

Lab4 – Lighting, Materials and Shading

Objectives

Play with various lighting models, light types, illumination parameters, materials and rendering pathways. Become familiar with how 3D tools, like Unity, use these.

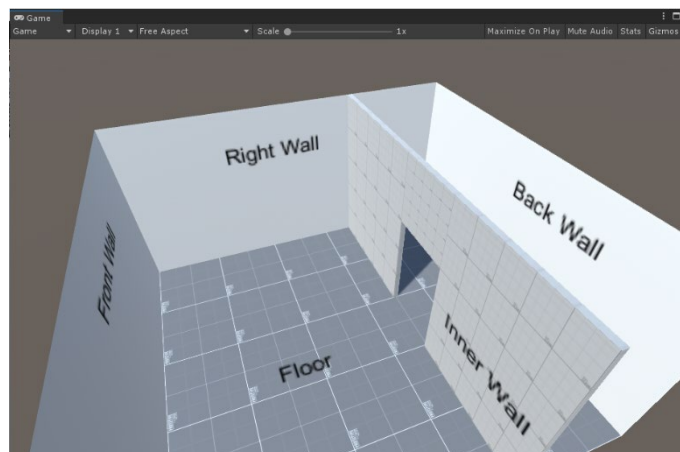
Videos and Required Reading

Your first assignment is to go through at least the first 3 videos (39 minutes) in this playlist I created (<https://www.youtube.com/playlist?list=PL-dl03Z0eHn-rqqkHnJPK1Io1PISCUNmB>). You will construct a scene following the 2nd and 3rd video, while also adding some real-time lighting. Study those videos carefully and repeat them. Some of the steps and additional ones are below. Additionally, read through the Unity manual pages:

- [Static Game Objects](#)
- [Shaders/Built-in shaders/Standard Shader](#)
- [Materials/Material Inspector reference](#)
- [Materials/Using materials with C# scripts](#)

Tasks

- 1) Create a new URP 3D project in Unity 2019.3 or higher. Create the folder structure as discussed for Lab1 (Scenes, Materials, Scripts, ...)
- 2) Create an interior scene similar to that shown to the right. This one is 6 planes for the floor, ceiling and 4 walls, and 3 cubes for the interior cutout. I used a wall thickness of 0.3 meters and the overall room size is 20x20 meters. Feel free to model your apartment or some closed arena, we just want some dark areas and some light areas. Place all of these in an Empty GameObject named Room (make sure to reset its transform before moving objects into it).
- 3) For the Camera, set the clear flag to Color and set the color to black. In the Lighting/Environment, Disable the Skybox, set the Realtime Shadow and Ambient Colors to black.
- 4) Create at least 5 PBR materials and add one to all surfaces, giving the floor, ceiling, back and front, left and right, and inner-walls different materials. The Unity Asset store has several free PBR materials. Look for ones that are bright and Updated Recently (sorting option). Cite what you use in your report. Some possibilities (Note: You may need to convert the materials to URP):
 - a. [9t5 PBR Textures Freebies](#)
 - b. [Gridbox Prototype Materials](#)

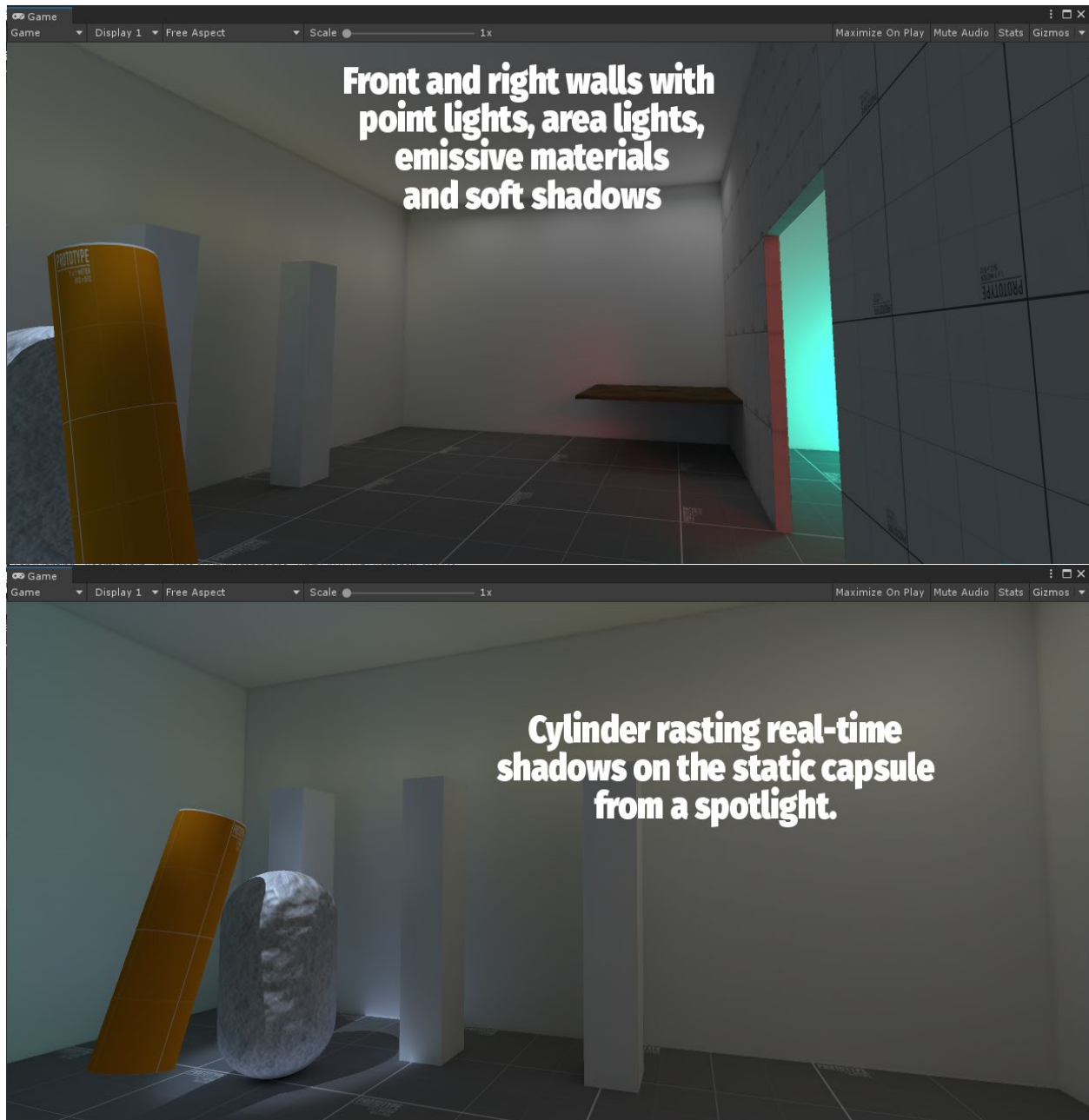


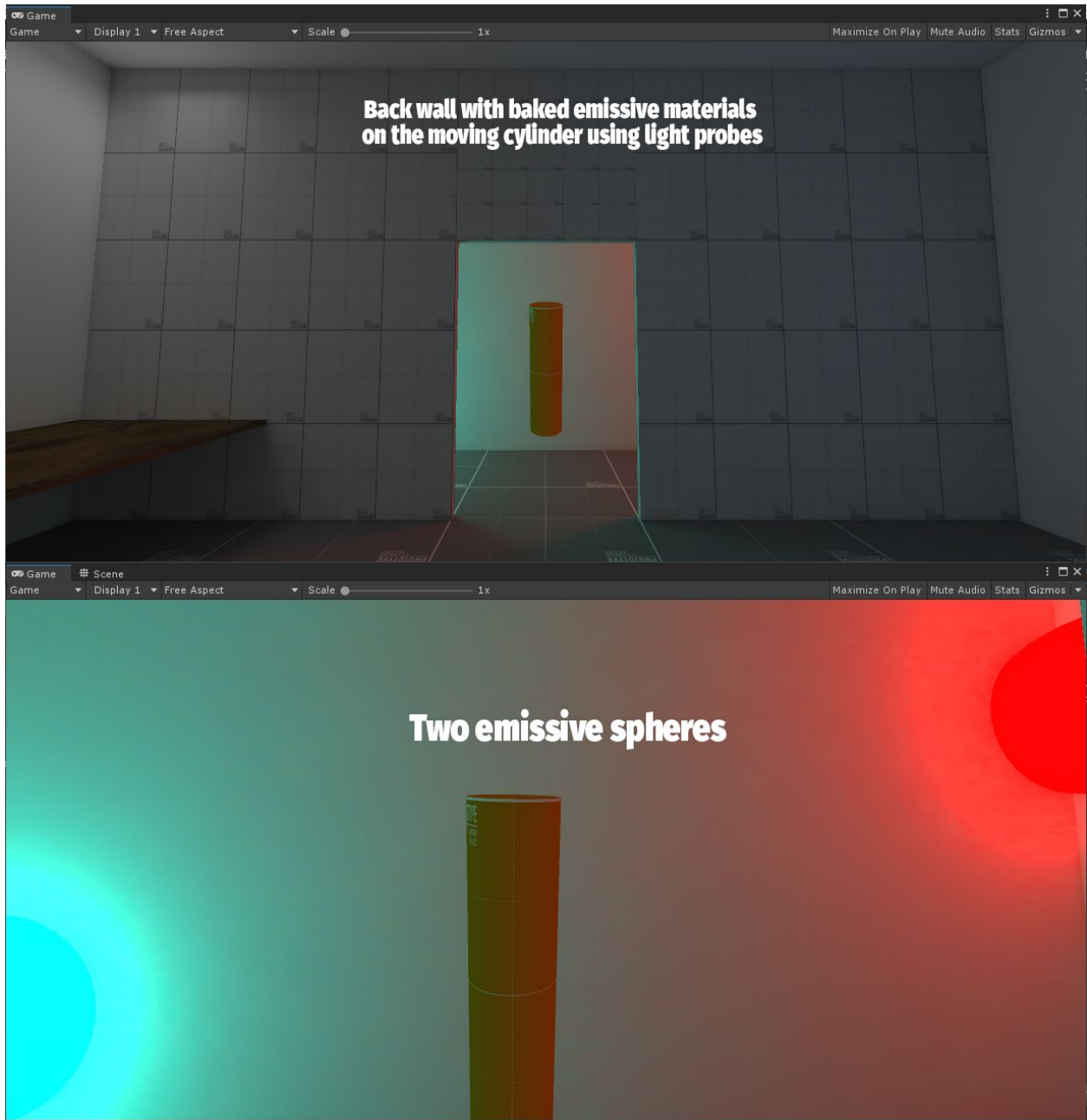
- 5) Add dynamic lights with Mode set to **mixed**:
 - a. Perhaps a downward facing spotlight in the center of the front room. I angled mine slightly. Range: 15, light bluish color, Intensity: 8, Indirect multiplier 1.3, Soft Shadows.
- 6) Add **static** lights with Mode set to **baked**:
 - a. 8-10 Point light sources along the front wall about 2-3 meters from the ceiling. I used 9 at 2-meter spacing, Range: 20, light yellowish color, Intensity: 0.5, Soft Shadows
 - b. 3 area light sources in the ceiling along the right wall in the front room. Rectangle, Range: 15, Width 2, Height 3, Color white, Intensity: 4, Indirect Multiplier: 2, Cast Shadows.
- 7) Create some emissive colors and static objects as follows:
 - a. A glowing-colored emissive object in the back-right corner.
 - b. A glowing-colored emissive object in the back-left corner (perhaps at a different height).
- 8) Add a few static objects that will cast shadows to your scene and assign them new PBR materials. These can be basic primitives in Unity or prefabs from the Asset Store (Look in the category 3D/ Props/Furniture or 3D/Props/Interior). Cite what you use in your report. Some asset store possibilities (Note: You may need to convert the materials to URP):
 - a. <https://assetstore.unity.com/packages/3d/props/furniture/big-furniture-pack-7717>
 - b. <https://assetstore.unity.com/packages/3d/props/interior/polygon-dining-room-199435>
 - c. <https://assetstore.unity.com/packages/3d/props/interior/kitchen-cabinets-low-poly-183890>
 - d. <https://assetstore.unity.com/packages/3d/props/industrial/fps-props-147172>
 - e. <https://assetstore.unity.com/packages/3d/environments/sci-fi/sci-fi-old-rusty-props-pbr-200267>
 - f. <https://assetstore.unity.com/packages/3d/props/interior/picture-frames-with-photos-106907>
 - g. <https://assetstore.unity.com/packages/3d/props/furniture/dublin-chair-185929>
 - h. <https://assetstore.unity.com/packages/3d/props/furniture/hdrp-furniture-pack-153946>
 - i. <https://assetstore.unity.com/packages/3d/props/furniture/bed-bath-furniture-pack-134117>
 - j. <https://assetstore.unity.com/packages/3d/props/interior/qa-books-115415>
 - k. <https://assetstore.unity.com/packages/3d/props/interior/christmas-decoration-props-159202>
 - l. <https://assetstore.unity.com/packages/3d/props/interior/free-rug-pack-118178>
 - m. <https://assetstore.unity.com/packages/3d/props/interior/clock-4250>
 - n. <https://assetstore.unity.com/packages/3d/props/interior/realistic-bed-01-107993>
- 9) Add a dynamic (not static) object to your scene. You can move this around with the transform to see how shadows and lights interact with it.
- 10) Add Light Probes. You can manually place these or better, write an editor script to create them. I will cover this in class. I went overboard and created a volume of 835 light probes procedurally.
- 11) Bake your lighting.
- 12) (Extra credit) Add a spotlight and give it a cookie image. Some free ones in:
 - a. <https://assetstore.unity.com/packages/3d/props/tools/flashlight-pro-53053>
 - b. <https://assetstore.unity.com/packages/3d/props/industrial/builders-torch-with-pbr-and-hdrp-versions-24756>

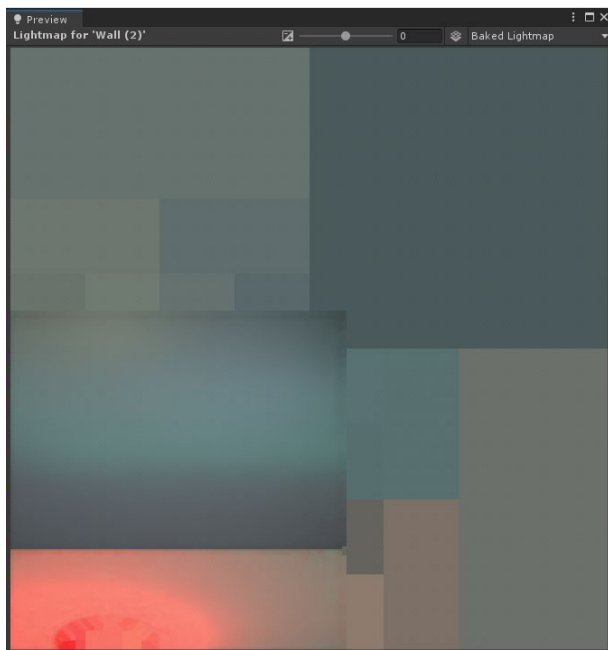
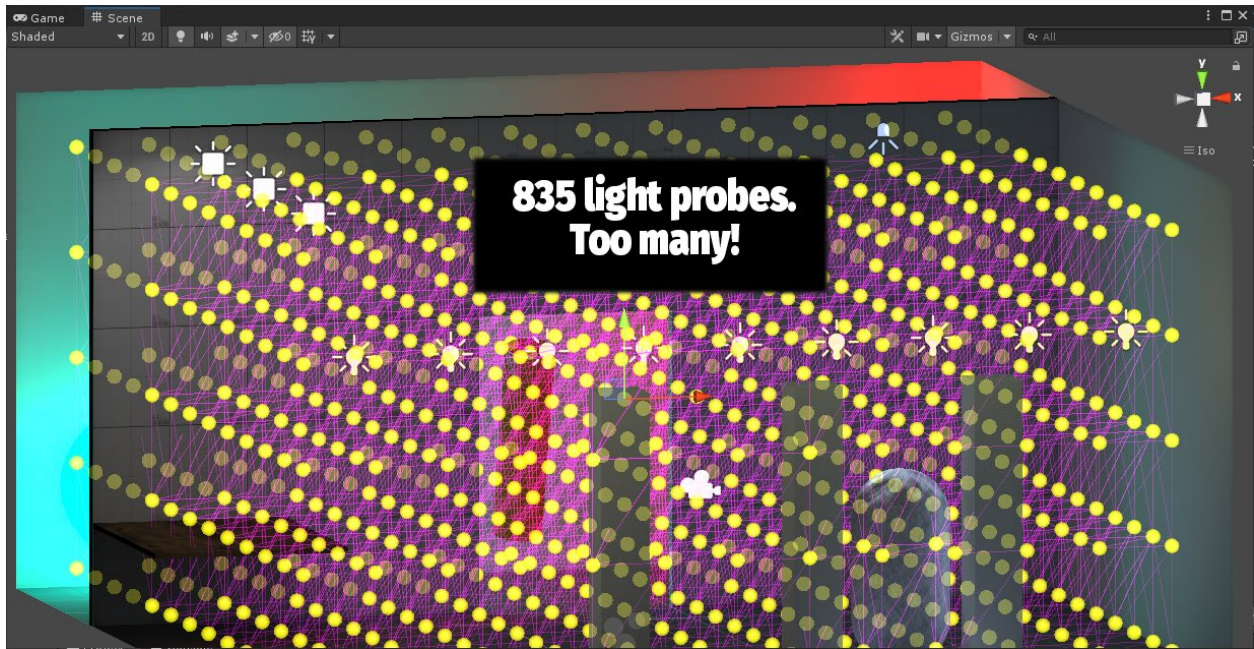
- c. <https://assetstore.unity.com/packages/3d/props/interior/spotlight-and-structure-141453>

- 13) (Extra credit) Add a transparent sprite (A translucent texture set to Fade) to your scene. I used a ghost.
- 14) (Extra credit) Create another perhaps darker scene.

Expected Results







Here is the baked lightmap for the right wall:

Project Report

For this assignment, you will only hand in a PDF report. Address the following questions in your report. Please include the question as well as your answer and use images to explain your answer:

- 1) What is in your scene? What is static? What is dynamic?
- 2) Where are your lights placed?
- 3) For your wall of 8-10 point-light sources. What is the difference between mixed lighting and baked lighting? Illustrate using images in both settings. Does your lighting need to be re-baked after changing these settings?
- 4) What happens when you turn some of these lights off, like say the first 4 in your hierarchy? Is there a difference when you turn off the first few in your hierarchy versus the last few?
- 5) What seems to be a good number of light probes placed on a grid?
- 6) What seems to be a good number of light probes adjusted as in the videos?
- 7) Why does my image of the right wall have a red tint?
- 8) What is a PBR material?
- 9) What is the difference between real-time, baked and mixed light modes?
- 10) How much memory did your baked lighting require?