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Christian Knauer
Romain Grunert

Computer Graphics
Exercise 1 (due: April 30, 2008)

Problem 1 (0 credits).
Familiarize yourself with OpenGL. Start by downloading and compiling the simple example program from the course webpage. Do a web search for more information and examples.

Problem 2 (20 credits).
We consider the problem of clipping a line segment in two dimensions against an axis-aligned rectangle. Show that you require only the endpoints of the line segment to determine whether the line segment is not clipped, is partially visible, or is clipped out completely.
Show that clipping against the top of the clipping rectangle can be done independently of the clipping against the other sides. Use this result to show that a clipper can be implemented as a pipeline of four simpler clippers.
Write an OpenGL program that implements your algorithms.

Problem 3 (20 credits).
Approximate the three-dimensional unit sphere starting with an inscribed regular tetrahedron, which is centered at the origin and has one vertex on the y-axis. Derive an algorithm for obtaining increasingly closer approximations, by subdividing the faces of the approximating polytope. Find a similar approach for approximating a cylinder and a cone.
Write an OpenGL program that implements your algorithms and displays the resulting approximations.

Problem 4 (20 credits).
Let T be a triangle in the plane and consider the following random process:

1. Pick an arbitrary point p inside T.
2. Select one of the three vertices v of T at random.
3. Find the midpoint p' between p and v and display p'.
4. Replace p with p' and return to step 2.

Write an OpenGL program that implements this algorithm and displays the resulting object after n iterations.