

# Brain Structure

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## 1 Introduction

The code includes functionality to load 3D mesh data from a VTK file, calculate various properties of the mesh, which includes calculating the area of triangles and edge lengths, and generate output files with the results.

## 2 Code Explanation

### 2.1 Class: VTK\_Handler

- The `VTK_Handler` class encapsulates methods for reading and processing VTK files.
- Private data members include information about the number of vertices, polygons, debug flag, and vectors storing points and polygons.

### 2.2 Methods

- `split`: Splits a string into parts using a given separator.
- `error`: Common error handler for all the methods in class.
- `edgeLength`: Calculates the length of an edge given two vertices.  
**Parameters:** `p1` - Vertex 1, `p2` - Vertex 2.
- `Load`: Loads a VTK file into memory, extracting information about points and polygons.  
**Parameters:** `filename` - The name of the VTK file to load.
- `TotalSurfaceArea`: Calculates the total surface area of all polygons in the mesh.  
**Returns:** `double` - Total surface area.
- `SurroundingAreaForVertex`: Calculates the total surface area of polygons surrounding each vertex and writes the result to a file.  
**Parameters:** `filename` - Name of the output file.
- `calculateEdgeLengths`: Calculates the length of edges in each polygon and saves the results to a file.  
**Parameters:** `filename` - Name of the output file.

### 2.3 Main Function

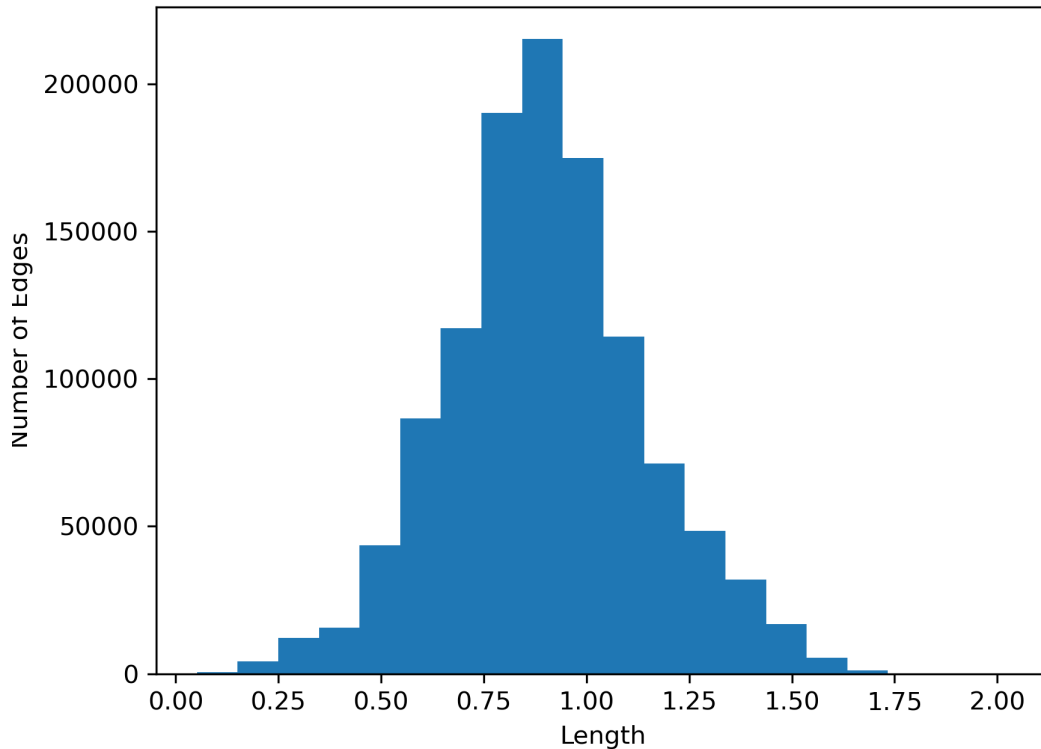
- The `main` function demonstrates the usage of the `VTK_Handler` class by loading a VTK file, calculating total surface area, and surrounding surface area for each vertex, and computing edge lengths.

## 2.4 Area of Triangle

The `areaOfTriangle` function in a separate file named `triangle_area.cpp` is used to calculate the area of the triangle given two vertices. This method uses the Heron's Formula to calculate area.[1]

## 2.5 Edge Length

The edge lengths calculated from the given VTK file are stored in the file named `edge_lengths.txt`. Below is the plotted histogram of these values.



# 3 Makefile

## 3.1 Explanation

The make file is used to compile the libraries and executables. For this project, we are compiling the static library named `libtriangle.a` which is compiled from the file `triangle_area.cpp` and then linked to the main file.[3]

## 3.2 Execution

The `Makefile` is included with this code. You can run the command `make` to compile the program. After successful compilation, you can find the executable named `main.out` inside the `bin` folder. Run this executable by `./bin/main.out`. The outputs generated by the program can be found in files `Surrounding_areas.txt` and `edge_lengths.txt`. To clean the generated folders and files, use the command `make clean`.

## 4 Testing

For testing the program, we have created a separate program in the file `test.cpp`. The main function inside this file calls the `VTK_Handler` class, provides it with a known input from the file `Test.vtk`, and compares the output with the known values. This method has been inspired by the JestJS [2] library, which also compares the outputs of the function to known results.

## References

- [1] Heron's Formula  
<https://bearboat.net/TriangleArea/Triangle.html>.
- [2] Jest JS  
<https://jestjs.io/>.
- [3] Chat-GPT Conversation  
<https://chat.openai.com/c/af9e178c-6770-4668-ad8a-5c656bc9e7d9>.