Mathematics 346m programming assignment 6, Michaelmas 2017

December 12, 2017

1 Sixth assignment, due Tuesday 9/1/18

In the programming samples subdirectory, there is a file `130-hedron` which contains a list of 67 points in 3 dimensions followed by a list of 130 faces. The points are the vertices of a convex polyhedron and the faces are faces of that polyhedron.

The file contains

```
n, the number of points
0 x_0 y_0 z_0    x_0, y_0, z_0 etcetera are doubles.
1 x_1 y_1 z_1
....
n-1 x_{n-1} y_{n-1} z_{n-1}
f, the number of faces
0 3 i_0 j_0 k_0      0 <= i_0, j_0, k_0 < n
1 3 i_1 j_1 k_1
...
f-1 i_{f-1} j_{f-1} k_{f-1}
```

Each face is given with an index (for readability) as is each point. The *size* of a face is the number of incident vertices. The polyhedron is *simplicial*, meaning that the faces have size 3.

Each face is listed first index, then size (3), followed by the 3 incident vertices in anticlockwise order with respect to the outer normal direction.

The edges bounding the faces form a (planar) graph G.

There is a *dual graph* D to G. Its vertices correspond to the faces of G and where faces f_1, f_2 have an edge in common then $\{f_1, f_2\}$ is an edge of D. There is a definite cyclic (anticlockwise) ordering of the edges (and faces) around every vertex, inherited from the ordering of vertices around faces of G.

The assignment is to construct the dual graph, efficiently. Lexical sorting will probably be needed. You should present the output as a list of *faces*. **Not** edges. In the dual graph, every vertex has degree 3, but the faces can have any size ≥ 3.

You can ignore the vertex coordinates (there is a notion of geometric dual where the vertices have well-defined placements, but it is only the face structure which is wanted for this assignment.)