Modeling and animation

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0 Introduction

Since I have worked a tiny bit with Blender before and I wanted to warm up, before staring on the project and show the knowledge I already have with the program. Therefore, I created a little scene with a vase on a table in a photo studio.
I haven't really used Textures and Materials so far, but know the basics of object modeling and scripting.
The following scene was mainly created with "extrusion", "loop-cut" and "bevel" operations. After that, everything in the project was new to me.

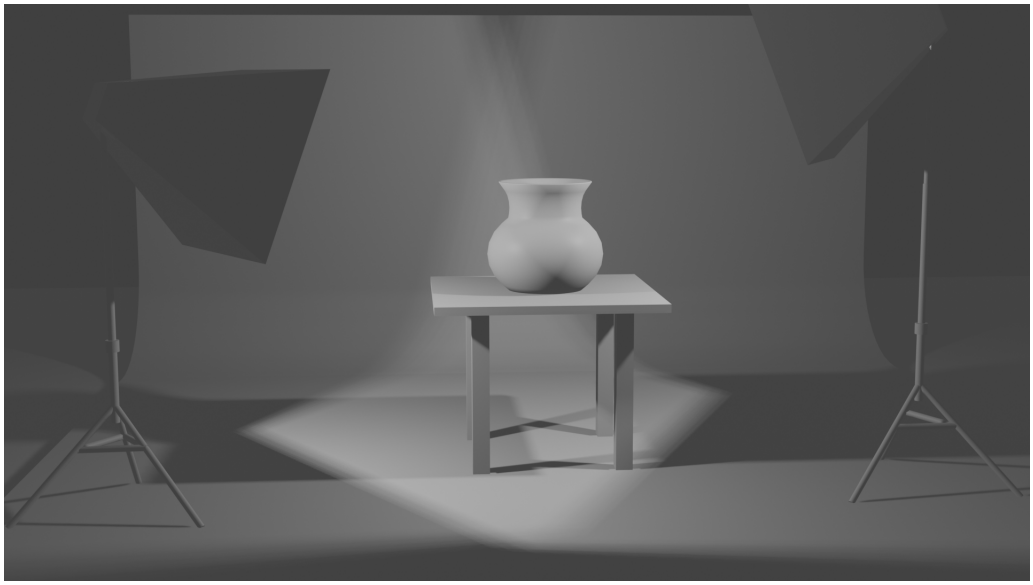


Figure 0.1: Created scene with existing knowledge

1 Objects, lights, camera and render! (Task 1)

1.1 Populate the scene

For the first task, I continued working in the created scene. This way I didn't have to create a new project and already had my first two light sources.

1.1.1 Importing Models

I downloaded a lightbulb and the plant models from polyhaven and the gun model from sketchfab. Since there were some problems with the blend-files, I got the .fbx ones and imported them into the scene.

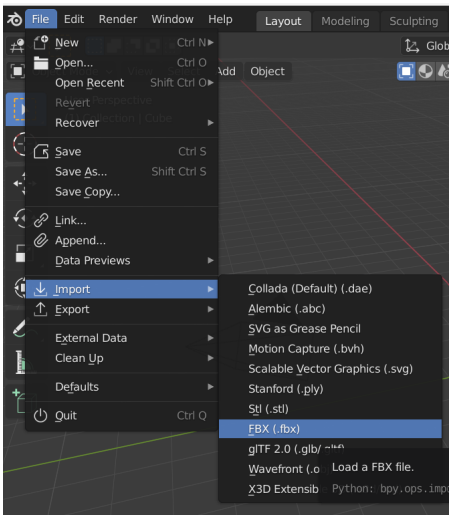


Figure 1.1: Importing fbx

One problem that occurred with the fbx-models, is that the materials didn't load correctly. The plant didn't have a material at all, the gun was all purple and the lightbulb only had one of two materials attached. To fix that, I activated the "Node-Wrangler" add-on and attached the textures to the Principled BDSF, by pressing Ctrl + Shift + t and selected the downloaded textures.

1.1.2 Lighting

For the environment lighting, I downloaded different HDRIs from Polyhaven and tried them out. At the end, I decided against the photo studio HDRI, because it was way too bright (And at that point I didn't realize you could change the strength of the environment lighting). For the non-physical lights, I already added two point-lights inside the soft-boxes, I created in the Introduction.
The emissive light source created a bigger problem, than expected. The plan was to make the lightbulb an emissive object, or to be more specific, I wanted the filament to be emissive. But no matter how bright/strong I turned the emission, the scene didn't get illuminated by it. The cause for this behavior was, that the material of the lightbulb I downloaded, blocked the lighting. To fix that I created my own glass material, with a Glass BSDF and a Transparent BSDF, and made the thickness of the glass 5 mm thick. Additionally, I added a "Light Path" Node to define how the light rays should behave. With these settings, the emissive light bulb looks realistic enough to move on.

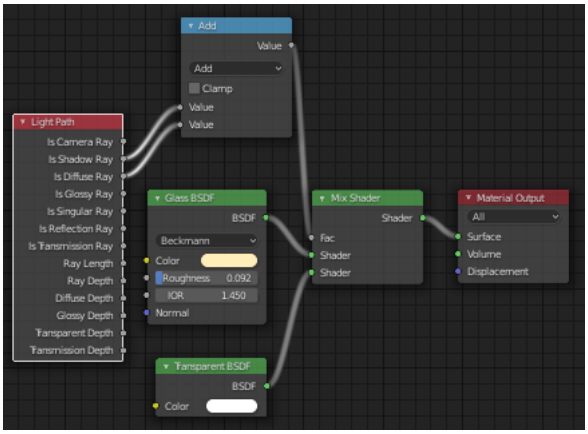
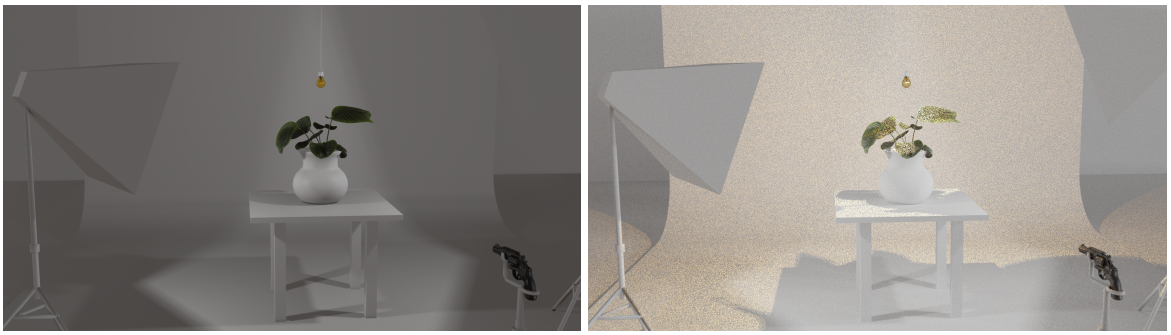


Figure 1.2: Glass Material

1.1.3 Camera and Render

The camera is positioned in a way, that you could see the vase in the middle of the screen and both soft boxes.
At the last step I rendered the scene with Eevee and Cycles.



(a) Eevee (b) Cycles

Figure 1.3: Rendered images with reworked textures

1.2 Compositing

Due to the fact, that the image that was rendered with Eevee doesn't give nice results in combination with the emissive light bulb, the Cycles image was chosen for compositing. Before trying out different operations, a "Denoise" node was added, because the image is very noisy, as you can see in 1.3b. A side effect of the denoise is, that the image looks like a painting. I have added some color grading as well to make the yellow appeal more warm. After that, different filters could be tested with better results.
Since you can still see the filament on the final render pretty clear, the first idea was to put a bloom on light sources to create a more realistic look. This was achieved by using the "Glare" Node with the "FogGlow" setting.
The other two operations that were used are the "Pixelated" and "Lens Distortion" Nodes.
To create a low resolution image with without an Anti-Aliasing effect. The original image gets scaled down, then the pixelated node gets added, and then the image get scaled to its original size.
To make the distorted image look more interesting, I've lowered the "hue" value to give it a purple touch.

Figure 1.4: Glare effect

Figure 1.5: Pixelated effect

Figure 1.6: Lens Distortion effect and changed Hue value

2 Editing objects: materials (Task 2)

2.1 UV-Mapping of Textures

2.1.1 Load and render reference object

To work on the second task, I created a new project and added a plane and a cube, on which I wanted to put the objects. I also added the same HDRI as in Task 1 and put a point light above the Camera to give the objects a shadow.
For the task, I downloaded a potted plant from "Polyhaven", where I didn't like the pot the Plant was in. The file-format I got, was .fbx, since I already knew on how to load them in a way, that the materials gets applied properly. The plant was then put on top of the Cube in the center of it's surface.
The camera was placed with the plant in the middle of its view and then angled in a way, that the front corner of the cube was still visible. After that, I rendered the scene with "Cycles" and the "NLM" denoiser. Image: 6.1a

2.1.2 Add new material

As new material for the pot of the plant, I downloaded a green painted concrete ground and connected it to the Principled BSDF of a new material, using the "node-wrangler" add-on.
In "Edit-Mode" of the potted-plant, I selected the pot, using "l" as a hotkey, to select all vertices of one connected mesh. Then the new material was added to the object and assigned to the selected vertices.
However, the green pot didn't have enough contrast to the green plant. That's why I added a "ColorRamp" Node between the texture and the Principled BSDF and changed the color to a clay brown.
Repeating the steps above, I also changed the texture of the stones inside the pot. Therefore, I downloaded the "coast_sand_rocks" texture and applied it to the rocks. To get better results, I moved the UV-shapes on the images around, until I got results I liked.

At last, I rotated the plant around its z-axes, because the cut of the UV-shape was visible.

2.1.3 Comparison

(a) Old (b) New

Figure 2.1: Rendered images with old and new material

2.2 Procedural Material

Since I already changed the material of the lightbulb in task 1 procedurally, I copied my work there and will explain it in more detail.
First, I positioned the lightbulb in front of the plant on the cube and rendered the reference image with Cycles. Image 2.2a
For the glass material, I combined a Glass BSDF and a Transparent BSDF with a mix shader node (Ref. image: 1.2). However, this time I change the color of the glass, to a brighter, less yellow shade.
At this point, the glass looks like a solid object and doesn't have the typical lightbulb look. To change that, we have to give the material a "Refraction Depth" in the settings. This approximates the thickness of the object. I put this value to 0.5 mm, which felt like a reasonable lightbulb thickness. I also defined, how the light rays should interact with the lightbulb, with the "LightPath" node. This time I removed the "Shadow Ray" connection to give the lightbulb a shadow on the cube. Without the "LightPath" node, the glass doesn't reflect the light realistically, and it looks like there isn't any glass at all.
At last, I assigned the glass material to the desired part of the lightbulb and rendered the image with Cycles.

2.2.1 Comparison

(a) Old (b) New

Figure 2.2: Rendered images with old and new material

3 Modeling objects (Task 3)

For the third task, I looked around my desk and planned to model my desk lamp and my laptop, as well as the vase I already created in the introduction.

3.1 Modeling

3.1.1 Vase

Since I already created a Vase in the Introduction, I just recreated the steps I did there. I started with a Cylinder and created a third ring of vertices in the middle, with the "Loop Cut" tool (Ctrl + r) and scaled it on the X- and Y-Axes to create a bigger circle. The middle ring then was beveled (Ctrl + b) to create a rounded body for the vase. The top face of the cylinder got removed, and then I extruded (e) the top ring and made it bigger. With another bevel, I created the inwards rounded top part of the vase. With a few more extruding and scaling of edges, the inner part of the vase was created. For the last step, the mesh got smoothed.

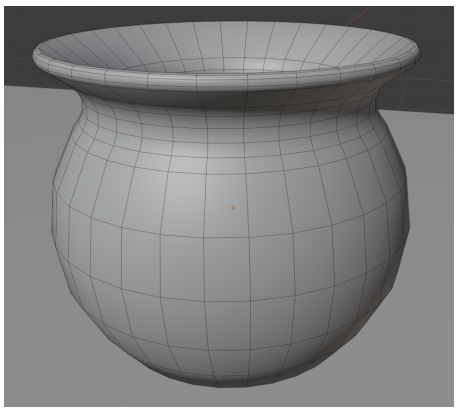


Figure 3.1: Modeled vase

3.1.2 Desk lamp

The second object I wanted to create was my desk lamp.
I started with a flat cylinder as a base and added a thin one for the pole. With the top ring of vertices selected and the "Spin" tool (Shift + Numpad 0), I curved the pole to 45° angle and repeated the step in the other direction, to give the pole a nice curve.
To create the lampshade holder, I created a few more cylinders and a flat cube, that I used the "Spin" tool on to create a semicircle. The cylinders were brought in the desired shape using, extrusion and scaling.
For the lampshade itself, I used a sphere, where I deleted the bottom half vertices and elongated it. With a "Solidify" modifier, I gave it some thickness.
The last step was to add the power cable, which leads from the top of the lampshade to the base and then away from the lamp. Since there were way too many smooth curves and different rotations in the power cord, using the "Spin" tool on a cylinder would be way too exhausting. That's why I added a "Path" curve, positioned it the way I wanted and gave it some thickness.

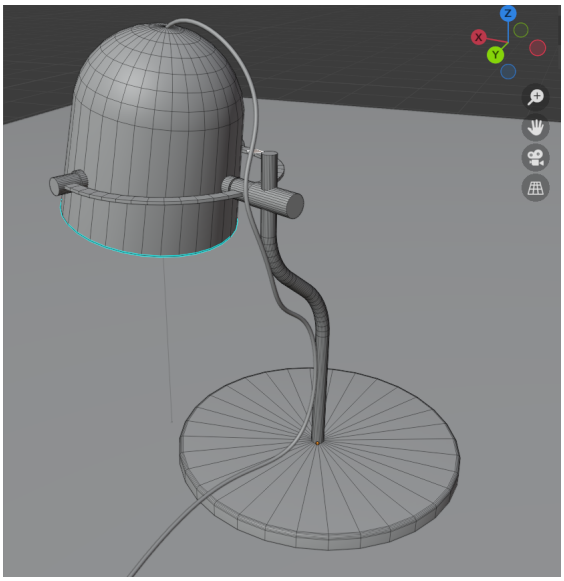


Figure 3.2: Modeled desk lamp

3.1.3 Laptop

The third object I wanted to model was my laptop. The main structures are two flat cubes for the screen and the keyboard. With the boolean modifier and some cubes, which were formed into the right shaped, I cut out the touchpad and the hole where the keys are in. By extruding the laptop cube and pushing it inwards, we can create the screen. At last, I added details like the keys and connection parts between keyboard and screen, as well as the correct text on the keys.

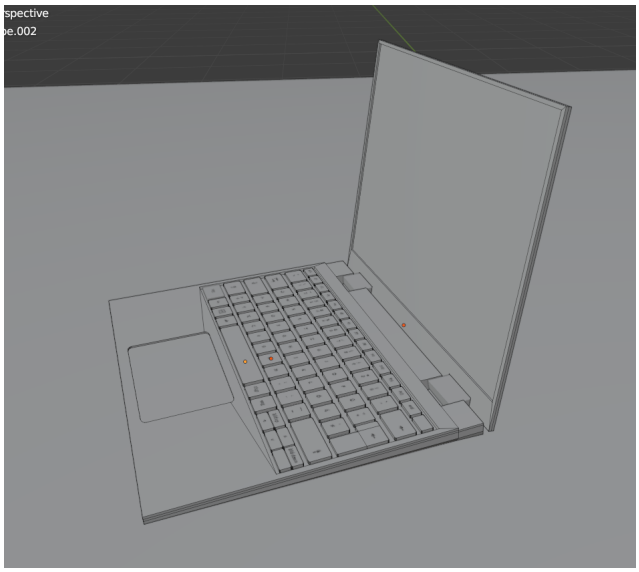


Figure 3.3: Modeled laptop

3.2 Material

3.2.1 Vase

For the vase, I downloaded two different clay materials. One with some structure and a smoother one. The smooth one got assigned to the inner part of the vase and the one with some structure to the outer part. To match the colors of the different textures, I added a "Hue Saturation Value" Node to the outer texture.

3.2.2 Desk lamp

The desk lamp has three different textures. A rough aluminum base, the plastic white power cable and a transmissive yellow plastic material for the lampshade. To create all of them, I played around with each "Principled BSDF" and assigned them to the desired part of the lamp. There was no need to download any materials.

3.2.3 Laptop

For the laptop, there were a few more materials to create. The base of it is an aluminum material with a black checkerboard styled carbon fiber on top. For that, I assigned a little darker shade of the aluminum material to the bottom of the base and created a new material for the top part. As input for the "Base Color" I used a "Checker Texture" with two different shades of black. The touchpad and keys do not have this checkerboard style black and just got a smooth black material assigned. For the screen, I assigned the aluminum and smooth black material to the frame and created a black glass material for the screen itself. For that, I used a glass bsdf in combination with a transparent bsdf. To give the laptop a finishing touch, I gave the text on the keys an emissive light blue material to create a glowing effect.

3.3 Render

To create the scene, I placed the objects on a plane and gave it a wood texture. I added an environment texture, as well as a point light inside the desk lamp.
For the light, inside the desk lamp, to render properly, I had to render with cycles.

Figure 3.4: Rendered modeled objects

4 Animation basics (Task 4)

Animations that loop have always been one of my favorite kind of animations. That is why my idea for the third task was, to create a ball rolling down a track infinitely.

4.1 Modeling

For the first step, I had to create the ball's path. Therefore, I added a Bézier curve, which curves downwards and then a little bit upwards again. Then I cut a cylinder out of a cube with the boolean modifier and made it follow the Bézier curve. I duplicated the path and put one in front and another one after the created one.
I also use the path as background with an array modifier, to give it a repetitive design, to make the animation seamless at the end.

4.2 Animation

For the animation, I added a sphere to the scene, gave it the "Follow Path" constraint and made it follow the Bézier curve. After applying that, the ball has a linear motion down the given path. To make it more realistic, I added some keyframes to the motion at the turning points of the curve. Then I open up the graph editor and edited the animation curve to give the ball the desired speed at the different parts of the path.

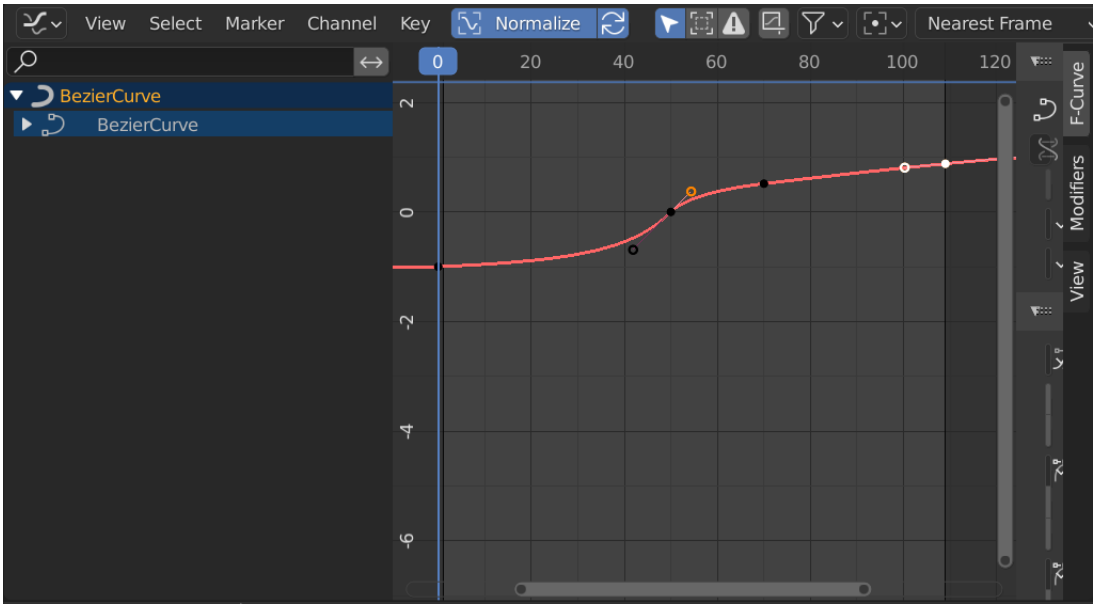


Figure 4.1: Graph editor with translation curve

Now the ball follows the path with the right speed, however, it is missing the rotation. So I added a keyframe for the sphere at the end of the bath with a -1080° rotation around the x-axis. Then again, I opened up the graph editor and increased the rotation speed when the ball rolls faster and decreased it during slow phases, for example at the end of the path.
At last, I gave the camera a linear motion to follow the ball during the animation.

4.3 Materials

Since I already had a wood material, I assigned that to the track. To give it the proper look, I had to edit the UV-Shape a little bit. For the ball, I downloaded a "Rusty metal" material and changed the color to give it a blue and greenish look.

4.4 Render

With all that done, I rendered the scene to a video with Cycles. I used Cycles because the ball reflects the light of a "Sun Light" I positioned behind the camera, which would not look good with an Eevee rendered animation.

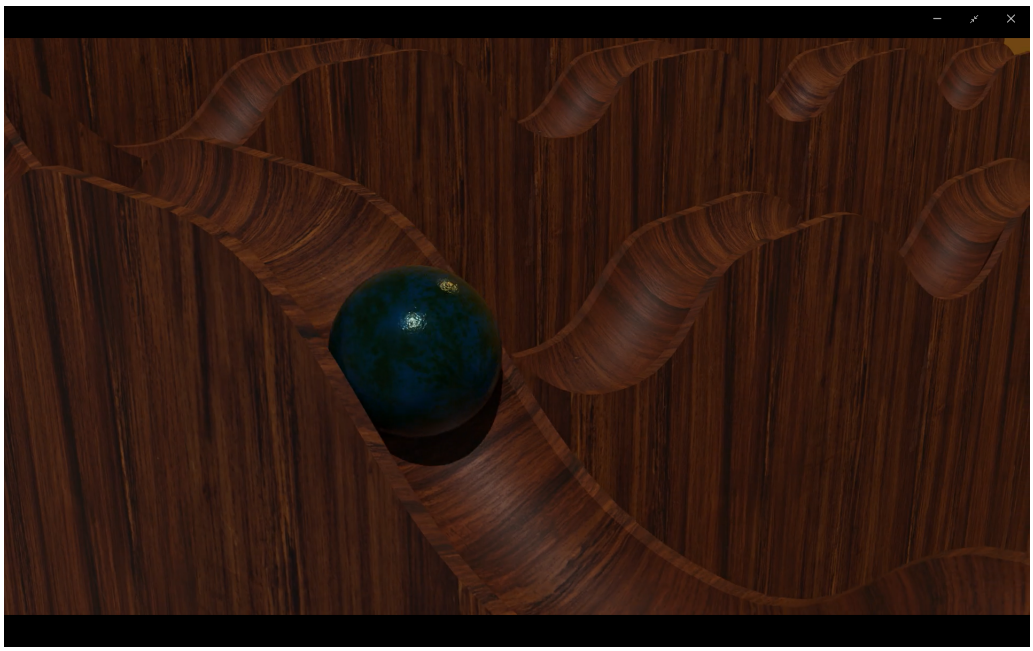


Figure 4.2: One frame from the rendered video

5 Physical Simulation (Task 5)

The main idea for the physics simulation was to let a ball drop into a bowl of water and create a splash, in combination with fog and backlighting.

5.1 Modeling

For the bowl, I cut out a smaller sphere from a bigger one and removed the top half of the remaining mesh. I did the same for the smaller sphere and scaled it down a bit to use it as the water for the following water simulation. Then I added a back wall and two spotlights. One shining from the top down and one as backlight, to achieve a blinding effect in combination with the fog. For which I used a big cube around the whole scene and added a volumetric material to it, with a noise texture and a "ColorRamp" node.

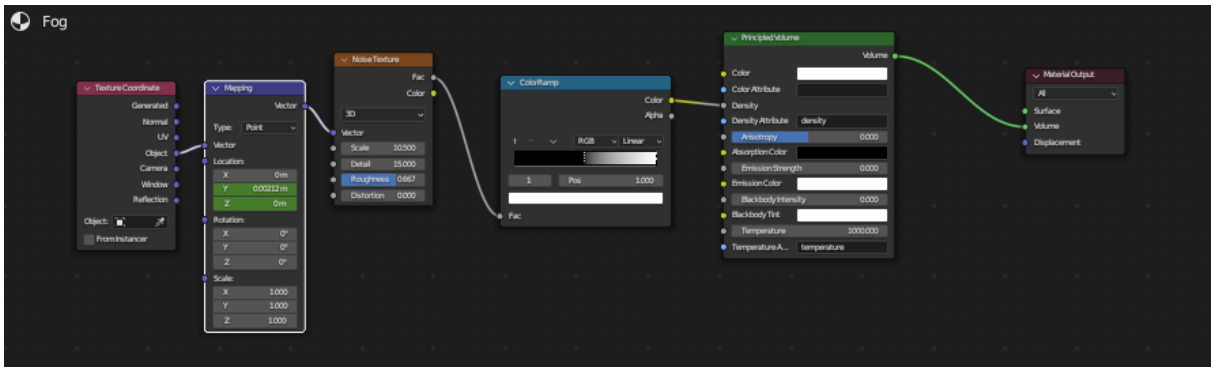


Figure 5.1: Volumetric fog material

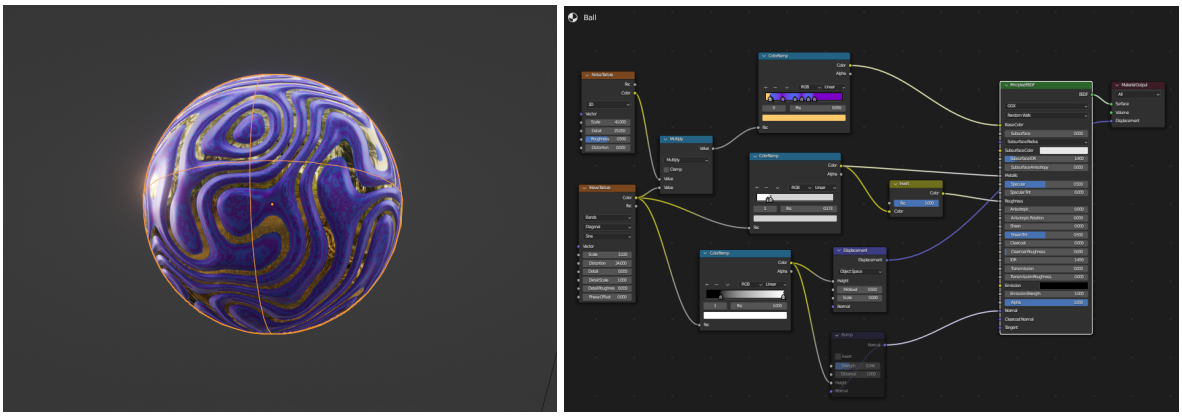
5.2 Simulation

For the physics simulation, I placed a cube around the bowl and the water and gave it a fluid modifier in the physics tab. It got the domain type, which means that the physics for the liquid will only be calculated inside this box. I gave it border collision on the bottom and the sides, so that the water stays on the table if it overflows out of the bowl. Then I added a cube as a collider for the water, because the walls of the bowl are too thin, which creates the risk for the water to clip through the bowl. I used the boolean modifier again, to cut the bowl out of the cube. To let the collider interact with the fluid, I applied a fluid property with the "Effector" type to it.
For the ball, I added a sphere to the scene and placed it above the bowl and added a rigid body modifier to the ball, as well as to the collider. The ball's rigid body type was set to active, the colliders to passive, because the ball is supposed to drop when the simulation starts and the collider is supposed to stay in place, but interact with the ball. To give the ball an initial speed, some frames before the drop got animated and the rest of the downfall simulated. This was achieved by giving the "Animated" Setting of the rigid body key frames.
In order for the ball to interact with the fluid as well, I gave it, similar to the collider, a fluid property with the "Effector" type.
After all that was set up, the simulation got baked and a mesh for the finished simulation of the fluid created.

5.3 Material

Apart from the fog, there were four more objects that needed a material.
Firstly the water, for which I used a "GlassBSDF" in combination with a "TransparentBSDF" and changed the color to a slight light blue. I also added a bump map with a noise texture, in order for the water to not be too smooth.
For the bowl, I downloaded another wood material and assigned it to the whole object.
The third object I worked on was the table the bowl is standing on. For the table I wanted to create a metallic table whit bumps on the surface. Similar to tables, you can find in front of bistros. That's why I added a "Bump" Node with a checker texture to the "PrincipalBSDF" and gave it a metallic look.
The last texture I worked on was the one for the ball. Even through it will fall through

the screen very fast and with a lot of motion blur on, I wanted to understand the material nodes a little better and put some work into the balls material. The idea was to have a purple ball with engraved gold. For the overall look, I added a wave texture with a color ramp and put the sliders close together to the left of the bar. Then I changed one to yellow and the other one to purple. Then I added another color ramp and moved the sliders to a similar position as the ones in the first color node. The output got plugged in the metallic part of the "PrincipledBSDF" and inverted into the roughness part. Since it uses the same wave texture, the yellow part of the ball is very metallic and looks like gold and the purple part is more rough and not that metallic. In order for the gold part to be engraved into the ball, I added another color ramp node to the same wave texture and put the black slider to the same position again. This output got plugged into a displacement node and added to the material output. In order for the purple side to not as clean as it does a that point, I added a noise texture, multiplied it with the wave texture and added it to the first color ramp I created. Then I added a few more sliders to then node and switched the colors between the purple and a light blue.



(a) Ball in material preview (b) Nodes of ball material

Figure 5.2: The finished ball material

5.4 Compositing

To give the images a finishing touch, I added a "Denoising" and a "Glare" node with the "FogGlow" property. Since the spotlight shines through the fog onto the bowl. This effected the water as well, because it applied the glare effect to little bright reflection spots on the water, which had an interesting effect.

5.5 Render

After everything was finished, I rendered the animation with "Cycles" to give the water realistic light reflections.

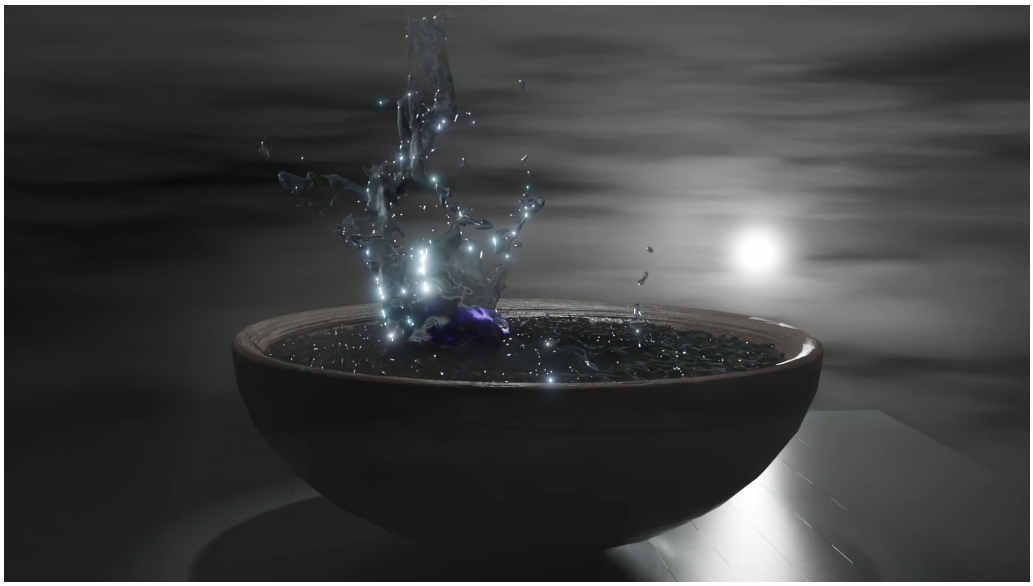


Figure 5.3: One frame from the rendered animation

6 Geometry Nodes (Task10)

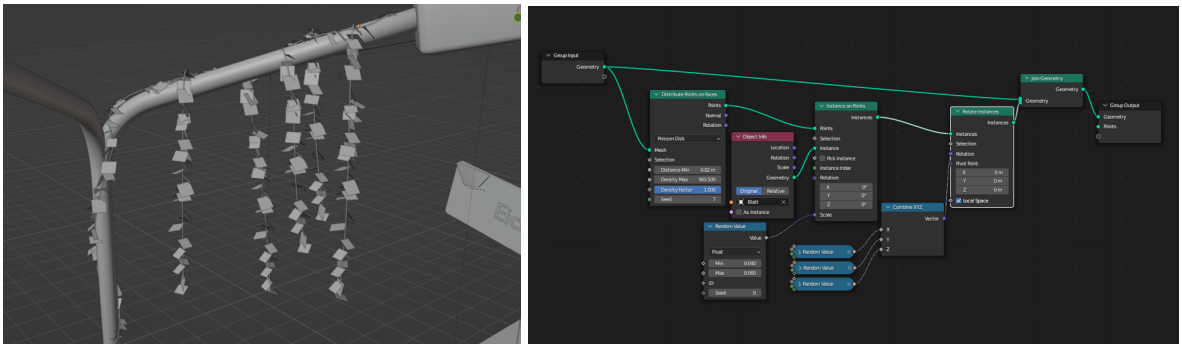
The main idea for the geometry node task was to create a short animation of an old, decayed entrance into a village. The street sign and the streetlight are supposed to be overgrown by plants for which I want to use geometry nodes. Since it would take too long (and been done several times for all the other tasks) to describe the whole process of creating the scene, I will just focus on then ivy on top of the streetlight I created using geometry nodes.

6.1 Modeling

Since ivy wrangles itself around objects an upwards towards the sun, I used path curves for the steam if the ivy and made it go around the pole of the streetlight and on top. Then I added a few more stems hanging down from the top, using path curves again.

6.1.1 Geometry Nodes

For the leafs, I used geometry nodes. Therefore, I added the "GeometryNodes" modifier to the stem of the ivy. In the geometry nodes tab, I then used a "Distribute Points On Faces" node to created random points on the curves. With the "Instance On Points" node, I added planes as leafs in different scale to the points. The last step was to use the "Rotate Instances" node, to give the leafs a random rotation to make it look more natural.



(a) Ivy on streetlight (b) Geometry Nodes

Figure 6.1: The finished Ivy object

6.2 Animation

I wanted the hanging ivy to swing a little in the wind, that's why I animated a rotation around the connections between the main stem and the hanging stems. I checked that the start and end positions were the same, in order for the animation to loop.

6.3 Material

For the material, I just made the stems brown, because they are pretty small and not very visible. For the leafs, I looked through my gallery of photos for a picture of a leaf. I then imported it into Blender and in the "TexturePaint" tab I made everything but one leaf black. In the "Shading" tab, I then bound this image texture to a color ramp node and put the right slider all the way to the left. The output of the color ramp was the plugged into the "Alpha" property of the "PrincipledBSDF". I also changed the saturation of the image a little with the "Hue Saturation Value" node and plugged that into the color of the "PrincipledBSDF"

6.4 Compositing

Before the rendering of the animation, I finished up the images with a "Glare" node and a "Pixelated" node. I wanted to pixelate the animation to give it a video game or pixel-art look.

6.5 Render

With everything done again, I rendered the finished animation with "Cycles", because I used a displacement in one of the materials, which wouldn't render if I used "Eevee".

Figure 6.2: One frame from the rendered animation

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