

# Homework 5

## CSCI-4962: Three-Dimensional Computer Graphics

### Fall 2002

Due: Monday, November 25, 2002

Homeworks are due at the **beginning** of lecture on Monday, November 25. **Late homeworks will receive no credit.** Homeworks are to be done individually and will be graded on the basis of correctness, clarity, and legibility. Show the steps in your work where appropriate. Each question is worth **10 points**, for a total of **50 points**.

Be sure to write your **name**, **section number**, and **RPI email address** on your homework submission.

- Consider a polygonal face  $f$  with outward normal vector  $\vec{n} = (5, -3, 2)$  and a viewing vector  $\vec{v} = (2, 1, 3)$  from the camera towards the polygon. Is face  $f$  a front or back face?
  - Consider any two methods for visible surface detection and state an advantage and disadvantage of each method.
- Suppose that visible surface detection is performed using a 8-bit integer depth buffer. Suppose that the nearest object to be displayed is  $x$  units away from the viewer and the furthest object is  $10x$  units away from the viewer. Assume the near clipping is set at a distance  $x$ , but the far clipping plane is set at distance  $1000x$ . What (if any) are some of the dangers of setting the far clipping plane at this unnecessarily large distance from the viewer?
- Consider a scene with  $l$  light sources that is to be ray traced. Let the maximum depth of the ray tree be  $d_{max}$  (where a ray tree of depth of 1 has a single reflected ray and a single transmitted ray after the first intersection with a surface). Assume a single ray is generated per pixel.
  - Compute the maximum number of reflected and transmitted rays generated.
  - Compute the maximum number of shadow rays generated.
  - Compute the maximum total number of rays generated if the image resolution is  $1024 \times 1024$ .
- Compute the intersection points of a ray  $P_0 + s\hat{u}$  with the infinite cylinder of radius 2 centered at the origin and with its axis along the  $Y$  axis. Assume  $P_0 = (4, 0, 3)$  and  $\hat{u} = \frac{1}{13}(-4, 12, -3)$ .
- Compute the fractal dimension of the Koch snowflake.
  - Mention an advantage of using shape grammars for object modeling.
  - Give a reason for introducing randomness in the application of rules when generating plants and trees using L-grammars.