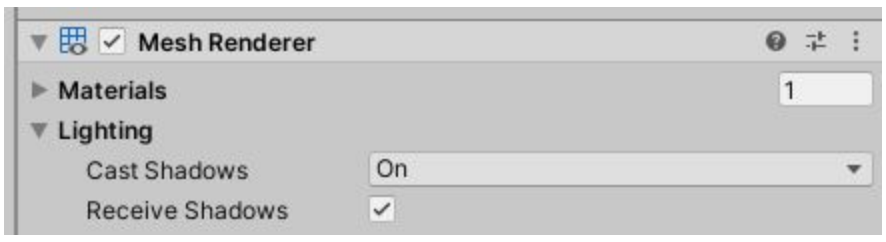
Ambient light, also known as **diffuse environmental light**, is light that is present all around the Scene and doesn't come from any specific source object



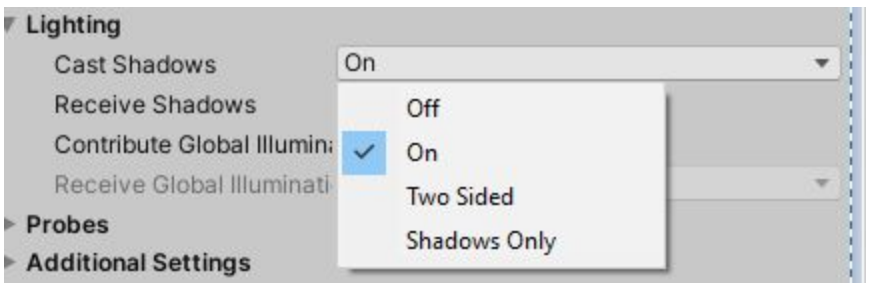
Shadows

Lights can cast **shadows** from a GameObject onto other parts of itself, or onto nearby GameObjects.

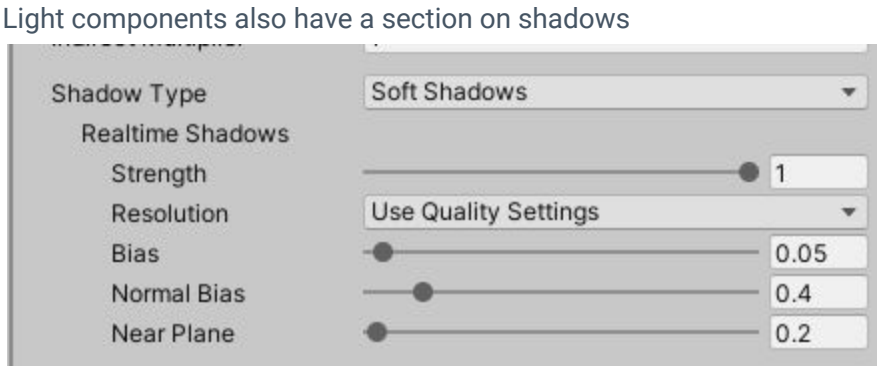
Each mesh renderer can set whether it casts and receives shadows



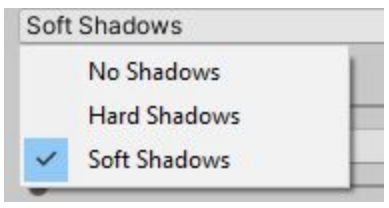
Shadows can also be cast from invisible or meshes with two sided faces



Light components also have a section on shadows

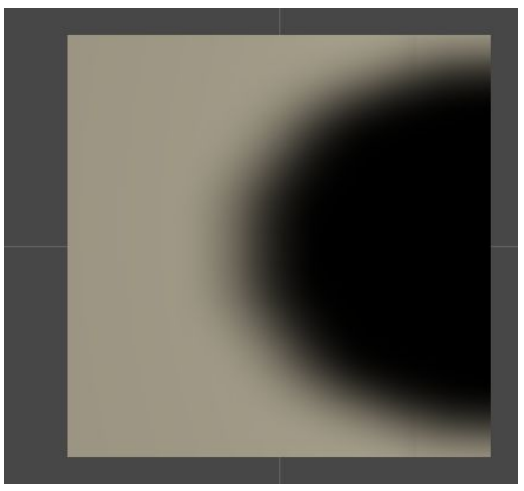


Soft shadows will take up more processing power than hard shadows



Soft shadow

- Best for geometry close to the camera
- More expensive processing



Hard shadow

- Best for meshes further from the camera
- Less expensive processing

Extra
A common technique is to use a Projector component with a “blob shadow” for the least expensive shadow (great for mobile etc)
https://docs.unity3d.com/2020.2/Documentation/Manual/class-Projector.html

Lighting Settings asset

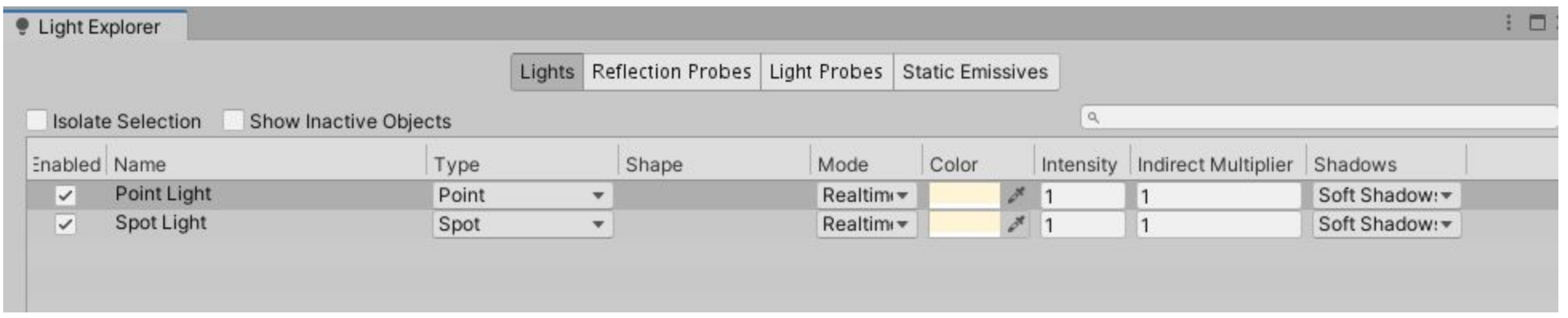
Stores data for the Baked **Global Illumination** and the Realtime Global Illumination systems

A lighting settings asset (left) with lightmaps and reflection probe (right) for baked global illumination

The light explorer window

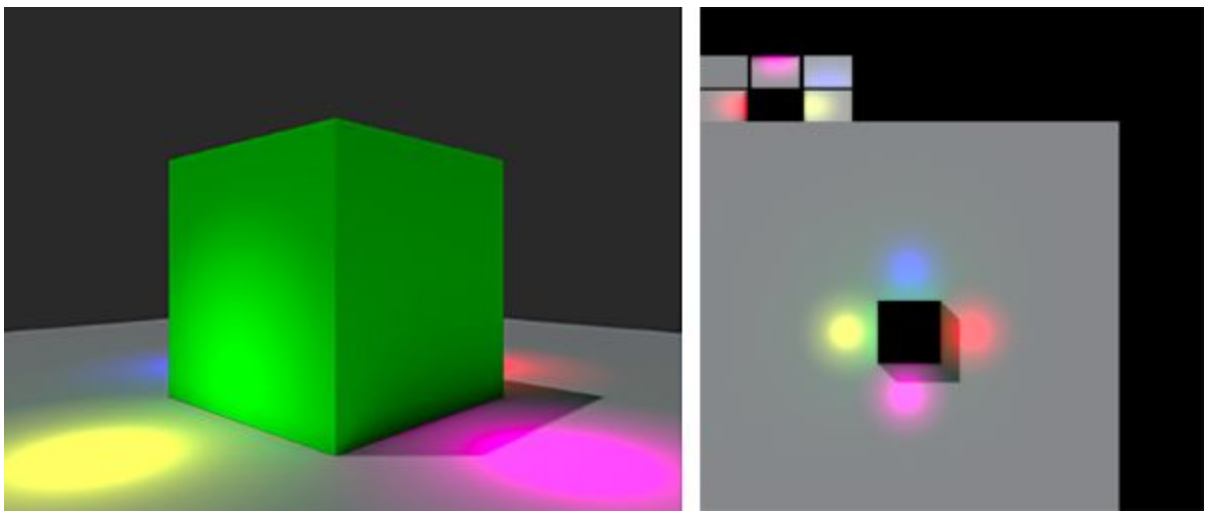
A convenient list of all the lights in your scene!

Go to Window -> Rendering -> Light Explorer



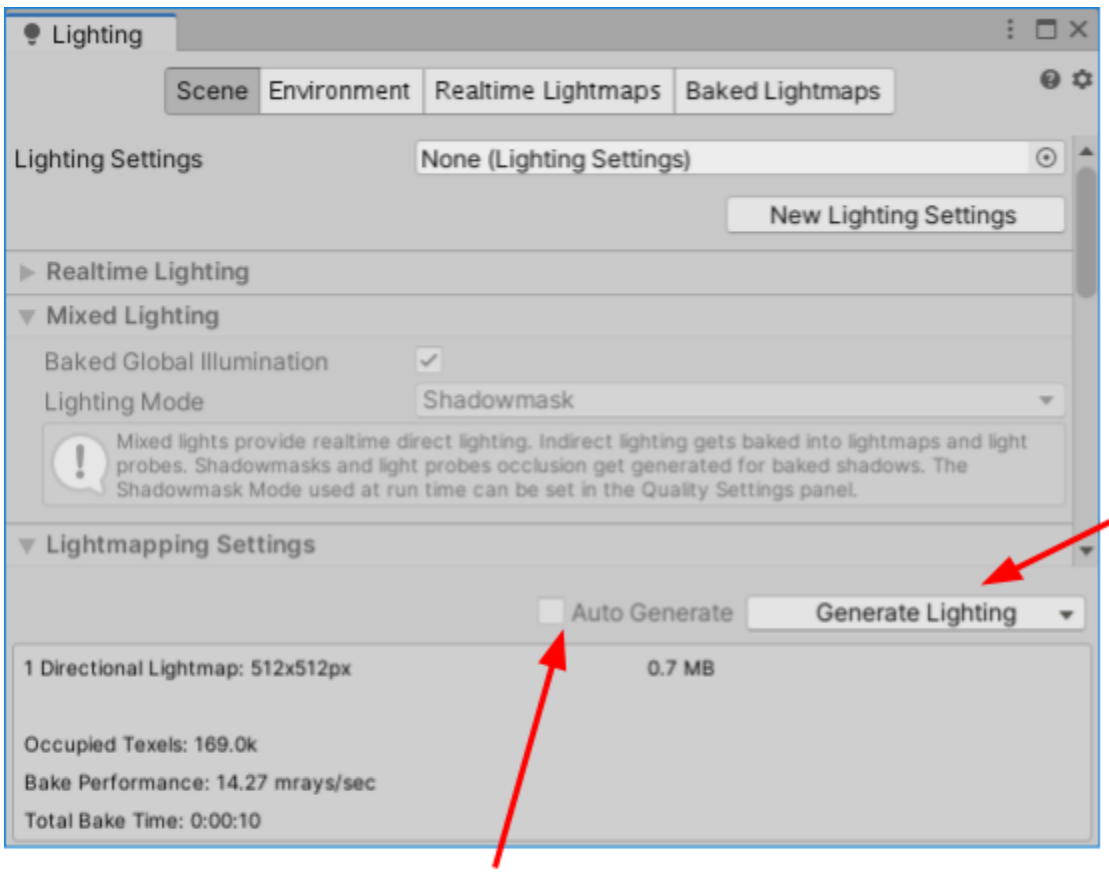
Lightmapping

Lightmapping is the process of pre-calculating the brightness of surfaces in a Scene, and storing the result in one or more Textures called lightmaps for later use.



Generating a lightmap

Go to Window -> Rendering -> Lighting



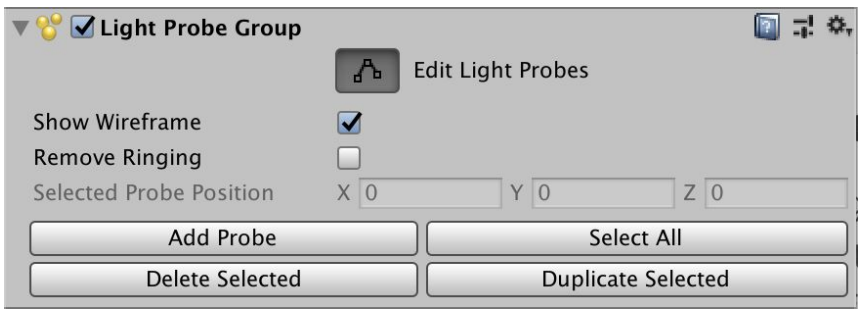
Generate a lightmap from the open scene from here

Auto generate will create a new lightmap every time a light or mesh is changed, moved or added

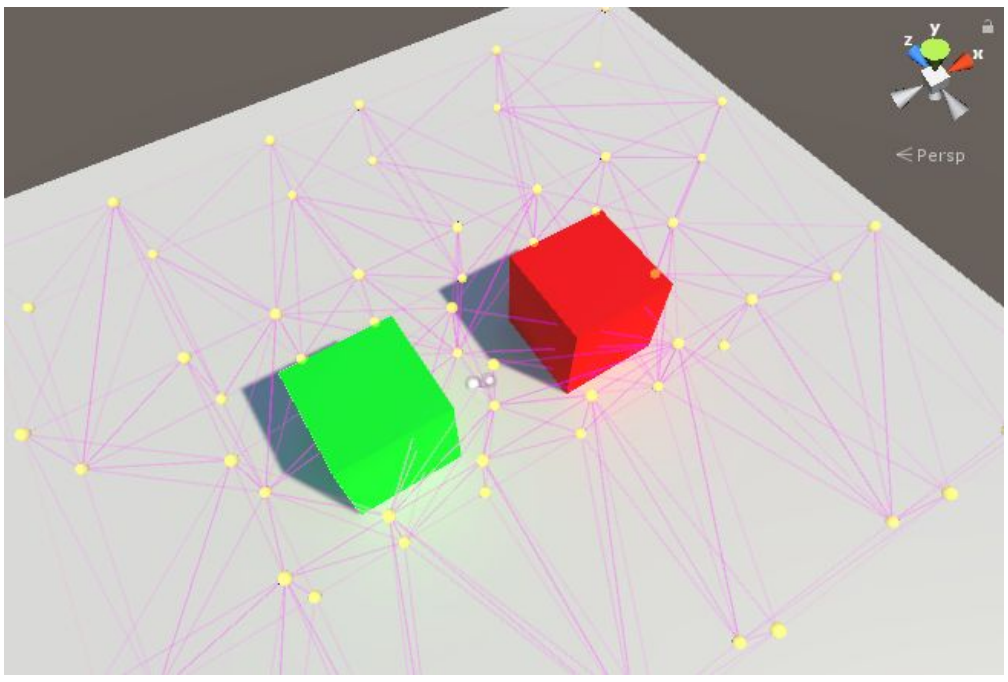
Light probes

Light Probes provide a way to capture and use information about light that is passing through the empty space in your scene.

A Light probe group component controls the setup of light probes in a scene



Manipulate the probes to find the light pathways between meshes
NOTE: keep the probes outside of the meshes or lighting may not bake correctly



Links

Lighting in Unity
https://docs.unity3d.com/2020.2/Documentation/Manual/LightingInUnity.html

Types of light component
https://docs.unity3d.com/2020.2/Documentation/Manual/Lighting.html

Emissive materials
https://docs.unity3d.com/2020.2/Documentation/Manual/lighting-emissive-materials.html

Ambient light
https://docs.unity3d.com/2020.2/Documentation/Manual/lighting-ambient-light.html

Lighting window
https://docs.unity3d.com/2020.2/Documentation/Manual/lighting-window.html

Lighting window
https://docs.unity3d.com/2020.2/Documentation/Manual/LightingExplorer.html

Lightmapping
https://docs.unity3d.com/2020.2/Documentation/Manual/Lightmappers.html

Light probes
https://docs.unity3d.com/2020.2/Documentation/Manual/LightProbes.html

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