Assignment – Brain Structure

File Cort_lobe_poly.vtk stores the half brain mesh structure.

The format of the data:
From Line 6 to line 191729, are the x, y, z coordinates of vertices, one vertex per line.
From Line 191731 to line 574971, each line is a triangle, which contains four numbers: the first number is always 3, indicating that three vertices form a triangle, the following three numbers are the indices of the three vertices.

Your work:

1. [20 pts] Read the data from the file to some arrays defined by yourself. Better to use dynamic arrays.
2. [20 pts] Calculate the total surface area. (Summation of the area of all triangles) Print it out on the screen.
3. [10 pts] For each vertex, calculate the total surface area of the triangles surrounding it. Output the result into a readable file, where each line contains one number (the area of the triangles connected to the vertex). The lines must be sorted by increasing vertex number.
4. [10 pts] Plot a histogram of the length of the edges of all the triangles describing the surface of the brain.
5. [10 pts] Create the Makefile (use GPT or standard web search to help you) and library (see Notes) to create an executable.
6. [10 pts] Develop and implement a strategy to confirm that your code is running correctly. This is an open-ended question. Explain your strategy and run it.
7. [20 pts] Document your code. Each function should have a few lines stating what it does. Add descriptive comments as necessary inside the code.

Notes

- Use the C++ compiler (g++ or equivalent)
- Use new/delete to handle dynamic memory allocation
- The main() function must be in a file “main.cpp”
- You should have a function “triangle_area(….)”, which should also be in a separate file: “triangle_area.cpp”
- Create a library (static or shared) that contains the object files “triangle_area.o” and the rest of your code (with the exception of main.o) and link the library to main.o

- Create a Makefile to compile and link your code.
- The Makefile should have a “clean” task to remove the executable and object (.o) files.

Please submit your code, output files, and a report.

Make use of web-based and AI tools to update your knowledge on anything you don’t understand.