UNIVERSITY OF MALTA
Institute of Digital Games

Creating Virtual Worlds

Lecture 4

Materials and Textures

Our topics today …

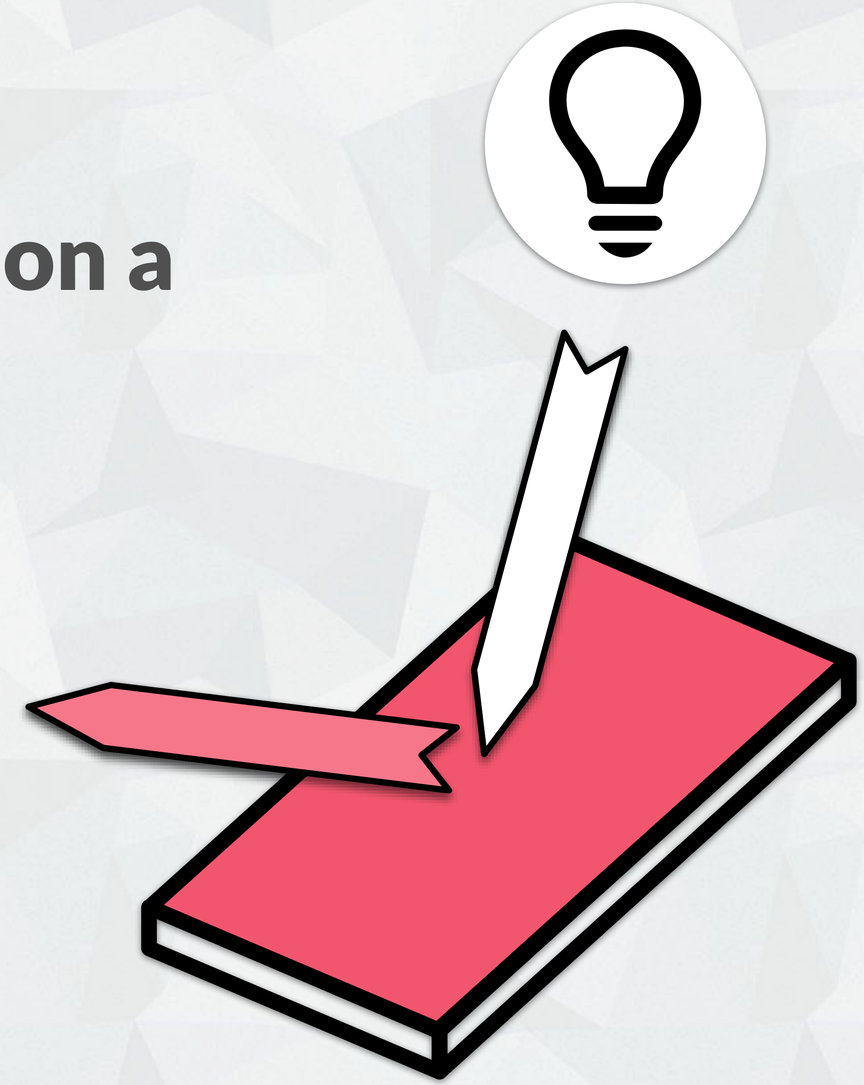
- **Materials and material properties**
  Changing the appearance of 3D objects
- **Textures**
  Assigning 2D images to materials
- **Color channels**
  Encoding information in a texture
- **UV mapping**
  Defining how a 2D image maps to a 3D object

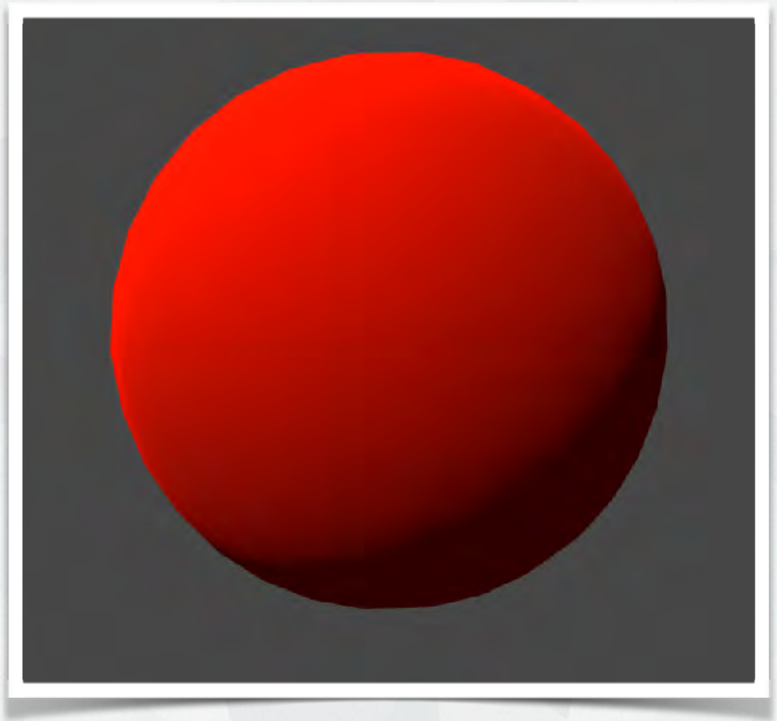
Materials

… define the **appearance** of surfaces on a 3D object!

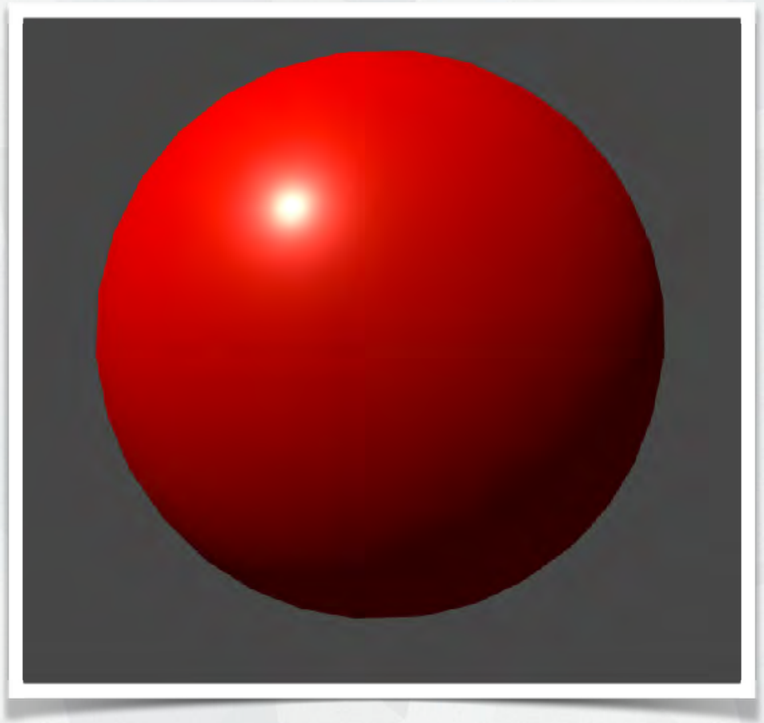
Apart of the surface **color**, materials include parameters such as **“shininess”**, **“bumpiness”**, and even **self illumination.**

Materials are independent from the 3D geometry they are assigned to.

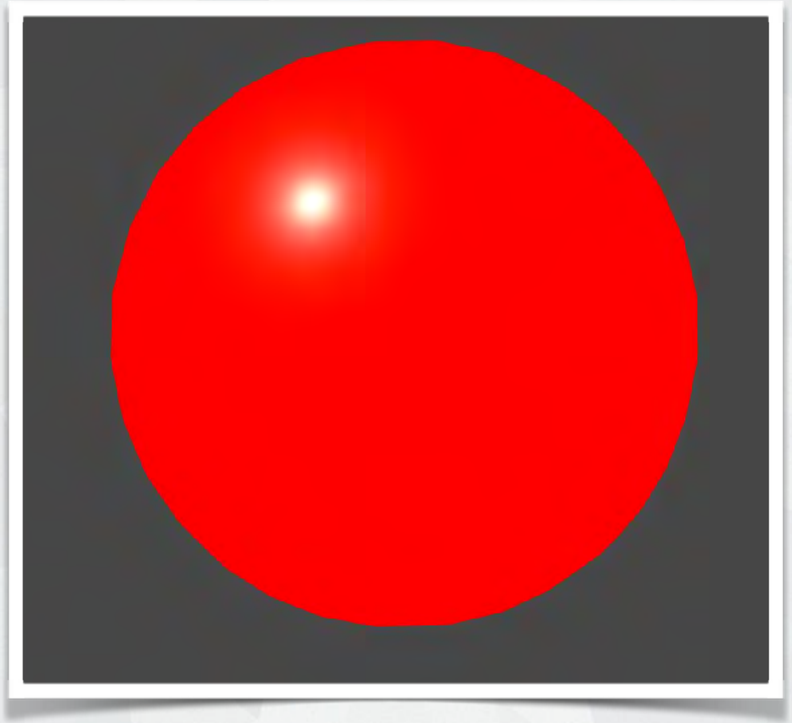




Diffuse
(Basic Color)

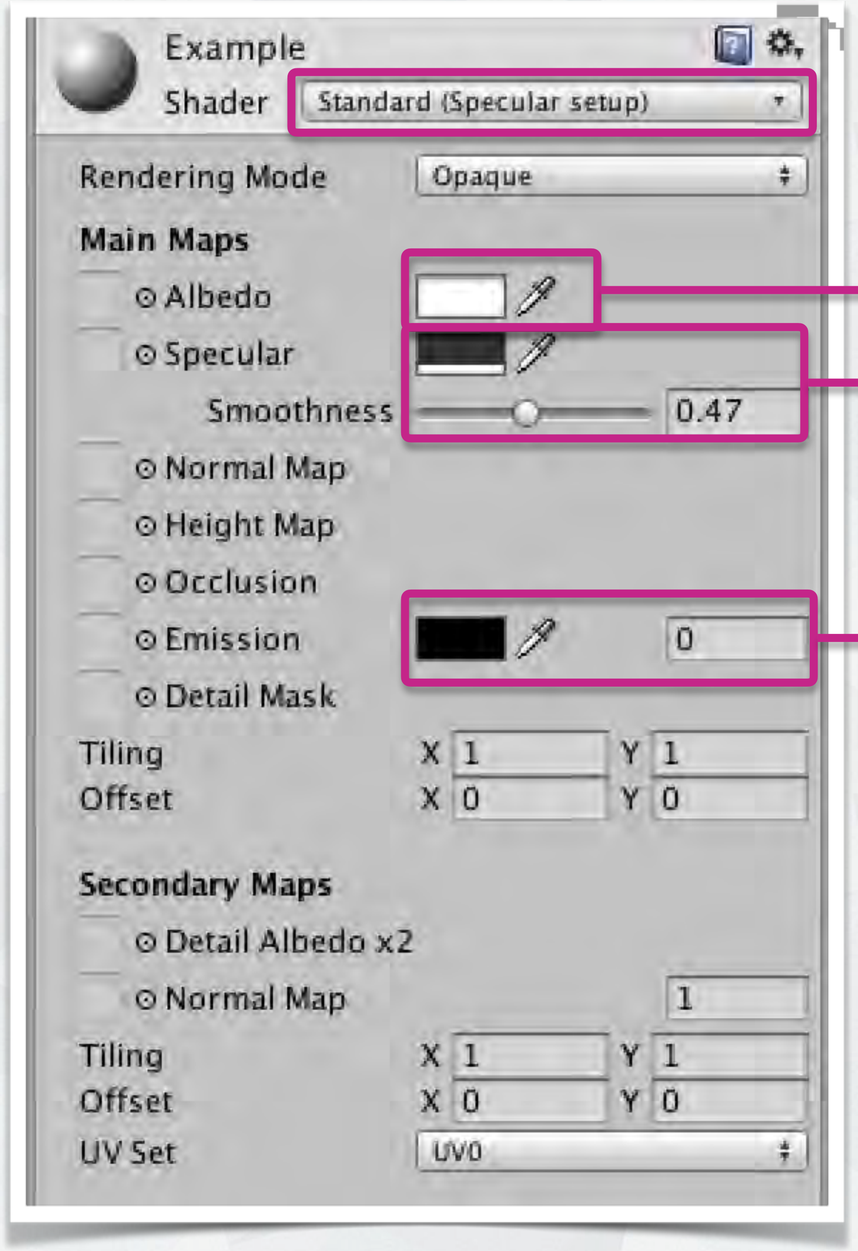


Diffuse
+ Specularity
(“Shininess”)



Diffuse
+ Specularity
+ Emission

Materials can have many other properties.



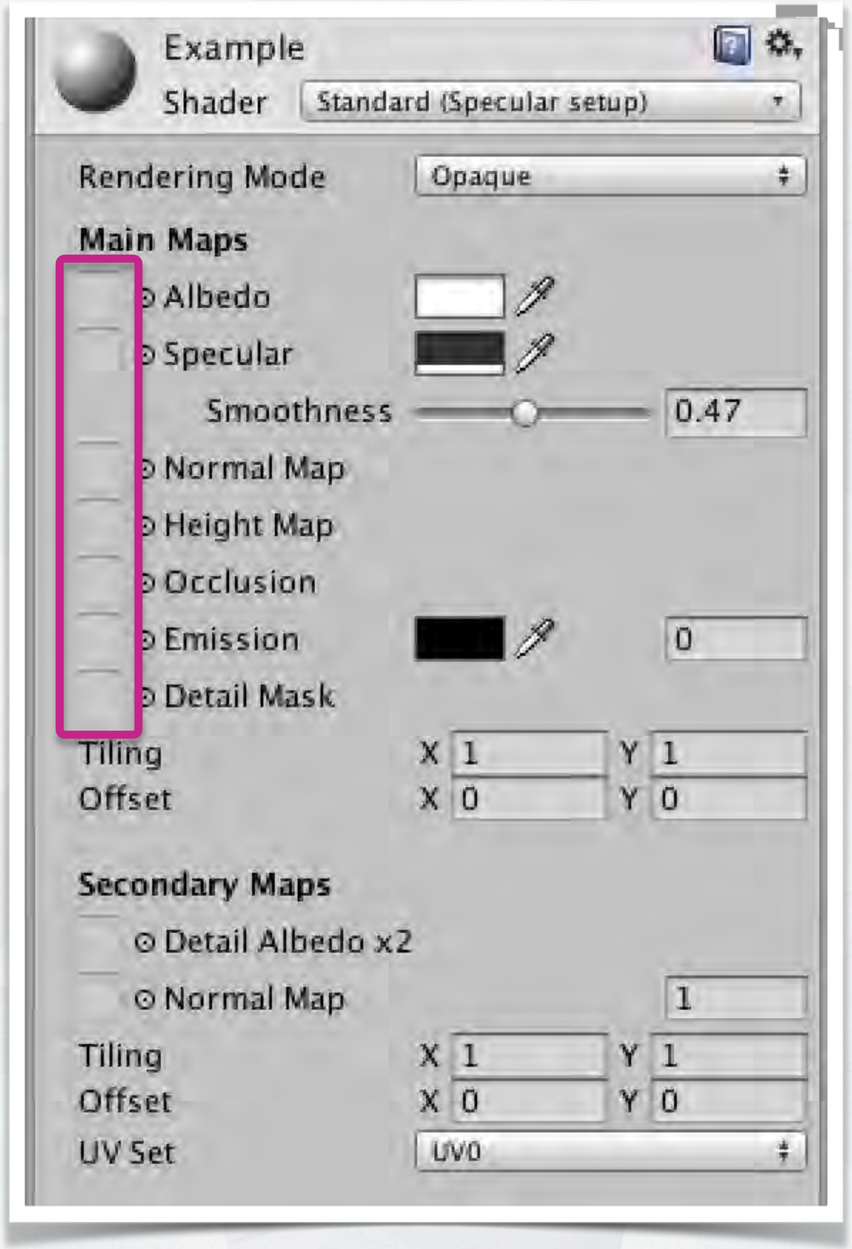
Standard Material in Unity

Assets > Create > Material

Shader changed to "Standard (Specular setup)"

- ***Diffuse / Albedo / "Surface color"***
- ***Specularity / "Shininess"***
- ***Emission / Self-illumination***

Don't be overwhelmed by the options!
Experiment with them
to see their effect!



Material properties can use maps — these allow us to use textures to define the look of a surface.

Some material properties only work with maps (e.g. Normal Map)

Textures

Instead of using a single value across the whole surface, we can define how a surface looks at a specific spot.

This is done by assigning **textures** to material channels.

Textures are **bitmap images** (e.g. PNG, TGA, TIFF), are **square** in shape, and usually use **pixel sizes of powers of 2** (e.g. 256, 512, 1024, 2048)

Texture Color Channels

Not to be confused with material channels!

Textures usually use 1, 3 or 4 color channels. These are:

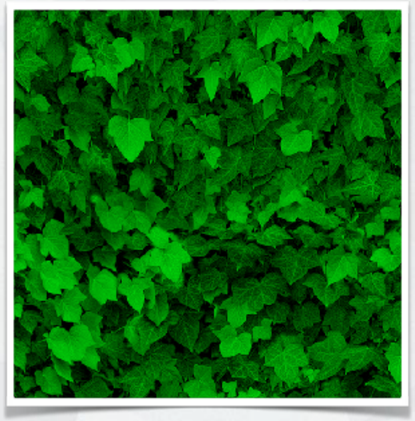
- **Greyscale (a single 8-bit channel, or 256 grey tones)**
- **RGB (red, green, blue, each with 256 tones)**
- **RGBA (adding an alpha channel of 256 tones)**

Alpha is usually used for transparency, but not always!

RGBA Texture

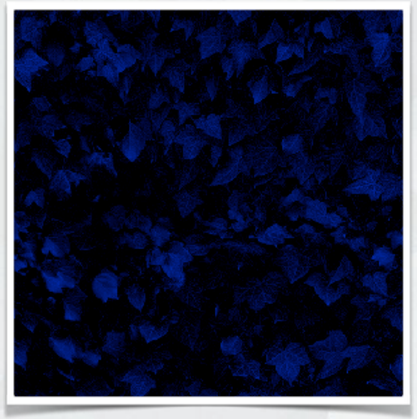
Red Channel

+



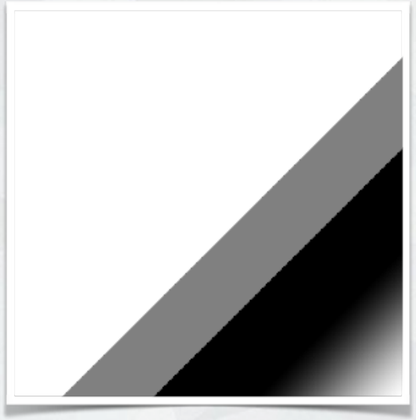
Green Channel

+



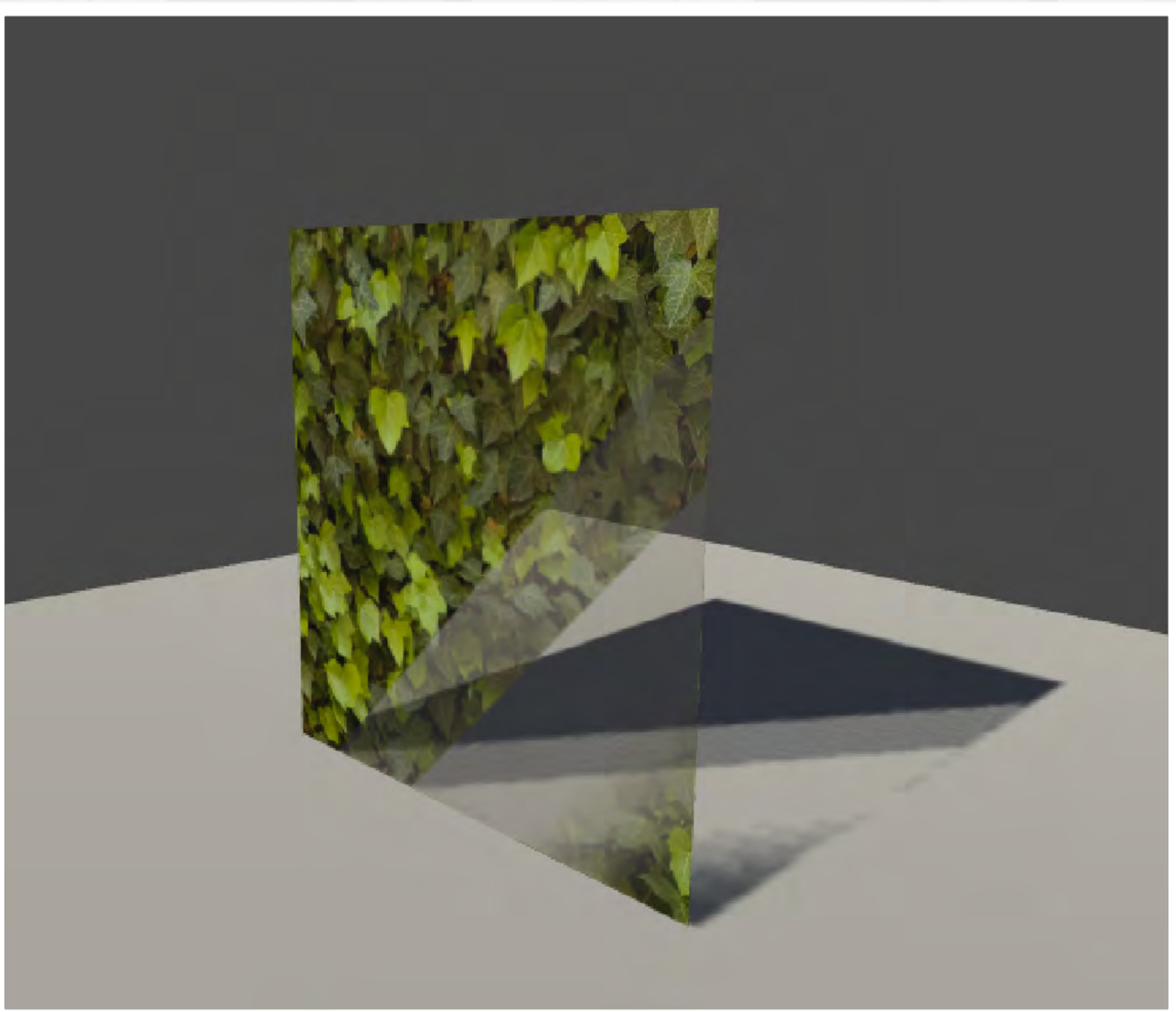
Blue Channel

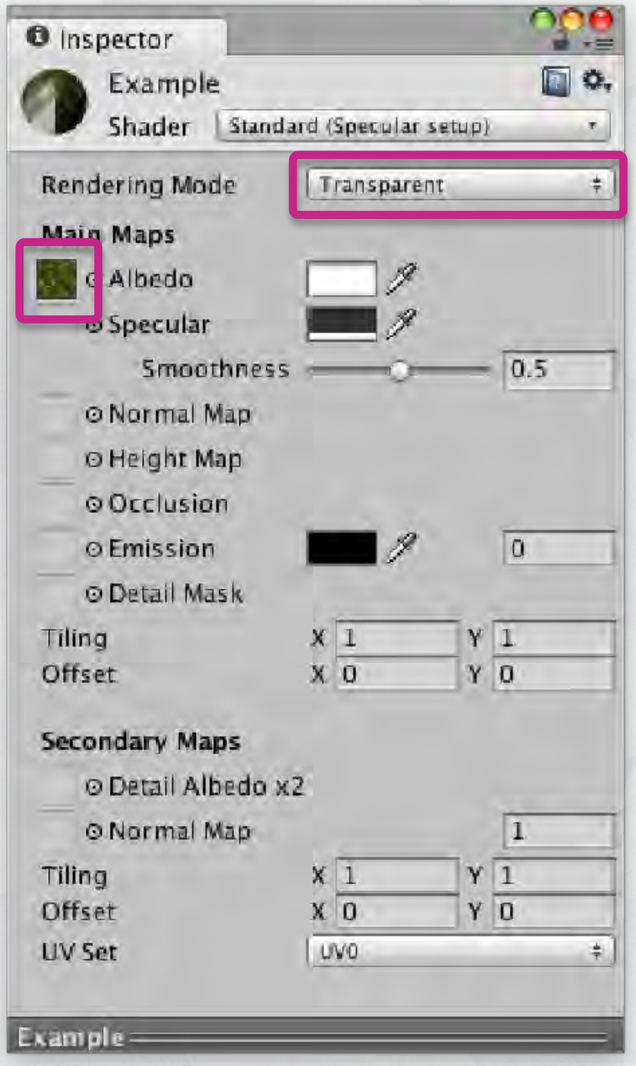
+



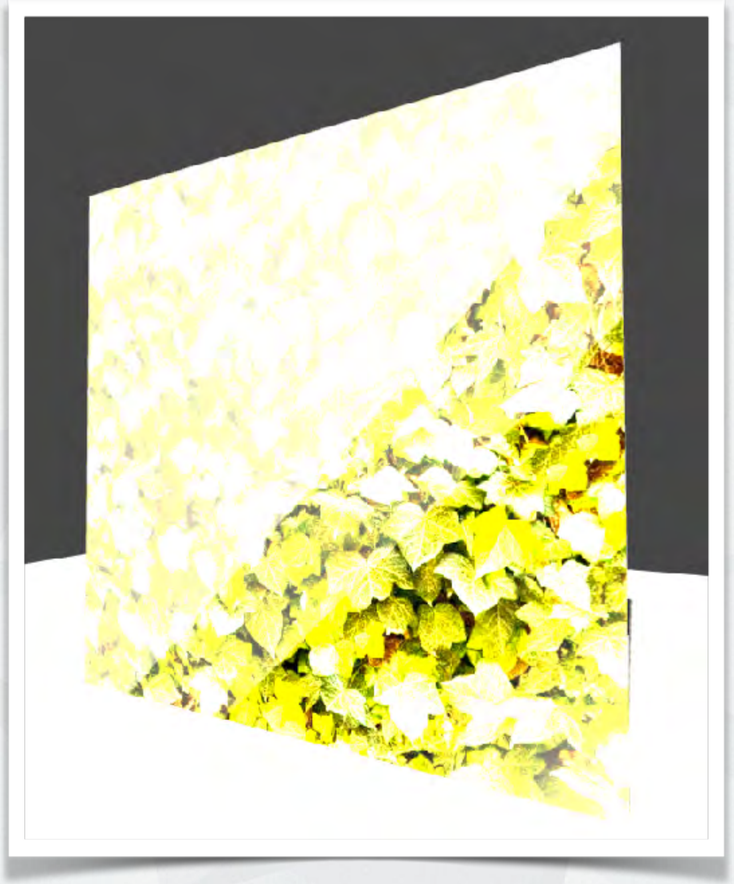
Alpha Channel

In this example, alpha is used to define transparency.
White is fully opaque, black is fully transparent.
Grey values are semi-transparent.

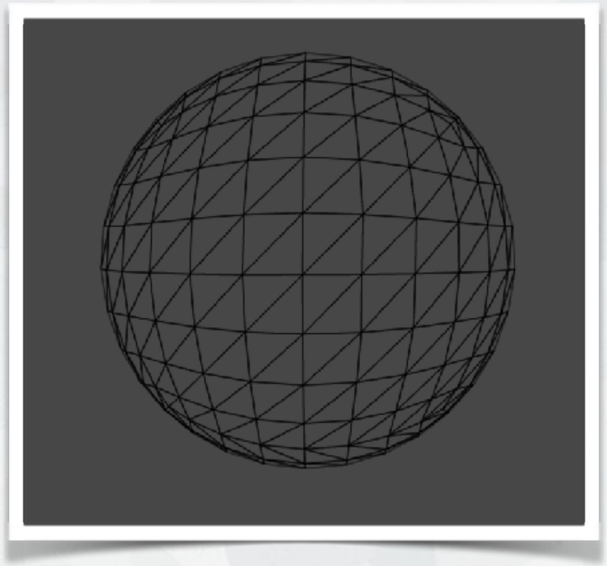



Inspector
Example
Shader
Standard (Specular setup)
Rendering Mode
Transparent
Main Maps
Albedo
Specular
Smoothness
0.5
Normal Map
Height Map
Occlusion
Emission
0
Detail Mask
Tiling
X 1
Y 1
Offset
X 0
Y 0
Secondary Maps
Detail Albedo x2
Normal Map
1
Tiling
X 1
Y 1
Offset
X 0
Y 0
UV Set
UV0
Example

Some materials use alpha in a different way, for example to define how reflective an area should be.



The light is overly bright here to show the effect better



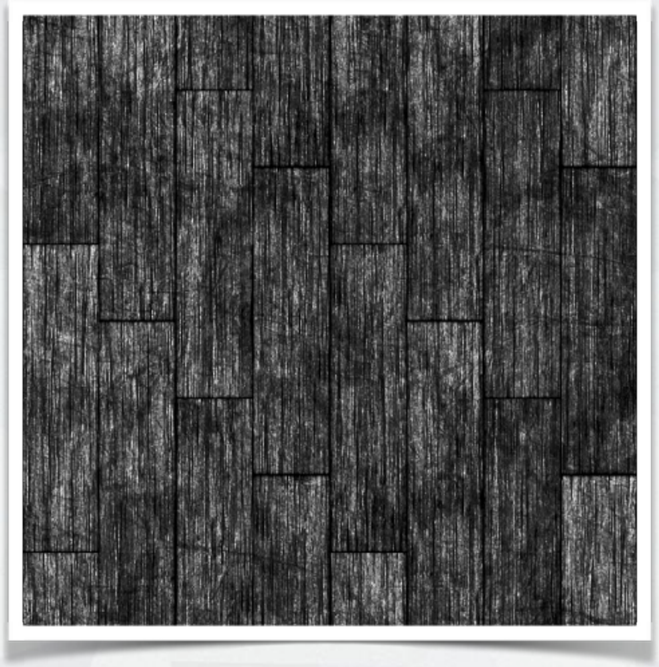
No Material

Diffuse
(using an image texture)

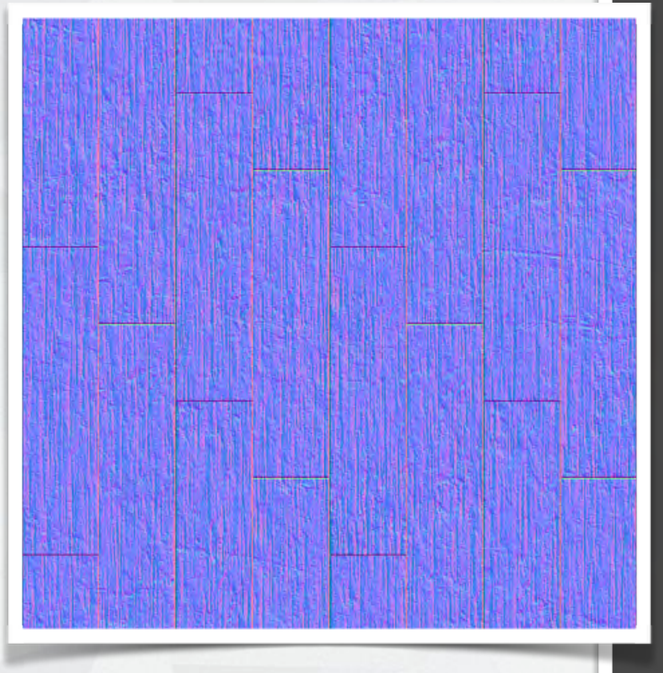
Diffuse
+ Specularity

Diffuse
+ Normal Map

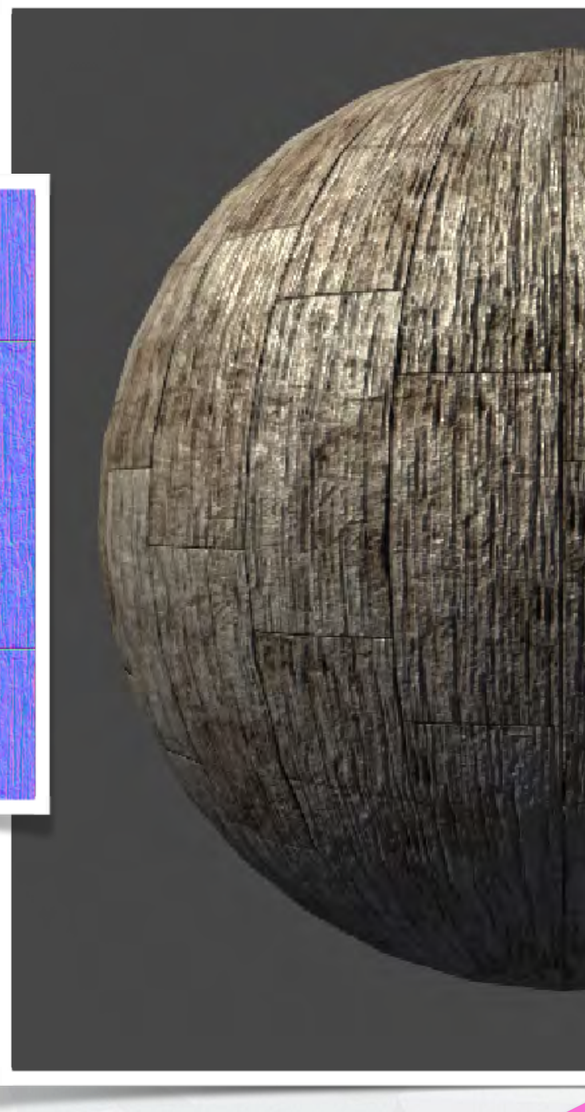
Diffuse
(RGB)



Specularity
(Greyscale)



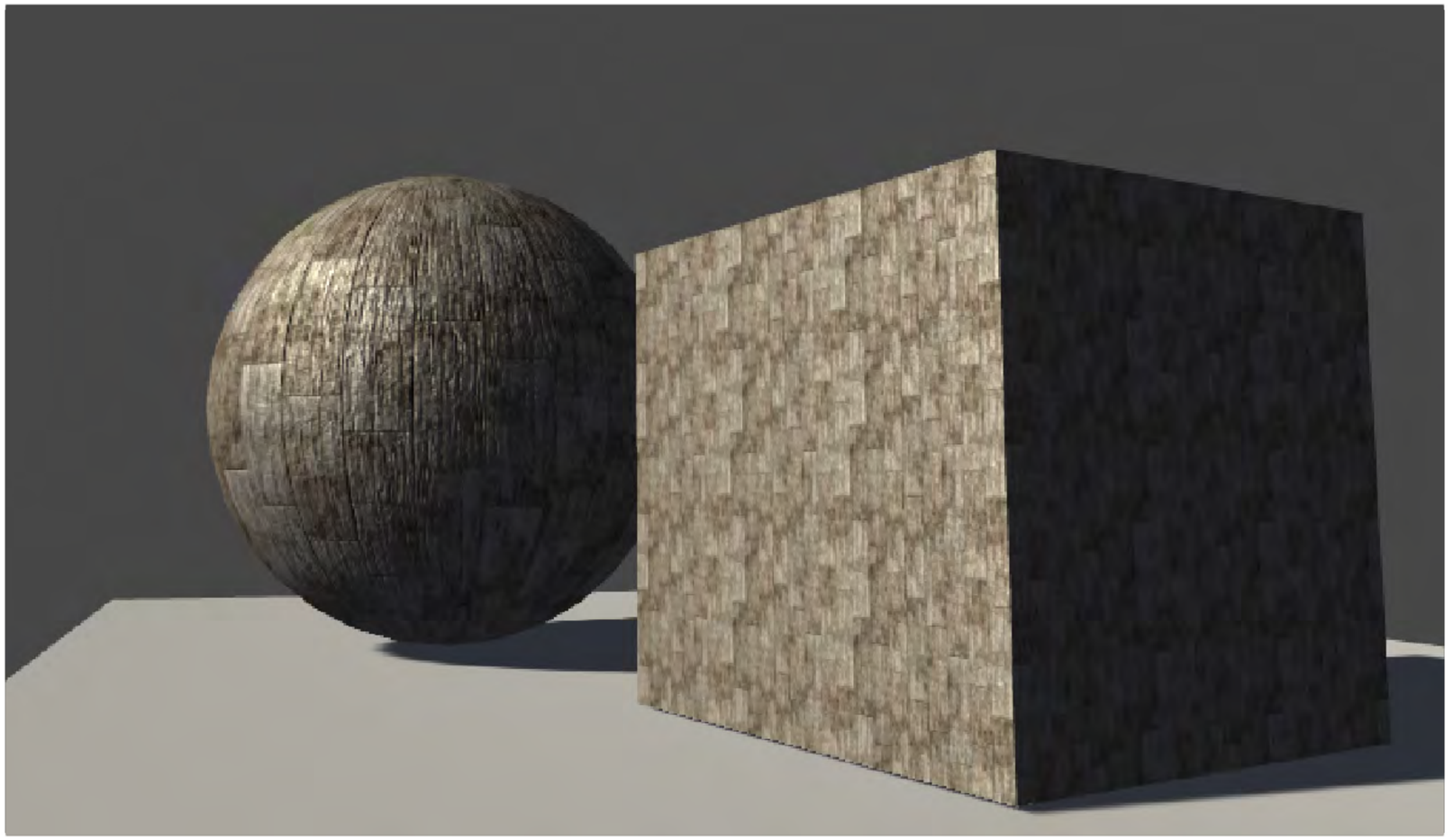
Normal Map
(RGB)



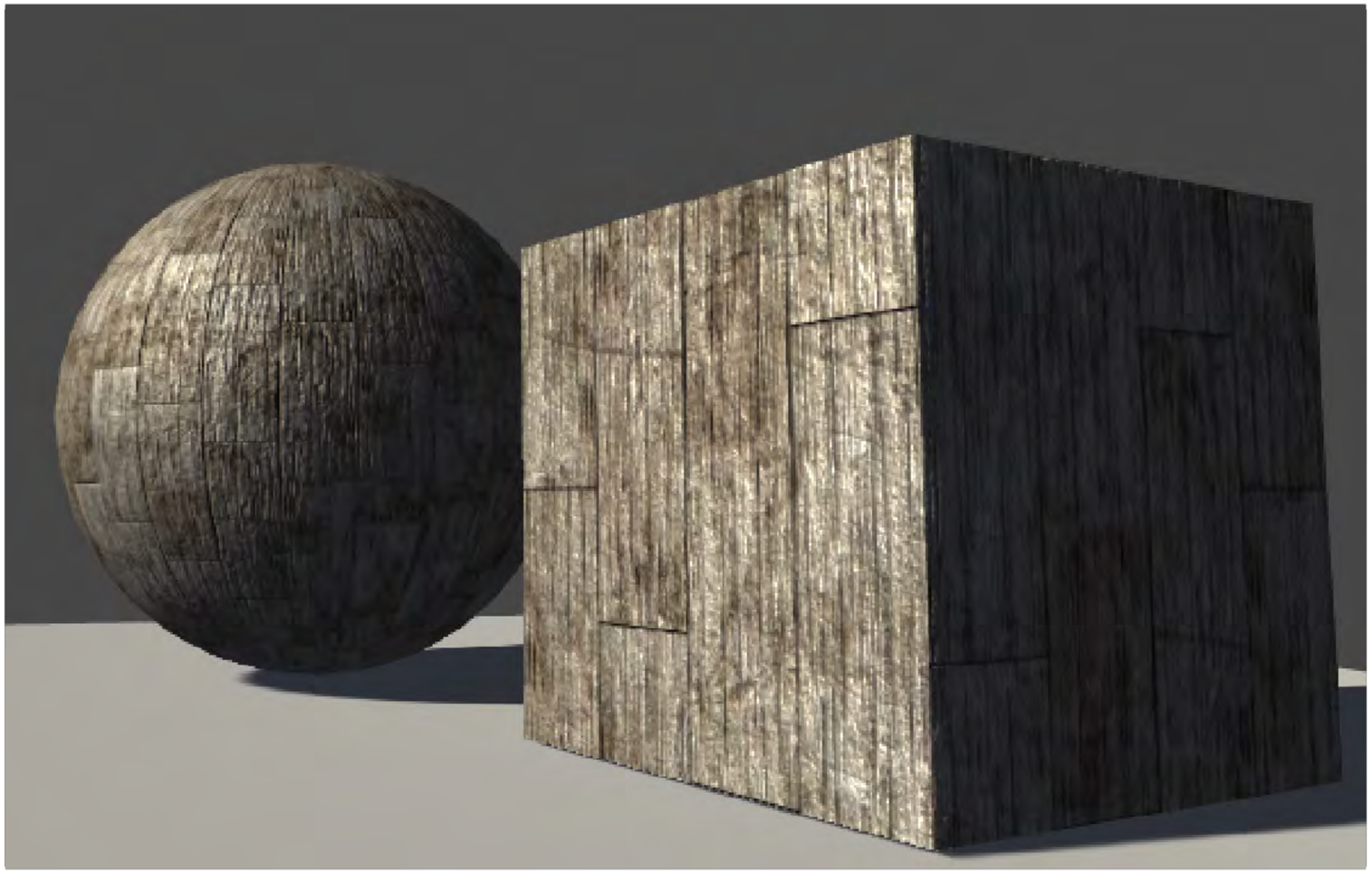
Diffuse

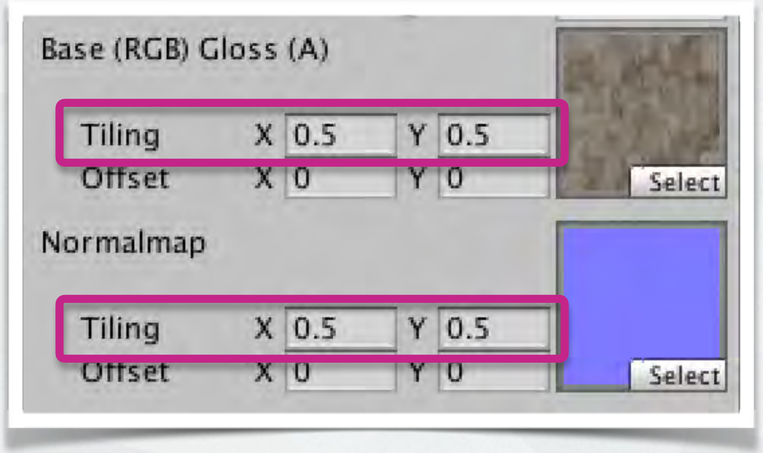
Diffuse + Normal Map

Remember that materials are independent from the geometry they are assigned to!



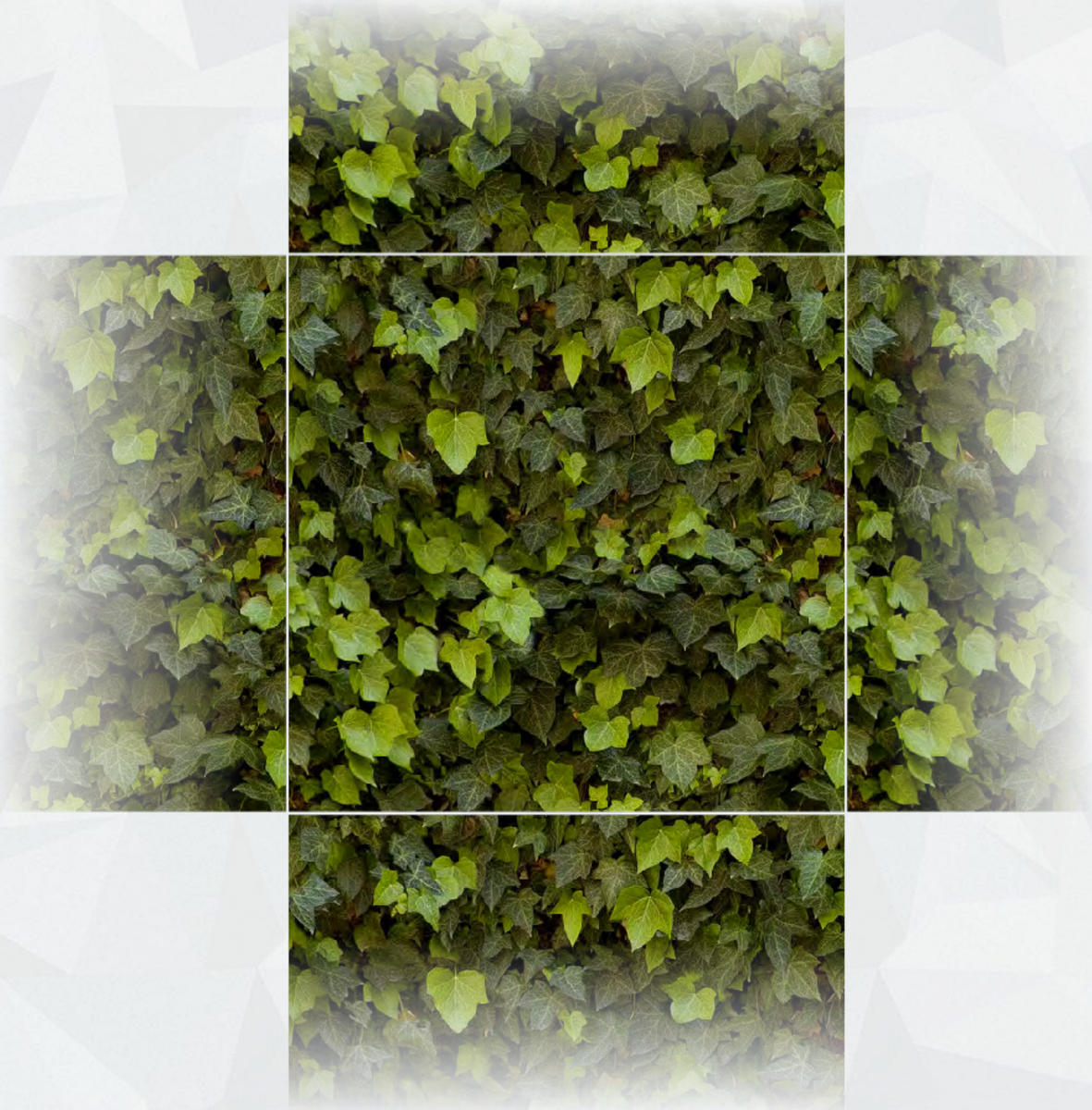
Sometimes, the scale is not quite right





Better!

With tiling textures, it is easy to set the scale!



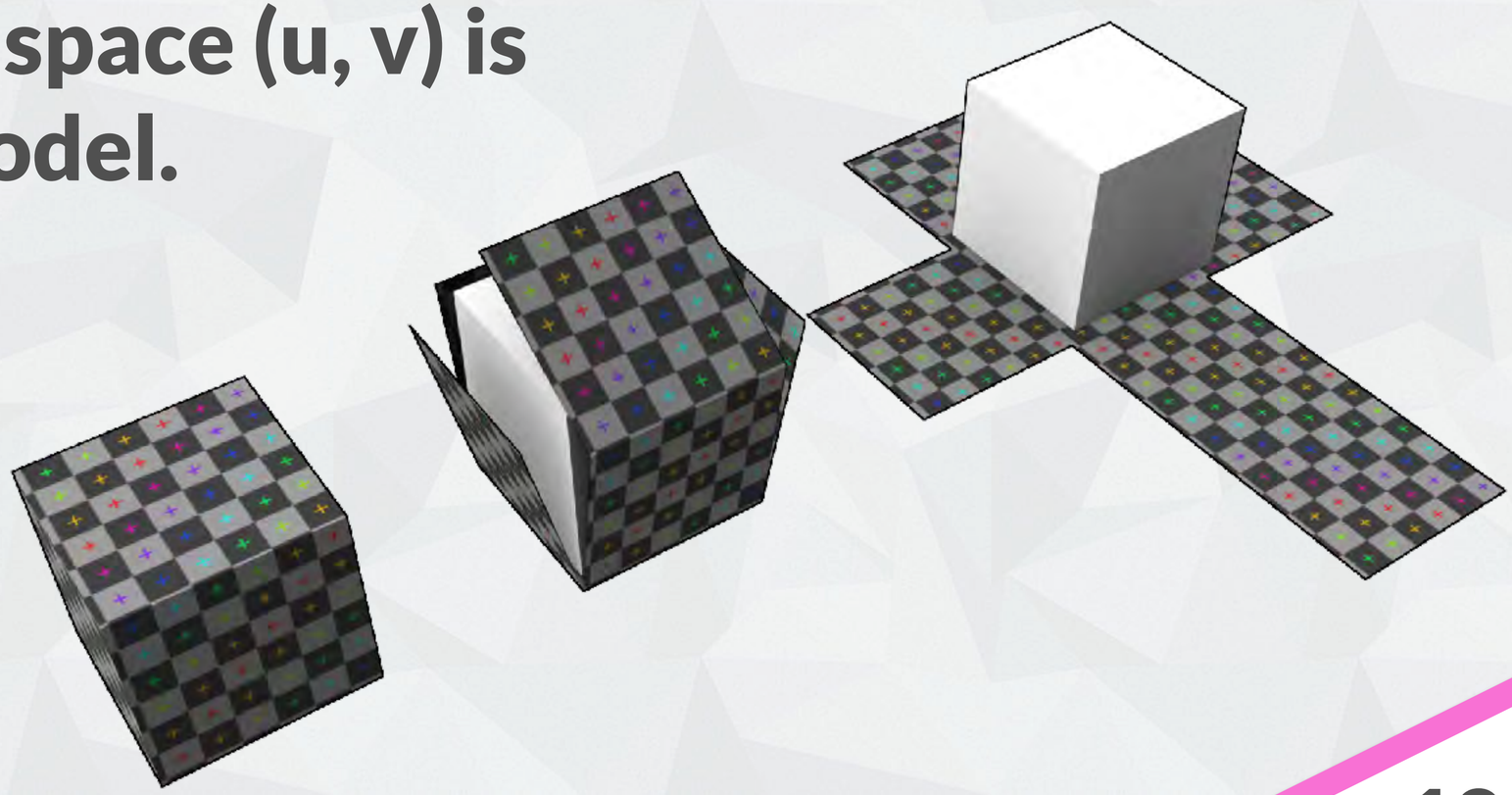
Notice how the image **wraps around** itself!

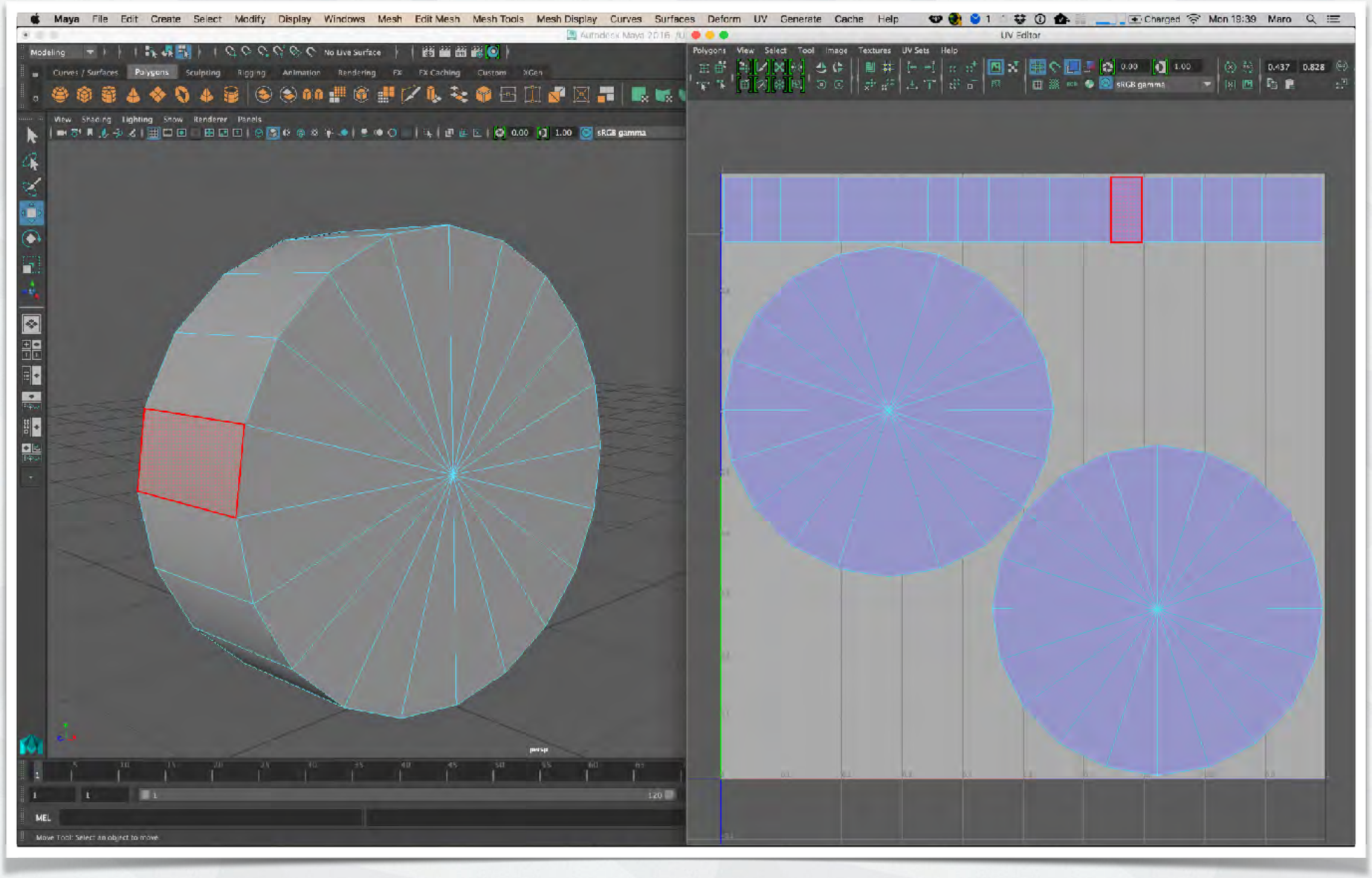
If a texture is not repeated too often, it can cover a large area with a lot of detail.

UV mapping

To apply 2D textures to a 3D model an additional coordinate space (u, v) is used to unwrap the model.

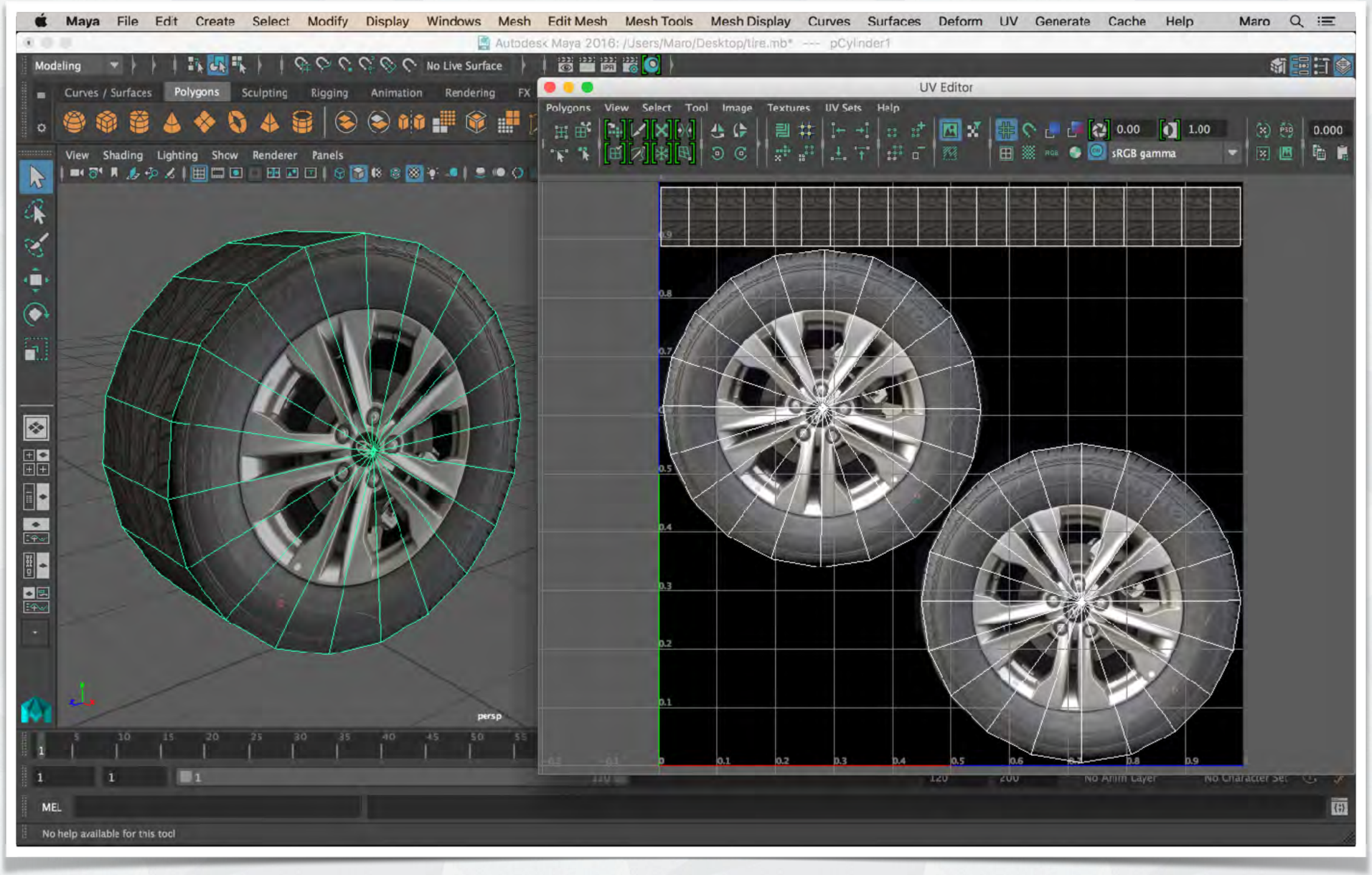
Primitives in Unity are already unwrapped!



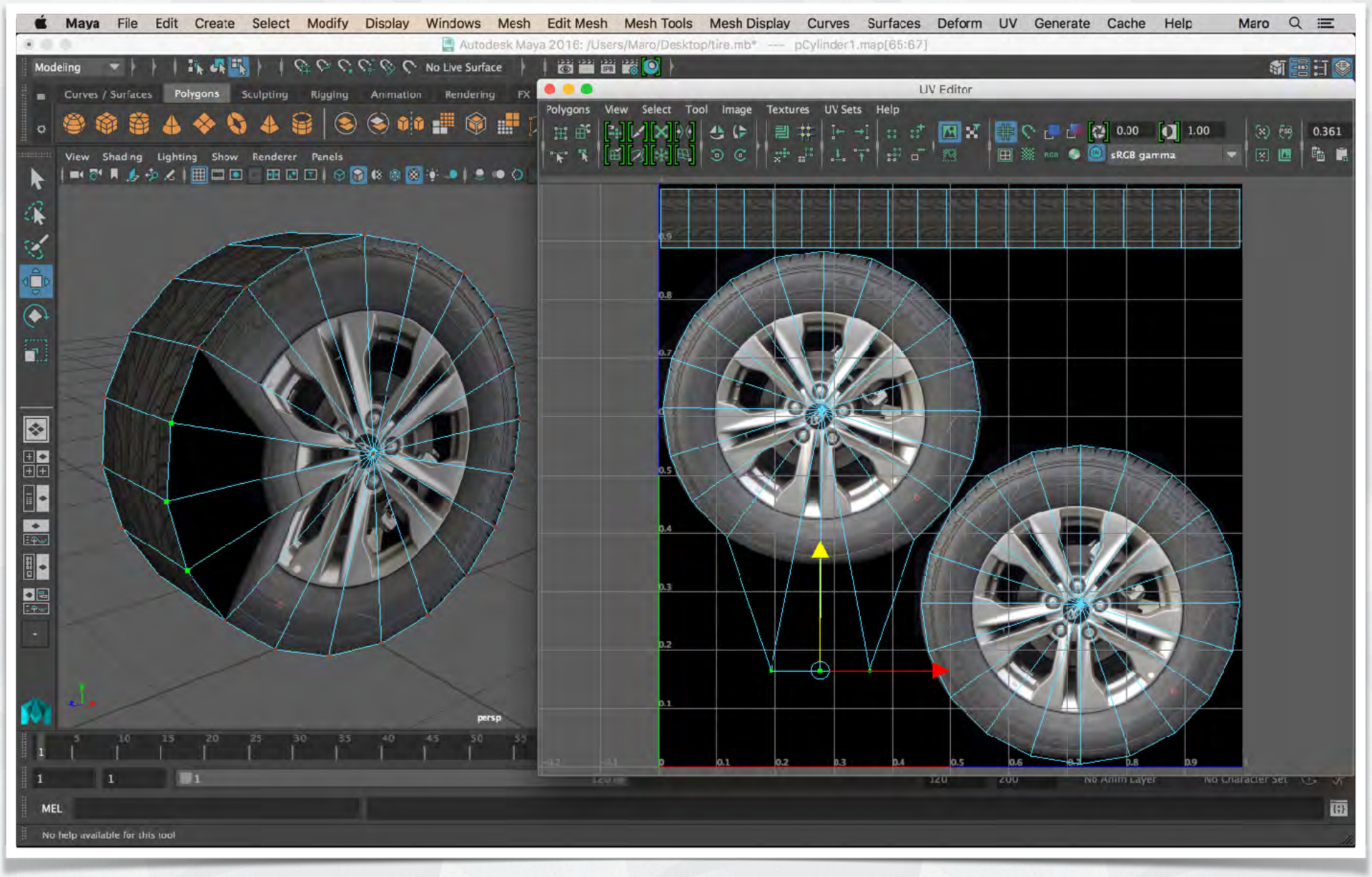


UV mapping in Maya

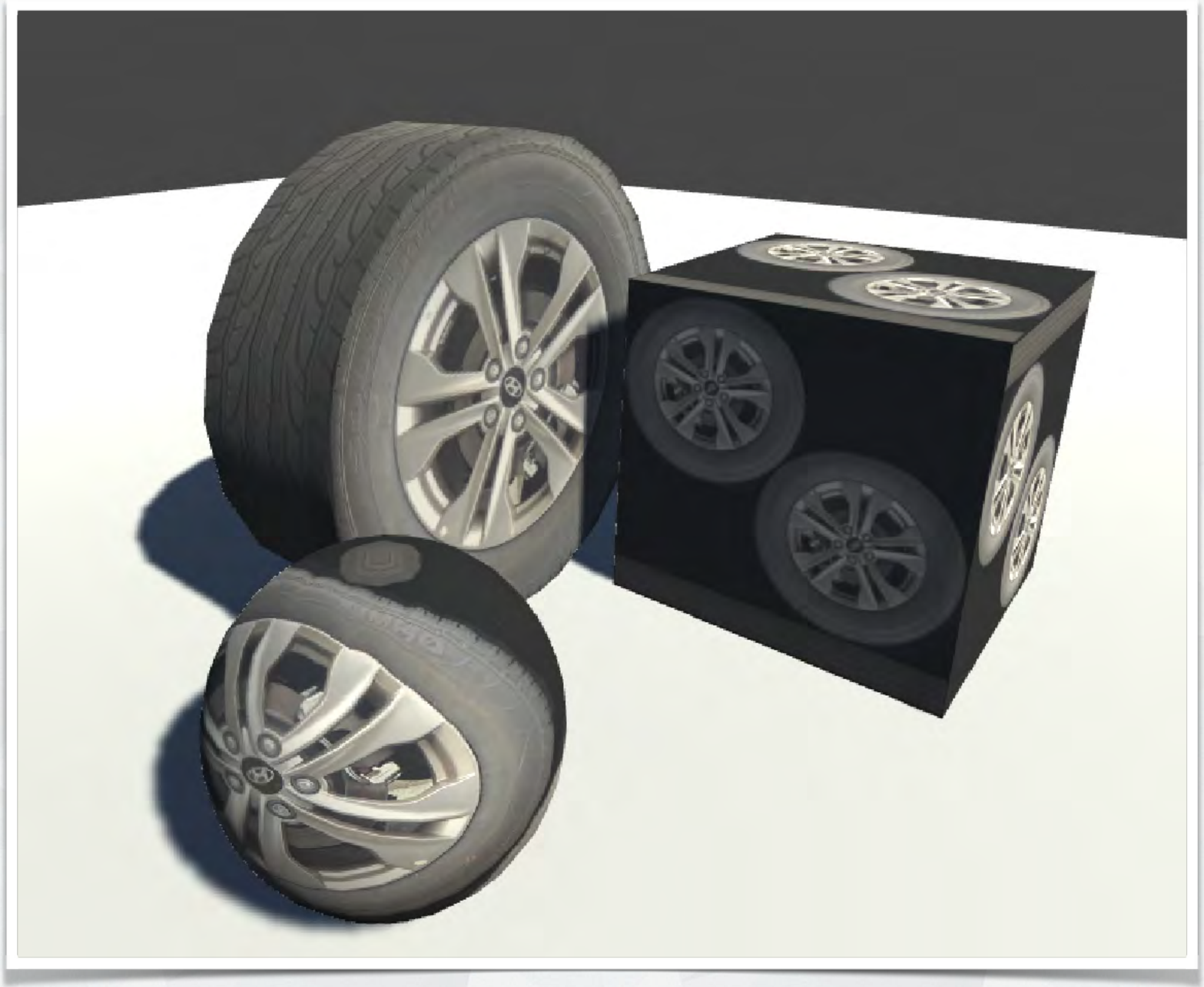
UV map space is **square** and goes from **0 to 1**



The same texture can be used to define different parts of an object



Note how UV space is independent from XYZ space!



There is no problem with assigning the material to objects with different UV mapping!

It just looks rather odd …

Break Time!
Any questions?

After the break:

Unity Practice — Creating and assigning materials