University of Stuttgart
Institute for Visualization and Interactive Systems (VIS)

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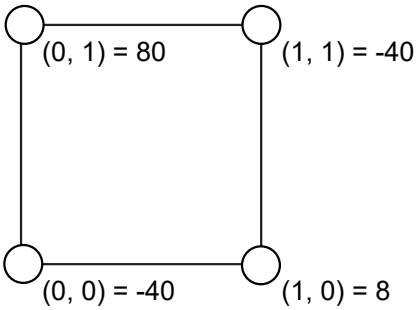
Scientific Visualization (Assignment 8)

Exercise 8. 1 [3 Points] Asymptotic Decider

Determine a solution for the following ambiguous case of the Marching Squares algorithm using the *Midpoint Decider*. Calculate the asymptotes and the function value at their intersection. The coordinates of the grid points are given in parentheses along with their function values.



Exercise 8. 2 [3 Points] Octrees

Consider a full octree where each leaf node represents a voxel for isosurface extraction. The volume to be visualized is a rectangular grid with $500 \times 500 \times 200$ voxels at 32-bit floating point precision. Calculate the estimated memory consumption...

(a) ...of the full octree in bytes.

(b) ...assuming that each node stores the minimum and maximum values of its subtree.

Exercise 8. 3 [6 Points] Volumetric Illumination

Prerequisites Obtain the skeleton shader (`volumetricLighting.glsl`) from ILIAS and load it into *ShaderToy* (`https://www.shadertoy.com/new/`). For further information see the introduction in assignment sheet 06.

NOTE: ILIAS changes the file extension automatically.

Tasks Volumetric Illumination is a good way to improve the visual quality of volume renderings. In this task, you will program your own simple volume lighting, including the computation of the needed surface normals.

The program skeleton provides a fully functional volume raycaster, raycasting a volume that encloses two cubes and a sphere. You should see the result as shown in Figure 1(a) when running the skeleton code in ShaderToy. Your tasks will be:

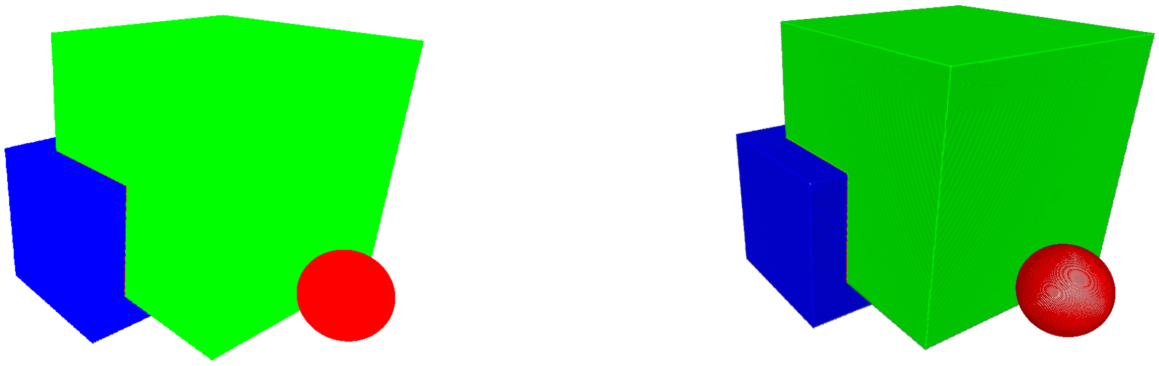


Figure 1: Volume raycasting without illumination (a) and with Phong illumination with central differences gradient computation (b).

1. Compute the gradients using intermediate differences.
2. Compute the gradients using central differences.
3. Shade the scene using the Blinn-Phong shading model.

All positions where code has to be added are marked with a `TODO` and `Insert code here`. Note that you will have to use parameters defined at the beginning of the code. By uncommenting / commenting the respective `#define` lines you can switch between the usage of central and intermediate differences. The result using central differences is shown in Figure 1.

Hint: `lightDir` is the direction away from the light, not towards it.

Hint: You can play with the alpha values in the transfer function to get transparent objects.

Submission Deadline: 26.06.2020, 23:55