CS 418: Interactive Computer Graphics
In-class Worksheet 3

3D Geometry and Mesh Data Structures

1. Draw a picture of a triangulated polygon that can be drawn using a single triangle fan but not a single triangle strip. No degenerate triangles can be used.

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3. Suppose a triangle has a normal vector of $\langle 1,1,0 \rangle$ and that the vector for the view direction is $\langle 1,-2,0 \rangle$. Is the triangle front-facing or back-facing?

4. The following vertex buffer is suitable for drawing 3 triangles using gl.TRIANGLES and gl.DRAW_ARRAYS. Convert the buffer to one suitable for drawing the same triangles using gl.TRIANGLE_STRIP and gl.DRAW_ARRAYS. Assume we are using a CCW winding order.

V1
V2
V3
V3
V4
V1
V4
V3
V5

5. The Euler Characteristic

The Euler Characteristic states the following relationship for the elements of a closed and connected surface mesh:

$$V-E+F=2(1-G)$$

V is the number of vertices
E is the number of edges
F is the number of faces
G is the genus of the surface (how holes/handles it has)

Show that for a triangle mesh with no holes we have F≈2V. Hint: each face has 3 edges and each edge is shared by 2 faces.

Memory Requirements

Using the fact that F≈2V, compare the storage requirements for an indexed face mesh and a triangle soup (in WebGL this corresponds to using `gl.drawElements` versus `gl.drawArrays`). Assume the mesh has V vertices and a number requires 4 bytes of space. Derive functions for the number of bytes the mesh will require as a function of V.