Geo Elevation Map to 3D object

1. Requirement

We have to create a 3D image of terrain from an array of elevation values. The goal is to take an elevation map as input (meaning a grid with elevation data, as the usage of ones), not images or videos (from drones for example). We will generate a file that is printable by 3D printer.
The output should be STL or an OBJ file. These file formats are used for 3D printing (STL especially).

STATE of delivery:
Input, we can accept **.TIF or .TIFF** file as inputs.
we can currently export the **.STL** format ,
more file format output will be enabled in further development.

2. Solution

There are libraries that can generate the files from the mesh but you will have to generate the mesh. There is a library in Python for STL files. We can use these libraries. We can test the output in the visualisation part of the software and try the file in any 3D software (such as Meshlab) or even free source 3D printer slicer (Cura for example). We can use the massive databases on the web from geological facilities (like USGS) or even NASA for landscape from the moon, mars or asteroids as input data.

3. Software architect

User interface
This is a TERMINAL based CLI tool

4. Data format

Input

The input data is LAS file format, TIFF file format, DEM file format.

The **LAS** file format is a binary data format that contains LIDAR nature information specific for the interchange of 3-dimensional point cloud data. This format which supports any 3-dimensional x, y, z tuplet is an alternative to ASCII file format although it is developed for exchange of LIDAR point cloud data. The problem with ASCII files is that data cannot be easily transferred from one system to another because it has some problems such as the file size is huge thus the speed of exchange ASCII data can be very slow, and all information specific to the lidar data is lost.

Tagged Image File Format, abbreviated TIFF or TIF, is a raster graphics images file format. TIFF is supported by optical character recognition, scanning, faxing, image manipulation, desktop publishing, word processing, and page-layout applications. Aldus Corporation invented this format. Several specifications have been created based on TIFF 6.0 including TIFF-F (RFC 2306), TIFF/IT (ISO 12639), TIFF-FX (RFC 3949), and TIFF/EP (ISO 12234-2). There is a new variant of TIFF that uses 64bit offsets called BigTIFF. BigTIFF logically extends the original TIFF file format, with 64bit offsets, over the 4 gigabyte limitation up to 18,000 petabytes in size.

3D computer graphics digital elevation model (DEM) is used for representation of elevation data to represent terrain, planet, moon, or asteroid. A "global DEM" refers to a discrete global grid which is used in geographic information systems, and for maps. While a digital surface model (DSM) is useful for landscape modeling, city modeling and visualization applications, digital terrain model (DTM) is often used for flood or drainage modeling, land-use studies, geological applications, and in planetary science.

Output

The output data is STL file format.

STL is a file format created by 3D Systems native to the stereolithography CAD software. This file format is supported by 3D printing and computer-aided manufacturing. STL files present the three-dimensional surface geometry of an object without any information of color, texture or other attributes. The STL file includes ASCII and binary format. Binary files are used more popularly because they are more compact. The STL file uses a three-dimensional Cartesian coordinate system to present a raw, unstructured triangulated surface by the unit normal and vertices (ordered by the right-hand rule) of the triangles. In the old specification, all STL coordinates must be positive numbers, but today this restriction is removed. STL files do not contain scale information, and the units are arbitrary.

OBJ (or .OBJ) is an open geometry definition file format developed by Wavefront Technologies which has been adopted by other software companies. The OBJ file format is a simple 3D geometry data-format that represents the position of each vertex, vertex normals, the list of vertices, the UV position of each vertex, and texture vertices. OBJ files can contain scale information but OBJ coordinates have no units.

5. User guide

Environment setup Python v3.6 with ANACONDA

```
conda create --name m2m python=3.6
conda activate m2m
conda install -c conda-forge whitebox_tools
conda install --channel conda-forge geopandas
conda install --channel conda-forge spaghetti
pip install --use-feature=2020-resolver git+git://github.com/ozak/georasters.git
conda install rasterio
pip install earthpy
```

```
conda install -c conda-forge gdal
conda install -c conda-forge pdal python-pdal
conda install -c conda-forge trimesh
conda install -c conda-forge laspy
conda install -c open3d-admin open3d
conda install -c conda-forge meshio
pip install git+https://github.com/rougier/matplotlib-3d
conda install Pillow
conda install -c conda-forge vtk PyQt5
conda install -c conda-forge pyside2
pip install -r requirements.txt
```

Execution CLI

Run the command with Anaconda environment enabled.

```
conda activate m2m && python main.py
```

user tips

The GeoTIFF file can be drag from File manager GUI and drop on the terminal for get the absolute FS paths exactly.