

## CS770/870 Assignment 5

Due: Monday, October 18th, 2021.

Lateness: Tue -5, Wed -10, Thu -20, Fri -50, Mon -100

1. Clipping: Consider the plane  $x + y + z - 4 = 0$ , and the triangle with three vertices  $V_1 = (2, 0, 0)$ ,  $V_2 = (0, 2, 0)$ , and  $V_3 = (1, 1, 4)$ . Split the polygon against the plane, and report the two resulting polygons.

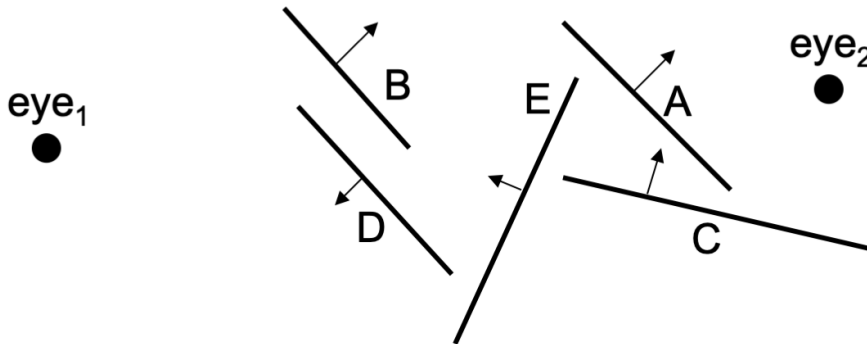
Details:

- The plane can also be written as  $N \cdot (P - Q) = 0$ , with  $N = (1, 1, 1)$  and  $Q = (4, 0, 0)$ .
- The intersection of
  - a line segment  $P = A + t(B - A)$
  - and a plane  $N \cdot (P - Q) = 0$can be obtained by computing

$$t = \frac{N \cdot (A - Q)}{N \cdot (A - B)}$$

and then substituting back into the line-segment equation to get  $P$ .

2. Consider these polygons. They are drawn in cross-section as line segments, with arrows indicating front-facing normals.



- (a) Using polygon sorting, in what order should they be drawn for the painter's algorithm, if the eye is at  $\text{eye}_1$ ?
  - (b) Repeat the question for eye at  $\text{eye}_2$ .
3. Consider the same polygons as above.
    - (a) Draw the BSP tree obtained by inserting the polygons in *alphabetical order*. If any polygons are split, label them on the diagram and in your tree.
    - (b) Is the resulting tree the smallest possible? Explain
    - (c) Traverse the tree for eye point  $\text{eye}_1$ , and list the polygons in the order they are visited.
    - (d) Repeat the question for eye point  $\text{eye}_2$ .

4. The BSP traversal algorithm considers only the eye point, and ignores the view volume. It considers **all** the polygons in the tree, and then clips *all of them* against the view volume. This is wasteful.

Modify the BSP traversal algorithm to take a view volume (6 planes, or 8 vertices) as a parameter, and thus avoid visiting whole subtrees, improving the algorithm's performance. Your algorithm should not modify the BSP tree.

### **Turn In Your Work**

Write your answers into a single file called `visibility-answers.pdf`. Please write legibly, or better yet, type your answers. When you are done, go to `mycourses`, and upload the file.