CMSC 23700 **Introduction to Computer Graphics** **Project 5**
Winter 2014 **February 25**

Terrain rendering (part 2)

Due: Tuesday, March 18, 1:00pm

1 Summary

Project 5 is the second part of the final project. In this part, you will add visual embellishments, of your own choosing, to your project 4 code.

2 Completing Project 4

The first part of the project is to make sure that your Project 4 code is working. The Project 4 features will be evaluated when grading Project 5, so take the time to address any outstanding issues.

3 Embellishments

In this section, we list some possible ideas for visual effects that you might add to your viewer, but you should not feel constrained by this list. We have annotated these suggestions with an estimate as to their difficulty of implementation.

You may also find `http://vterrain.org` as a useful source of information.

3.1 Detail textures [Easy]

To make the surface of the terrain look more realistic, you can blend in a *detail texture*, which is essentially a noise texture. The detail texture is used to modulate the surface color close to the camera (say out to 80 to 100 meters for a ground viewer). A detail texture will be added to the `proj-4/data` directories in your repositories. The texture is allocated as an RGB image, you may want to copy it to an RGBA representation with a 40-50% alpha channel, which will mute its effect somewhat. You can also use alpha blending to get a smooth transition from textured polygons to untextured ones.

3.2 Procedural detail [Medium]

For most of the map data sets, the geometric detail is fairly crude (especially for a ground viewer). For example, there are 60m between heightfield samples in the Grand Canyon map. To make the

terrain look more realistic, you can use tessellation shaders and fractal noise to add geometric detail close to the viewer.

3.3 Shadow texture [Medium]

The map format includes the direction of the sun (specifically, the vector for a directional light). In this project, you will precompute a shadowmap from the heightfield that can be blended with the surface texture to result in a shadowed landscape. For each grid cell in the heightfield, you should compute a 2×2 texture sample (*i.e.*, the shadow texture will have size $2^{n+1} \times 2^{n+1}$ for a 2^n wide heightfield. Use one byte per texel, with 0 meaning shadowed and 255 meaning lit. You can determine if a texel is in shadow by casting a ray from its center back towards the direction of the light (see Figure 1). Using this information, you precompute the lighting information and

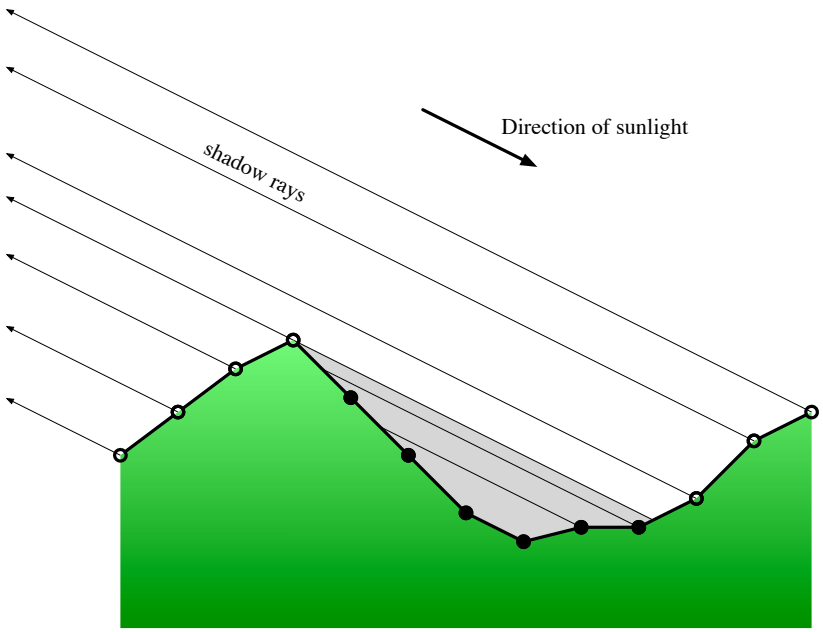

Figure 1: Computing shadows by ray casting

luminance map for the terrain. A better result can be obtained by computing several samples per texel and averaging their values.

3.4 Skybox [Easy]

Outdoor rendering engines use skyboxes (or skydomes) to provide a backdrop for the terrain. The basic idea is define a cube with the edges of the terrain mesh as sides and to render it with a texture of distant mountains, clouds, etc. Fancier skyboxes will animate the clouds.

3.5 Vegetation [Varying]

Terrain usually has trees, shrubs, grass etc. Trees and shrubs might be represented by models that are placed on the terrain, while grass can be rendered using a particle system (each blade of grass is modeled as a particle). To handle large numbers of trees, you may want to use impostors.

3.6 Particle effects [Medium]

Particle systems are low-cost physics simulations that are used to render *fuzzy phenomena*, such as smoke, fire, liquids, explosions, *etc.*. In the context of this project, particle effects could be used to implement weather effects (rain or snow); erupting volcanoes and lava; or flocking birds.

3.7 Water animation [Hard]

Some of the maps have major bodies of water. The surface of the lakes is flat and static. We can make it more interesting by adding waves to the water surface. For such cells, there is a file called `water.png`, which is a black-and-white image that you can use as a mask to determine which vertices in the cell are in water and which are not. At startup time, you can load this file and to determine which areas are water.

3.8 Submission

Project 5 is due on Tuesday, March 18 (during exam week). We will be having project demos starting at 1:30pm on the 18th in CSIL.