CS 543 – Spring 2017 – EXAM 3

Name:

Instructions: Read questions carefully before answering. Do not hesitate to ask for clarifications. Show all work. Partial credits are given, so do not leave anything blank! Ask for extra paper if you need it! Good luck!

Bonus Question (1 point) What was your favorite topic in this class?

Question 1: (20 points) Basic Definitions

Define/Explain the following terms

a. (4 points) Depth of Field

b. (4 points) As the size of a mean filter applied to an image increases in radius, what happens to the resulting image?

c. (4 points) Why is it hard to use the Painters HSR algorithm when polygons in the scene penetrate each other?

d. (4 points) What is Beer’s law? How is it used in rendering fog?

e. (4 points) In what situations does a uniform scaling factor not work for tone mapping High Dynamic Ranges?
Question 2: (8 points) Antialiasing

a. (4 points) Describe the Pre-filtering antialiasing method

b. (4 points) What is the accumulation buffer in OpenGL? How is the accumulation buffer used in implementing antialiasing?

Question 3: (8 points) Clipping

Given a rectangular clipping window bounded by corners (4, 2) and (12, 8), what are the results of clipping the following edge that goes from (6,10) to (13, 15) using Cohen-Sutherland clipping? Show your work!!
Question 4 (4 points): Ray Tracing

What are Octrees? How can they be used to accelerate ray tracing?

Question 5 Backface Culling (10 points)

For a camera viewpoint located at (10, 10, 10) looking at the origin, indicate which of the triangles defined in Table 1 are back facing. Show your work!

<table>
<thead>
<tr>
<th>Triangle</th>
<th>Vertices</th>
<th>Back facing (circle one)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>(3, 4, 5) (2, 8, 3) (1, 5, 0)</td>
<td>YES NO</td>
</tr>
<tr>
<td>T₂</td>
<td>(0, 0, 1) (0, 1, 0) (1, 0, 0)</td>
<td>YES NO</td>
</tr>
</tbody>
</table>
**Question 6: (18 points) Polygon Filling**

In the polygon-defined fill algorithm discussed, in class, in some cases, intersections of the current scanline with endpoints of the polygon can result in wrong parity conditions and hence the wrong intervals (e.g. outside the polygon) are shaded.

a. (4 points) Draw a polygon and scanline where this may occur. Be sure to annotate your diagram properly.

b. (2 points) Give a rule that fixes this and show how your rule would fix this parity violation.

c. (12 points) Using the following flood-fill algorithm pseudocode, for each white square in Figure 1, starting at the “seed” pixel (denoted by a ‘1’), write the number that indicates the order in which it will be filled.

```c
void RunFill{
    Push the address of the seed pixel on the stack;
    While (stack not empty){
        Pop the stack to provide the next seed;
        Fill in the run defined by the seed;
        In the row above find interior runs reachable from this run;
        Push the addresses of the rightmost pixels of each such run;
        Do the same for the row below the current run;
    }
}
```

![Figure 1: Run-fill region-filling](image)
Question 7: (12 points) Line Drawing

a. (4 points) In the midpoint version of Bresenham’s line drawing algorithm, write out the key expression used to determine if the next \((x + 1, y)\) or \((x + 1, y + 1)\) should be shaded.

b. (8 points) Consider using Bresenham’s algorithm to draw a line from end point \((4, 1)\) to \((16, 4)\). Using the expression in part a. from the point \((11, 3)\), would you shade \((x+1, y)\), the pixel on the same \(y\) or \((x+1, y+1)\) the pixel one pixel up? Please show your work!!
**Question 8: (8 points) Curves**

a. (4 points) What does it mean if we say a curve is 3-continuous?

b. (4 points) One technique for designing curves is to generate a polynomial that interpolates (passes through) all user-provided control points. What problem results from using this approach?

**Question 9 (12 points): Shadows**


c. (4 points) The shadow buffer algorithm uses the depth buffer but slightly differently. Specifically, in hidden surface removal, the depth buffer is a map of the distances of objects from __________, while in the shadow buffer algorithm, the shadow buffer is a map of distances of objects from _____________.

Fill in the two blanks above.