

## Assignment 2: Mesh

Instructor: Steve Marschner / Assignment by Xi Deng

Name: \_\_\_\_\_, NetID: \_\_\_\_\_

**Problem 1: Manifolds**

(10 points)

Many algorithms assume that meshes are manifold, and it's always a good idea to verify this property to prevent crashes or infinite loops if you are handed a malformed mesh as input.

- (a) For each of the following cases, decide if the mesh is a 2-manifold (possibly with boundary) or not. If not, explain why. (Hint: Read textbook 12.1.1 Mesh Topology ) (10 points)

<i>Mesh</i>	<i>2-Manifold(Yes/No)</i>	<i>Explain</i>

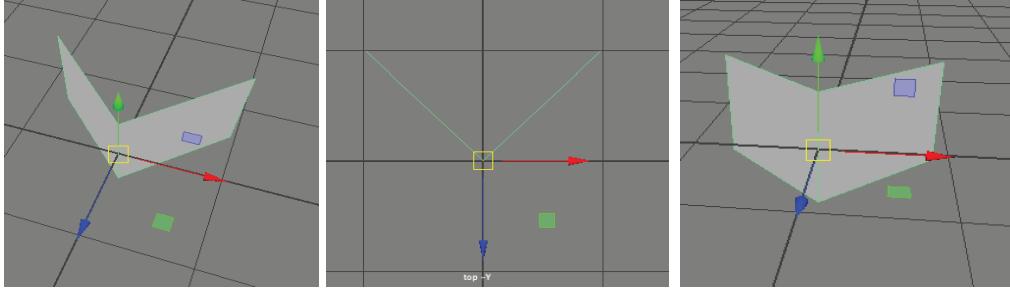


Figure 1: A surface comprising two rectangles in 3D space: All the faces in the left most and right most images are shown from their front sides. The mesh in the middle column is viewed from top side.

woh



Figure 2: Textured book and the texture.

**Problem 2: Mesh storage & data structures**

(10 points)

Suppose we have an L-shaped mesh in 3D space as shown in Figure 1. The grid lines in the figure are spaced one unit apart, and the arrows represent three axes in Cartesian coordinates (Green:  $y$  axis, Blue:  $z$  axis, Red:  $x$  axis). The height of this mesh along the  $y$  axis is 1 unit length, and all the edges along the  $y$  axis are perpendicular to the  $xz$  plane. The yellow rectangle stands for the point  $(0, 0, 0)$ . Write down the data you need to save in an OBJ file for this mesh. (Hint: To validate your answer, you can paste your results into an OBJ file and view it in our visualization tool provided on the website.)

(a) Write down the vertices you need to store in OBJ format.(2 points)

(b) Write down the  $uvs$  in OBJ format to texture the mesh like Figure 2. (  $(u, v)$  should always be in  $[0, 1]^2$ ). (2 points)

(c) Write down the normals you need to store in OBJ format. (Write down both facet and smooth situation.) (3 points)

(d) Write down the faces you need to store in OBJ format. (Hint: you can first triangulate each rectangle, and then store triangles faces.) (3 points)

**Problem 3: A Mesh Example**

(5 points)

Consider the following file in OBJ format as we have discussed and used in class.

```
v 0 8.5 0
v 1 7 1
v 1 7 -1
v -1 7 -1
v -1 7 1
v 1 0 1
v 1 0 -1
v -1 0 -1
v -1 0 1
f 1 2 3
f 1 3 4
f 1 4 5
f 1 5 2
f 2 6 7
f 2 7 3
f 3 7 8
f 3 8 4
f 4 8 5
f 5 8 9
f 5 9 6
f 2 5 6
f 6 9 8
f 6 8 7
```

(a) What familiar landmark does this mesh resemble? (2 points)

(b) What are the distinct normals you need to store for this mesh? (round to 3 significant figures) And for each normal, how many triangle faces share it?(3 points)