CS 559: Computer Graphics

Homework 6

This homework must be done individually. Submission date is Tuesday, May 7 in class.

Question 1:

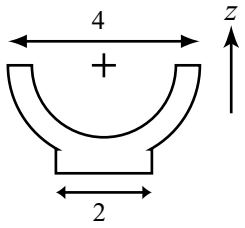
You would like to model a dining plate as a surface of revolution. Sketch the curve you would revolve to make the shape, marking the axis of revolution on your sketch.

Question 2:

You plan on using CSG to model a round bowl with the cross section shown. The origin is located at the cross in the figure and the z axis is marked. As primitives for your CSG construction, you have a sphere of radius 1, a cube of side length 2, and a cylinder of height 1 and radius 1. The cylinder axis is aligned with the z axis.

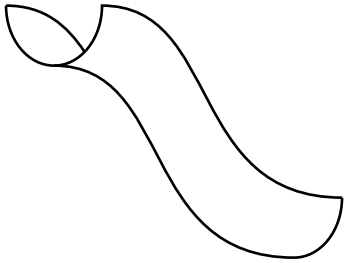
Build a CSG tree to model the bowl. Ensure that you specify the primitives that are used, the CSG operations to apply, and the transformations to apply.

Hint: It can be done with 4 primitives, two subtractions and one union. Or, you can do one union, one subtraction and one intersection. There are a range of possible transformations too – choose one reasonable set.



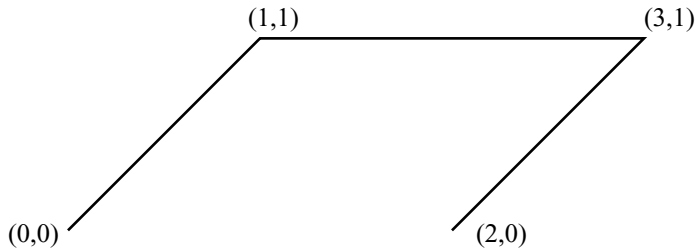
Question 3:

Give a set of 16 Bezier control points that could be used to generate the water-slide shape below. The slide must start off horizontal, and end horizontal. Indicate your points on a 4×4 grid.



Question 4:

Use de-Casteljau's algorithm to find the point corresponding to $t = \frac{1}{3}$ on the Bezier curve defined by the given control points. Show your construction.



Question 5:

Find the matrix, $M_{H \to B}$ that converts control points for a Hermite curve into control points a Bezier curve. Recall from lecture how this is done:

a. Write a point on the curve as it is evaluated using the matrix equation for Hermite curves: $x(t) = P_H^T M_H T$. Write down the appropriate matrix M_H.

b. Write a point on the curve as it is evaluated using the matrix equation for Bezier curves: $x(t) = P_B^T M_B T$. Write down the appropriate matrix M_B.

c. Now equate the two equations and rearrange and simplify them to find an equation of the form $P_B = M_{H \to B} P_H$. Show your working and write down the matrix $M_{H \to B}$.

Question 6:

The uniform B-spline curve below has used repeated control points to control its tangent and interpolation properties. For each control point, 0 through 6, state how many times it has been repeated. Hint: Infer your answers based on the shape of the curve and the location of the control points.