Lux LWRP Essentials

Lux LWRP Essentials provide a growing collection of manually written and optimized HLSL shaders and custom nodes for Shader Graph to cover a wide range of use cases.

Environment related shaders
Mesh terrain, grass, foliage, rock and water

Advanced Materials and lighting
Skin, hair, cloth, transmission, clear coat, glass, toon lighting and lit and shadowed particles

Effects
Fast outlines, rim based animated highlights, hidden surfaces, screen space decals and billboards

Shader Graph
Custom nodes for cloth, transmission, clear coat, glass and toon lighting next to some handy helper nodes

FAQ
Please make sure you have a look into the section FAQ were i will collect frequently asked questions as well as tips and tricks and visit the forum.

Compatibility

Lux LWRP Essentials have been successfully tested in Unity 2019.1.3, 2019.1.6 and 2019.1.10 using LWRP 5.16.1 and Unity 2019.2.0f1 using LWRP 6.9.1 on macOS and Metal, Windows 10 and DX11 and Android (Mali GPU) using Vulcan. Single pass stereo rendering has been tested using DX11 and Oculus Rift.

All shaders support the **SRP Batcher.**

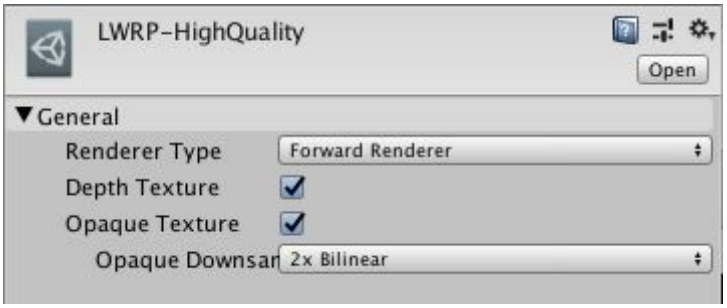
All shaders support **Single Pass Stereo rendering** — this includes shaders, which sample the camera depth or opaque texture like water, particles, decals and glass.

A preview package for URP 7.1.2. Is included.

Table of Content

Getting started

- Make sure you have the proper version of the *Core RP Library* and the *Lightweight RP* installed (5.16.1 or 6.9.1) in the *Window → Package Manager*.
- Set *Color Space* to *Linear* in *Project Settings → Player → Other Settings*
- Open the *Scriptable Render Pipeline Settings* assigned under *Project Settings → Graphics* and check *Depth Texture* and the *Opaque Texture* as both are needed by the water shader. If you check *Opaque Downsample* or not is up to you.



- Lux LWRP Essentials fully support the SRP batcher. So you should enable it your *Scriptable Render Pipeline Settings*.
- Import the package – if you have not done already – and open the included "Environment Demo" scene (located in *Lux LWRP Essentials → Demos*).

Shader Overview

Environment related shaders

Mesh Terrain Shader

The mesh terrain shader lets you shade any custom mesh using up to 4 detail textures (albedo, smoothness and normal) mixed together based on a RGB splat map. It usually samples all textures according to the UVs allowing you to texture even cliffs and overhangs without texture stretches – however the first detail layer may use top down projection to enhance mesh blending with objects using the *Top Down Projection shader* or hide texture seams at UV shell borders. Details →

Grass and Foliage Shaders

The grass and foliage shaders allow you to place individual patches of grass and foliage as single game objects within your scene whose bending is globally controlled by a built in wind zone and a custom render texture. In order to speed up rendering all grass and foliage patches in the demos are placed on the built in layers *TransparentFX* or *Water* which get culled at a distance of 30 / 50 meters using the simple LuxLWRP_LayerBasedCulling script . Details →

Top Down Projection Shader

The top down projection shader allows you to add one texture set on top of the regular texture set based on the up direction of the normal in world space to create effects such as moss on rocks, eroded sand or snow.

The projected texture set is sampled in world space and thus gives seamlessly textured surfaces even over multiple objects.

Normals are blended properly in world space using Reoriented Normal Mapping. The shader does not need to do expensive triplanar mapping. Details →

Water Shader

The water shader offers fast yet compelling water rendering for rivers or lakes and supports proper refractions, view depth based underwater fog, soft edge blending with the surrounding geometry and dynamically generated edge and slope based foam – both using perspective and orthographic projection. Details →

Tree Creator Shaders

The Lux LWRP tree creator shaders are a port of the original tree creator shaders for the built in render pipeline and allow you to use tree creator trees along with LWRP and URP. Details →

Advanced Materials and Lighting

Skin Shader

The skin shader uses pre-integrated diffuse lighting and lets you create state of the art skin surfaces. Details →

Hair Shader

The hair shader supports anisotropic Kajiya-Kay specular hair lighting and transmission: Details →

Cloth Shader

The cloth shader supports Charlie Sheen or GGX anisotropic lighting and transmission to cover a wide range of different fabrics. It allows properly lit double sided rendering using VFACE. Details →

Clear Coat Shader

A versatile clear coat shader that lets you use duo coloring, add metallic flakes and even mix clear coat with standard lighting within the same material.
Details →

Transmission Shader

A versatile subsurface scattering or transmission shader, that lets you create materials like wax or thin plastics and supports transmission as well as wrapped diffuse lighting and can mix both with standard lighting within the same material.
Details →

Glass Shader

The glass shader allows you to add refractive, tinted and bump mapped glass like objects.
Details →

Lit and shadowed Particles Shaders

The lit particles shaders offer advanced lighting support such as additional lights, transmission and real time shadows. Details →

Effects

Fast Outline Shader

The fast outline shader allows you to highlight objects by adding a colored outline to them without having to use any expensive full screen image effect. The shader instead is based on the stencil buffer and needs the objects to be drawn twice. Details →

Toon Outline Shader

The toon outline shader is a rather simple shader which creates outlines by drawing the geometry a second time extruding the vertices along the geometry's normals. Details →

Decal Shaders

The decal shaders let you add screen space decals which act more or less like deferred decals. Details →

Billboard Shader

The billboard shader lets you create fully camera aligned or camera facing upright oriented lit and unlit billboards suitable to create e.g. light halos, UI icons or distant trees and objects
Details →

Mesh Terrain Shader

Shader Inputs

Surface Options

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Surface Inputs

Enable normal Turns normal maps on and off.

Enable Top Down Projection If checked the *first detail texture* will be sampled in world space using a top down projection. This feature is helpful in case:

- you add objects like rocks using the *Top Down Projection shader* and want to make these blend better with the terrain.
- your terrain mesh has several UV shells. Add the top down projected detail texture at the seams to hide them. *See: Path example in the Demo scene.*

Tiling in world space Tiling of the top down projected detail texture in world space. A value of 0.25 means that the texture will be repeated every 4 meters.

Detail [0-3] Albedo (RGB) Smoothness (A) Detail albedo in RGB and smoothness in Alpha.

Normal [0-3] The related normal maps.

Use Vertex Colors If checked the shader will ignore the *Splat Map* and mix the detail textures based on vertex colors. Just like in the spalt map red maps to detail 0, blue to detail 1, green to detail 2. If the vertex color is black detail 3 will show up.

Splat Map (RGB) The splat map drives the distribution of the detail maps. Red maps to detail 0, blue to detail 1, green to detail 2. If the splat map is black detail 3 will show up. **Please note:** The splat map must be imported as linear texture and should be uncompressed., So uncheck “sRGB (Color Texture)” in the import settings.

Detail Tiling (UV) Tiling of all non top down projected detail texture according to the UVs.

Specular Overall specular color.

Occlusion Although the shader currently does not support explicit occlusion maps you may tweak occlusion to better make the terrain grounded.

Tips

Use common UV tricks to:

- break up tiling.
- make the textures follow the actual geometry like in the *path example* by creating several UV shells.

Grass and Foliage Shaders

The grass and foliage shaders allow you to place individual patches of grass or foliage as single game objects within your scene whose bending is globally controlled by a built in wind zone.

These are the most complex shaders/solutions as they involve proper meshes with baked bending information, a wind input, layer based culling and finally the shaders themselves.

Performance

The **grass** shader is the faster one as it performs simple bending and lighting. The **foliage** shader does a more complex bending animation and supports translucent lighting or transmission.

Using the SRP batcher combined with layer based culling → allows us to render even a vast amount of grass patches / foliage instances quite efficiently on the CPU. Of course 1 mio grass patches in a 1x1 km level are out of scope. But running 3K grass patches in a 300 x 300 meters levels isn't a problem at all.

When placing **grass** you do not want to place each grass instance separately but want to place patches containing several grass meshes instead: Doing so you will keep the number of game objects and renderers at a reasonable amount. On the other hand it makes it a bit more difficult to place the patches as outer grass meshes might not align up well with the given terrain. So create rather small patches of 1x1 – 3x3 meters in size and place them properly.

When it comes to **foliage** you most likely will place each instance individually.

In order to improve performance use layer based culling → so all grass or foliage instances will be skipped at a distance of e.g. 30 / 50 meters (lightweight!). The grass and foliage shaders support distance based fading so you can hide any popping.

LuxLWRP_LayerBasedCulling Script

This script is just a placeholder and offers to setup layer based culling for two layers. You most likely will extend it and connect it to your quality settings.

Layer based culling is an effective performance optimization as it is pretty fast. In order to make it work properly you should add a special layer on which you will place all objects which shall be culled at a distance smaller than the camera's far clip plane.

The inputs of the script are the following:

Small Details Layer Choose a layer and make sure that small objects actually are set to this layer.

Small Details Distance The distance at which all objects on the specified *Small Details Layer* will be culled.

Medium Details Layer Choose a layer and make sure that medium sized objects actually are set to this layer.

Medium Details Distance The distance at which all objects on the specified *Medium Details Layer* will be culled.

Wind Input

Bending is driven by a **global wind render texture** which contains a slightly modulated wind strength and some additional noise in order to create some more distinguished gusting wind.

This wind render texture gets updated each frame which enables us to rotate the wind direction at runtime without creating weird bending grass instances. Using a wind texture allows us to have spatial differences concerning wind strength and gust without having to implement any fancy per instance logic in the vertex shader.

The global wind render texture is created by the *LuxLWRP_Wind.cs* script, which has to be assigned to your main directional wind zone as it gets its main inputs like wind turbulence and direction from that wind zone:

- *Main* (wind strength) from the wind zone settings will be directly pushed to the shaders.
- *Turbulence* will effect the contrast of the global wind render texture.
- *The rotation* of the wind zone will drive the scroll direction.

Either add the *LuxLWRP_Wind.cs* script to your main wind zone or – in case you have none – drag the *PF Lux LWRP Wind* into your scene.

LuxLWRP_Wind Script

Update In Edit Mode If checked the wind render texture will be updated in editor each frame which helps you to adjust the settings. In case you do not work on tweaking the the wind just uncheck it to free resources in the editor.

Render Texture Settings

Resolution Resolution of the created global wind texture. Keep it as low as possible to save resources like memory and GPU time.

Format Choose between ARGB32 (faster and less memory consumption) and ARGBHalf (more precise).

Wind Base Tex In order to be able to create a global wind texture you have to provide a proper base texture. The package ships with a default wind base texture (*Default Wind Base texture.psd*). This texture contains various grayscale perlin noise textures at different scales in each of the color channels (RGBA). While RGB will only be used to calculate the final wind strength the texture assigned to the alpha channel (A) will contribute to the wind strength but also determine the wind gusting.
Please note: The texture should be imported as linear texture, so uncheck “sRGB (Color Texture)” in the import settings. In order to get the best quality i recommend to set the *Compression* to *None* – at least to *High*.

Wind Composite Shader Shader which is used to render the final global wind texture. Assign the included *Lux LWRP WindComposite.shader* – or a proper custom one.

Wind Multipliers

Grass Global multiplier for the wind strength as retrieved from the assigned wind zone and applied in the grass shader.

Foliage Global multiplier for the wind strength as retrieved from the assigned wind zone and applied in the foliage shader.

Wind Speed and Size

Base Wind Speed Speed in meters per second at which the global wind texture will “scroll” in world space. The value is relative to the *Main* (Wind Strength) value of the attached wind zone.

Size In World Space Determines the area in world space the global wind texture covers before it gets tiled and repeats.

Speed Layer 0, Speed Layer 1, Speed Layer 2 These are multipliers for the overall set *Base Wind Speed*. In order to create a lively global wind texture you should use varying values here.

Noise

Grass Gust Tiling RGB channels of the assigned *Wind Base Texture* will be sampled using fixed UVs as they already contain perlin noise textures at various scales – however you may finetune gusting wind by changing this parameter. Higher values will create smaller waves of gusting wind.

Grass Gust Speed Just like the other Speed multipliers.

Layer To Mix With Lets you choose a Wind Layer you want the dedicated Gust sample to be combined with.

Jitter

When using the foliage shader and texture driven wind high frequent edge fluttering will be fed by the two jitter frequencies and

Grass Shader Inputs

Surface Options

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Surface Inputs

Albedo (RGB) Alpha (A) The grass texture (RGB) and the Opacity mask (Alpha)

Alpha Cutoff If the alpha channel contains different shades of gray instead of just black and white, you can manually determine the cutoff point by adjusting the slider.

Smoothness Overall smoothness factor. As grass should use upwards pointing normal specular lighting and ambient reflections will look pretty odd. So i recommend to use quite low values here like 0.1. This will make grass being grounded within the environment but not looking crazy.

Specular The specular color. **Smoothness** Overall smoothness factor. As grass should use upwards pointing normal specular lighting and ambient reflections will look pretty odd. So i recommend to use quite low values here like 0.1. This will make grass being grounded within the environment but not looking crazy.

Specular The specular color.

Occlusion Lets you adjust the ambient occlusion as sampled from the vertex colors.

Wind

Wind Strength acts as a multiplier on the global settings and lets you adjust bending without having to rework the vertex colors.

Normal Strength determines the impact of the bending on the normal. Any value > 0.0f will effect diffuse and specular lighting.
Please check the Normal Strength under various lighting conditions (light angle, view angle) to find the right value. Increasing smoothness and having a look at the ambient specular reflections can be a help here.

Sample Size Wind strength is sampled from the render texture at the world position of the given vertex offsetted by vertex.color.red. *Sample Size* scales the value of vertex.color.red. So setting it to 0.0 will fully flatten vertex.color.red and all vertices will sample the wind strength at their world position while setting it to 4.0 will allow certain vertices to use a world position + 4 (along the xz axis) as sample location.
So think of it being some kind of additional local turbulence factor.

LOD Level lets you specify the LOD level at which the wind render texture gets sampled. Using higher LOD levels will flatten out the sampled wind strength and smooth bending over all instances.
So think of it as some kind of negative local turbulence factor.

Distance Fading

Max Distance Determines the distance at which grass will be fully faded out. The distance should match the culling distance you use in the layer based culling.

Fade Range Determines the fade range.

Please note: Both values are "manipulated" by the material editor. *Max Distance* maps to _DistanceFade.x and *Fade Range* to _DistanceFade.y where *_DistanceFade.x = Max Distance * Max Distance;* and *_DistanceFade.y = 0.1f / (Fade Range * Fade Range);*

Important: Please make sure that the grass actually gets culled by the layer based culling and not only fades out. Check it by setting *Max Distance* to a much greater value than the one you use in the layer based culling settings.

Advanced

Enable Blinn Phong Lighting Lets you switch to a cheaper lighting model.

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper.

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Foliage Shader Inputs

Surface Options

Receive Shadows If unchecked the material will not receive shadows (faster).

Surface Inputs

Albedo (RGB) Alpha (A) The foliage texture (RGB) and the Opacity mask (Alpha)

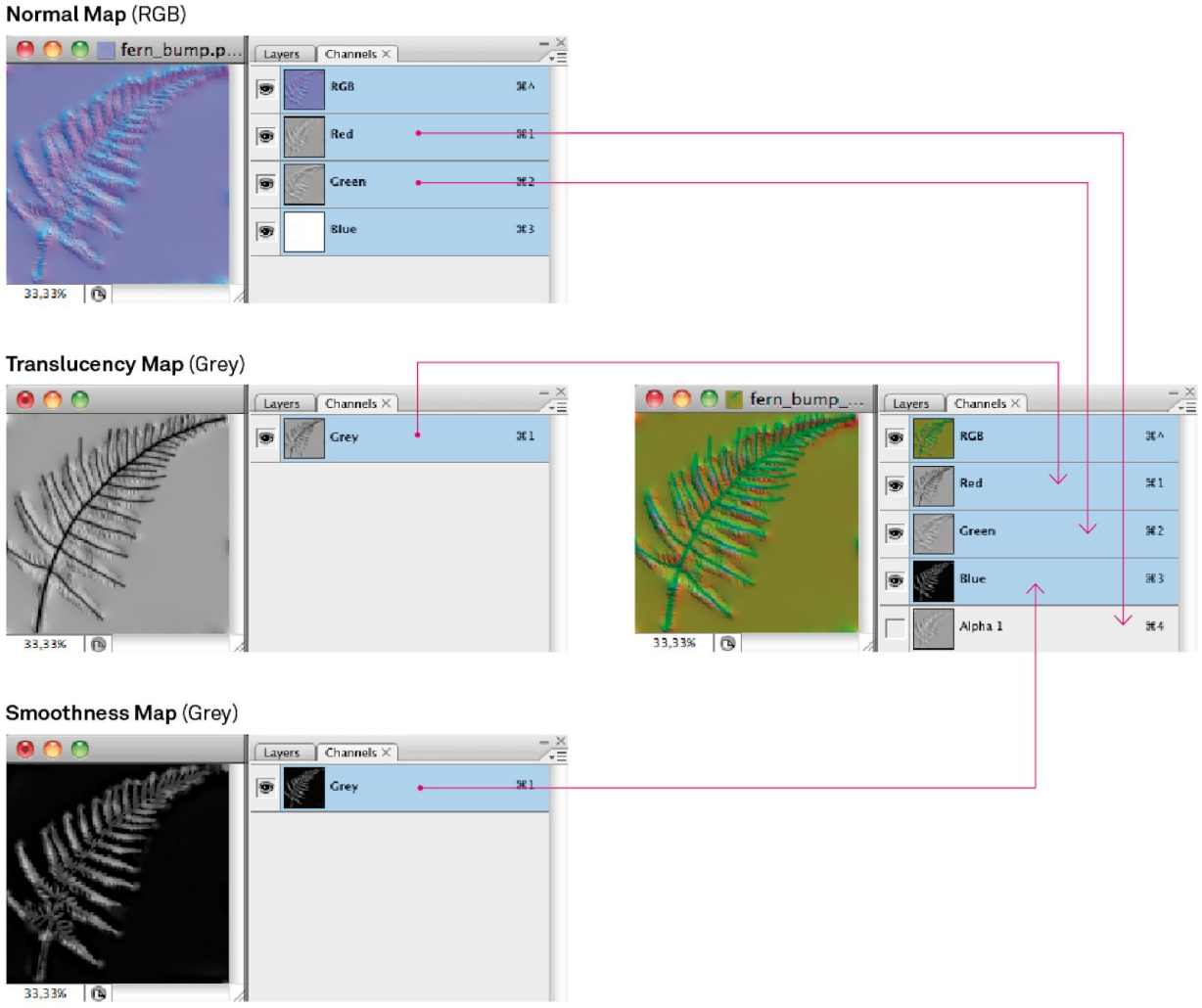
Alpha Cutoff If the alpha channel contains different shades of gray instead of just black and white, you can manually determine the cutoff point by adjusting the slider.

Smoothness Overall smoothness factor.

Specular The specular color.

Enable Normal Smoothness Trans Map If checked the shader will sample the according texture.

Normal (AG) Smoothness (B) Trans (R) Combined texture which stores the normal in AG, smoothness in B and translucency or thickness in R. The texture can be assembled like shown below:



Combined Normal/Smoothness/Translucency Texture Color Channel Layout

Please note: These combined textures do not contain a color or albedo texture – so uncheck “sRGB (Color Texture)” in the import settings.
As the texture contains a normal map you might consider setting the *Filter Mode = Trilinear*.

Smoothness Scale Lets you remap the sampled smoothness value.

Transmission

Power Determines view dependency. Higher values will make transmission kick in only when the view ray more or less directly points towards the light source.

Strength Lets you scale transmission.

Shadow Strength As transmission might be totally eliminated by self shadowing this parameter lets you suppress shadows when it comes to transmission. Other lighting features (diffuse, specular) are not affected.

The subsurface color will be derived from albedo.

Wind

Wind Input Choose between *Math* or *Texture*. *Texture* should be a bit faster. *Math* a bit more predictable.

Primary Strength Lest you remap the primary or main bending strength as encoded in vertex color alpha.

Secondary Strength Lest you remap the secondary or detail bending strength as encoded in vertex color blue.

Edge Flutter Lets you adjust the edge flutter strength as encoded in vertex color green.

LOD Level lets you specify the LOD level at which the wind render texture gets sampled. Using higher LOD levels will flatten out the sampled wind strength and smooth bending over all instances. *Wind Input = Texture only.*

Sample Size Primary and secondary wind strengths are sampled from the render texture at the world position of the given vertex. Setting *Sample Size* to 0.0 will make all vertices fetch the wind strengths at the pivot of the given instance while setting it to 1.0 will make the shader sample strengths at the vertex positions in world space which will add some more noise and disturbance.

Distance Fading

Max Distance Determines the distance at which grass will be fully faded out. The distance should match the culling distance you use in the layer based culling.

Fade Range Determines the fade range.

Please note: Both values are "manipulated" by the material editor. *Max Distance* maps to _DistanceFade.x and *Fade Range* to _DistanceFade.y where *_DistanceFade.x = Max Distance * Max Distance;* and *_DistanceFade.y = 0.1f / (Fade Range * Fade Range);*

Important: Please make sure that the foliage actually gets culled by the layer based culling and not only fades out. Check it by setting *Max Distance* to a much greater value than the one you use in the layer based culling settings.

Advanced

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper.

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

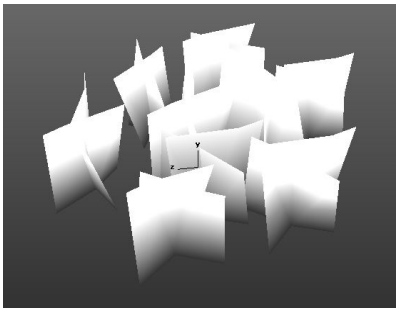
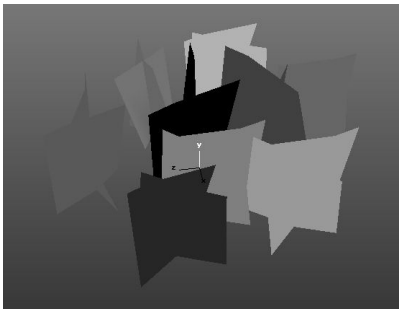
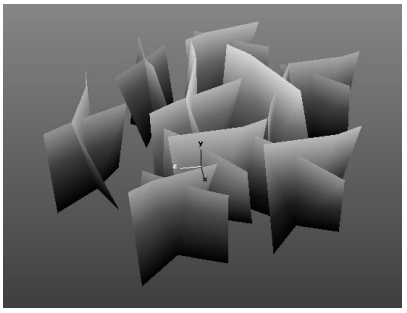
Custom Grass and Foliage Models

When using custom grass or foliage models you have to take care about:

- the fact that the grass shader expects single sided geometry.
- vertex colors properly set up as they drive the bending.
- the vertex normals.

Vertex Colors Grass Shader

The **grass shader** uses vertex.color.rgb to control ambient lighting and bending.

Red – Ambient Occlusion	**Green** – Phase Variation	**Blue** – Bending
		
Just some ambient occlusion added to the lower vertices.	Different grass “instances” have different green values to add some variation to the bending as the final sampling position for the wind texture will be displaced by the amount of the green color value.	The blue color channel contains a gradient from black at the bottom to a medium gray or white at the top. This will fix lower vertices while upper ones may bend.

The vertex color usage in the grass shader is similar to how Vegetation Studio expects vertex colors. So any grass mesh working with VS should work with Lux LWRP as well.

In order to apply bending (blue) on import please have a look into the section Adding Bending on Import →

Vertex Colors Foliage Shader

The **foliage shader** supports a more complex bending as you might already know from the built in tree creator shaders and is based on Crytek’s original tree bending. It is controlled by the vertex colors applied to the model and consists of 3 blended animations:

1. **Primary or main bending** which animates the entire model along the wind direction.
2. **Secondary or detail bending** adding a higher frequent animation mostly along the y-axis.
3. **Edge fluttering** which is a high frequent bending animation originally invented by Crytek to simulate single leaves on large leave planes.
4. In order to make the whole blending more believable, there is a fourth factor: per leaf / per branch **phase variation** which controls the delay of the detail bending.

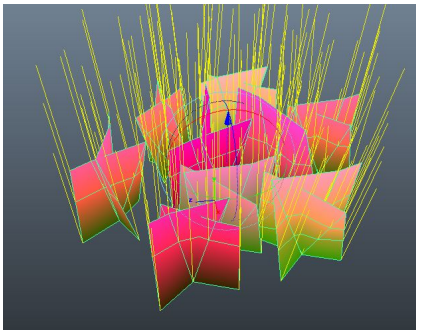
Red Phase Variation	**Green** Edge Flutter	**Blue** Detail Bending	**Alpha** Main Bending
			
Red stores phase variation. Each branch should always have one single red value.	Just some small **green** values (barely visible here) only at the outer tips of the leaves. Make sure that the pivot and the spine of the leaves are set to green = 0.	The **blue** color channel stores detail bending. It should be a gradient from black at the pivot of the branches to a medium gray or white at their outer tips.	**Alpha** stores main bending which is a gradient from black (bottom) to some brighter gray or even white at the upper vertices,

The vertex color usage in the foliage shader is similar to how AFS or ATG expect vertex colors. So you may use the AFS Foliage tool to apply or adjust vertex colors. Furthermore you can use the Custom Tree Importer to add vertex colors automatically on import.

In order to apply main bending (alpha) on import please have a look into the section Adding Bending on Import →

Normals Grass Shader

The vertex normals should more or less all point upwards so the final lighting of the grass patch is mainly driven by its overall orientation. This way the lighting of the grass matches the lighting of the underlying terrain.



Normals Foliage Shader

When using the foliage shader the vertex normals should match the given geometry: The shader will do wrapped around diffuse lighting by default and as it uses VFACE any smoothed normals will cause very harsh lighting on backfaces.

Adding Bending on Import

In case you do not want or can't apply a proper gradient in the blue color channel (grass) or the alpha channel (foliage) of the vertex colors you can make use of the *LuxLWRP_GrassMeshPostprocessor* script. This script will add the related vertex color automatically on import and whenever the grass or foliage mesh is updated.

In order to let the script find all models that should be processed you will have to name them properly: The script finds them by name which must contain “_LuxGM“ for grass meshes and “_LuxFM“ for meshes using the foliage shader.

Maximum Bending

You also have to specify the max bending value by adding it directly after “_LuxGM“ or “_LuxFM”. Bending values must be in the range of 0.0 – 1.0 and have to be written as 2 digits without the period:

“00“ -> 0.0 / “05“ -> 0.5 / -> “10“ -> 1.0

So a file named: “SM MyTallGrass_LuxGM05_test.fbx” would be processed using a max bending value of 0.5.

A file named: “SM MySuperfern_LuxFM03Testnew.fbx” would be processed using a max bending value of 0.3.

A file named: “SM MySuperfern_LuxFM1Testnew.fbx” would throw an error.

Power

In case you have a more complex model which consists of several triangles you may also specify a **power factor**. Adding a power factor will change the linear gradient which gets applied towards an exponential gradient and results in much livelier bending.

Do so by adding “_POW” + 2 digits to the file name e.g.:
“SM Grass Patch_LuxGM10_POW19.fbx”

Processing Details

Main bending (vertex color blue in case of grass meshes and vertex color alpha in case of foliage meshes) will be set according to the “local” y position of the given vertex, the max bending and the power value: Main bending = 0 for all vertices if vertex.pos.y < 0 and a lerped value for all other vertices according their y coordinate divided by the height of the bounding volume.

Please note: The postprocessor expects a single flattened mesh. It does not merge sub meshes and skips processing on models which have more than 1 sub mesh. It does not bake occlusion or phase but keeps the values stored in the vertex colors.

Setting up Wind

In order to give you a better understanding of how the wind works an help you setting it up i added the *Wind Setup* scene.

It contains the *PF Lux LWRP Wind Prefab* and a plane which uses the *M Lux LWRP Vegetation Wind Visualize material:* This actually lets you view the generated wind render texture.

In order to see how the wind render texture changes over time and reacts to changes in the settings of the script or the rotation of the game objects which holds the wind zone and script make sure you have checked *Update In Edit Mode.*

By default the plane shows the *Combined Wind* which is how the vegetation shaders will combine *Wind Strength* and *Wind Gust*.

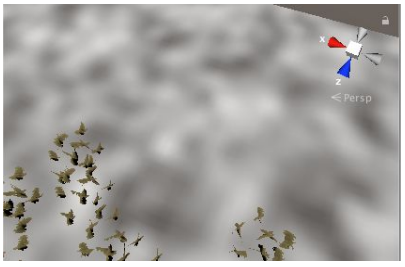
In order to visualize the original inputs as stored in the wind render texture you have to edit the visualisation material and change *Visualize* to *Wind Strength* or *Wind Gust*.

In case you get confused because the bending of the grass does not match the wind strength as visualized by the underlying plane: Due to "Sample Size" in the grass material and according to the baked vertex colors → red = phase grass may sample wind at a different location. If you set "Sample Size" to 0.0 it should perfectly match.

Wind Strength

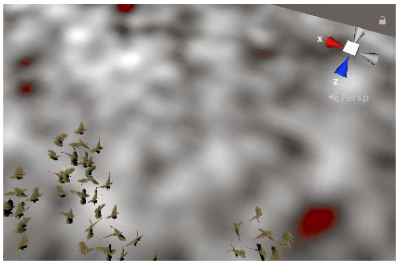
The combination of the 3 + 1 wind layers. Contrast will change according to the *Turbulence* settings in the wind zone.

Wind Gust



The combination of the dedicated gust layer and the selected *Layer To Mix With*. Contrast according to the *Turbulence* settings in the wind zone.

Combined Wind



The combination of *Wind Strength* and *Wind Gust* as calculated within the vegetation shaders. Red pixels indicate negative wind strengths.

Now you should be able to adjust speeds and tilings driving the render texture and adjust your materials.

Final bending on each prefab will be controlled by:

- the Main (wind) parameter in the wind zone settings
- the input from the wind render texture
- the according wind multiplier in the script
- the baked vertex colors
- the wind parameters in the used material

Bending quality

Bending quality depends on:

- the number of vertices in the mesh: Less vertices will result in harsher bending.
- the accuracy of the bending information stored in the vertex colors: Any discontinuities here will result in jagged bending.
- the accuracy/compression and resolution of the wind input textures: The one that gets sampled to create the render texture and the render texture itself.

Top Down Projection Shader

Shader Inputs

Surface Options

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Surface Inputs

Albedo (RGB) Smoothness (A) Albedo texture in RGB, Smoothness in Alpha.

Enable dynamic tiling If checked the shader will adjust the giving tiling values according to the scale of the object. This is a nice feature in case you care about texel density, use a tiling texture and add the related object at various scales.

Smoothness Scale Lets you remap the sampled smoothness value.

Specular Specular color.

Enable Normal Map If checked the shader will sample the assigned normal map(s).

Normal Map The normal map.

Normal Scale Scale of the sampled normal.

Mask Map

Enable Mask Map Check to make the shader sample the mask map.

Metallness (R) Occlusion (G) Height (B) Emission (A) This combined texture contains all other features supported on the base material. Height (B) in this case does not do anything to the base material but acts as detail mask for the top down projection. So it does not have to contain a height value but could also store a simple noise map.
Please note: The texture should be imported as linear texture, so uncheck “sRGB (Color Texture)” in the import settings.

In case you do not need Metallness, Occlusion or Emission always consider to use *Get Mask from Normal* as described below because this will strip off one texture lookup.

Emission Color Tint color for the emissive lighting.

Bake Emission Must be checked in case you bake lightmaps.

Occlusion Lets you dampen the sampled occlusion.

Top Down Projected

Enable Top Down Projection Check this to make the shader add the top down projected texture set..

Albedo (RGB) Smoothness (A) Albedo texture in RGB, Smoothness in Alpha.

Smoothness Scale Lets you remap the sampled smoothness value.

Get Mask from Normal If checked the shader expects a tweaked normal map which also contains a mask map. See Get Mask from Normal for details.

Normal (RGB) or Normal (AG) Mask (B) The normal map. Either as regular normal map (if *Get Mask from Normal* is unchecked or as combined normal and mask texture)

Normal Scale Scale of the sampled normal.

Tiling Tiling in world space. A value of 0.25 means that the texture will be repeated every 4 meters.

Terrain Position Describes the offset for the sampling in worldspace. Useful in case you want to make the projected texture match a detail texture on the terrain.

Blending

Angle Limit Lets you limit the projection according to the y (or up) component of the world space normal.

Strength Will scale the blend amount.

Base normal Influence Lets you determine the impact of the base normal on the blend amount.

Base Normal Strength Lets you reveal the base normal – even if the projected layer fully covers the surface.

Height Influence Lets you determine the impact of the height (or noise) sample on the blend amount. This will only work if the *Mask Map* is enabled or you have checked *Enable Normal Map* and *Get Mask from Normal*.

Advanced

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper.

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Get Mask from Normal

Usually the shader samples the blend mask from the assigned Mask Map – if any. This texture gets sampled based on the UVs of the given mesh. If the mesh has several UV shells the sampled mask will most likely show up some discontinuities which may be quite distracting.

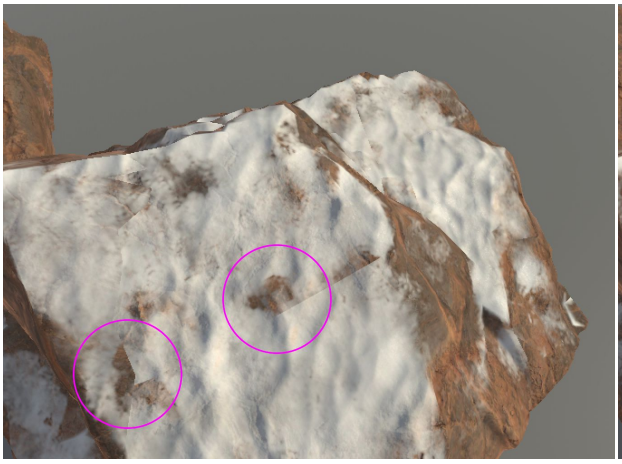
In case you enable *Get Mask from Normal* the shader will sample the mask from the top down projected normal in world space instead – which never has any discontinuities.

In order to use this feature you have to prepare the projected normal:

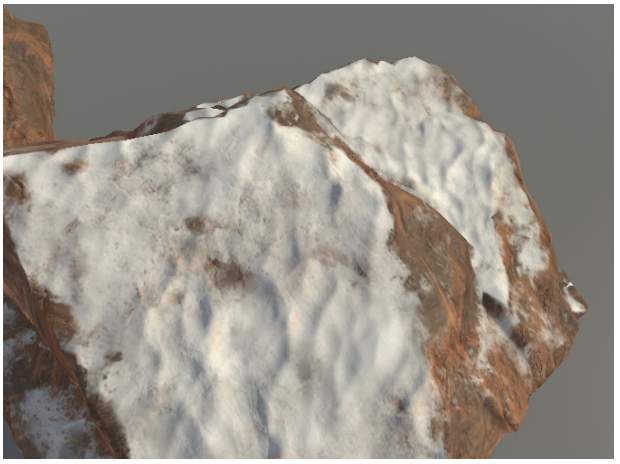
1. Take a regular normal map and add an alpha channel.
2. Copy/paste the red color channel into the alpha channel.
3. Fill the red color channel with pure white.
4. Copy the mask texture into the blue color channel.
5. Import the tweaked normal mask texture as linear texture by unchecking *sRGB (Color Texture)* in the import settings. *Compression* should be set to *High Quality*.

Why do i do this to you? Because we want as less texture lookups as possible!

Have a look at the snow sample to find out more.



Masking artifacts from sampling the mask from the Mask Map using the UVs.



No artifacts when sampling the mask from the tweaked projected normal texture in world space.

Tips

As the projection heavily depends on geometry normals the final result on different LODs when using LODGroups most likely will not match. So consider using cross fading – at least on large objects.

Please note: The progressive CPU lightmapper may fail to calculate proper blending as it does not always?! calculate a fitting world space normal. In order to fix this disable lightmap static, rebake, then enable lightmap static and bake again… Enlighten just works fine tho.

Water Shader

Please note: Make sure your lightweight scriptable render pipeline settings have *Depth Texture* and *Opaque Texture* checked.

Shader Inputs

Surface Options

ZWrite Lets you choose whether the shader writes to the depth map or not. Usually it should write to the depth buffer

ZTest Lets you choose how the shader should do depth testing. Usually it should be set to “LessEqual”. You may choose “Disabled” as well in case you use forward rendering, MSAA do get artifacts around your objects on top of the water surface, do not displace the water and look from above.

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Enable Orthographic Support In case your camera uses an orthographic perspective you have to enable this to make water being rendered properly.

Surface Inputs

The water shader mixes two normal samples to create the final bumpiness.

Water Normal Map The normal map used by both samples. Adjust *Tiling* and *Offset* to make the first sample fit your geometry.

Normal Scale Scale of the first sampled normal.

Speed (UV) Scroll speed in UV space. X equals U, Y equals V.

Secondary Bump This Vector4 combines all parameters for the second normal sample.

Tiling (X) acts as multiplier on the given *Tiling* from the first sample

Speed (Y) acts as multiplier on the given *Speed (UV)*

Refraction (Z) The amount of refraction added to the UVs based on the first normal sample.

Bump Scale Scale of the sampled normal.

Smoothness Smoothness of the water surface which defines the size and shape of the specular highlights.

Specular Specular color which defines the reflectivity und thus drives the relation between refraction and reflection. Actually water has a pretty dark specular color.

Edge Blending Lets you fade out the shore line or borders of the water surface.

Refraction Specifies the strength of the refraction effect.

Reflection Bump Scale Specifies the influence of the normal maps as far as the distortion on reflections is concerned: Choose values around 0.3 to get nice and smooth reflections.

Underwater Fog

Fog Color Color of underwater fog added.

Density Density of the underwater fog according to depth along the view vector.

Foam

Enable Foam Check to enable dynamic foam at shore lines

Foam Albedo (RGB) Mask (A) RGB will tint the foam mask. Alpha drives the opacity.

Foam Tiling Tiling relative to the base UVs

Foam Speed (UV) Scroll speed of the foam texture.

Foam Scale Foam is masked by various inputs such as the water's normals and the edge blending factor so it might get more or less invisible. Use *Scale* to bring it back to screen.

Foam Edge Blending Determines the size of the dynamically calculated foam border.

Foam Slope Strength Lets you add foam according to the normal up direction of the water geometry.

Foam Smoothness The smoothness of the foam.

Advanced

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper.

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Tips

Use common UV tricks to:

- speed up water at special locations (by shrinking the UVs).
- distort water normals and foam.
- In case you need more foam at special locations just lower the distance between the river bed and the river surface. The closer the river bed is to the river mesh the more foam you will get.

Tree Creator Shaders

The tree creator shaders are a port of the tree creator shaders for the built in render pipeline and allow you to use trees created using Unity's tree creator along with LWRP and URP.

Please note: These shaders do not support the SRP batcher by design. Enable GPU instancing to speed up rendering.

Usage

In order to make your trees use the Lux LWRP tree creator shaders you have to assign the *Lux LWRP Tree Creator Bark* and the *Lux LWRP Tree Creator Leaves* shader to the **base materials** you use to create the tree (the materials which are assigned e.g. in the *Branch Material* or *Break Material* slot of the tree creator). Then refresh the tree.

The final tree will be rendered using the *LWRP Tree Creator Bark Optimized* and the *Lux LWRP Tree Creator Leaves Optimized* shaders. These need the related "Rendertex" shaders which will be used to render the billboard textures.

Shader Inputs

The inputs of the *base* shaders match those of the original Unity shaders. So please have a look at Unity's documentation in case you need more information.

However if you look into the *optimized* shaders you will notice that these contain some LWRP related inputs:

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Enable Dithering for VR If you are rendering for a VR device Unity will totally change the rendering for trees and billboards. The original implementation solely relies on the keyword "BILLBOARD_FACE_CAMERA_POS" to be enabled — which gets enabled if you enable *Billboards Face Camera Position* in *Project Settings → Quality* — regardless if VR actually is enabled or not.
In order to prevent more expensive rendering if you have checked *Billboards Face Camera Position* but do not use VR i added *Enable Dithering for VR* as a safeguard. So check this if you are using VR and the shaders will do the expensive dithering. If you do not use VR keep it unchecked.

VR only

If VR is enabled Unity will use the built in *CameraFacingBillboardTree* shader to render the billboards. I could not locate or identify the shader, which is responsible for creating the billboard textures (albedo, alpha and normals) – nevertheless this shader sometimes (?!) seems to create *false* textures with leaves having a far too dark alpha. As the original *CameraFacingBillboardTree* shader uses AlphaToCoverage this will give you more or less transparent billboards :(

So i added a hacked *CameraFacingBillboardTree* shader which does not use AlphaToCoverage and applies a little different dithering. If you want to go with the built in one deactivate this shader by e.g. adding a "_" to its file name: "CameraFacingBillboardTree._shader".

Changes compared to the original shaders

I added some little improvements to the shaders:

- Point and spot lights, wind and shadows fade in and out over the billboard *Fade Length* as specified in the terrain settings.
- When calculating the wind based bending the vertex shaders preserve the length of the original vertex which will result in a little less distortion.
- Billboards will be lit using proper SH ambient lighting.

Skin Shader

The skin shader uses pre-integrated skin lighting based on the work of Eric Penner and adds transmission from a static thickness map on top.

Diffuse and specular lighting use different normals giving you smooth diffuse lighting while keeping all details when it comes to specular highlights.

Using a skin mask it allows you to mix standard lighting and skin lighting within a single material. You can also fade out skin lighting over distance.

In order to make it match the *Lux LWRP Lit Extended* shader it supports (animated) rim lighting and all stencil buffer features.

Shader Inputs

Surface Options

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Surface Inputs

Albedo (RGB) Smoothness (A) Albedo texture in RGB, Smoothness in Alpha.

Smoothness Lets you remap the sampled smoothness value.

Specular Specular color.

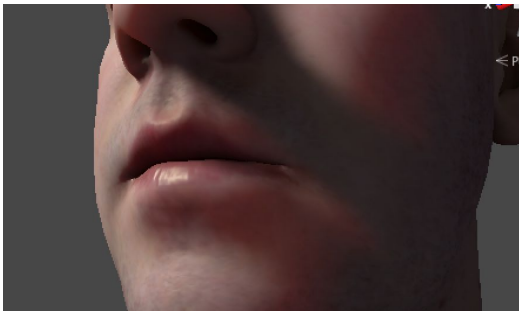
Enable Normal Map If checked the shader will sample the assigned normal map.

Normal Map The normal map.

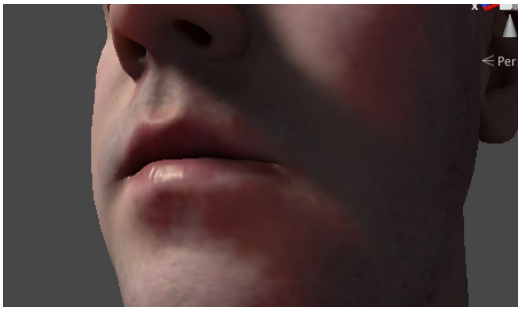
Normal Scale Scale of the sampled normal.

Enable Diffuse Normal If checked the shader will do a 2nd sample of the assigned normal map and blur it according to the chosen *Bias* value.

Bias Amount of blur added to the sampled diffuse normal (by sampling a lower mip level) In case you want to use subtle blur amounts the normal map must be set to *Filter Mode = Trilinear*.



***Enable Diffuse Normal Sample* disabled:** The shader will simply use the vertex normals when it comes to diffuse lighting so diffuse lighting will not show up any details. This saves one texture lookup in the shader.



***Enable Diffuse Normal Sample* enabled:** The shader will sample a “blurred” version of the normal map according to the *Bias* and use it when it comes to diffuse lighting. Please note the subtle changes in lighting on the cheek or chin.

Skin lighting

Skin Mask (R) Thickness (G) Occlusion (A) Texture which contains skin mask in red, thickness in green and ambient occlusion in alpha.

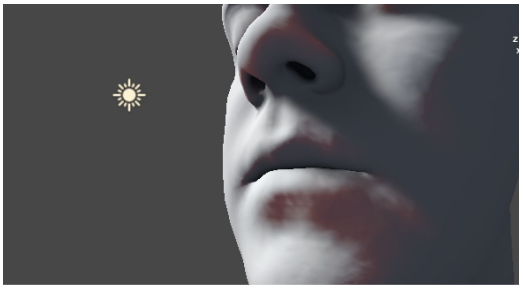
Skin Mask White pixels in the mask define the parts which shall be lit using the skin lighting. Black pixels define the parts where regular lighting shall be applied.

Thickness Bright pixels define thin parts where there will be a lot of subsurface scattering and transmission like on the nose or the ears.

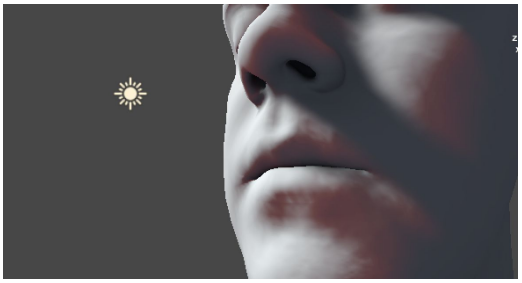
Please note: The texture should be imported as linear texture, so uncheck "sRGB (Color Texture)" in the import settings. *Compression* should be set to *High*.

Curvature Drives the pre-integrated diffuse lighting according to the given thickness map and lets you control small scale light scattering.

Basically the pre-integrated diffuse lighting adds some kind of reddish tint (based on the Skin LUT) according to the dot product of the normal and the light direction to simulate the small scale light scattering within the human skin.



Curvature = 0 – rather subtle light scattering



Curvature = 0.3 – stronger light scattering.

Subsurface Color Color used to tint transmission.

Transmission Power Drives the view dependency of the transmission effect. Larger values will make it more view dependent.

Transmission Strength Lets you scale the transmission effect.

Shadow Strength As transmission might be totally eliminated by self shadowing this parameter lets you suppress shadows when it comes to transmission. Other lighting features (diffuse, specular) are not affected.

Transmission Distortion When calculating transmission the shader distorts the inverted light direction vector slightly by the given normal to simulate the scattering. Default value is 0.01. Higher values will give you more scattering and break up the uniform look.

Skin LUT Holds the results of the pre-integration and acts as a lookup table in the lighting function. For human skin please use the provided LUT "DiffuseScatteringOnRing".

Please note: This texture is absolutely mandatory. If it is missing lighting will look totally odd. But the shaderGUI should always load the default "DiffuseScatteringOnRing" texture from the Resources folder if the slot was empty.

Please note: If you want to assign your own LUT make sure that its *Wrap Mode* is set to *Clamp*. *Compression* should be *None*. The texture should be imported as linear texture, so uncheck “sRGB (Color Texture)” in the import settings.

Distance Fading

Enable Distance Fade If checked the shader will fade out skin related lighting such as transmission and pre-integrated diffuse lighting. This lets you swap out the shader at lower LODs so you might use the built in "Lit" shader or even create a unified material for your characters.

Max Distance Determines the distance at which skin lighting will be fully faded out.

Fade Range Determines the fade range.

Please note: Both values are “manipulated” by the material editor. *Max Distance* maps to _DistanceFade.x and *Fade Range* to _DistanceFade.y where *_DistanceFade.x = Max Distance * Max Distance;* and *_DistanceFade.y = 0.1f / (Fade Range * Fade Range);*

Rim Lighting

Enable Rim Lighting Check to enable Rim Lighting

Rim Color The Rim Color

Rim Power Higher values will push the effect towards grazing angles only.

Rim Frequency Lets you add a simple sinus based animation. If set to values > 0.0 the shader will lerp between *Rim Power* and *Rim Min Power*.

Rim Min Power Second Power value used if Rim Frequency is > 0.0.

Rim Per Position Frequency Slightly offsets the animation based on the object’s pivot in worldspace and prevents objects all pulsating at the same frequency.

Advanced

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper.

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Hair Shader

The hair shader supports hair specific Kajiya-Kay anisotropic lighting and multiple specular highlights: one representing the reflection at the outer shell of the hair fibre with the color of the light (primary) and another that represents the backscatter from the other side of the hair fibre's shell and is a mix of hair color and light color (secondary).

The shader is derived from Unity's implementation in the HDRP.

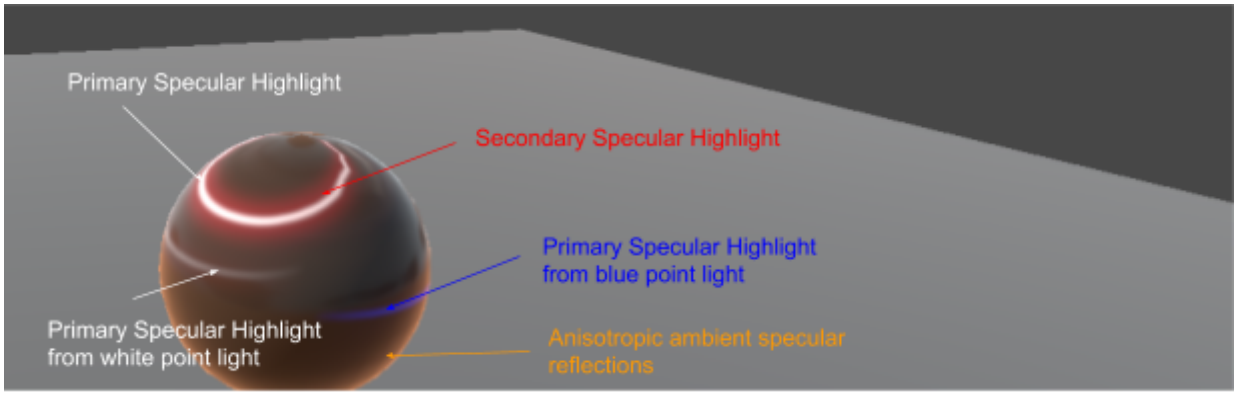
It does not support "correct" backface lighting (VFACE) but always lits the surfaces according to the given geometry normal in order to achieve smooth shading.

In order to make it match the *Lux LWRP Lit Extended* shader it supports (animated) rim lighting and all stencil buffer features.

The hair shader comes in two flavors: *Lux LWRP/Human/Hair* and *Lux LWRP/Human/Hair Blend*.

Lux LWRP/Human/Hair uses alpha testing and alpha to coverage. It creates rather harsh edges but writes to depth and receives proper shadows. Furthermore it does not cause any depth sorting issues.
Use this shader for hair which may not always be close to the head.

Lux LWRP/Human/Hair Blend uses alpha blending and gives you nicer edges. However it does not write to depth (as it is a transparent shader), thus it will suffer from depth sorting issues and may not receive proper shadows but simply pick them up from the underlying geometry (which may be very far away…).
Use this shader variant only on hair cards close to the skin, where proper depth sorting is not really required and shadows will more or less just fit – such as eyebrows or beards.
You may also add a 2nd material using this shader in case you really need HD hair. Please have a look at the included demo to find out more.



Shader Inputs

Surface Options

ZTest Lets you tweak depth based face culling. In case you use two stacked materials for the hair, set it to "Less" for the blended version to save fill rate *(blended only)*.

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Surface Inputs

Base Color Color which tints the sample from the albedo texture.

Secondary Color Secondary tint color. The shader lerps between base and secondary color based on vertex color alpha: Vertex color alpha = 1 → Base Color will be applied.
Use this feature to create brown hair with some gray strands (like on the Challenger in the demo) or to lerp from base to tip color.

Albedo (RGB) Alpha (A) The Albedo (RGB) and the Opacity mask (Alpha)

Alpha Cutoff If the alpha channel contains different shades of gray instead of just black and white, you can manually determine the cutoff point by adjusting the slider.

Enable Normal Map If checked the shader will sample the assigned normal map.

Normal Map The normal map.

Normal Scale Scale of the sampled normal.

Enable secondary highlight If unchecked the shader will skip the secondary highlight, which makes it faster.

Shift (B) Occlusion (G) Texture which contains *Shift* values in the blue and *Ambient Occlusion* in the green color channel. The sampled *Shift* value breaks up the uniform look over hair patches as derived from the *Primary Specular Shift* and *Secondary Specular Shift*.
Please note: The texture should be imported as linear texture, so uncheck “sRGB (Color Texture)” in the import settings.

Specular Specular color which drives fresnel on ambient reflections.

Smoothness Lets you remap *Primary* and *Secondary Smoothness*.
Ambient Reflections are calculated based on the Primary Smoothness.

Hair Lighting

Strand Direction Lets you choose between *Bitangent* (hair strands are laid out from top to bottom) and *Tangent* (hair strands are laid out left to right).

Primary Specular Shift Shift the primary specular highlight towards the hair tip

Primary Specular Tint Specular color used to calculate the primary reflection. Should be grayscale.

Primary Smoothness Smoothness used to calculate the primary reflection.

Enable Secondary Highlight If unchecked the shader will skip the secondary highlight, which makes it faster.

Secondary Specular Shift Shift the secondary specular highlight towards the hair root.

Secondary Specular Tint Specular color used to calculate the secondary reflection. Should somehow match the hair color.

Secondary Smoothness Smoothness used to calculate the secondary reflection.

Rim Transmission Intensity Lets you adjust the intensity of transmitted rim lighting.
This rim lighting has nothing to do with the Rim Lighting further down in the inspector.

Ambient Reflection Strength Lets you adjust the intensity of ambient specular reflections.

Rim Lighting

Enable Rim Lighting Check to enable Rim Lighting

Rim Color The Rim Color

Rim Power Higher values will push the effect towards grazing angles only.

Rim Frequency Lets you add a simple sinus based animation. If set to values > 0.0 the shader will lerp between *Rim Power* and *Rim Min Power*.

Rim Min Power Second Power value used if Rim Frequency is > 0.0.

Rim Per Position Frequency Slightly offsets the animation based on the object's pivot in worldspace and prevents objects all pulsating at the same frequency.

Advanced

Enable Specular Highlights *is missing here, as it simply does not make any sense: If you disabled specular highlights you would not need a hair shader.*

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Stencil

Stencil Reference The value to be compared against

Read Mask Bit mask which determines which bit will be read from.

Write Mask Bit mask which determines which bit will be written to.

Stencil Comparison The function used to compare the reference value to the current contents of the buffer.

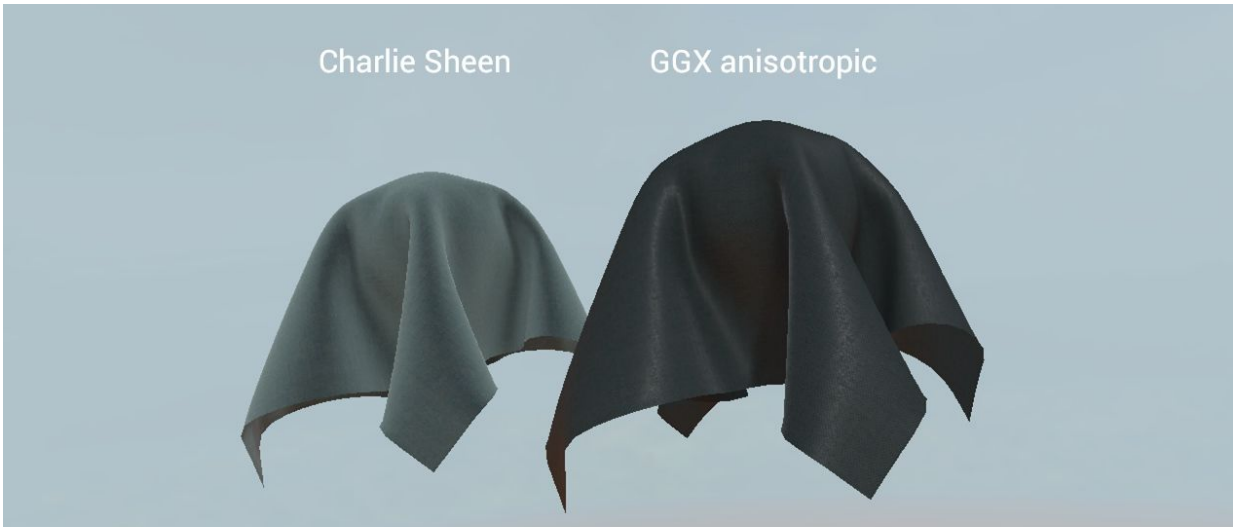
Stencil Pass Op What to do with the contents of the buffer if the stencil test (and the depth test) passes.

Stencil Fail Op What to do with the contents of the buffer if the stencil test fails.

Stencil Z Fail Op What to do with the contents of the buffer if the stencil test passes, but the depth test fails.

Cloth Shader

The cloth shader supports Charlie Sheen and GGX anisotropic lighting to cover a wide range of different fabrics and uses functions provided by the SRP Core.



Charlie Sheen lighting versus GGX anisotropic.
Please note that the GGX anisotropic material uses a darker albedo and less transmission.

The shader supports correct backface lighting using VFACE and transmission.

In order to make it match the *Lux LWRP Lit Extended* shader it supports (animated) rim lighting and all stencil buffer features.

Shader Inputs

Surface Options

Culling Lets you choose between rendering front faces, back faces or both.

Alpha Clipping If checked the shader will perform alpha clipping or alpha testing. *Enabling Alpha Clipping needs you to enable and assign the Mask Map as well, because alpha is stored in the Mask Map only.*

Threshold aka Alpha Cutoff: If *Alpha Clipping* is enabled this value determines where the alpha clipping starts.

Receive Shadows If unchecked the material will not receive shadows (faster).

Shadow Offset Lets you offset the casted shadows in order to prevent or minimize self shadowing.

Charlie Sheen Lighting

Enable Charlie Sheen Lighting If checked the shader will apply Charlie Sheen lighting which is suitable for materials like cotton or wool. If unchecked the shader will use GGX anisotropic lighting.

Sheen Color Color which tints the specular highlights.

GGX anisotropic lighting

If *Enable Charlie Sheen Lighting* is unchecked the shader will use GGX anisotropic lighting.

Anisotropy Controls the scale factor for anisotropy. 0 would be standard isotropic lighting, values smaller or greater 0 will shift the specular highlights according to the tangent or bitangent.

Transmission

Enable Transmission Check this to enable transmission.

Power Determines view dependency. Higher values will make transmission kick in only when the view ray more or less directly points towards the light source.

Strength Lets you scale transmission

Shadow Strength As transmission might be totally eliminated by self shadowing this parameter lets you suppress shadows when it comes to transmission. Other lighting features (diffuse, specular) are not affected.

Distortion When calculating transmission the shader distorts the inverted light direction vector slightly by the given normal to simulate the scattering. Default value is 0.01. Higher values will give you more scattering and break up the uniform look.

The subsurface color will be derived from albedo.

Surface Inputs

Color Color which gets multiplied on top of the base texture sample.

Albedo (RGB) Smoothness (A) Base texture which contains albedo (RGB) and smoothness (A). Tiling and Offset will drive the sampling of this texture and the assigned normal map.

Smoothness Lets you scale down the sampled smoothness from the base texture .

Specular The specular color.

Enable Normal Map If checked the shader will sample the assigned normal map.

Normal Map The normal map.

Normal Scale Scale of the sampled normal.

Enable Mask Map If checked the shader will sample the assigned mask map below.

Thickness (G) Occlusion (B) Alpha (A) The mask map which contains thickness (G) ambient occlusion (B) opacity (A). Thickness is needed by transmission, opacity is only needed in case you check *Enable Alpha Testing*.

***Please note:** The mask map gets sampled using unique tiling and offset values. This way it can store thickness, occlusion and alpha for the entire mesh while albedo, smoothness and the normal will use a higher tiling.*

Occlusion Lets you dampen the sampled occlusion.

Enable Alpha Testing If checked the shader will perform alpha testing. Alpha Testing needs the mask map to be enabled as well.

Alpha Cutoff If the alpha channel contains different shades of gray instead of just black and white, you can manually determine the cutoff point by adjusting the slider.

Rim Lighting

Enable Rim Lighting Check to enable Rim Lighting

Rim Color The Rim Color

Rim Power Higher values will push the effect towards grazing angles only.

Rim Frequency Lets you add a simple sinus based animation. If set to values > 0.0 the shader will lerp between *Rim Power* and *Rim Min Power*.

Rim Min Power Second Power value used if Rim Frequency is > 0.0.

Rim Per Position Frequency Slightly offsets the animation based on the object's pivot in worldspace and prevents objects all pulsating at the same frequency.

Stencil

Stencil Reference The value to be compared against

Read Mask Bit mask which determines which bit will be read from.

Write Mask Bit mask which determines which bit will be written to.

Stencil Comparison The function used to compare the reference value to the current contents of the buffer.

Stencil Pass Op What to do with the contents of the buffer if the stencil test (and the depth test) passes.

Stencil Fail Op What to do with the contents of the buffer if the stencil test fails.

Stencil Z Fail Op What to do with the contents of the buffer if the stencil test passes, but the depth test fails.

Advanced

Enable Specular Highlights *is missing here, as it simply does not make any sense: If you disabled specular highlights you would not need a cloth shader.*

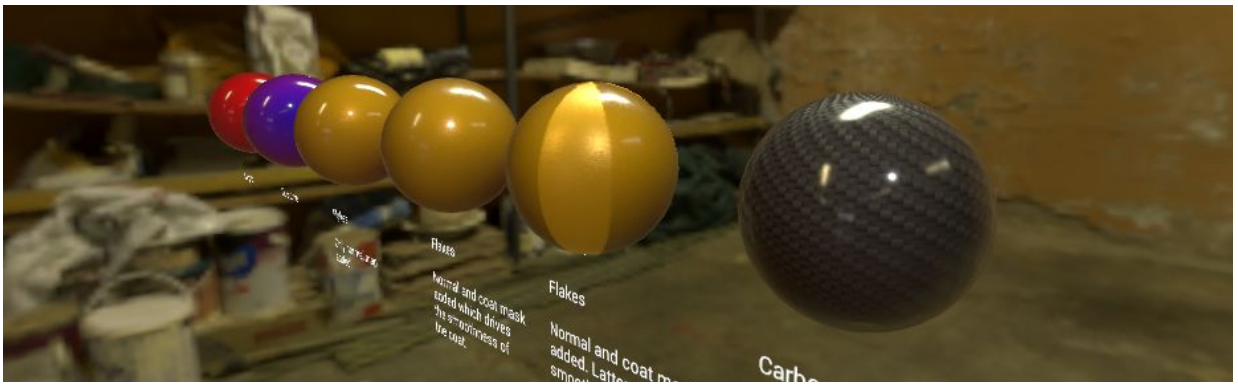
Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Render Queue

Queue Offset Equals *Priority* in the standard Lit shader. As the material inspector sets the render queue based on *Enable Alpha Testing* you are not able to edit the *Render Queue* property at the bottom of the inspector manually. Use *Queue Offset* to adjust the final *Render Queue*.

Clear Coat Shader

Versatile clear coat shader that lets you use duo coloring, add metallic flakes and even mix clear coat with standard lighting within the same material.



In order to make it match the *Lux LWRP Lit Extended* shader it supports (animated) rim lighting and all stencil buffer features.

Please note: The clear coat shader effectively doubles the cost of specular computations.

Shader Inputs

Surface Options

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Clear Coat Inputs

Clear Coat Drives the thickness of the coat which influences the darkening of the albedo of the base layer towards grazing angles.

Clear Coat Smoothness Smoothness of the clear coat.

Clear Coat Specular Specular of the clear coat. Default is RGB(51,51,51). *Actually you should not really change it as some calculations are based upon the default value.*

Enable Coat Mask Map If checked the shader will sample the maske map.

Mask (G) Smoothness (A) Mask map which stores the clear coat mask in G and smoothness in A. The sampled mask value will be multiplied on top of the *Clear Coat* value and lets you adjust the thickness.

Enable Standard Lighting If checked and if *Enable Coat Mask Map* is checked as well the shader will fall back to standard lighting were the *Clear Coat* value (thickness) equals 0. *Expensive as the shader will use branching. It may however save you one more material.*

Base Layer Inputs

Color Primary albedo color.

Enable Secondary Color If checked the shader will mix *Color* and *Secondary Color* according to the view angle.

Secondary Color Color which will be applied at grazing angles.

Smoothness Smoothness of the base layer.

Metallic Metallness of the base layer.

Enable Normal Map If checked the shader will sample the normal map.

Normal Map The normal map.

Normal Scale Lets you scale the normal.

Enable Base Layer Mask Map If checked the shader will sample the maske map.

Metallic (R) Occlusion (G) Smoothness (A) Mask map which stores metallic in R, ambient occlusion in G and smoothness in A.

Occlusion Lets you scale the occlusion.

Enable secondary Reflection Sample If checked the shader will sample the given reflection probe twice: once for the coat layer and once for the base layer. By default reflections get only applied to the coat layer. *Expensive but worth it on certain materials such as coated carbon fibres.*

Rim Lighting

Enable Rim Lighting Check to enable Rim Lighting

Rim Color The Rim Color

Rim Power Higher values will push the effect towards grazing angles only.

Rim Frequency Lets you add a simple sinus based animation. If set to values > 0.0 the shader will lerp between *Rim Power* and *Rim Min Power*.

Rim Min Power Second Power value used if Rim Frequency is > 0.0.

Rim Per Position Frequency Slightly offsets the animation based on the object's pivot in worldspace and prevents objects all pulsating at the same frequency.

Stencil

Stencil Reference The value to be compared against

Read Mask Bit mask which determines which bits will be read from.

Write Mask Bit mask which determines which bits will be written to.

Stencil Comparison The function used to compare the reference value to the current contents of the buffer.

Stencil Pass Op What to do with the contents of the buffer if the stencil test (and the depth test) passes.

Stencil Fail Op What to do with the contents of the buffer if the stencil test fails.

Stencil Z Fail Op What to do with the contents of the buffer if the stencil test passes, but the depth test fails.

Advanced

***Enable Specular Highlights** is missing here, as it simply does not make any sense: If you disabled specular highlights you would not need a clear coat shader.*

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Transmission Shader

Shader Inputs

Surface Options

Culling Lets you choose between rendering front faces, back faces or both.

Alpha Clipping If checked the shader will perform alpha clipping or alpha testing. *Enabling Alpha Clipping needs you to enable and assign the Mask Map as well, because alpha is stored in the Mask Map only.*

Threshold aka Alpha Cutoff: If *Alpha Clipping* is enabled this value determines where the alpha clipping starts.

Receive Shadows If unchecked the material will not receive shadows *(faster)*.

Shadow Offset Lets you offset the casted shadows in order to prevent or minimize self shadowing.

Surface Inputs

Color Color which gets multiplied on top of the base texture sample.

Albedo (RGB) Alpha (A) Base texture which contains albedo (RGB) and opacity (A). Tiling and Offset will drive the sampling of this texture and the assigned normal map.

Smoothness Smoothness or smoothness factor.

Enable Normal Map If checked the shader will sample the normal map.

Normal Map The normal map.

Normal Scale Lets you scale the normal.

Enable Mask Map If checked the shader will sample the mask map.

Mask (R) Thickness (G) Occlusion (B) Smoothness (A) Texture which stores a mask, thickness, occlusion and smoothness in the according channels.

Please note that mask in this case is not a metallic mask (the shader uses the specular setup). Instead it masks transmission lighting, so parts which are black in the mask will use standard lighting.

The mask map gets sampled using unique tiling and offset values. This way it can store mask, thickness, occlusion and smoothness for the entire mesh while albedo, alpha and the normal might use a higher tiling.

Transmission

Power Determines view dependency. Higher values will make transmission kick in only when the view ray more or less directly points towards the light source.

Strength Lets you scale transmission.

Shadow Strength As transmission might be totally eliminated by self shadowing this parameter lets you suppress shadows when it comes to transmission. Other lighting features (diffuse, specular) are not affected.

Distortion When calculating transmission the shader distorts the inverted light direction vector slightly by the given normal to simulate the scattering. Default value is 0.01. Higher values will give you more scattering and break up the uniform look.

The subsurface color will be derived from albedo.

Wrapped Lighting The shader will apply smooth wrapped around diffuse lighting. This value lets you adjust the light wrapping. Setting it to 0 will give you built in Lambert lighting.

Rim Lighting

Enable Rim Lighting Check to enable Rim Lighting

Rim Color The Rim Color

Rim Power Higher values will push the effect towards grazing angles only.

Rim Frequency Lets you add a simple sinus based animation. If set to values > 0.0 the shader will lerp between *Rim Power* and *Rim Min Power*.

Rim Min Power Second Power value used if Rim Frequency is > 0.0.

Rim Per Position Frequency Slightly offsets the animation based on the object's pivot in worldspace and prevents objects all pulsating at the same frequency.

Stencil

Stencil Reference The value to be compared against

Read Mask Bit mask which determines which bits will be read from.

Write Mask Bit mask which determines which bits will be written to.

Stencil Comparison The function used to compare the reference value to the current contents of the buffer.

Stencil Pass Op What to do with the contents of the buffer if the stencil test (and the depth test) passes.

Stencil Fail Op What to do with the contents of the buffer if the stencil test fails.

Stencil Z Fail Op What to do with the contents of the buffer if the stencil test passes, but the depth test fails.

Advanced

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper.

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Glass Shader

Limitations

The glass shader uses a non physically correct but eyeballed solution to simulate refraction.

As we do not use any fancy techniques such as ray tracing we can only refract what already is on screen. This means that a) we can only refract what actually is on screen already and b) will refract everything that is on screen.

a) If a refraction ray leaves the screen we will get heavy stretching on the refraction sample as the _CameraOpaqueTexture is clamped. This will most likely effect objects which are rather close to the screen border only.
In order to get rid of the stretching you may check *Enable Screen Edge Fade* which however will only make the refractions lerp towards the unrefracted sample.

b) By default the shader refract everything – even objects which are in front of the refracting surface.
In order to get rid of these you can check *Exclude Foreground* in the shader. Doing so however will add a lookup into the depth buffer (not free) and leave “holes” in the final refraction sample, as the shader simply falls back to the unrefracted sample.

Furthermore LWRP and URP do not support grabbing the framebuffer once for each draw – like the built in render pipeline does. So we can not stack glass on top of glass: Glass in front of another glass will make the glass lying in the background fully vanish.

Alpha or transparency

Although the shader renders on the transparent queue, it actually is an “opaque” shader by design: Adding the refractions just overwrites anything in the background.

So alpha or transparency only control the mix between opaque parts plus the specular reflections and refraction.

Complex glass objects

Not being able to render “glass refracting glass” already makes a problem when it comes to a simple glass as – when looking at the bowl – you should see both outer and inner faces. However, only the outer faces get rendered (due to depth testing and writing). Disabling depth writing would lead to quite unpredictable results, because faces lying in the back may randomly overwrite faces lying in the front (depending only on the triangle order in the mesh).

So we have to split up the bowl into two materials: One used on the outer faces (Outer Material, the second one (Inner Material) used on the faces forming the inner parts of the bowl.

In case you want to use opaque “decals” on the outer faces of the bowl (like the glass with the Lux logo applied) you have to make the inner faces render first. Outer faces then get rendered on top using one of the two provided blending methods:

Inner Material

This material should render first.

If *Culling* is set to *Back* we do not have to write to the Z Buffer as we do not have any overlapping front facing faces in a shape such as the bowl.

Outer Material

This material should render on top of the inner material. Do so by:
a) either tweaking the *Render Queue* to e.g. Transparent+1, *which is not ideal as it breaks proper back to front sorting...*
b) or make sure that the order of the materials (= submeshes) is setup properly from material which shall render first to the material which should render on top. *This keeps back to front sorting intact. As all materials can share the same Render Queue which should be: Transparent.*
As i am no expert in modelling i had to go with a), sorry.
Rendering the outer material on top of the inner material will make sure that any "decal" defined in the base map (Albedo Alpha) will fully overwrite the inner faces and thus not receive any glass specific lighting.

Using *Alpha Blending* will only reveal opaque parts and specular reflections if *Final Alpha* is set to 0. Raising *Final Alpha* will also reveal the refraction.

Using *Additive Blending* will reveal the inner faces even more – but of course will corrupt the final shading as the bowl and the refractions get too bright (additive!). Adjust the *Final Alpha* to reduce these artifacts.

Glass using one single material for the bowl Backfaces of the bowl are invisible.

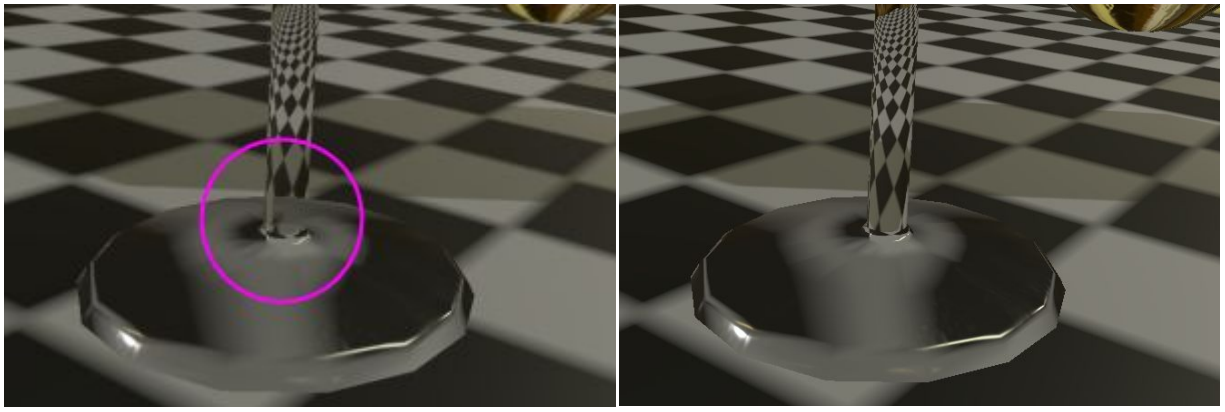
Glass using two materials for the bowl Backfaces of the bowl are visible. The Outer Material uses *Transparent Blending* and a *Final Alpha* value of 0.4.

Glass using two materials for the bowl Backfaces of the bowl are visible. The Outer Material uses *Transparent Blending* and a *Final Alpha* value of 0.4. Base Map is enabled and adds tinting to the glass and the "Lux" logo decal.

In case you do **NOT** want to use opaque "decals" on the outer faces of the bowl you may swap the settings of the outer and inner material and render the outer material first. This way you will ensure that the refraction on the outer material will be fully tinted. Otherwise it depends on the chosen *Final Alpha* value.

The importance of enabling ZWrite

The following screenshots demonstrate the importance of writing to the depth buffer:



ZWrite disabled Stem gets party overwritten by the foot. **Zwrite enabled** Stem is rendered properly.

Shader Inputs

Surface Options

ZWrite Lets you choose whether the shader writes to the depth buffer or not. Usually it should write to the depth buffer. In case you use multiple materials for certain parts of you glass object you may want want to set it to *Off*.

Culling Lets you choose between rendering front faces, back faces or both.

Blending

None Will make the shader simply overwrite the current frame buffer value. Use this for simple objects only using one glass material.

Transparent Will make the shader blend the shaded pixel with the frame buffer using “traditional transparency” or alpha blending.

Additive Will make the shader blend the shaded pixel with the frame buffer additively.

Final Alpha If blending is activated this lets you adjust how much the given pass will contribute to the final image. It uses a max operator, so it will lift the visibility of parts (like refractions), which do not have a corresponding alpha value.

Receive Shadows If unchecked the material will not receive shadows *(faster)*.
Please note: As glass does not contribute to the screen space shadows it may not receive proper shadows but simply pick them up from the underlying geometry (which may be very far away…).

In order to receive proper shadows you have to render an invisible object using the “Depth Only” shader. Please have a look at the “Glass Demo” where you will find a proper example.

Surface Inputs

Color (RGB) Alpha (A) Color which tints the refractions and opaque parts.
Alpha in this case does not drive the opacity of the material but the fade between glass lighting and standard lighting as used by the decals. In order to get fully transparent glass, alpha must be set to 0.0.

Enable Base Map If checked the shader will sample the base map.

Albedo (RGB) Alpha (A) Albedo (RGB) allows you to achieve multi colored glass or add decals. **Alpha** in this case does not drive the opacity of the material but the fade between glass lighting and standard lighting as used by the decals. In order to get fully transparent glass, alpha must be set to 0.0.

Tiling and Offset of this texture will drive sampling of the mask and bump map as well – even if it is disabled.

Smoothness Smoothness of the glass layer.

Smoothness Opaque Smoothness of the opaque parts as defined by alpha.

Specular Specular color of the glass.

Specular Opaque Specular color of the opaque parts.

Enable Mask Map If check the shader will sample the mask map.

Thickness Mask (R) Smoothness (A) Texture which contains the “invers” glass thickness (solid = 0, thin shell = 1) in the red color channel and the smoothness in the alpha channel. **Please note:** The texture should be imported as linear texture, so uncheck “sRGB (Color Texture)” in the import settings.

Enable Normal Map If checked the shader will sample the normal map.

Normal Map The normal map.

Normal Scale Lets you scale the normal.

Refraction

Enable geometric Refractions If checked the shader will refract the given background based on the normals of the geometry and the following settings:

Index of Refraction The material specific index of refraction which drives the amount of refraction. Glass has an IOR of roughly 1.5.

Thin Shell A solid glass sphere would use a value of 0.0, while a hollow sphere like a christmas ornament should use a value of 0.98. A value of 1.0 would give you no refraction. This parameter drives the final shape of the refraction.
See: Solid and Thin Shell Glass in the demo.

Enable Screen Edge Fade If checked the shader will fade out geometry driven refractions towards the screen edges to suppress stretchings.

Fade Width Lets you define a falloff used to fade out geometric driven refraction towards the edges of the screen.

Bump Distortion Distortion of the refraction based on the normal map.

Exclude Foreground If checked the shader will not refract objects lying in front of the given pixel but return a refraction sample from the actual screen position.

This will make the shader sample the _CameraDepthTexture (more expensive) and will cause holes in the refraction sample.

Rim Lighting

Enable Rim Lighting Check to enable Rim Lighting

Rim Color The Rim Color

Rim Power Higher values will push the effect towards grazing angles only.

Rim Frequency Lets you add a simple sinus based animation. If set to values > 0.0 the shader will lerp between *Rim Power* and *Rim Min Power*.

Rim Min Power Second Power value used if Rim Frequency is > 0.0.

Rim Per Position Frequency Slightly offsets the animation based on the object's pivot in worldspace and prevents objects all pulsating at the same frequency.

Stencil

Stencil Reference The value to be compared against.

Read Mask Bit mask which determines which bits will be read from.

Write Mask Bit mask which determines which bits will be written to.

Stencil Comparison The function used to compare the reference value to the current contents of the buffer.

Stencil Pass Op What to do with the contents of the buffer if the stencil test (and the depth test) passes.

Stencil Fail Op What to do with the contents of the buffer if the stencil test fails.

Stencil Z Fail Op What to do with the contents of the buffer if the stencil test passes, but the depth test fails.

Advanced

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper.

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Lit Particles Shaders

The lit particle shaders are derived from the *LWRP Particle SimpleLit* shader and support Blinn Phong Lighting and all other options you may know from this shader. Lux LWRP lit particles shaders however enable all light types and add support for real time shadows and cheap transmission lighting next to some minor optimizations on top.

The particle shaders have been written with classic camera aligned alpha blended billboards in mind. Other billboard modes like *Horizontal Billboards* are only partly supported. Alpha tested or solid particles using a custom mesh are not supported but covered well with the built in shaders.

Additive blending like other blending modes is supported but most likely not suitable as it is mainly used to renderer emissive materials like flames which do not need to receive real time shadows.

Real Time Shadows

Classical billboarded particles are just flat surfaces pointing towards the camera. As they are transparent they do not write into the depth buffer and thus may not receive any screen space shadows from the sun. Furthermore Unity deactivated the support for additional lights in the built in particle shaders so they of course do not receive shadows from spot lights either.

Lux LWRP lit particles sample all shadows in world space, either per pixel – which may get pretty expensive – or per vertex.

Per pixel shadows suffers the most from the fact particles being a flat surface only while per vertex sampled shadows may already look smoother due to the interpolation from vertex to fragment shader.

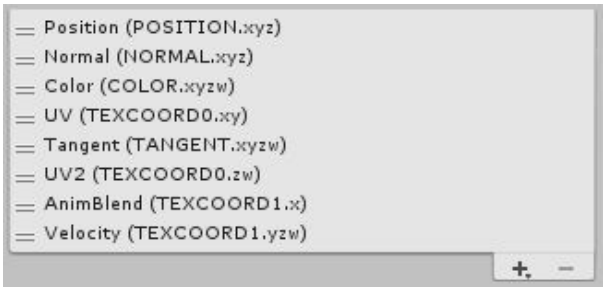
In order to make the per vertex sampled shadows even smoother the shaders offer two possibilities:

1. **Tessellation**: While being a bit expensive and not supported on all platforms this will just increase the number of vertices and thus give you more accurate shadows. Tessellation affects all light types and shadows.
2. Using **Sample Offset**: If this parameter is set to 0 the shader will only do a single look up into the shadow map of the directional light per vertex. As soon as you raise it, the shader will perform three lookups and mix the final result. The additional sample locations in world space are calculated according to the vertex's velocity and the chosen *Sample Offset*. This only affects shadows from the main directional light.
   In order to provide the shader with the *Velocity* you have to add the according vertex stream to your particle system.

Vertex Streams

Unity can output x? different combinations of vertex streams depending on their order and the selection. The shaders however only support two different vertex streams layouts when it comes to features such as *Flipbook Blending* and *Sample Offset*:

Supported Vertex Stream Layouts



Full feature Vertex Stream: Flipbook Blending and Sample Offset active If *Sample Offset* was deactivated the last stream *Velocity* would be obsolete.

Vertex Stream: Only Sample Offset active If *Sample Offset* was deactivated the last stream *Velocity* would be obsolete.

Of course if normal mapping is deactivated no *Tangent* stream is needed. Same goes with the *Color* in case your particle system did not write to any color – which however hardly ever happens.

In order to fix or check your streams you can use the button *"Check Vertex Streams"* at the very bottom of the material inspector. The particle system will also inform you about missing or obsolete streams.

Normal Direction

When it comes to particle lighting the *Normal Direction* of the particles as set in the *Renderer* module of the particle system plays an important role. Unity Docs >

A *Normal Direction* of 1 will give you quite accurate ambient lighting from the Skybox or a Gradient as the particle normals will more or less will fit the world normal of the particle's billboard. Per vertex lighting however might look a bit harsh. Values around 0.5 should be fine.

Shader Inputs

Tessellation *Tessellation shader only*

Tessellation Number of subdivisions created by the tessellator. Keep this number as low as possible for performance reasons. Make sure you always use an odd value (like 3, 5, 7, …) as even values will create odd tessellation.

Near (X) Far (Y) Near: Distance from the camera where the specified number of subdivisions will be reached. Far: Distance from the camera where no tessellation will be applied anymore.

Surface Options

ZTest Lets you tweak depth based face culling.

Cull Lets you choose between rendering front faces, back faces or both. *For classical billboarded particles "Back" is the right choice.*

Blending Mode

Alpha Will make the shader blend the shaded pixel with the frame buffer using "traditional transparency" or alpha blending.

Premultiply Will make the shader multiply alpha on top of the albedo. Usually needed for pbr lighting - which is not supported by the shaders.

Additive Blends particles using additively blending.

Multiply Blends particles using multiplicative blending.

Color Mode

Controls how the particle color (color added to vertex colors by the particle system) and Material color blend together.

Receive Shadows If checked the material will receive real time per pixel shadows from the main directional light.

Additional Light Shadows If checked the material will receive real time per pixel shadows from the additional spot lights.

Per Vertex Shadows If checked all shadows will be fetched per vertex instead of per pixel which speeds up rendering. Soft shadows will be disabled and smooth borders come from the vertex to fragment interpolation only.

Sample Offset If set to > 0.0 the shader will sample the shadow map three times for the main directional light and offset the sample position according to the given velocity of the particle and the chosen value. Needs *Velocity* to be added to the vertex streams of the particle system. See: *Vertex Streams* above.

Surface Inputs

Base Color

Base Map

Specular Highlights

Enable Spec Gloss Map

Spec Gloss Map

Specular Color (RGB) Shininess (A)

Enable Normal Map If checked the shader will sample the assigned normal map.

Normal Map The normal map.

Enable Emission If checked the shader will sample the Emission Map

Emission Map Emission texture (RGB)

Color Color which will multiplied on top of the sampled emission

Enable Transmission If checked the shader will add fast transmission lighting which is derived from the dot product between view vector and light vector and masked by (1.0 - alpha) so less opaque parts get more transmission.

Transmission Lets you scale the transmission.

Distortion Distorts the light vector by the given normal and breaks up the uniform transmission.

Particle Options

Enable Flipbook Blending If checked frames in a flip book will be blended together smoothly. Needs a 2nd *UV* coord and *Animblend* to added to the vertex stream. See: *Vertex Streams* above.

Enable Distortion Creates a distortion effect by making particles refract objects drawn before them.

Strength Controls how much the particle distorts the background

Blend Controls how visible the distortion effect is.

Enable Soft Particles If checked particles will smoothly fade out when intersection with other geometry in the depth buffer.

Near (X) Far (Y) Near: Distance from the other surface where the particle is fully transparent. Far: Distance from the other surface where the particle is fully opaque.

Enable Camera Fading Makes particles fade out close to the camera

Near (X) Far (Y) Near: Distance from the camera surface where the particle is fully transparent. Far: Distance from the camera where the particle is fully opaque.

Check Vertex Streams Press this button to check your vertex streams. If all are fine the material editor will simply prompt a message into the Console. Otherwise you will get a message which renderers do not fit the material settings and the possibility to fix them.

Known Issues

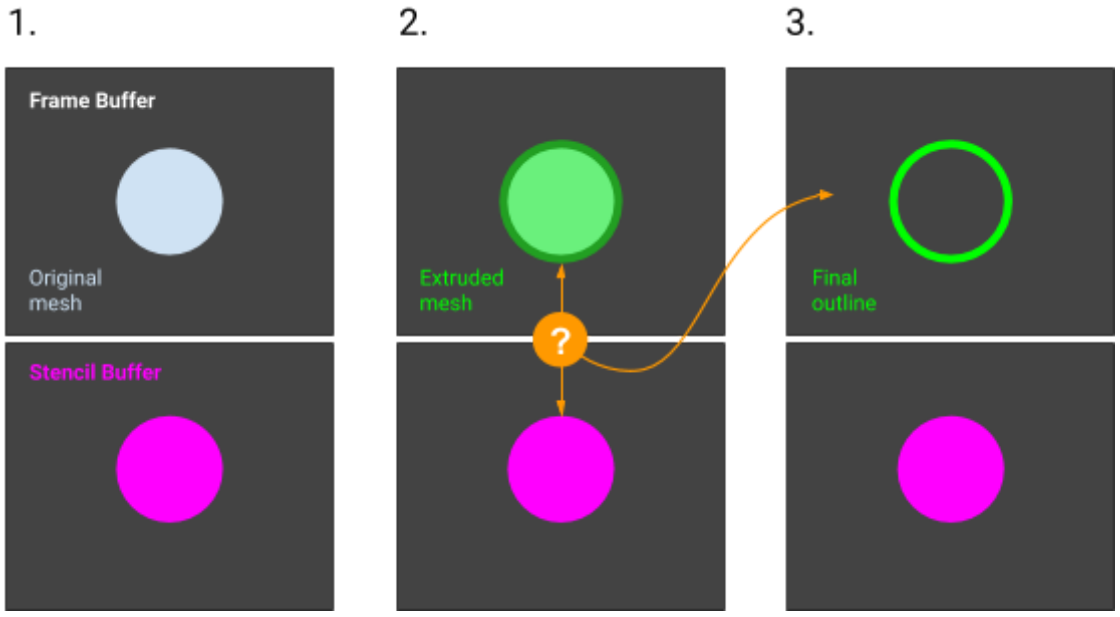
- Unity's built in particles shaders render at render queue 3050 by default – for what reason ever. This will make them appear on top of any other transparent object which uses the standard transparent queue which is 3000. You may fix this by setting their *Priority* to *50* which will make them render at 3000 so they get regularly sorted from back to front respecting all other transparent materials.
- If spot lights shall casts shadows onto particle systems ALL visible spot lights have to cast shadows! I thought this was a bug in my shader… but in fact this is a bug or feature in LWRP (tested in unity 2019.1. and LWRP 5.16.1, 2019.2 and LWRP 6.9.1.) Using LWRP 6.9.1. it looks as if it was fixed in the scene view. In game view (play mode) shadows vanish as soon as there is one spot light without shadows visible on screen. On all objects – even the opaque ones using the built in shaders.

Highlight Shaders

Lux LWRP/Fast Outline Shader

The Fast Outline shader allows you to highlight objects by adding a colored outline to them without having to use any expensive full screen image effect. The shader instead is based on the stencil buffer and needs the objects to be drawn twice:

1. First you render the object using a “regular” shader which renders your material just as is but also writes a reference value x into the stencil buffer. Do so by assigning the *Lux LWRP/Lit Extended Shader*
2. Then you render the object a second time just on top using the *Lux LWRP/Outline* shader. This will draw a slightly extruded version of the mesh taking the stencil buffer into account: It writes only to screen if the stencil buffer does not contain the reference value x.
3. All pixels covered by the regular mesh (where it wrote to the stencil buffer) will be excluded in the second pass giving you the desired outline.



Further information about the stencil buffer can be found in Unity’s documentation.

Using a method like this allows you to create various outline effects like the one shown below, just by editing the materials’ depth write property and the setting the stencil options.

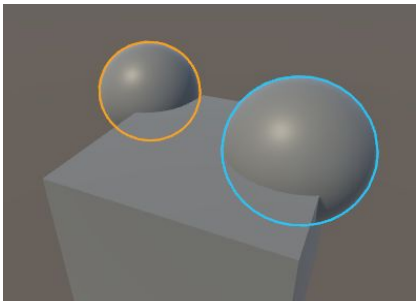
Outline Overview Demo

The *Outline Overview Demo* shows various outline effects and how to set these up.

Basic Outline

The outline will always be drawn regardless if the object is (partly) visible or not.

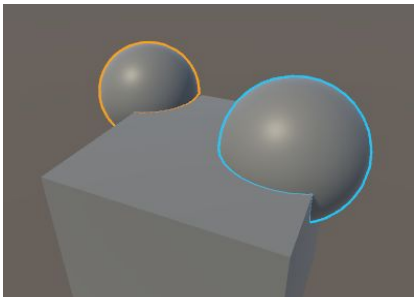
- Base Material simply writes to the stencil buffer, always.
- Outline Material uses Stencil Comparison = NotEqual and does not do depth testing: ZTest = Always



Depth Culling

Only the visible parts of the objects will be outlined.

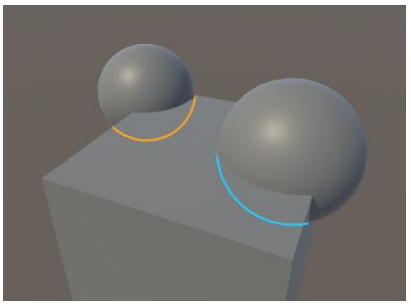
- Base Material simply writes to the stencil buffer.
- Outline Material uses *Stencil Comparison = NotEqual* and does regular depth testing: *ZTest = LessEqual*.



Depth Culling inverted

Only the invisible parts of the objects will be outlined.

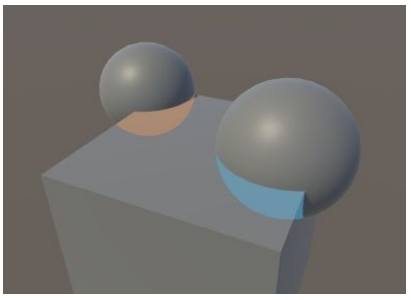
- Base Material simply writes to the stencil buffer
- Outline Material uses *Stencil Comparison = NotEqual* and does inverted depth testing: *ZTest = GreaterEqual*



Hidden Surfaces

Invisible parts of the objects will be drawn as flat, tinted surfaces.

- Actually this effect does not need any stencil buffer usage as we do not draw any outline but just the “regular” faces.
- So the Outline Material simply is set to: *Ztest = Greater*.

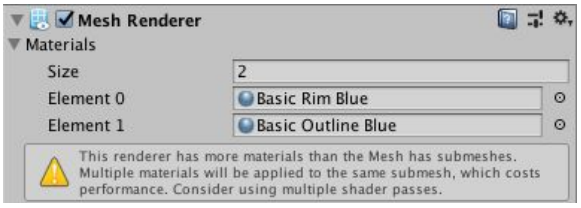


Setup

As mentioned before: The object or mesh has to be drawn twice. The easiest way to do this is just to apply two materials to the renderer component – in case your mesh does not have any submeshes/already uses multiple materials. Letter would actually need you to copy the mesh, assign proper outline materials and let unity do the rest. Or draw it from script.

In order to keep things simple, let's assume that out mesh has only one material assigned.

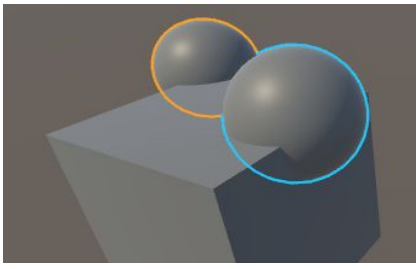
- Duplicate the material in the project tab.
- Assign the *Lux LWRP Lit Extended* shader to the new material. It is a copy of the built in Lit shader but offers some extra features such as the configuration of the stencil. And as the base material has to prepare the stencil buffer we will need such features.
- In the foldout *Surface Option* find *Advanced Options* and set *Stencil Reference* to *1*, set *Stencil Comparison* to *Always*. This will make the shader always write 1 into the stencil buffer:
- Next create a new material and assign the Lux LWRP Outline shader.
- Set its *Stencel Reference* to 1 as well.
- Now select Mesh Renderer component of the game object you want to add the outline to and set *Material → Size* to 2. Assign the new material using the *Lux LWRP Lit Extended* shader to the first slot and the outline material to the second slot.



- Done. Unity now should draw the object twice: First using the *Lux LWRP Lit Extended* shader and then using the outline shader.
- In case you mesh uses multiple materials this method will fail. Please have a look here to find out how to solve this.

Limitations

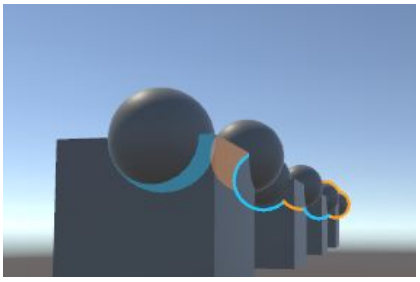
Overlapping outlines



As both spheres write 1 as stencil reference the blue outline of the sphere in the foreground will be partly suppressed by the sphere in the background.

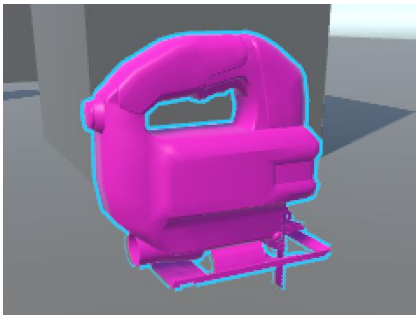
You would have to use different stencil reference values here which unfortunately breaks when using the SRP batcher right now.

Mixing outline modes



Mixing various outline modes within a single scene might lead to quite unpredictable results – especially if you mix *depth culling* and *depth culling inverted* or *Stencil Z Fail Op = Replace* and *Stencil Z Fail Op = Keep*.

Concave and complex models



The outline is generated by extruding the vertices along their normals. This works absolutely fine on convex objects – however may not always produce perfect outlines regarding complex and concave models and smoothed normals. The results are still pleasant.

Alpha testing

Alpha tested objects are not supported by design. Here e.g. using rim lighting would be a fast alternative to highlight the objects.

In order to create an outline like in the scene view in the Unity editor you have to use a full screen image effect – expensive.

Outline Runtime Demo

Let's have a look if we can combine the outline effects (always visible and not hidden according to depth to highlight selected objects) and hidden surfaces (to always show certain objects): Here we have two concurring demands as both outlines and hidden surfaces shall always be visible regardless of depth… Do some funky stencil things?

Luckily we do not need a stencil test in order to draw hidden *surfaces*: A simple depth test done by the second material (that draws the hidden) surfaces is enough. So we will start with this material:

M Hidden Surfaces Base
Like said we do not need to write anything to the stencil buffer when drawing the regular mesh. So this material simply uses the built in Lit shader.

M Hidden Surfaces Surfaces
This material shall draw the hidden surfaces. Therefore we have to assign a material that let us choose how the depth test will be performed. We use the Lux LWRP Outline shader because of this and set *ZTest* to *Greater.* Assign this material as second material – done. Stencil tests are not needed.

We do not need a scriptable render pass or Renderer Features or anything else. We just have to make sure that the hidden surfaces are drawn after all opaque objects and most likely after all transparent objects as well. As the shader by default uses the *Queue = 3059* (which is Transparent+59) in order to get drawn on top of other transparent materials you may want to change it to *Transparent* in the material editor in case you want proper back to front sorting. In case you need front to back sorting consider using *AlphaTest*.

If you want to exclude hidden surfaces from being drawn behind selected objects you may active the stencil test and check against the reference value as written by the selected objects.

M Outline Base always visible
The selectables which shall always show an outline (when selected) however have to write to the stencil buffer due to the fact that we want to draw an outline. So this material uses the *Lux LWRP/Lit Extended* shader. The stencil buffer options are straight forward: we simply write our reference value (1) under all conditions: So *Compare* is set to *Always* (which means no compare), all other operations use *Replace.*

M Outline Outline always visible

This material is used to draw the outline and checks the stencil buffer for the reference value (1). *Compare* is set to *NotEqual* so it only gets drawn on top of pixels if the corresponding stencil value is not 1.

Hidden surfaces

In case you want to use the outline shader to make hidden surfaces visible you can simply assign the second needed material permanently to your prefabs.

Selection outline

In this case we have to dynamically *change* the materials. Not selected objects should not use the base shader as it writes to the stencil buffer and would block outlines on other objects.

But we do not want to *change* materials at runtime as these most likely are *shared materials*. We have to *swap* materials on the desired game object/renderer as there might be several enemies or pickables using the same shared material.

The demo ships with a pretty two simple scripts (*MouseSelect.cs* and *ToggleOutlineSelection.cs*) that show how you can handle this without producing any garbage or spikes.

Usage

In order to add an outline effect select the *Renderer* component of your object, open the *Materials* foldout and set the *Size* to 2. Then assign a outline material as second material.

In case you mesh uses multiple materials this method will fail. Please have a look here to find out how to solve this.

Shader Inputs

Surface Options

ZTest Lets you tweak depth based face culling.

Culling Lets you choose between rendering front faces, back faces or both.

Stencil Reference The value to be compared against.

Read Mask Bit mask which determines which bits of the stencil buffer will be read from.

Stencil Comparison The function used to compare the reference value to the current contents of the buffer.

Outline

Color The color (RGB) and opacity (Alpha) of the outline

Width Width of the outline in pixels

Enable Fog If checked the outline will receive fog.

Lux LWRP/Lit Extended Shader

This shader is needed to prepare the stencil buffer in case you want to draw outlines as described above.

You will find all needed stencil buffer options in the foldout *Surface Options:*

ZTest Lets you tweak depth based face culling.

Stencil Reference The value to be compared against

Read Mask Bit mask which determines which bit will be read from.

Write Mask Bit mask which determines which bit will be written to.

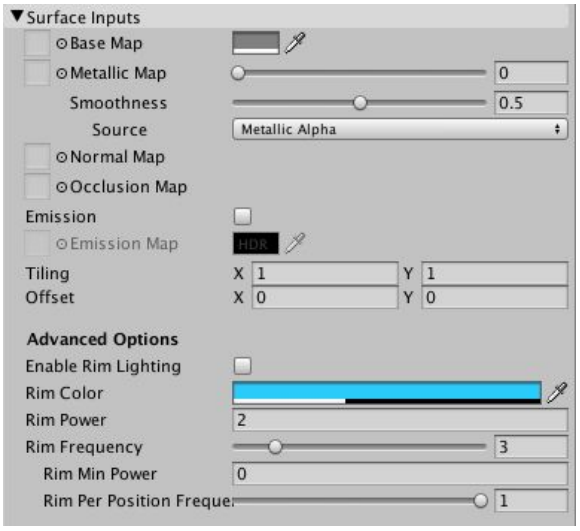
Stencil Comparison The function used to compare the reference value to the current contents of the buffer.

Stencil Pass Op What to do with the contents of the buffer if the stencil test (and the depth test) passes.

Stencil Fail Op What to do with the contents of the buffer if the stencil test fails.

Stencil Z Fail Op What to do with the contents of the buffer if the stencil test passes, but the depth test fails.

Next to exposing the needed stencil options it also allows you to simply highlight objects by adding Rim Lighting. You will find the corresponding settings in the foldout *Surface Inputs*.



Enable Rim Lighting Check to enable Rim Lighting

Rim Color The Rim Color

Rim Power Higher values will push the effect towards grazing angles only.

Rim Frequency Lets you add a simple sinus based animation. If set to values > 0.0 the shader will lerp between *Rim Power* and *Rim Min Power*.

Rim Min Power Second Power value used if Rim Frequency is > 0.0.

Rim Per Position Frequency Slightly offsets the animation based on the object'S pivot in worldspace and prevents objects all pulsating at the same frequency.

Adding stencil options to custom shaders

Shader graph currently does not support stencil operations. If you have a manually written shader: fine. If you use shader graph: Get the shader code (right click into the master node's header and select "Copy Shader". Create a new file in your IDE or text editor and paste the code).

Now that you have the shader code you have to a) add the needed properties and b) add the actual stencil operations.

a) In order to add the needed properties you can simply copy and paste the following lines to the property block of the shader:

```
[Header(Stencil)]
[Space(5)]
[IntRange] _Stencil ("Stencil Reference", Range (0, 255)) = 0
[IntRange] _ReadMask (" Read Mask", Range (0, 255)) = 255
[IntRange] _WriteMask (" Write Mask", Range (0, 255)) = 255
[Enum(UnityEngine.Rendering.CompareFunction)]
_StencilComp ("Stencil Comparison", Int) = 8 // always
[Enum(UnityEngine.Rendering.StencilOp)]
_StencilOp ("Stencil Operation", Int) = 0 // 0 = keep, 2 =
replace
[Enum(UnityEngine.Rendering.StencilOp)]
_StencilFail ("Stencil Fail Op", Int) = 0 // 0 = keep
[Enum(UnityEngine.Rendering.StencilOp)]
_StencilZFail ("Stencil ZFail Op", Int) = 0 // 0 = keep
```

b) At the beginning of the lighting pass you have to add the stencil operations:

```
Pass
{
      Name "ForwardLit"
      Tags{"LightMode" = "LightweightForward"}
      Stencil {
            Ref [_Stencil]
            ReadMask [_ReadMask]
            WriteMask [_WriteMask]
            Comp [_StencilComp]
            Pass [_StencilOp]
            Fail [_StencilFail]
            ZFail [_StencilZFail]
      }
```

...

Toon outline shader

The toon outline shader is a rather simple shader which creates outlines by drawing the geometry a second time extruding the vertices along the geometry's normals.

Alpha tested materials or feathered outlines are not supported. These would require a full screen image effect.

Usage

In order to add a toon outline select the *Renderer* component of your object, open the *Materials* foldout and set the *Size* to 2. Then assign a toon outline material as second material.

In case you mesh uses multiple materials this method will fail. Please have a look here to find out how to solve this.

Shader Inputs

ZTest Lets you specify how the shader performs depth testing. Regular *LessEqual* should just be fine.

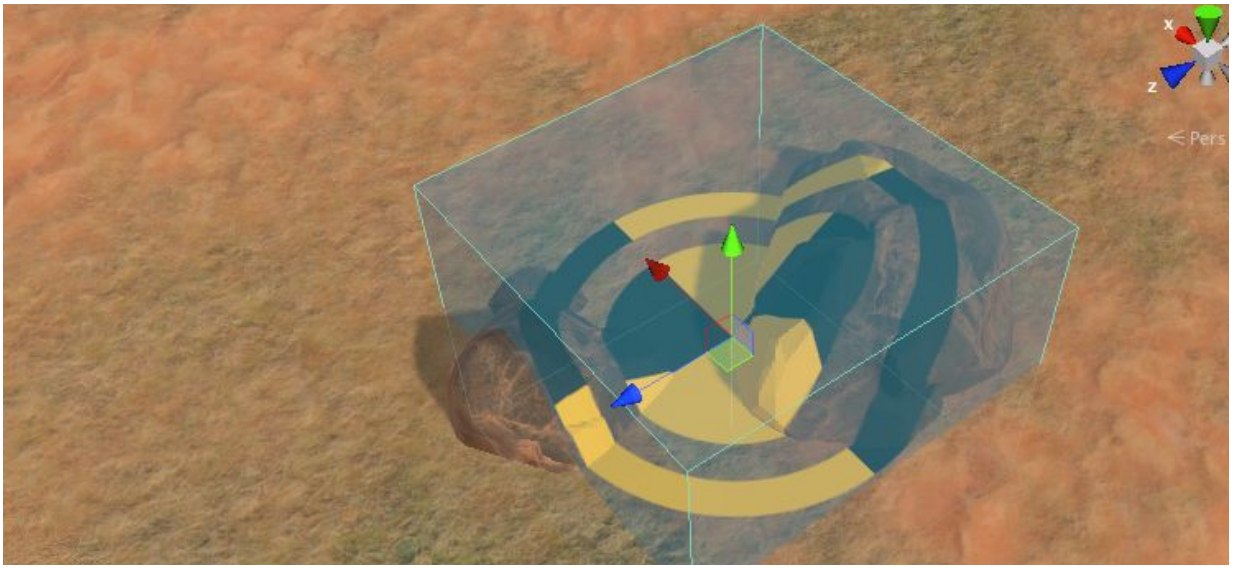
Culling Lets you specify if the shade shall cull back or front faces. I recommend to let it cull front faces.

Outline

> **Color** Color of the outline. *You may set the alpha here as well as the shader uses alpha blending.*
>
> **Width** Width of the outline. *Depends on the scale of the object unless you check "Compensate Scale" or "Calculate width in screen space".*
>
> > **Compensate Scale** If checked the outline will have the same width regardless of the scale of the object. Otherwise the width will scale with the scale of the object. *Useful if you have several instances of the same mesh at different scales. In case you have complex hierarchies of skinned mesh renderers this may not produce the desired result tho as scale in this case is handled in a special way.*
> >
> > **Calculate width in screen space** If checked the shader will calculate the width of the outline in screen space and keep it stable over distance - just like the regular outline shader does. *However – this does not really look nice on a toon outline shader...*

Decals

Lux LWRP Essentials ship with two rather simple decal shaders which allow you to project decals on arbitrary geometry – just like you might know from deferred decals: If you draw a cube onto screen using a proper decal material then everything within the cube's volume will receive the decal:



Decal projected onto a mesh terrain and two rocks. The blueish volume marks the volume of the decal. The local up or y axis (green arrow) shows the decal's projection axis.

The decal shaders reconstruct the world position of the underlying geometry from the depth buffer and then calculate a corresponding decal UVs – according to the decal's projection axis.

Limitations

In case you use the *lit decal shader* the shader also reconstructs the underlying normals from the depth buffer. This leads to quantized normals and a common "flat shading" look:

Usage

- Make sure that you have checked *Depth Texture* in the *Scriptable Render Pipeline Settings* assigned under *Project Settings → Graphics*.
- Drag the *PF Decal Manager* into your Scene. This manager and the assigned script is only needed in the editor and lets you draw the decal gizmos which are needed to be able to select decals. Check/uncheck *Gizmos* to toggle the decal gizmos.
- Drag the *PF Decal* on top of any geometry in scene. This prefab contains a simple mesh renderer and uses the built in cube as decal mesh. It furthermore contains the Decal.cs which is only needed in editor and identifies the game object as decal so it will be found by the *DecalGizmos.cs* script (editor only as well). The script also offers the possibility to simply align the decal to the underlying normal by checking "Align" once.
- Move, scale and rotate the *PF Decal* to your needs.
- **Please note:**
    - The decal gets projected along its main axis which equals the local y-axis (green arrow). The decal texture will be stretched if the normal of the underlying surface is not aligned with the decal main axis.
    - Shading costs are determined by the size of the decal's volume. So try to make it as small as possible.
- Do **not** use decals on flat geometry as they would be too expensive. If you have flat geometry like a wall of floor use a simple quad or any other geometry and a transparent material instead.

Performance

Unlit decals of course are faster than lit decals.

In order to improve performance use layer based culling → so decals will be skipped at a distance of e.g. 50 meters (lightweight!). The decal shaders support distance based fading so you can hide any popping.
Decals in the Decal Demo are set to layer "Water" which gets culled at 50m according to the settings in "00 Wind and Settings" → LuxLWRP_LayerBasedCulling.cs

Exclude objects from receiving decals

Using the Stencil Buffer

The decal shaders support stencil buffer operations and may be masked out on certain objects if these use a shader that writes to the stencil buffer (like provided by the *Lit Extended Shader*). So if the decal shader compares against the stencil reference value of 0 you may simply create a material using the *Lit Extended Shader* which writes 1 to the stencil buffer and assign it e.g. to the player or your npcs.

Please have a look at the *Decals Demo* which uses two materials which are set up properly:

M Exclude Decals This material is used by the red capsules which shall not receive any decals. It uses the *Lit Extended Shader* and writes *Stencil Reference = 1* into the stencil buffer. *Stencil Comparison* is set to *Always* as we do not want the stencil buffer drive the rendering of the objects but rely on depth testing solely.

M Default Decal The default decal material. *Stencil Reference* is set to *0* and *Stencil Comparison* is set to *Equal* – so the decal will only be drawn if the stencil buffer contains 0.

Mesh Terrain and Top Down Projection Shader Excluding decals on materials using these shaders does not make much sense in my opinion. But in case you need variants of these shaders which allow you to write to the stencil buffer just let me know.

Using the Render Queue

Rendering certain objects after the decals have been drawn will automatically exclude these from receiving decals.

This method is used in the *Decals Demo* to prevent decals on grass and water:

Grass Shader The grass shader does not support stencil operations – so grass would always receive decals. In order to exclude grass you may however make the decal shader run before the grass shader by editing its render queue: Grass renders at *Render Queue* = *Alpha Test* (2450). So if you set the decal shader to e.g. *Render Queue* = *2448* grass will not be affected by the decals.

Water Shader Like the grass shader the water shader does not support stencil operations. So in order to exclude water from receiving decals make sure the decals use a lower *Render Queue*. If you set the decal shader to *Render Queue* < *3000* water will not be affected by the decals.

Decals on top of decals

Decals on top of decals are not automatically supported. And if you place decals on top of decals the sorting order might suddenly change according to the camera position.

In order receive predictable results stacked decals will have to use different *Render Queues* – like Render Queue = 2448 for the lower decal and Render Queue = 2449 for the upper one.

Decals and Outlines

Decals and outlines (objects highlighted using the outline shader) are somewhat tricky as both usually depend on the stencil buffer – especially when the outline always shall be visible.

In order to mix both i exposed *Write* and *Read Mask* in the stencil options. This lets us use the stencil buffer together with a bit mask. So you may think of stencil values like flags: If a certain bit is set render or do not render special features.

Outline material receiving decals

Stencil Shader – using *M Basic Lit Stencilwrite Receive Decals*

Stencil Reference	2	00000010
Write Mask	2	00000010
Stencil Buffer	2	00000010

Outline Shader

Stencil Buffer	2	00000010	
Read Mask	2	00000010	
Final Ref Value	2	00000010	*The masked value equals the used Stencil Reference value in the Outline material. So the outline gets properly drawn.*

Decal Shader

Stencil Buffer	2	00000010	
Read Mask	1	00000001	*Only the lowest bit will be taken into account.*
Final Ref Value	0	00000000	*The masked value from the stencil buffer equals the used Stencil Reference value. So decals will appear on top.*

Outline material not receiving decals

Stencil Shader – using *M Basic Lit Stencilwrite Dont Receive Decals*

Stencil Reference	3	00000011
Write Mask	3	00000011
Stencil Buffer	3	00000011

Outline Shader

Stencil Buffer	3	00000011	
Read Mask	2	00000010	
Final Ref Value	2	00000010	→ The masked value equals the used Stencil

Decal Shader

Stencil Buffer	3	00000011	
Read Mask	1	00000001	
Final Ref Value	0	00000001	*The masked value from the stencil buffer is greater than the used Stencil Reference value. So no decals will be drawn on top.*

Shader Inputs

Surface Options

Receive Shadows If unchecked the material will not receive shadows *(faster)*. *Lit only.*

Surface Inputs

Color Tints the color sample from the texture input (HDR).

Albedo (RGB) Alpha (A) Albedo in RGB and Alpha in A.

Smoothness Overall smoothness. Will be multiplied with Smoothness sampled from the *Mask Map* if it is enabled. *Lit only.*

Specular Specular color. *Lit only.*

Enable Normal Map Check this to sample the normal map. *Lit only.*

Normal Map Normal map. *Lit only.*

Normal Scale Scale of the sampled normal. *Lit only.*

Mask Map *Lit only.*

Enable Mask Map Check to make the shader sample the mask map.

Metallness (R) Occlusion (G) Emission (B) Smoothness (A) This combined texture contains masks/maps for all other features supported on the lit decals.
Please note: The texture should be imported as linear texture, so uncheck “sRGB (Color Texture)” in the import settings.

Emission Color Tint color for the emissive lighting.

Occlusion Lets you dampen the sampled occlusion.

Stencil

Stencil Reference The value to be compared against.

Read Mask Bit mask which determines which bit will be read from.

Write Mask Bit mask which determines which bit will be written to.

Stencil Comparison The function used to compare the reference value to the current contents of the buffer.

Advanced

Enable Fog If checked the decals will receive fog. *Unlit only.*

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper. *Lit only.*

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper. *Lit only.*

Billboard Shader

The billboard shader lets you create all kinds of camera facing billboards. It excepts the default Unity quad as mesh input but should work with other geometry as well.

It collapse all vertices towards the pivot in the vertex shader and expands them in view space according to the uv coordinates.

Due to this dynamically or statically batched meshes will not work: Both methods will create one big mesh in world space with just a single pivot. GPU instancing works.

Shader Inputs

Surface Options

ZTest Lets you tweak depth based face culling.

Alpha Lest you choose between alpha testing and alpha blending. Alpha testing is needed to cast and receive real time shadows and writes to depth. Alpha blending creates way softer edges and is suitable for all kind of unlit billboards.

Threshold aka *Alpha Cutoff*: If *Alpha* is set to *Testing* this value determines where the alpha clipping starts.

Blending If *Alpha* is set to *Blending* you may choose between *Transparent* (traditional transparency based on the alpha channel in the *Albedo (RGB) Alpha (A)* texture), *Additive* (additive blending) and *SoftAdditive* (soft additive blending).
If *Alpha* is set to *Tested* the shader will always use traditional transparency and *Blending* will be ignored.

Receive Shadows If unchecked the material will not receive shadows (faster).

Billboard Shadow Offset Lets you offset the shadows to prevent odd self shadowing.
Please have a look at the "PF Billboard Sphere" which uses this feature.

Billboard Options

Enable upright oriented Billboards If checked the shader will extrude the mesh along world y axis resulting in billboards such as from SpeedTree. By default the shader will create camera aligned billboards.

Set Pivot to Bottom Especially if *Enable upright oriented Billboards* is checked it might be helpful to expand to the billboard only upwards.

Expand X Lets you scale down the expansion of the billboard along the x axis. This feature is helpful to reduce overdraw and safe fill rate in case the billboard texture does not cover the entire geometry.
Please have a look at the "PF Billboard Spruce" which uses this feature.

Surface Inputs

Base Color Color which tints the sample from the albedo texture.

Albedo (RGB) Alpha (A) The Albedo (RGB) and the Opacity mask (Alpha)

Lighting

Enable Lighting If checked the shader will perform full pbr lighting. Please note: The *Normal Map* will always be sampled – as lighting with just the billboard normal does not make much sense.

Normal Map The normal map.

Normal Scale Scale of the sampled normal.

Smoothness Overall smoothness.

Specular The specular color.

Shadow Offset Lets you offset the shadows to prevent odd self shadowing.
Please have a look at the "PF Billboard Sphere" which uses this feature.

Fog

Enable Fog If checked the shader will apply fog.

Render Queue

Queue Offset Equals *Priority* in the standard Lit shader. As the material inspector sets the render queue based on chosen *Alpha* property you are not able to edit the *Render Queue* property at the bottom of the inspector manually. Use *Queue Offset* to adjust the final *Render Queue*.

Advanced

Enable Specular Highlights If unchecked the shader does not calculate direct specular highlights which makes it cheaper.

Environment Reflections If unchecked the shader will not sample any reflection probes which makes it cheaper.

Custom Nodes for Shader Graph

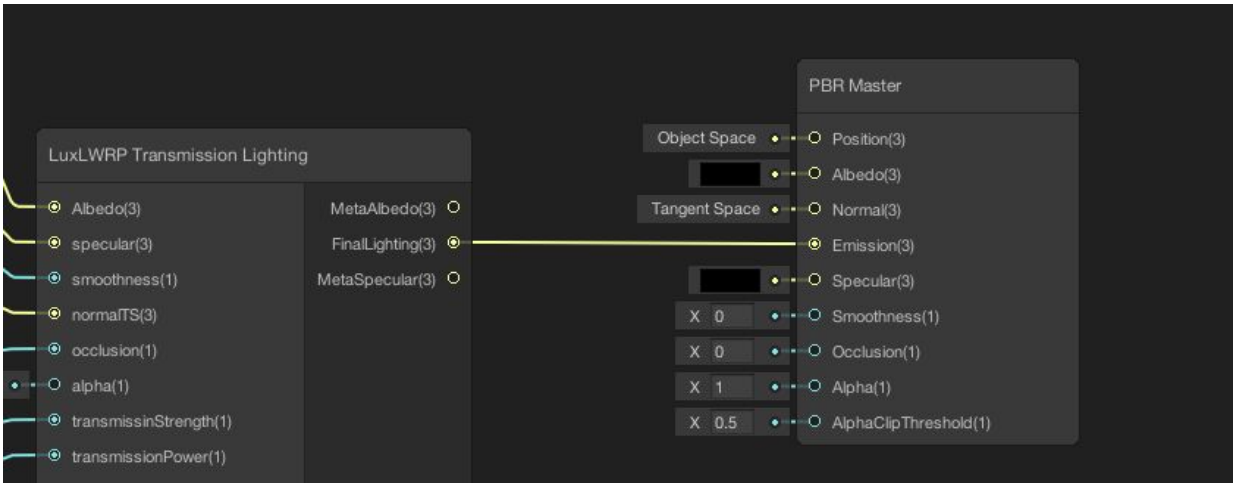
Starting with version 1.11 Lux LWRP Essentials ships with a collection of custom nodes for Shader Graph. Most nodes are custom lighting functions which hijack the *PBR master node* to get access to all variables and shader keywords.

You can read an in depth explanation of how and why it works on Medium →.

Custom lighting nodes — Introduction

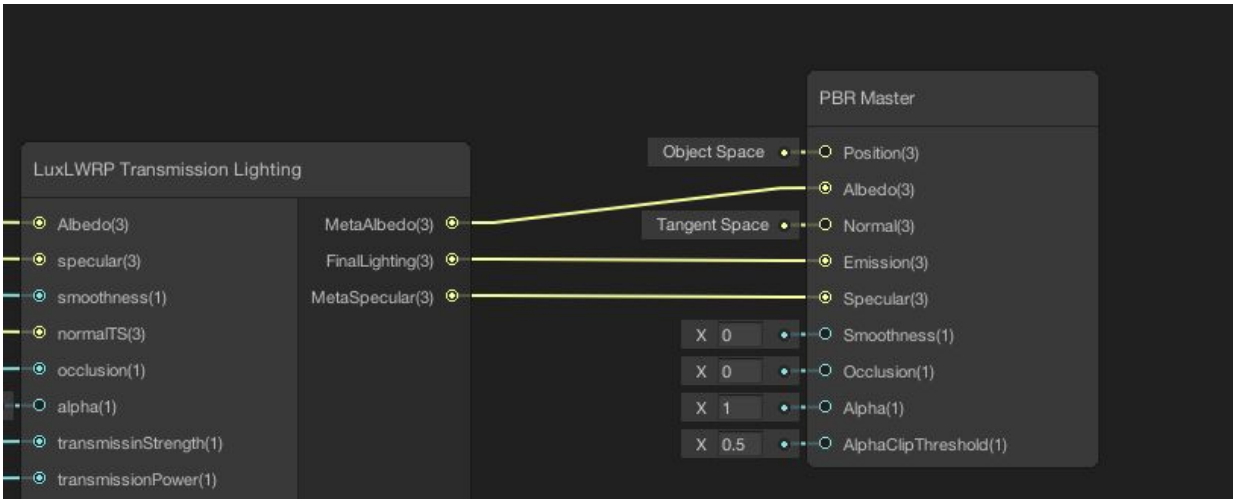
The basic idea is to "mute" the *PBR Master node* by nulling all its inputs so its result will always be half3(0,0,0) and the shader compiler will strip it. The custom lighting then is plugged into the *Emission* node.

Please note: *Workflow* **must** be set to *Specular*.
Using *Metallic* instead would make lighting be calculated twice. You may use the *LuxLWRP Metallic Albedo to Specular Albedo* node to convert from metallic to specular.



Manually nulled PBR Master node Albedo and specular are set to black, smoothness and occlusion to 0.0.

In case you use *GI* just setting *Albedo* and *Specular* to black won't let the material contribute to GI. So the lighting functions provide "Meta" outputs that will set *Albedo* and *Specular* to black in the regular *lighting pass* but provide proper values in the *meta pass*.



Nulled PBR Master node with proper inputs for albedo and specular in the meta pass Albedo and specular are fed by the “Meta” outputs of the lighting function.

Unfortunately we do not have access to per *vertex lighting*. So the lighting function will force Unity to render all additional lights per pixel — even if the pipeline asset defines them per vertex.

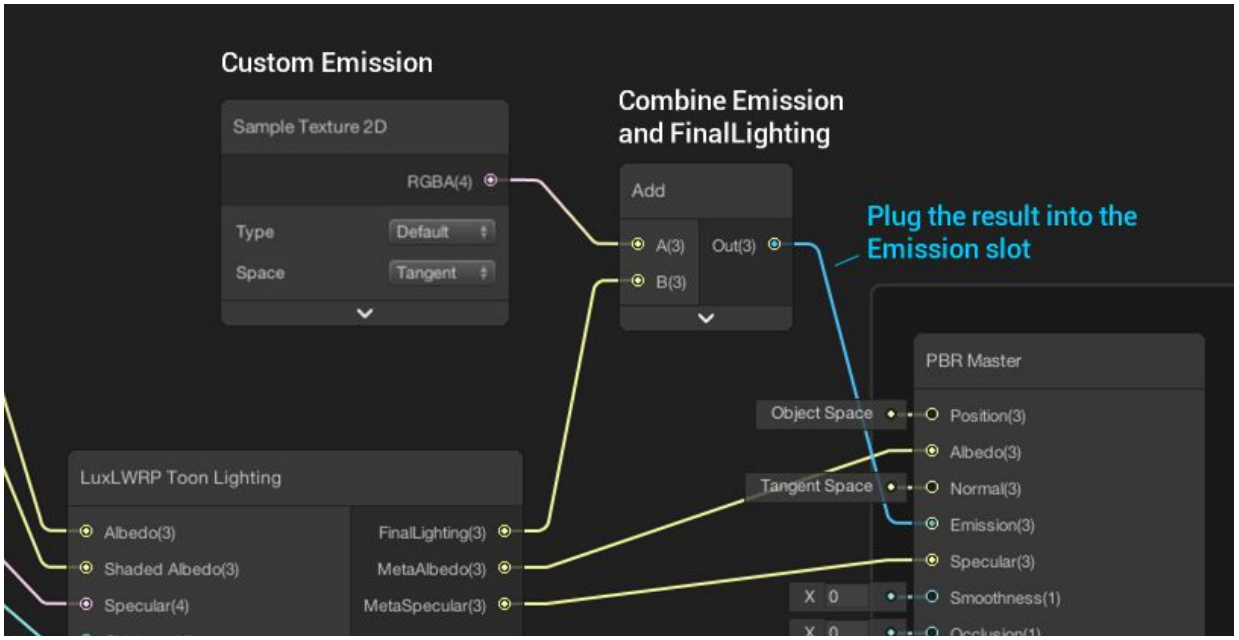
The lighting functions are written in HLSL and wrapped in a Sub Graph. So in order to add them to your Shader Graph just add the desired Sub Graph.

Next to the already mentioned shortcomings we have further restrictions when it comes to Shader Graph at the time of writing: No alpha to coverage, no stencil support. So Shader Graph and custom nodes will let you achieve a lot of things not possible without custom nodes but they do not fully replace the need for manually written HSLS shaders.

Adding Emisission

In case it is not obvious :) — adding a “real” emission feature is straight forward: Just combine your custom emission with the *FinalLighting* most likely using “add” and plug the result to the *Emission* slot of the *PBR Master*. *FinalLighting* will be set to black = 0,0,0 in the meta pass, so the meta pass actually only sees the custom emission.

Unfortunately Shader Graph’s material inspector does not set the *Lightmap Flags* for emission. This one can be fixed by editing the material: Select the material, change the inspector to *Debug* mode, then set the *Lightmap Flags* from 4 to 2.



Feature variants

As Shader Graph does not support custom keywords, optional features such as normal mapping or rim lighting are controlled by booleans exposed by the lighting functions. You have to feed these inputs with constant(!) values (which are known at compile time), so that the shader compiler can wipe out all related “if” constructions and will produce performant code. Do not expose these booleans in the inspector. At least not in the final build :)

So in order to create feature variants for different materials you actually have to duplicate the shader graph, then edit the constants within the graph.

Please have a look at the provided sample graphs.

Toon Lighting

I never ever looked into toon lighting before. So this is my first toon lighting function inspired by Unity's Chan project. It supports duo tone lighting by letting you define lit and unlit albedo values, supports rim lighting as well as eyeballed *BlinnPhong* specular highlights (no PBR).

As simple Toon Outline shader is included in the package as well.

Toon lighting using duo tone shading and rim lighting. Specular lighting is muted as *Specular* is set to black in the example materials. Deactivating Specular lighting in the shader however would be more performant.

Sub Graph Inputs

Albedo Diffuse color

Shaded Albedo Darkened diffuse color which is used on unlit pixels.

Specular Color of the specular highlights.

Shininess Drives the brightness and size of the specular highlights.

NormalTS Normal in tangent space (needs *Enable Normal Mapping* to be checked at compile time).

Occlusion Ambient occlusion.

Diffuse Step Lets you define where the shader switches from unlit to lit.

Diffuse Falloff Lety you define the edge or feather between unlit and lit. *Smaller values will result in a sharper edge.*

Specular Step Lets you define where the shader switches from no highlight to highlight. *Should be around 0.5*

Specular Falloff Lets you define the edge or feather of the highlight. *Smaller values will result in a sharper edge.*

Shadow Falloff Lety you define the edge or feather of the real time shadows. *Smaller values will result in a sharper edge.*

Rim Power Defines the width of the rim lighting

Rim Falloff Lets you define the edge or feather of the rim lighting. *Smaller values will result in a sharper edge.*

Rim Color Rim color.

Rim Attenuation Drives the influence of diffuse lighting (angle attenuation and shadows) on rim lighting.

LightMapUV In case you use lightmaps feed in the proper lightmap UV channel (UV1)

Enable Specular (Feature variant to be defined at compile time) If checked the shader will calculate specular BlinnPhong based highlights.

Enable Normal Mapping (Feature variant to be defined at compile time) If checked the shader will transfer the provided normal in tangent space to world space. Otherwise the vertex normal will be used for shading.

Enable Rim Lighting (Feature variant to be defined at compile time) If checked the shader will calculate rim lighting.

Main light colorizes shadows (Feature variant to be defined at compile time) If checked the directional light will colorize all pixels of the material — even the unlit ones. NdotL and shadows will be ignored.

Add lights colorize shadows (Feature variant to be defined at compile time) If checked additional lights will colorize all pixels of the material — even the unlit ones – based on distance attenuation only. NdotL and shadows will be ignored.

Additional Lights colorize the shaded parts.

Additional Lights do not colorize the shaded parts.

Sub Graph Outputs

FinalLighting The final lighting to be plugged into the Emission slot of the PBR node.

MetaAlbedo Outputs black for the regular lighting pass, contains albedo for the meta pass.

MetaSpecular Outputs black for the regular lighting pass, contains a standard dielectric specular value for the meta pass (the specular color as used by the shader is not physically based).

Transmission Lighting

The transmission lighting function is a slightly simplified version of the lighting used by the HLSL shaders as it does not support wrapped around diffuse lighting.

The package provides two shader examples with different complexity.

Sub Graph Inputs

Albedo Diffuse color

Specular Specular color.

Smoothness Smoothness.

NormalTS Normal in tangent space (needs *Enable Normal Mapping* to be checked at compile time).

Occlusion Ambient occlusion.

Alpha In case you switch your shader graph to transparent you have to feed in an alpha value here.

Transmission Strength Lets you scale transmission. Usually fed with thickness and a multiplier.

Transmission Power Determines view dependency. Higher values will make transmission kick in only when the view ray more or less directly points towards the light source.

Transmission Distortion When calculating transmission the shader distorts the inverted light direction vector slightly by the given normal to simulate the scattering. Default value is 0.01. Higher values will give you more scattering and break up the uniform look.

Transmission Shadow Strength As transmission might be totally eliminated by self shadowing this parameter lets you suppress shadows when it comes to transmission. Other lighting features (diffuse, specular) are not affected.

LightMapUV In case you use lightmaps feed in the proper lightmap UV channel (UV1)

Enable Normal Mapping (Feature variant to be defined at compile time) If checked the shader will transfer the provided normal in tangent space to world space. Otherwise the vertex normal will be used for shading.

Sub Graph Outputs

FinalLighting The final lighting to be plugged into the Emission slot of the PBR node.

MetaAlbedo Outputs black for the regular lighting pass, contains albedo for the meta pass.

MetaSpecular Outputs black for the regular lighting pass, contains the specular value for the meta pass.

Charlie Sheen Lighting

Charlie Sheen lighting is suitable for most cloth materials as it adds some sheen or fuzz lighting at grazing angles — caused by little fibres stinging out of the material.

The provided Shader Graph is set up to support single sided materials as well using the *Double sided flipped normalTS* node handle normals on back faces properly.

Sub Graph Inputs

Albedo Diffuse color

Specular Specular color.

Smoothness Smoothness.

NormalTS Normal in tangent space (needs *Enable Normal Mapping* to be checked at compile time).

Occlusion Ambient occlusion.

Alpha In case you switch your shader graph to transparent you have to feed in an alpha value here.

Sheen Color Color which tints the specular highlights.

Transmission Strength Lets you scale transmission. Usually fed with thickness and a multiplier.

Transmission Power Determines view dependency. Higher values will make transmission kick in only when the view ray more or less directly points towards the light source.

Transmission Distortion When calculating transmission the shader distorts the inverted light direction vector slightly by the given normal to simulate the scattering. Default value is 0.01. Higher values will give you more scattering and break up the uniform look.

Transmission Shadow Strength As transmission might be totally eliminated by self shadowing this parameter lets you suppress shadows when it comes to transmission. Other lighting features (diffuse, specular) are not affected.

LightMapUV In case you use lightmaps feed in the proper lightmap UV channel (UV1)

Enable Normal Mapping (Feature variant to be defined at compile time) If checked the shader will transfer the provided normal in tangent space to world space. Otherwise the vertex normal will be used for shading.

Enable Transmission (Feature variant to be defined at compile time) If checked the shader will add transmission lighting.

Sub Graph Outputs

FinalLighting The final lighting to be plugged into the Emission slot of the PBR node.

MetaAlbedo Outputs black for the regular lighting pass, contains albedo for the meta pass.

MetaSpecular Outputs black for the regular lighting pass, contains the specular value for the meta pass.

GGX Anisotropic Lighting

GGX Anisotropic lighting is suitable for cloth materials, which have a rather closed surface and more or less no fibres stinging out. It can be used for any other anisotropic surface as well. It is a quite expensive lighting model tho.

The provided Shader Graph is set up to support single sided materials as well. It uses the Double sided flipped normalTS node to handle normals on back faces properly.

Sub Graph Inputs

Albedo Diffuse color

Specular Specular color.

Smoothness Smoothness.

NormalTS Normal in tangent space (needs *Enable Normal Mapping* to be checked at compile time).

Occlusion Ambient occlusion.

Alpha In case you switch your shader graph to transparent you have to feed in an alpha value here.

Anisotropy Controls the scale factor for anisotropy. 0 would be standard isotropic lighting, values smaller or greater 0 will shift the specular highlights according to the tangent or bitangent.

Transmission Strength Lets you scale transmission. Usually fed with thickness and a multiplier.

Transmission Power Determines view dependency. Higher values will make transmission kick in only when the view ray more or less directly points towards the light source.

Transmission Distortion When calculating transmission the shader distorts the inverted light direction vector slightly by the given normal to simulate the scattering. Default value is 0.01. Higher values will give you more scattering and break up the uniform look.

Transmission Shadow Strength As transmission might be totally eliminated by self shadowing this parameter lets you suppress shadows when it comes to transmission. Other lighting features (diffuse, specular) are not affected.

LightMapUV In case you use lightmaps feed in the proper lightmap UV channel (UV1)

Enable Normal Mapping (Feature variant to be defined at compile time) If checked the shader will transfer the provided normal in tangent space to world space. Otherwise the vertex normal will be used for shading.

Enable Transmission (Feature variant to be defined at compile time) If checked the shader will add transmission lighting.

Sub Graph Outputs

FinalLighting The final lighting to be plugged into the Emission slot of the PBR node.

MetaAlbedo Outputs black for the regular lighting pass, contains albedo for the meta pass.

MetaSpecular Outputs black for the regular lighting pass, contains the specular value for the meta pass.

Clear Coat Lighting

Clear coat lighting for materials such as car paint.
Please note: The clear coat lighting effectively doubles the cost of specular computations.

The provided Shader Graph uses simple slider inputs for most properties. You may however change it to texture lookups of course.

Sub Graph Inputs

Base Color Diffuse color (albedo) of the base layer.

Secondary Color secondary diffuse color of the base layer which will be applied at grazing angles (needs *Enable Secondary Color* to be checked at compile time).

Base Layer Specular Specular color of the base layer.

Base Layer Smoothness Smoothness of the base layer.

Base Layer NormalTS Normal of the base layer in tangent space (needs *Enable Normal Mapping* to be checked at compile time).

Base Layer Occlusion Ambient occlusion for the base layer.

Alpha Would be needed if you created a transparent material. Default is 1.

Clear Coat Drives the thickness of the coat which influences the darkening of the albedo of the base layer towards grazing angles.

Clear Coat Smoothness Smoothness of the clear coat.

Clear Coat Specular Specular of the clear coat. Default is RGB(51,51,51). *Actually you should not really change it as some calculations are based upon the default value.*

LightMapUV In case you use lightmaps feed in the proper lightmap UV channel (UV1)

Enable Normal Mapping (Feature variant to be defined at compile time) If checked the shader will transfer the provided normal in tangent space to world space. Otherwise the vertex normal will be used for shading.

Enable Secondary Color (Feature variant to be defined at compile time) If checked the shader will mix *Base Color* and *Secondary Color* according to the viewDirection.

Enable Secondary Reflection Sample (Feature variant to be defined at compile time) If checked the shader will sample the given reflection probe twice: once for the coat layer and once for the base layer. By default reflections get only applied to the coat layer. *Expensive but worth it on certain materials such as coated carbon fibres.*

Sub Graph Outputs

FinalLighting The final lighting to be plugged into the Emission slot of the PBR node.

MetaAlbedo Outputs black for the regular lighting pass, contains albedo for the meta pass.

MetaSpecular Outputs black for the regular lighting pass, contains the specular value for the meta pass.

Transparent Lighting

This lighting node offers advanced lighting for transparent surfaces and makes them receive proper directional light shadows.

You may combine a material using this shader with a material using the *Lux simple multiply* Shader Graph to actually tint transparent objects or tweak the albedo/alpha input so that it looks as if it would somehow tint the background. Please have a look at the *Custom Shader Graphs Demo* scene to find out more.

Important: In order to get proper PBR lighting you have to set *PBR Master* → *Blend* to *Premultiply*. You also have to feed *Alpha* in the *PBR Master* node as otherwise Shader Graph will not set the needed keyword *_ALPHAPREMULTIPLY_ON* will not be set.

Sub Graph Inputs

Albedo Diffuse color

Specular Specular color.

Smoothness Smoothness.

NormalTS Normal in tangent space (needs *Enable Normal Mapping* to be checked at compile time).

Occlusion Ambient occlusion.

Alpha The alpha value here. **Please note:** You also have to feed *Alpha* in the *PBR Master* node as otherwise Shader Graph will not set the needed keyword *_ALPHAPREMULTIPLY_ON* will not be set.

LightMapUV In case you use lightmaps feed in the proper lightmap UV channel (UV1)

Enable Normal Mapping (Feature variant to be defined at compile time) If checked the shader will transfer the provided normal in tangent space to world space. Otherwise the vertex normal will be used for shading.

Sub Graph Outputs

FinalLighting The final lighting to be plugged into the Emission slot of the PBR node.

MetaAlbedo Outputs black for the regular lighting pass, contains albedo for the meta pass.

MetaSpecular Outputs black for the regular lighting pass, contains the specular value for the meta pass.

Simple Multiply

This Shader Graph lets you create a material which will just multiply on top of the given screen buffer and therefore tint it.

Important: In order to get proper results you have to set *Unlit Master* node → *Blend* to *Multiply*.

Graph Inputs

Tint Color The tint color.

Power The strength of the tint color is calculated according to the NdotV product to add more tint to areas where we might assume a longer way of the light to travel through the medium..

Tint min Lets you specify the minimum amount of tint at flat viewing angles.

Using Multiply we can not handle fog properly. The shader currently simply fades out according to the fog density which makes it vanish when looking towards the skybox.

Double sided flipped normalTS

Helper node for double sided materials which flipps the tangent space normal according to VFACE.

Sub Graph Inputs

NormalTS Normal in tangent space.

Sub Graph Outputs

NormalTS Flipped or unflipped normal in tangent space based on VFACE.

Metallic Albedo to Specular Albedo

Helper node to convert Metallic/Albedo to Specular/Albedo as needed by the custom lighting nodes.

Sub Graph Inputs

Albedo Albedo input.

Metallic Metallic input.

Sub Graph Outputs

Albedo Calculated albedo output.

Metallic Calculated specular color.

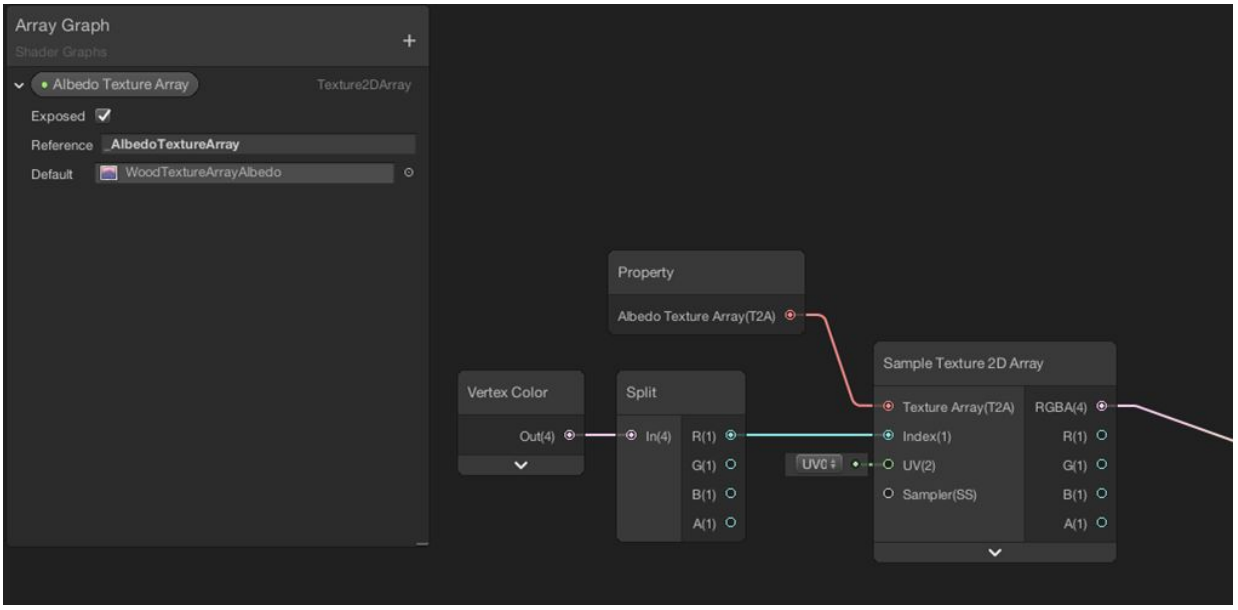
FAQ

Fast or Toon Outlines and multiple Materials

As we can't use multiple passes in LWRP/URP we add the outline effect by adding an additional material to the renderer component. This works fine if your mesh just uses one single material but does not work with multiple materials on the same mesh as Unity will always only draw the last submesh.

So you can either:

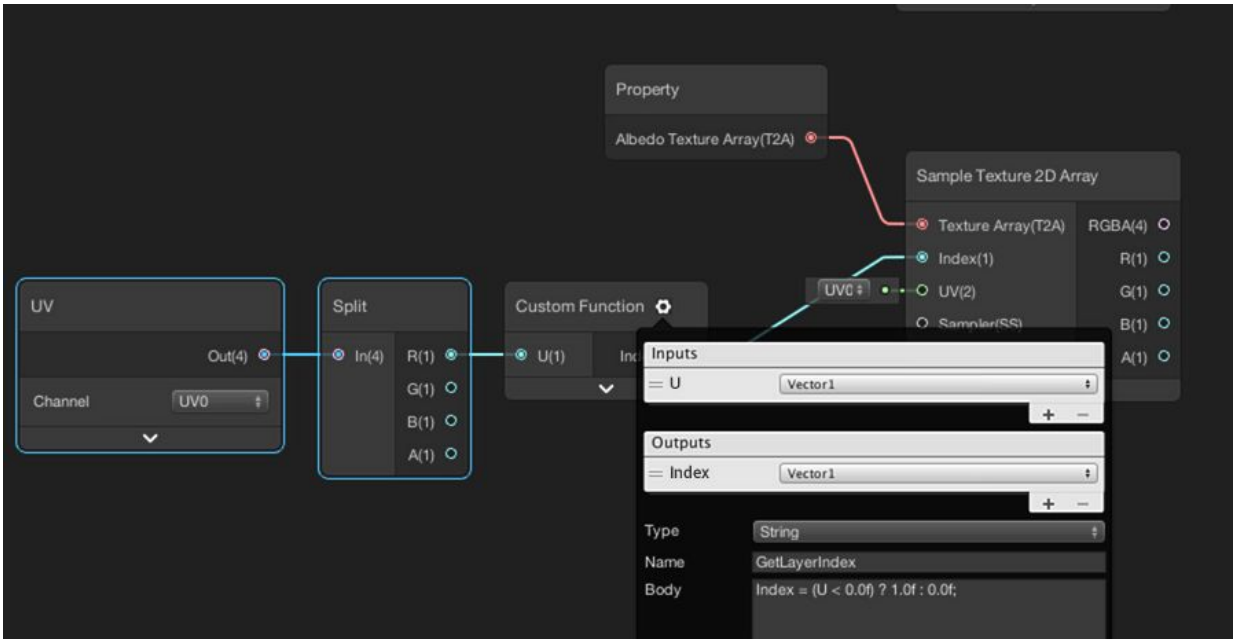
1. Use an additional proxy mesh which only consists of a single material used to only render the outline.
   Might be expensive in case you use skinned meshes.
2. Split up the mesh into 2 meshes = 2 renderers = 2 game objects.
   This far from being ideal but the only solution right now in case the materials use different shaders, different fixed functions or alpha testing and non alpha testing (well, alpha testing is not supported by the outline shaders anyway).
   Please note that some Lux HSLS shaders support advanced and standard lighting like skin and clear coat.
3. Merge the submeshes into one. Then you "simulate" two materials by assigning vertex colors. So material 0 uses e.g. vertex color 0,0,0,0 while material 1 is set to vertex color = 1,0,0,0. In the pixel shader you do not sample a texture2D but a texture array with 2 layers. Which layer will be sampled is then determined by the vertex color. In shader graph this might look like this:



If you do not want to add vertex colors to the mesh (as they will make the mesh data a bit fatter) you could also use different *uv shell positions* to determine material 0 and material 1: Just put the uv shell for material 1 into the negative uv (u) space and keep the shell of material 0 in the positive space.

Then get the index by using: `float index = (uv.x < 0) ? 1.0f : 0.0f;`
Please note that this needs the uvs of mat 1 always to be smaller than 0.0.

In Shader Graph this might look like this:



You will have to do this for all the used textures like albedo, shaded albedo and normal. But of course you have to get the *Index* only once.

In order to **create texture arrays** you may use this free tool from the asset store:

https://assetstore.unity.com/packages/tools/utilities/texture-array-inspector-109547

Creating a tinting glass material

No matter which blending mode you use — you won't be able to create a tinting glass material: Either tinting will look fine or your specular highlights will do. But there is no blending mode which will cover both: Tinting needs multiply, transparent glass however needs premultiply...

The "in shader" solution would be to grab the background, tint it in shader code and render the reflections on top. Then write the result back to the frame buffer. This however would need a "grab pass", read the "grab texture" in the shader, combine both and write the result back to the frame buffer. This is how the included glass HLSL shader does it.

So the question is: Can we get away cheaper?

The answer is yes: If we can afford to render the mesh twice using two different materials.

The first material just tints the background using blendmode = multiply. The second material will add all the lighting using premultiplied alpha blending.

Please have a look at the Custom Shader Graphs Demo → _Transparent Lighting.