**Implementation:**

Terrain generation:

- Will probably use Inigo Quilez's method of using raymarching and value noise derivatives
- Initially, we're going to start off with what we have in the lab, but if we end up having enough time, we plan on adding in extra features for the terrain (eg. value noise)

Stylized Rendering:

- Lighthouse3d tutorial for basic toon shading included in resources as well as some style inspiration shadertoy examples (ideally we will put our own spin on this and develop our own style)
- basic idea for cell shading is to calculate intensity of the light based on the dot product of the incoming light vector and the normal and then to map each intensity to a fixed interval corresponding to different colors providing a more flat 2D look
- Wikibooks tutorial includes information about outlines: checks if fragment is close to edge of silhouette using dot product of normal and view vectors and colors it to be an outline accordingly

HDR:

- shader tutorial included in resources section
- uses float framebuffers instead of GL_RGB format which automatically clamps values between 0 and 1
- uses Reinhard tone mapping algorithm to scale values to 0 to 1 range without loss of detail and gamma correction (pseudocode included in resource links)

Bloom:

- shader tutorial included in resources section
- picks out brightest colors in the scene
- renders to 2 buffers: first regular lighting then if brightness of fragment is above specified threshold, render to second buffer
- blurs the brightness texture and then blends with original scene's texture

**Feature Resources:**

Terrain generation:
https://www.iquilezles.org/www/articles/terrainmarching/terrainmarching.htm
https://www.iquilezles.org/www/articles/morenoise/morenoise.htm
https://www.shadertoy.com/view/MdX3Rr
https://developer.nvidia.com/gpugems/gpugems3/part-i-geometry/chapter-1-generating-complex-procedural-terrains-using-gpu

HDR/Bloom:
https://learnopengl.com/Advanced-Lighting/HDR
https://learnopengl.com/Advanced-Lighting/Bloom
https://learnopengl.com/Advanced-Lighting/Gamma-Correction

Stylized Rendering:
http://www.lighthouse3d.com/tutorials/glsl-12-tutorial/toon-shading/
https://en.wikibooks.org/wiki/GLSL_Programming/Unity/Toon_Shading
https://en.wikibooks.org/wiki/GLSL_Programming/Unity/Silhouette_Enhancement

Stylistic Inspiration?
https://www.shadertoy.com/view/MscSzf
https://www.shadertoy.com/view/ts2cWD

**Overview:**
Each feature can be implemented individually in its own shaders
Terrain → stylized rendering → HDR → Bloom

**Division of labor/Plan of action:**

- We start with a simplified version of the terrain generation code (built upon the lab)
- Each person takes one of each of stylized rendering (simple toon shading), HDR, and Bloom
- Then depending on who finishes their task first, they can develop more details (more complicated terrains and unique stylized rendering methods)
- Camera movement (camtrans lab)