COMP2007 - Game Development

Rendering in Unity

What is rendering?

In computer graphics, rendering is the **process of drawing objects** to the screen in 2D or 3D
Unity has dedicated components for rendering 2D and 3D objects in the engine

- SpriteRenderer for 2D
- MeshRenderer for 3D

3D Mesh components

Mesh filter
https://docs.unity3d.com/2020.2/Documentation/Manual/class-MeshFilter.html

Mesh renderer
https://docs.unity3d.com/2020.2/Documentation/Manual/class-MeshRenderer.html

Skinned mesh renderer
https://docs.unity3d.com/2020.2/Documentation/Manual/class-SkinnedMeshRenderer.html

Other renderer components

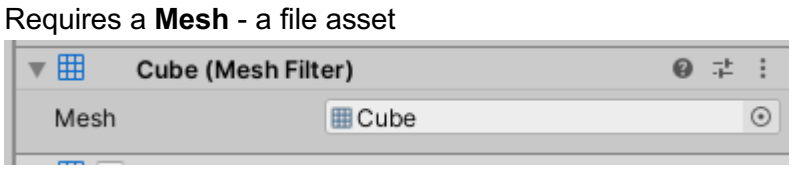
Trail renderer
https://docs.unity3d.com/2020.2/Documentation/Manual/class-TrailRenderer.html

Line renderer
https://docs.unity3d.com/2020.2/Documentation/Manual/class-LineRenderer.html

Particle system
https://docs.unity3d.com/2020.2/Documentation/Manual/class-ParticleSystem.html

MeshFilter component

Requires a **Mesh** - a file asset



All of these pieces of data combined make up the mesh and are used by the **MeshFilter** component

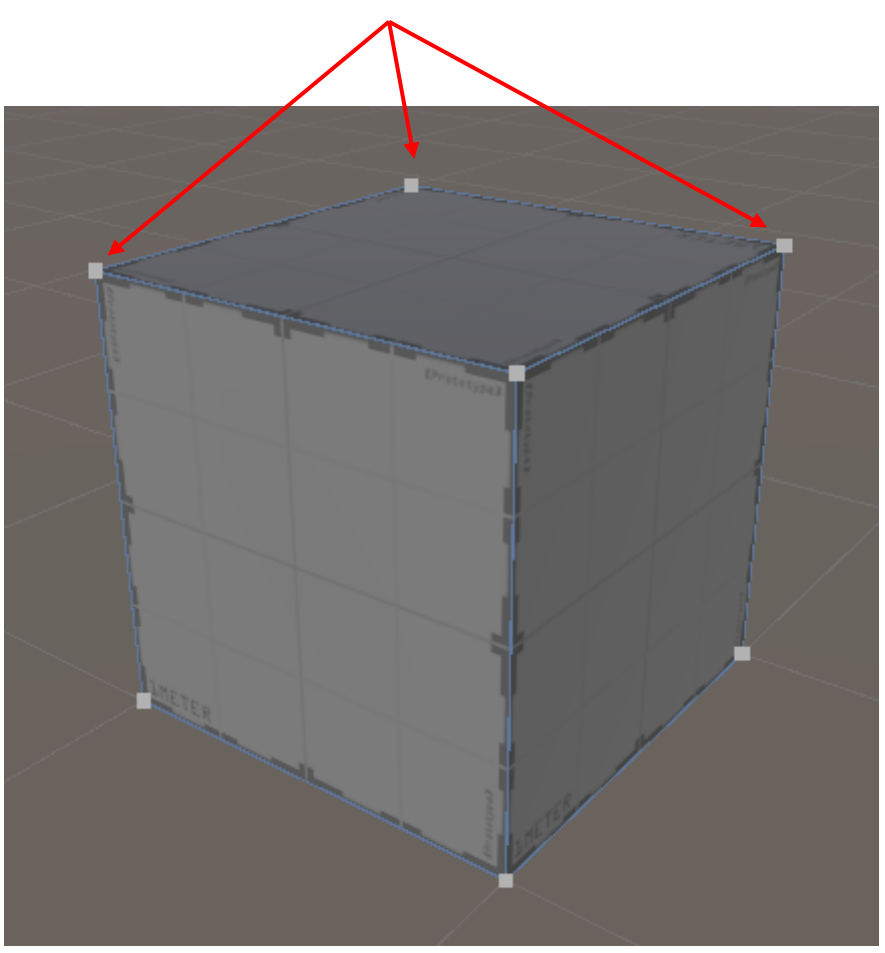
- Mesh
    - Vertices, edges, faces
- UV coordinates
- Surfaces (or smoothing groups)

Parts of a mesh

Vertex

A position usually in 3D space. (may contain other information as well)

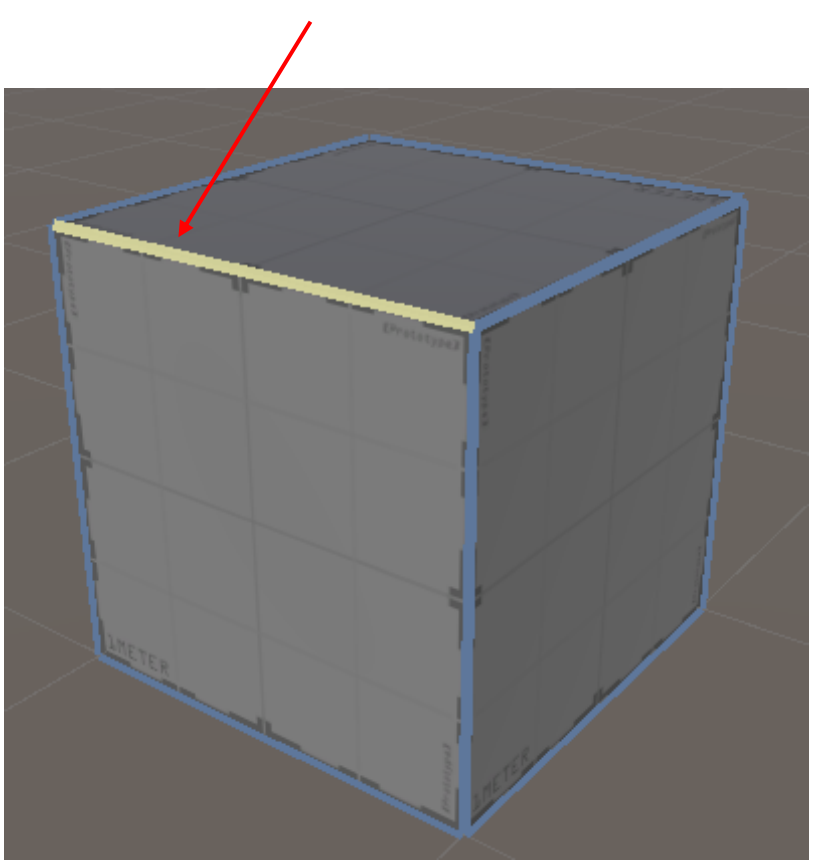
Vertices



Edge

A connection between two vertices.

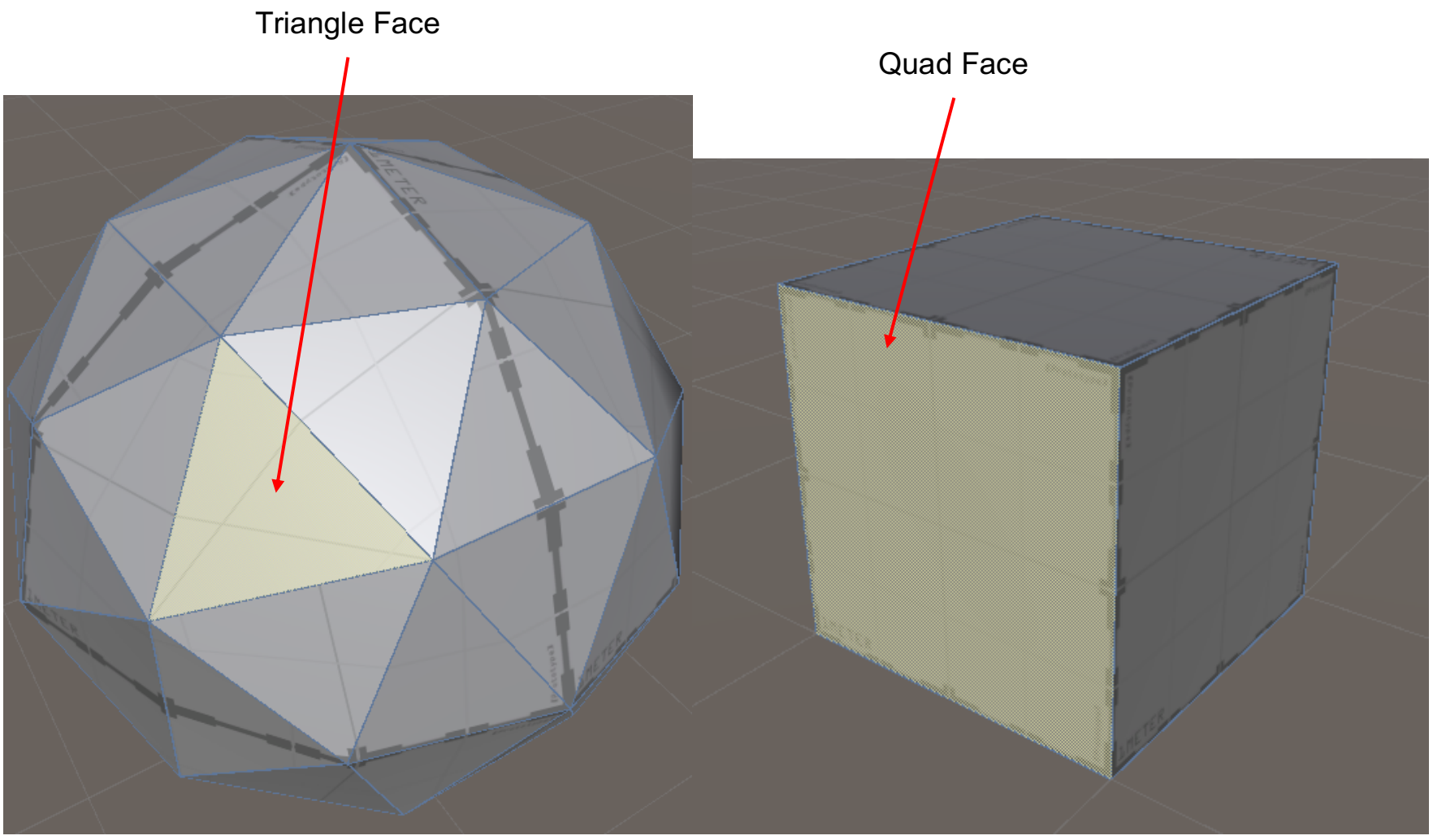
Edge



Face (triangle or quad)

The face is where a texture is drawn onto the model
A face is a closed set of edges, in which a triangle face has three edges, and a quad face has four edges.
Each corner has a vertex connecting the edges (3 for the triangle, 4 for the quad)

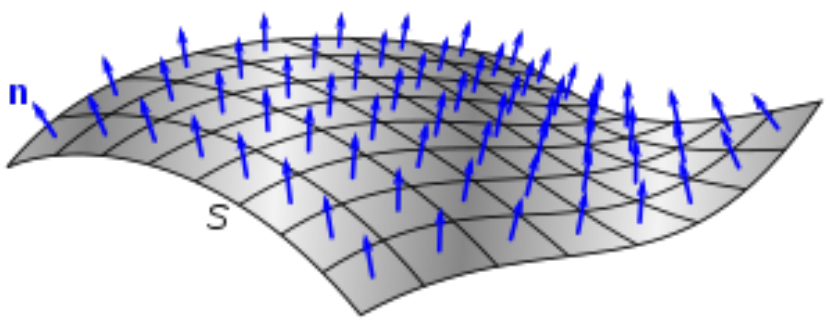
NOTE: a Quad face actually just consists of 2 triangles!



Normals

As well as a position, a vertex has a facing direction; called a **Normal**.
Normals are used to calculate **lighting** for a face.
Normals face an angle perpendicular to the face by default

The blue arrows are the normals for each face of the mesh
Note how each arrow points at an angle perpendicular (at a 90 degree right angle) to each face



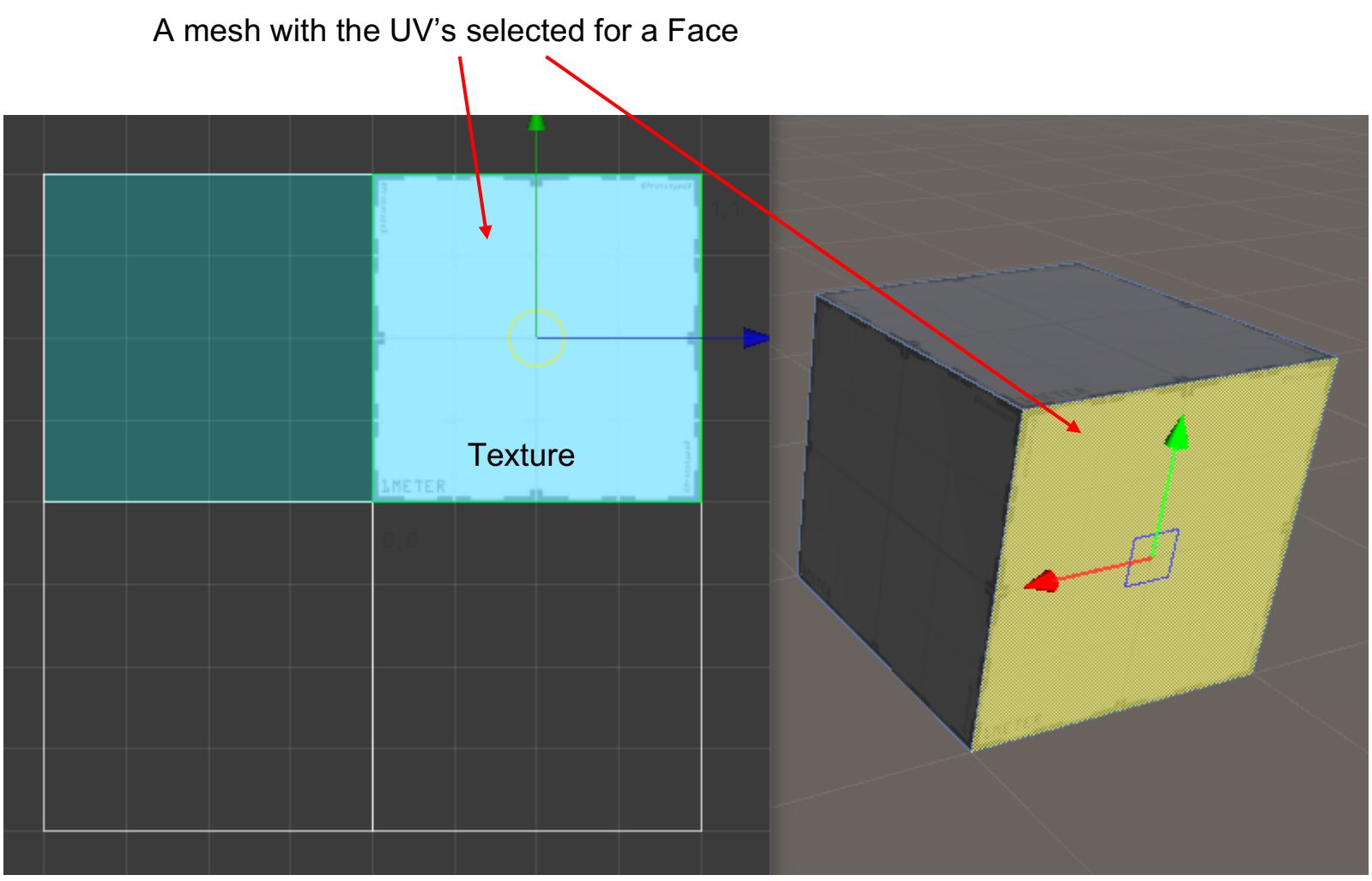
UV (or UVW) coordinates

A separate 2D representation of the mesh "unfolded" to show which portion of a 2D texture to apply to different faces of the mesh.

Example

Think of UV coordinates like stickers you put on the correct place of a toy - you align the 2D stickers to the 3D toy's shape

UV coordinates align a 2D image to a 3D model

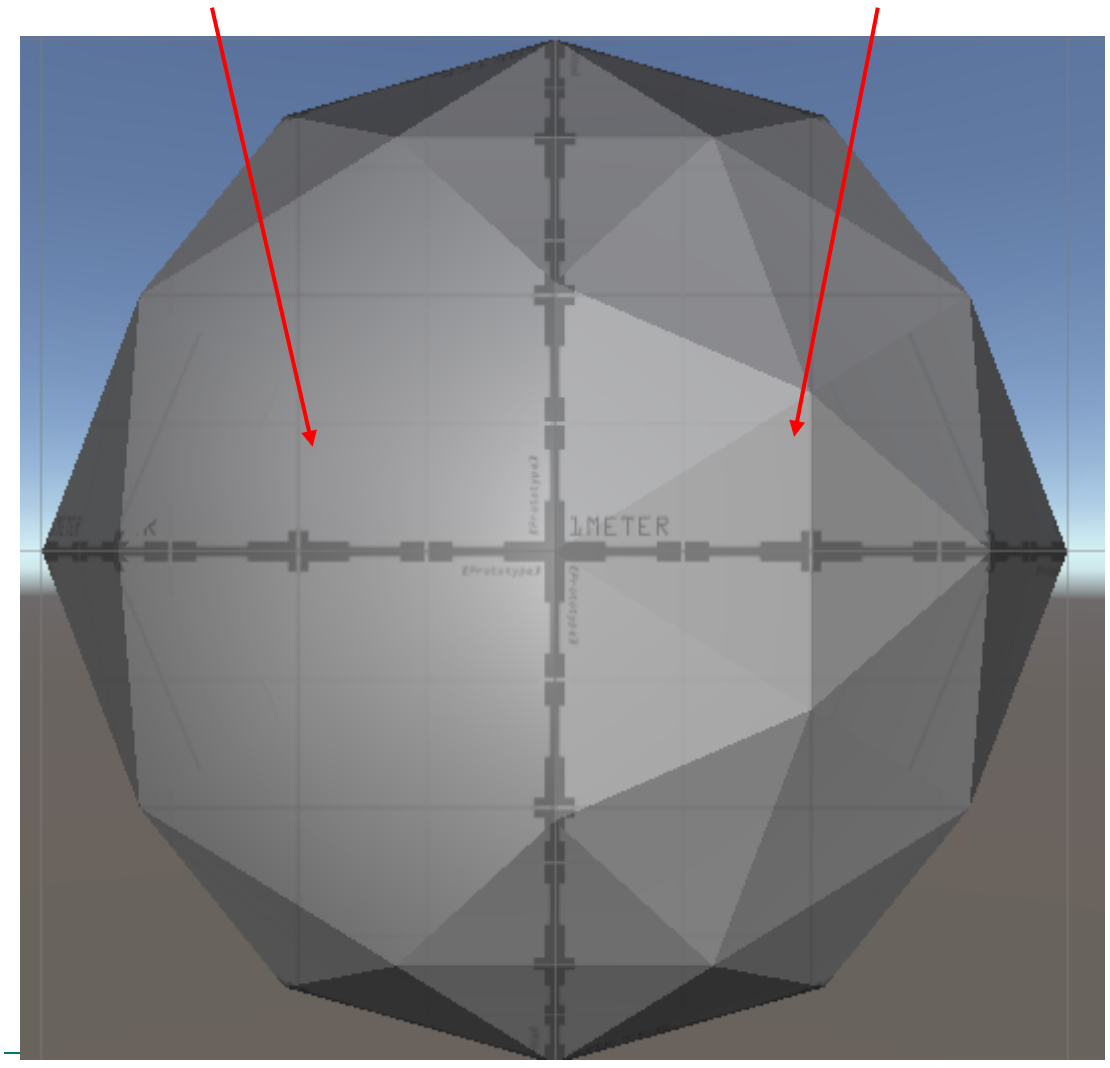


Surface (smoothing group)

More often called smoothing groups, these are not required for all meshes.
A surface will “smooth” out the lighting on a part of a mesh, so corners and edges are not visible

Smoothed geometry

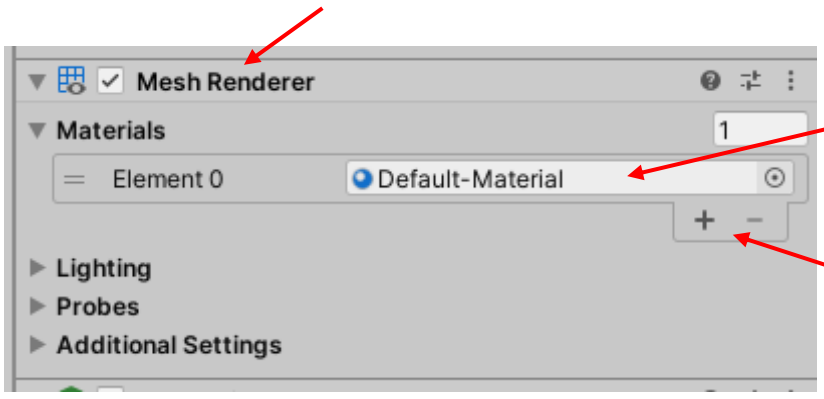
Unsmoothed geometry



Rendering a mesh - Materials, Shaders and Textures

A Mesh can have one or more materials assigned to render it.
Materials are assigned to the MeshRenderer component

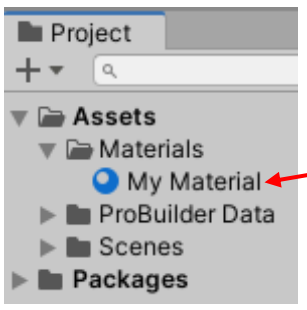
MeshRenderer component



Materials slot

Add/remove Material slots
using the + and - buttons

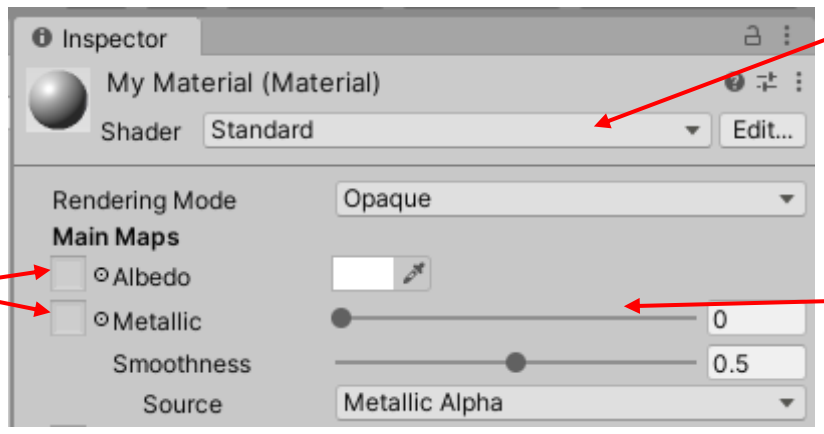
A **Material** is a file that a MeshRenderer uses to implement a **Shader**.
A **Shader** is a piece of code that implements the rendering strategy for the mesh.
Shader language code is often written in HLSL, a variant of the C programming language.
Shaders contain custom “slots” for **textures** (2D images), colours and other data.
A material stores custom settings for a shader.



A Material Asset in the Project view

NOTE: Materials are separate files

Material settings in the Inspector



Shader selection

“Standard” is the Unity
Standard Shader

Texture
slots

Settings are provided by the
Shader code

Importing files

Common file formats Unity can use for exported mesh data

- FBX
- OBJ

NOTE: Unity can read files directly from popular 3D modeling software (.blend, .max etc)

File asset types used in Unity
https://docs.unity3d.com/2020.2/Documentation/Manual/AssetTypes.html

Links

Renderer scripting links

MeshFilter
https://docs.unity3d.com/2020.2/Documentation/ScriptReference/MeshFilter.html

MeshRenderer
https://docs.unity3d.com/2020.2/Documentation/ScriptReference/MeshRenderer.html

SkinnedMeshRenderer
https://docs.unity3d.com/2020.2/Documentation/ScriptReference/SkinnedMeshRenderer.html

TrailRenderer
https://docs.unity3d.com/2020.2/Documentation/ScriptReference/TrailRenderer.html

LineRenderer
https://docs.unity3d.com/2020.2/Documentation/ScriptReference/LineRenderer.html

Mesh
https://docs.unity3d.com/2020.2/Documentation/ScriptReference/Mesh.html

About Meshes

Anatomy of a mesh
https://docs.unity3d.com/2020.2/Documentation/Manual/AnatomyofaMesh.html

Using the mesh class
https://docs.unity3d.com/2020.2/Documentation/Manual/UsingtheMeshClass.html

Creating a Quad mesh in code
https://docs.unity3d.com/2020.2/Documentation/Manual/Example-CreatingaBillboardPlane.html

About Materials, Textures & Shaders

Materials
https://docs.unity3d.com/2020.2/Documentation/Manual/Materials.html

Textures
https://docs.unity3d.com/2020.2/Documentation/Manual/Textures.html

Unity’s Standard Shader
https://docs.unity3d.com/2020.2/Documentation/Manual/shader-StandardShader.html

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