Assignment 4

COS 344

Department of Computer Science

Total: 30 Marks
Deadline: 7 June 2023 at 23:59

Objectives:

- Generate a terrain mesh from a heightmap image.
- Calculate and create polygon normals for colouring.

General instructions:

- This assignment should be completed individually, **no group effort** is allowed.
- Be ready to upload your assignment well before the deadline, as no extension will be granted.
- You must use native WebGL (no external libraries).
- You may use the book's helper files *webgl-utils.js, initShaders.js,* and *MV.js* if you wish.
- Your upload must have a separate folder for each task.
- **All submissions will be checked for plagiarism.**

Plagiarism:

The Department of Computer Science considers plagiarism as a serious offence. Disciplinary action will be taken against students who commit plagiarism. Plagiarism includes copying someone else's work without consent, copying a friend's work (even with consent) and copying material (such as text or program code) from the Internet. Copying will not be tolerated in this course. For a formal definition of plagiarism, the student is referred to https://www.

library.up.ac.za/plagiarism/index.htm (from the main page of the University of Pretoria site, follow the Library quick link, and then choose the Plagiarism option under the Services menu). If you have any form of question regarding this, please ask one of the lecturers, to avoid any misunderstanding. Also note that the OOP principle of code re-use does not mean that you should copy and adapt code to suit your solution.

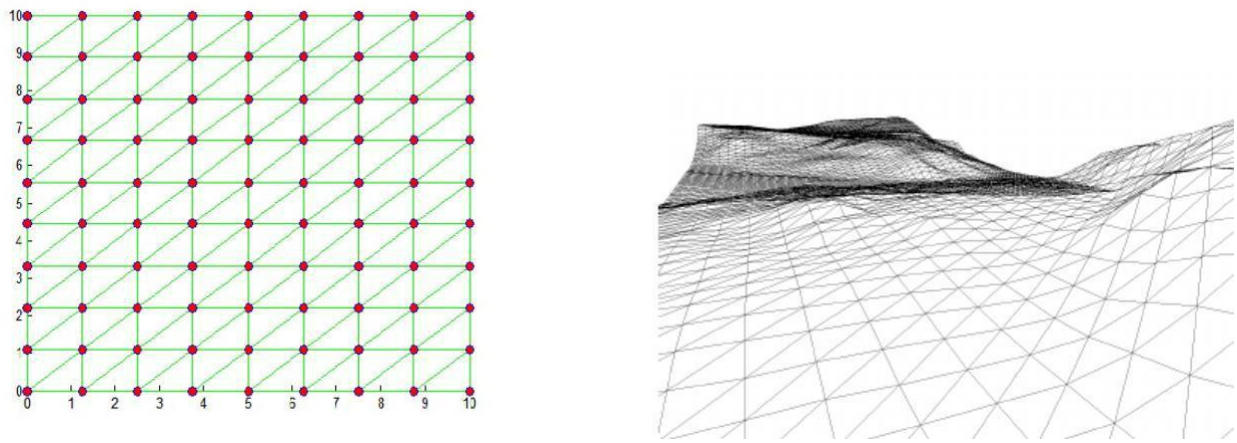
After completing this assignment:

Upon successful completion of this assignment you will have created a terrain using a mesh and polygons from a given heightmap.

Task 1: Building a mesh from a heightmap image [12 Marks]

You need to provide an interface for a user to select a grey-scale image on the clients machine and construct a terrain mesh from it. You only have to support the JPEG file format for this assignment. This uploaded image will be referred to as the heightmap from this point onwards.

- The width and the height of the heightmap defines the number and ratio of vertices in a rectangular mesh. For example if the uploaded heightmap was 11x11 pixels in size, we would construct the mesh as shown in Figure 1a.
- The colour value for each pixel in the heightmap must be used to determine the height of each of the corresponding vertices. An example mesh, rendered using wireframe, is given in Figure 1b.



(a) Flat mesh (b) Terrain mesh

Figure 1: Mesh illustrations

- In terms of colouring the triangles, you must use only two colours. Then colour each triangle within the mesh using one of the two colours such that no two triangles with a shared edge are the same colour.
- The terrain should slowly rotate around its y-axis so that the whole terrain can be seen.

It is possible that building the mesh may not be instantaneous, so make sure you indicate that loading is in progress to the user.
There are three test heightmaps provided for this assignment: *HM1.jpg*, *HM2.jpg* and *HM3.jpg*.

Task 2A: Adding normal vectors to each triangle [10 Marks]

For each of the triangles, within your terrain from task 1, calculate the corresponding normalised outwards normal vector. This normal vector must be rendered as follows:

- A line starting from the centre of the corresponding triangle.
- All lines must be the same length in the render.
- There must be a thicker point rendered at the tip of the line.
- The selected colour of the line must be clearly visible.

One again the terrain should slowly rotate so that the whole terrain can be seen.

Task 2B: Adding zooming and tilting [4 Marks]

Add zooming and tilting capability to your terrain view by adding buttons to your interface:

- Add two buttons to zoom in and zoom out of your terrain.
- Add two buttons to tilt your terrain up and down so you can view it from above or below.

The terrain should still slowly rotate so that the whole terrain can be seen.

Task 2C: Colouring mesh using the normal vector [4 Marks]

Colour the face of each triangle in the mesh based on the calculated normal vector. This means triangles with the same normal vector will have the same colour. Triangles with similar normals should have a similar colour and triangles with completely different normals should have different colours. The colour of the whole triangle face however, must be the same.
The zoom and tilt buttons should still be available. The terrain should still slowly rotate so that the whole terrain can be seen.

Submission instructions

For your submission, you need to place all your source files in a zip or tar/gzip archive (you need to compress your tar archive) named uXXXXXXXX.zip or uXXXXXXXX.tar.gz where XXXXXXXX is your student/staff number.

Submit your code for marking under the appropriate item on ClickUP (Assignment 4) before the deadline.