

# TNM061 3D Computer Graphics Materials Lab instructions 2024

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# 1 Introduction

After having created some models in the last lab, it is now time to bring in some colors. Materials, sometimes also called shaders, define the look of an object and can be assigned to the entire object or just parts of it. They give a scene additional depth and details. There is a wide variety of different materials available including standard illumination models like Lambert and Phong as well as more elaborate models for dielectric materials like glass and much more.

Topics covered in this lab:

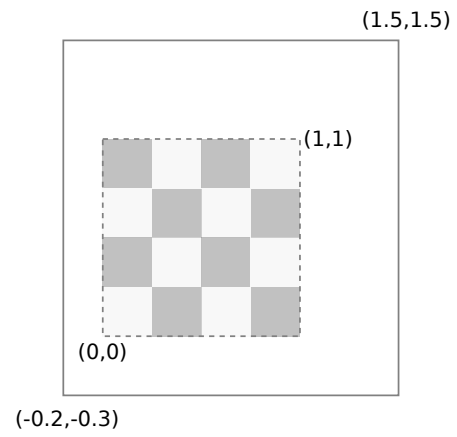
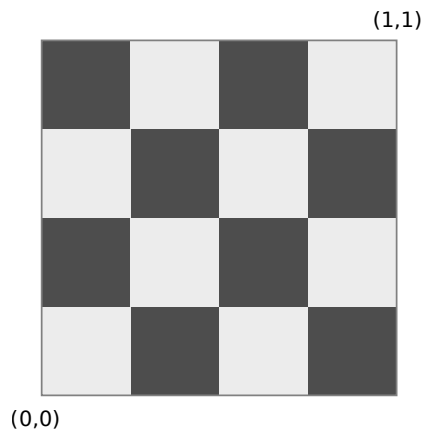
- Material editor
- Basic materials
- Composite or layered materials
- Procedural materials

# 2 Theory

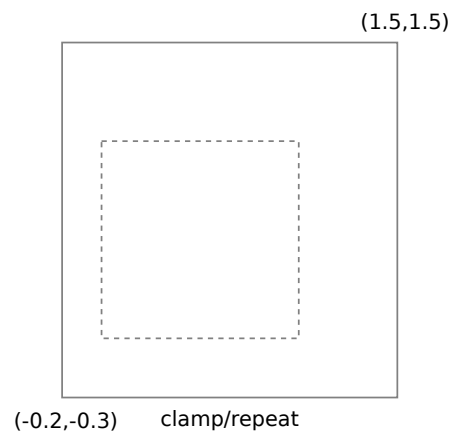
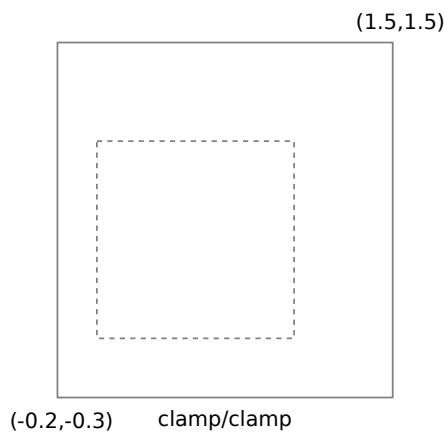
1. Someone modeled a simple lamp shade using a revolution surface for the base and a loft surface for the lamp shade. You can assume that the surfaces created by the loft and revolve operations are a parametric surfaces.

What steps are necessary to use this surface in a game you develop on your own and render it with OpenGL?

2. Is there a difference between normal mapping and bump mapping? Why would you use one or the other? Briefly explain your reasoning.
3. Your task is to model and animate the creation of a marble statue which is chiseled out step-by-step of a solid marble block. What kind of texture would you use here to avoid unnecessary re-texturing when arbitrary parts are cut away?
4. Consider the checkerboard texture defined in texture coordinates  $(0, 0)$ - $(1, 1)$ . This texture is applied to a larger quad. The texture wrapping mode determines how the texture continues outside the range  $[0, 1]$ .



Fill in the textures below. On the left using a clamp wrapping mode for both directions. On the right, use clamp horizontally and repeat in the vertical direction.



## 3 Assignments

In the following you will be using the material editor to create and design new materials for different purposes. You open Blender's [Shader Editor](#) by clicking the drop down menu in the upper left corner of any of Blender's sub-windows (for example the Timeline). When you select **New** in the menu bar of the Shader Editor you create a material and assign it to the object you have selected.

Begin with downloading the [supplemental material](#) for this lab from Lisam.

**Note:** Make sure to save your scene and create rendered images of the final material applied to the objects as defined in the tasks. Present the images to the lab assistant for assessment and feedback during the lab session.

### 3.1 Simple material

1. Import the model of the Utah Teapot (`teapot.obj`) from the lab material. The teapot is quite useful since its curved surfaces can demonstrate the reflection properties of shiny materials. However the default material looks quite boring.
2. Create a new material in the material editor and apply it to the teapot. Adjust the Base Color to a red shade. Set the Roughness and Specular exponent so that the material appears to be made of plastic. You can find a description of some of the material settings here: [docs.blender.org/manual/en/latest/render/materials/](https://docs.blender.org/manual/en/latest/render/materials/).
3. Replacing the colors with a texture or map can add more variation and details to the object's surface. This can either be a texture from a photograph or a procedural texture. Apply a noise texture/map instead of the red diffuse color. Play with the different settings of the noise texture and observe their effect. It might be necessary to adjust the scaling of the texture.
4. Render the teapot with the noise material you created.

### 3.2 Mix material

Have a look at the three textures from the lab material (`stone.jpg`, `grass.jpg`, and `mask.png`). You will now use these textures to create a more complex material with a [Mix Shader](#). The idea is to use a gray-scale mask that defines where the stones are visible and where the grass.

1. Add a cube to your scene, tab into Edit Mode, think about which edges you would need to cut to place the sides on a flat plane, switch to edge select, select the edges, press **U** followed by **Mark Seam**, then press **U** and select **Unwrap**. This is called *UV Unwrapping*.
2. Add a material to the cube.
3. Use the `mask.png` to mix `stone.jpg` and `grass.jpg` with a *Mix Shader* or *MixRGB* nodes to create a material similar to the one shown in Figure 3.2. What is the difference between a Mix Shader and MixRGB nodes?
4. Render the result.

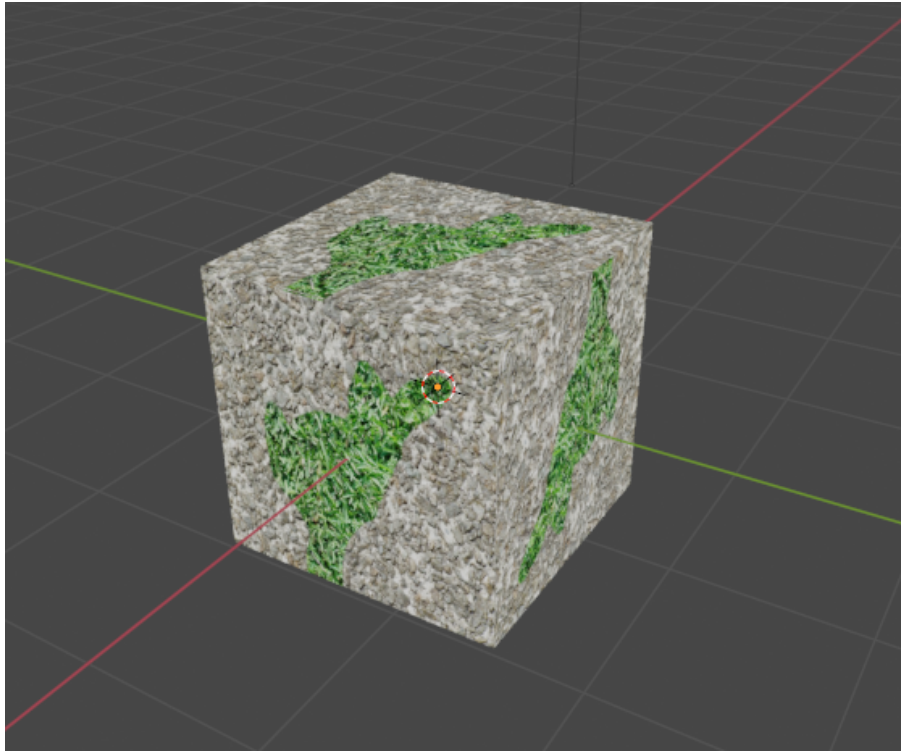


Figure 1: A material using a *Mix* material combining multiple textures into a more complex surface appearance.

### 3.3 Procedural material

Procedural materials can be used to create complex materials without using any images or photographs. It might be hard to get the same level of realism and level of detail as you get from a photo, but the advantage is that every detail such as color, contrast, size, and type of pattern are editable with a few simple changes of parameters, instead of using a separate image editing program and spending considerable effort.

1. Make a checkered tile floor with a *Checker* map.
2. Continue by replacing the colors of the checker board with two *Noise* maps and try to make it look like marble.
3. Noise textures are very important in the context of procedural materials. Create a new material that mimics the look of Task 3.2. Use several noise maps/textures for the different parts of the material. Experiment with different types of noise (*Noise*, *Wave*, *Voronoi*, ...).

*Hint:* start with a coarse noise and apply a threshold with a Colormap node. This should give you a decent mask for blending between the stones and the grass.

4. Apply the material to some objects and render the result.

### 3.4 Procedural materials on objects

Pick at least **three** of the following objects and design a material to create an impression of the real thing. Render the result and save the image.

- An orange or round avocado (sphere). Mimic both glossiness and bumps.
- Meatball (sphere), fresh from the frying pan and slightly charred and greasy.
- Hamburger patty (cylinder), charcoal-grilled with black stripes from the grid.
- Sugar-sprinkled donuts (torus).
- Cobblestone made of granite (cube).
- Worn wooden floor plank (cube), *Wave* map as foundation with a *Bump Map*.
- Heavily-used croquet ball (sphere) with impact marks and flaked paint.

### 3.5 Optional tasks

- **Optional:** Create a suitable material for the custom object you modeled in Lab 3 and apply it.
- **Optional:** Try to apply different materials to different sides of a *Box*. Select a face in Edit Mode and assign a new material to the face under Material Properties.
- **Optional:** Apply a two-sided material (Use the Backfacing plug on the Geometry node) to some object like the teapot or the monkey (Blender). Make the outside appear as orange metal while the inside should be a silvery metal. You may want to remove part of the object's surface to be able to look inside.
- **Optional:** Make thin smoke above the coffee mug from the first lab session, by using a nearly transparent material applied to a plane. Use *Noise*, preferably combined with a *Gradient*.