CSC 317/2504: Computer Graphics

Course web site (includes course information sheet):
https://github.com/karansher/computer-graphics-csc317

Lectures: Tuesdays 18:00-20:00 on zoom
Many lecture topics videos will be pre-recorded and posted. Slides will posted on website.

Prof. Karan Singh
karan@dgp.toronto.edu
Office hours Tuesdays 17:00-18:00 on zoom or by appointment.

Tutorials: Tuesdays 20:00-21:00 on zoom

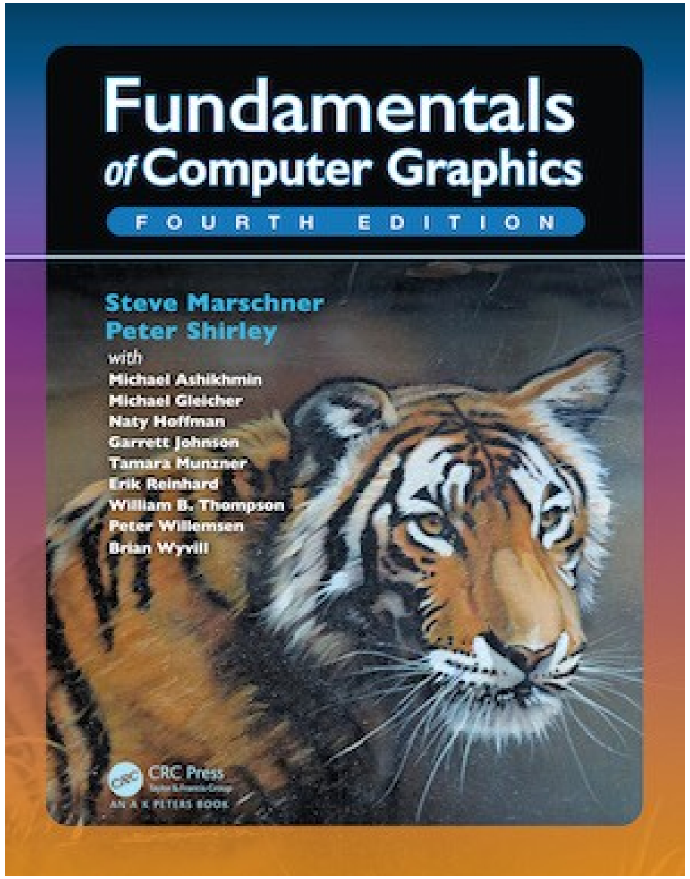
Questions:

on Assignments: Github issues pages
on Administrative stuff: Quercus

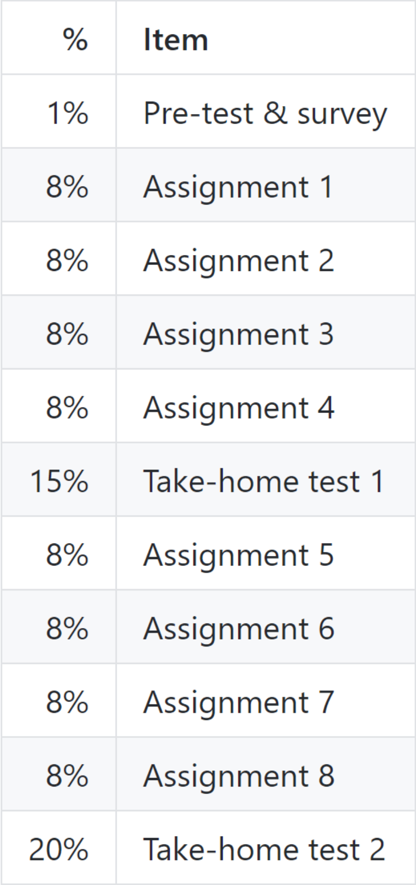
Textbooks: Fundamentals of Computer Graphics
OpenGL Programming Guide & Reference

You will need:

- A computer to install and program the assignments.
- An internet connection to join class meetings on zoom.
- Availability during class and tutorial times.
- The textbook for required readings



Marking Scheme



%	Item
1%	Pre-test & survey
8%	Assignment 1
8%	Assignment 2
8%	Assignment 3
8%	Assignment 4
15%	Take-home test 1
8%	Assignment 5
8%	Assignment 6
8%	Assignment 7
8%	Assignment 8
20%	Take-home test 2

Academic Honesty Policy

It’s on the webpage and is mandatory reading!

Tutorials sessions will be invaluable for the assignments.

Prerequisites

Goals:

1. Show you the kind of mathematical background expected in this course.
2. Show you what you need to brush up on. Questions about these math operations will not be answered by either Professors or TAs, we expect you to know this stuff.
3. Give you a sense of how ready you are to take this course.

Time: 20 minutes (should be more than enough).

Lecture Topics

- Introduction: What is Computer Graphics?
- Raster Images (2D image representation, manipulation and compositing) Assignment 1.
- Ray Casting (camera, visibility, normals, lighting, Phong illumination)
- Ray Tracing (shadows, supersampling, global illumination)
- Spatial Data Structures (AABB trees, OBB, bounding spheres, octree)
- Meshes (connectivity, smooth interpolation, uv-textures, subdivision, Laplacian smoothing)
- 2D/3D Transformations (Translate, Rotate, Scale, Affine, Homography, Homogeneous coordinates)
- Viewing and Projection (matrix composition, perspective, Z-buffer)
- Shader Pipeline (Graphics Processing Unit)
- Animation (kinematics, keyframing, Catmull-Romm interpolation, physical simulation)
- 3D curves and objects (Hermite, Bezier, cubic curves, curve continuity, extrusion/revolve surfaces)
- Advanced topics overview

Today

1. Introduction to Computer Graphics.
2. Preview of Assignments.
3. Raster Images.

Introduction to Computer Graphics

What is Computer Graphics?

Computers:

accept, process, transform and present information.

Computer Graphics:

accept, process, transform and present information **in a visual form**.

Ok but… what is the course really about?

The science of turning the rules of geometry, motion and physics into (digital) pictures.

What its not about?

Photoshop, AutoCAD, Maya, Blender, Renderman, Graphics APIs.

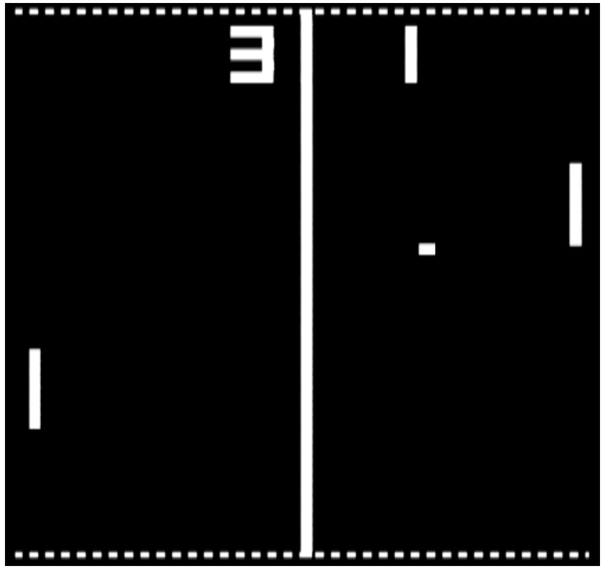
Movies

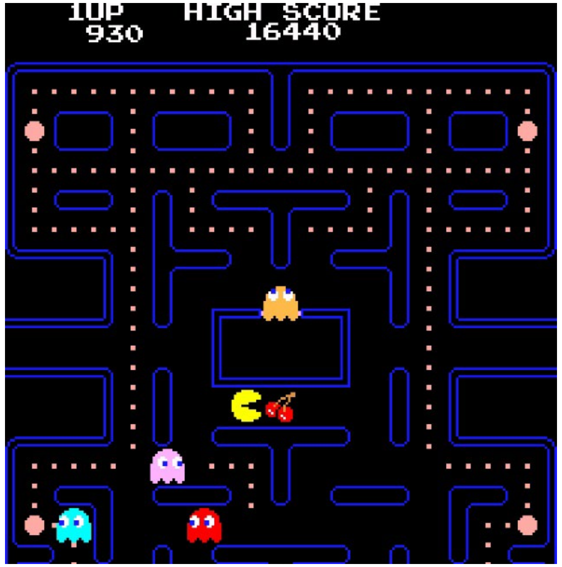
- Drive new directions in CG
- Set quality standards for CG

Games

Drive interactivity and AI in CG

Push CG hardware to its limits

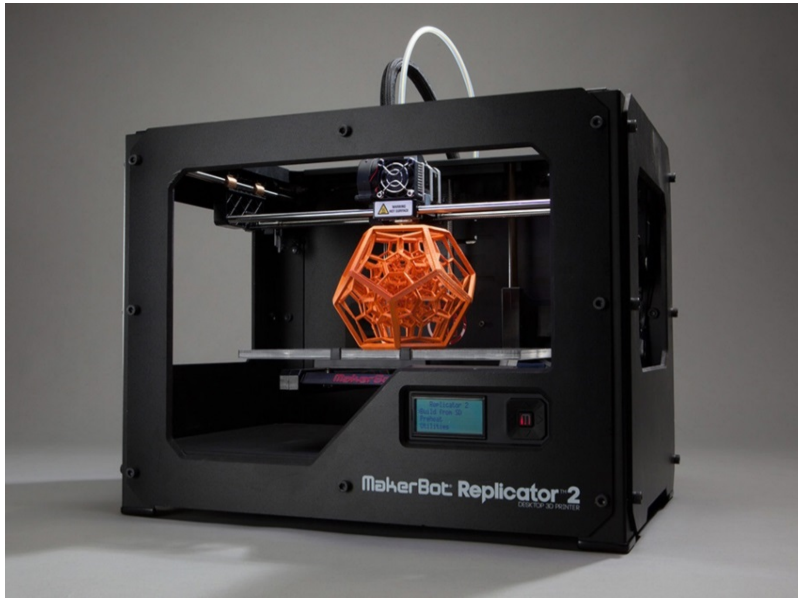


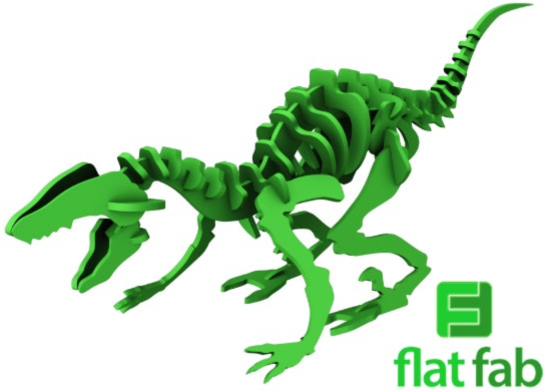


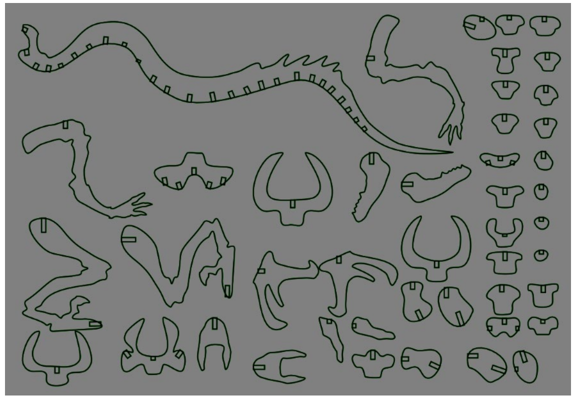
Design

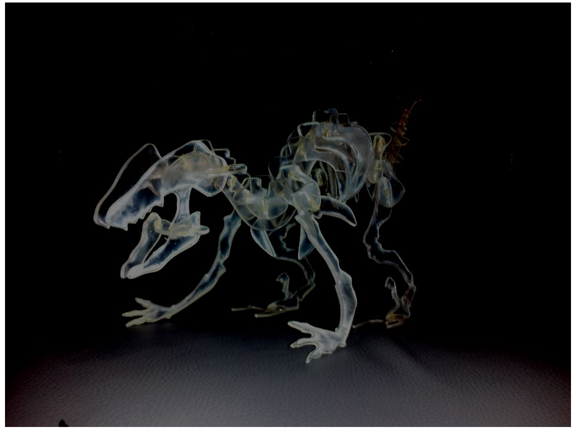
CG for prototyping and fabrication

Drives precision modeling and engineering visualization







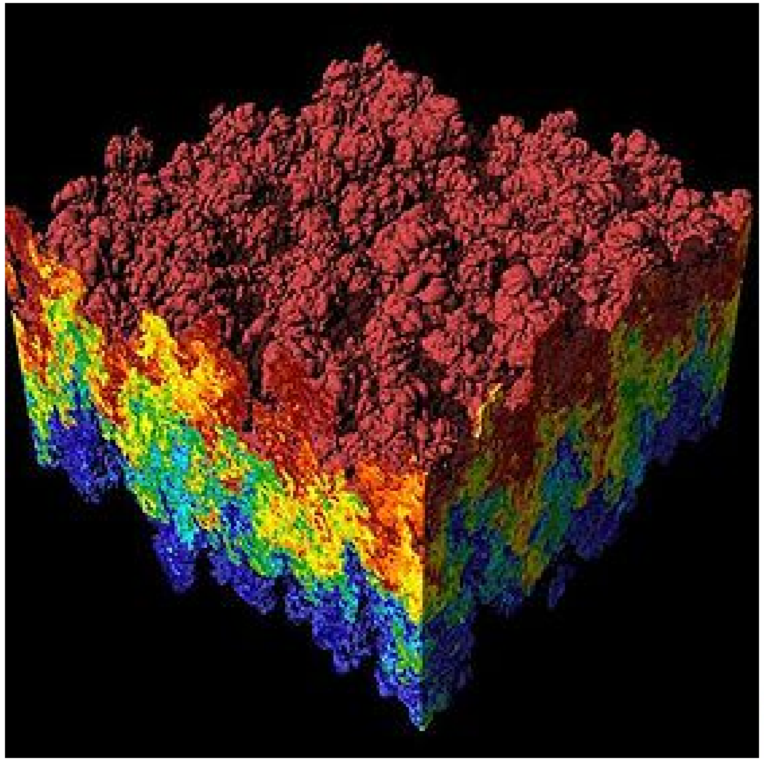


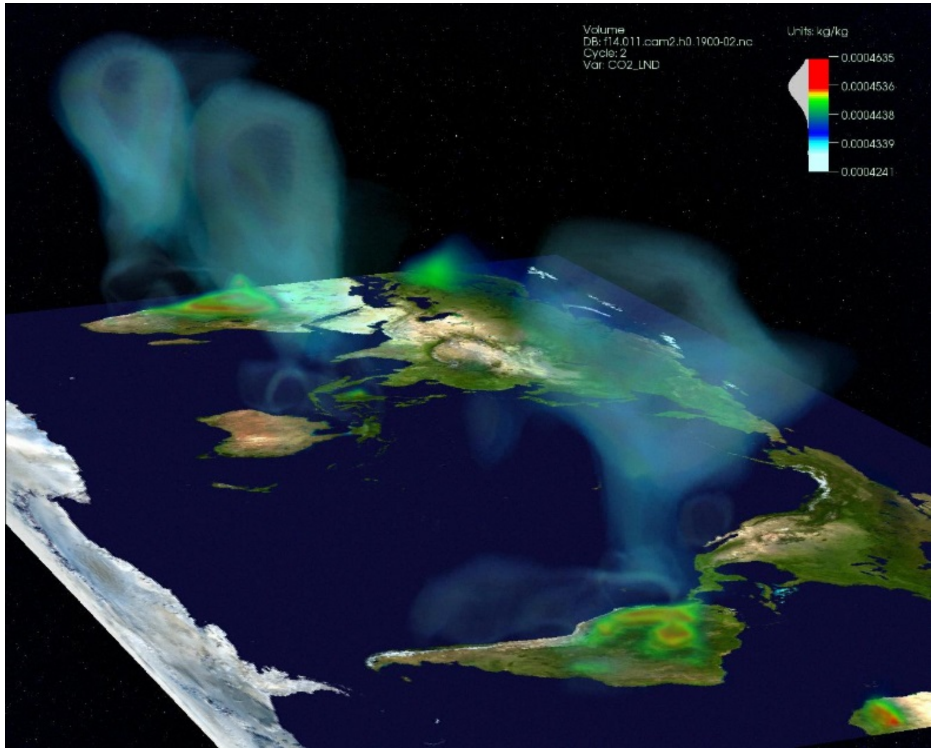
Scientific and Medical Visualization, Operation

Drives the rendering of large datasets

May need device integration

Real-time and interactive

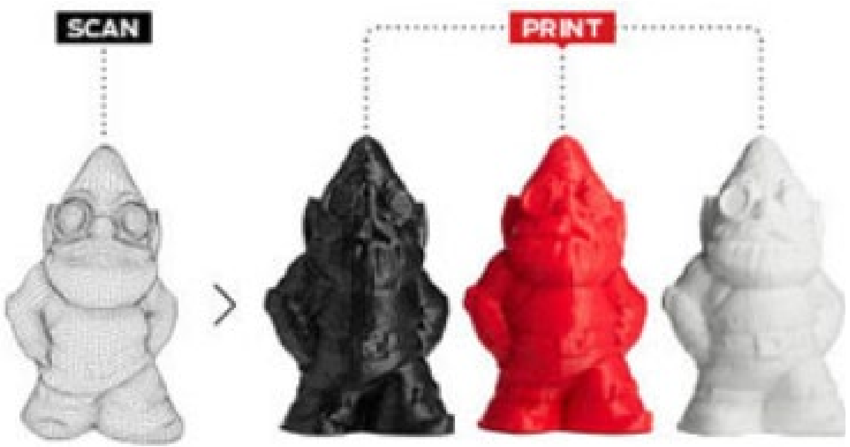


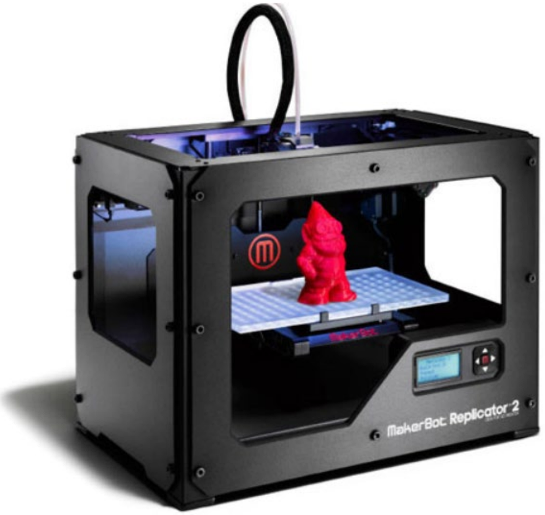


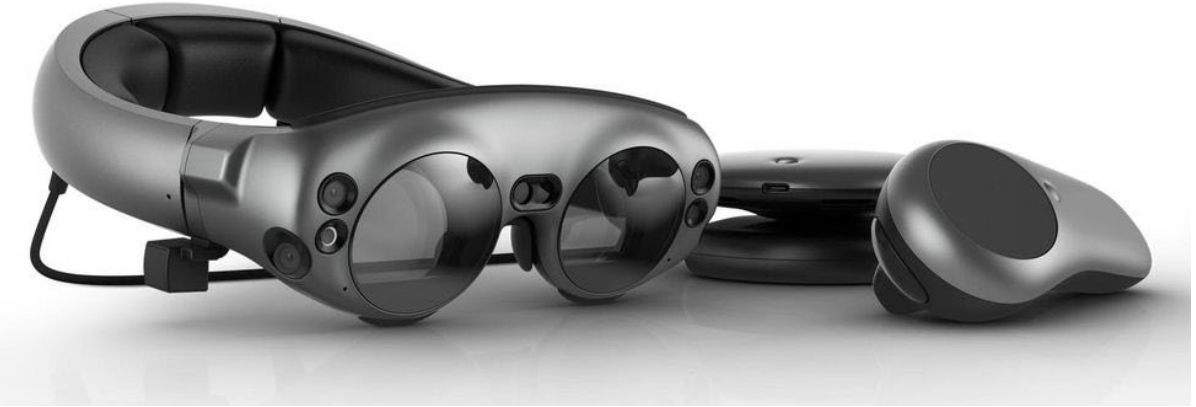
GUIs, AR/VR, scanners, Computational Photography…

I/O of 3D data in CG

Drives interaction and usability





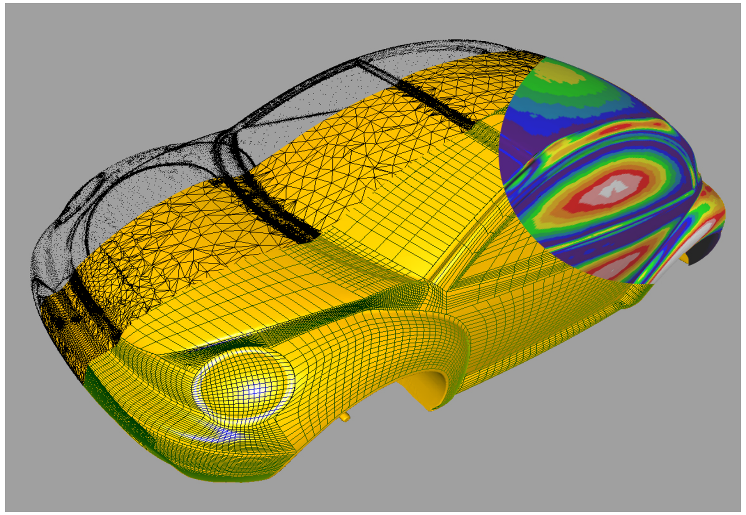


“Core” Areas of Computer Graphics

- Form (modeling)

  How do we represent (2D or 3D) objects & scenes?

  How do we build these representations?



- Function, Behavior (animation)

  How do we represent the way objects move?

  How do we define & control their motion?

- Appearance (rendering)

  How do we represent the appearance of objects?

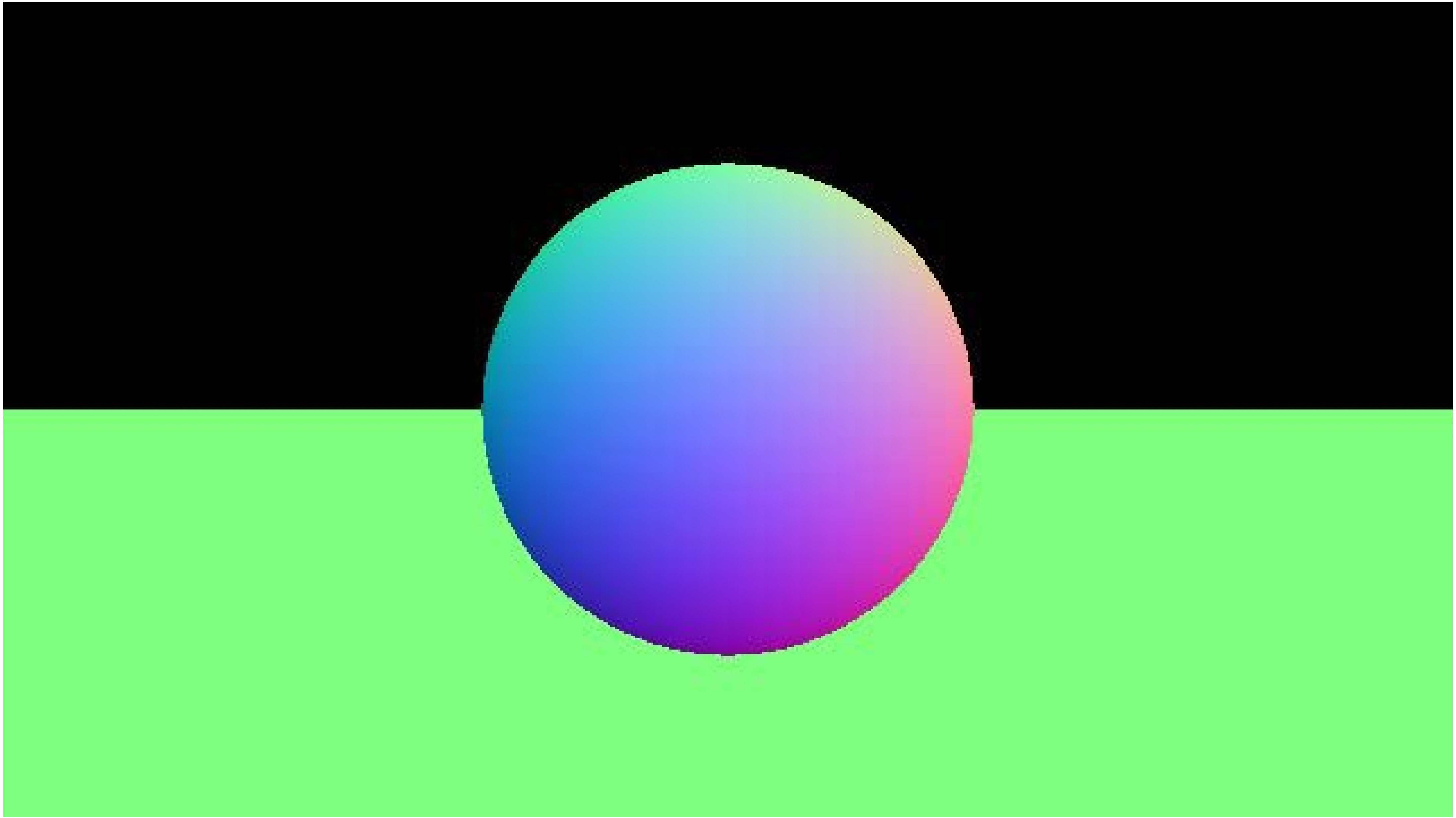
  How do we simulate the image-forming process?

THE DAY THE EARTH STOOD STILL

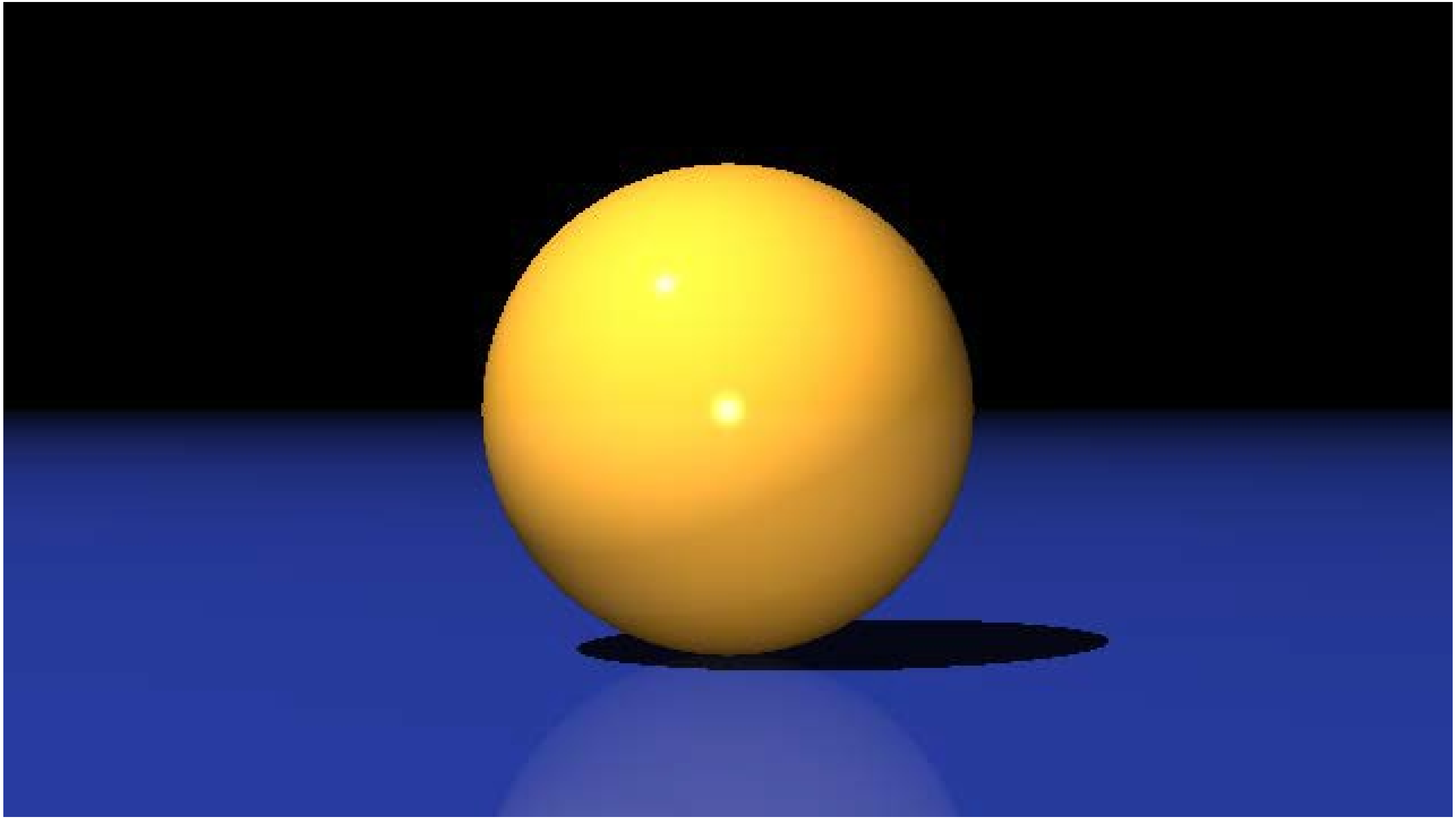
Assignment Previews

- Raster Images
- Ray Casting
- Ray Tracing
- Boundary Volume Hierarchies
- Meshes
- Shaders
- Kinematics
- Mass-Springs
- Final Project: Image Showcase! (extra credit)

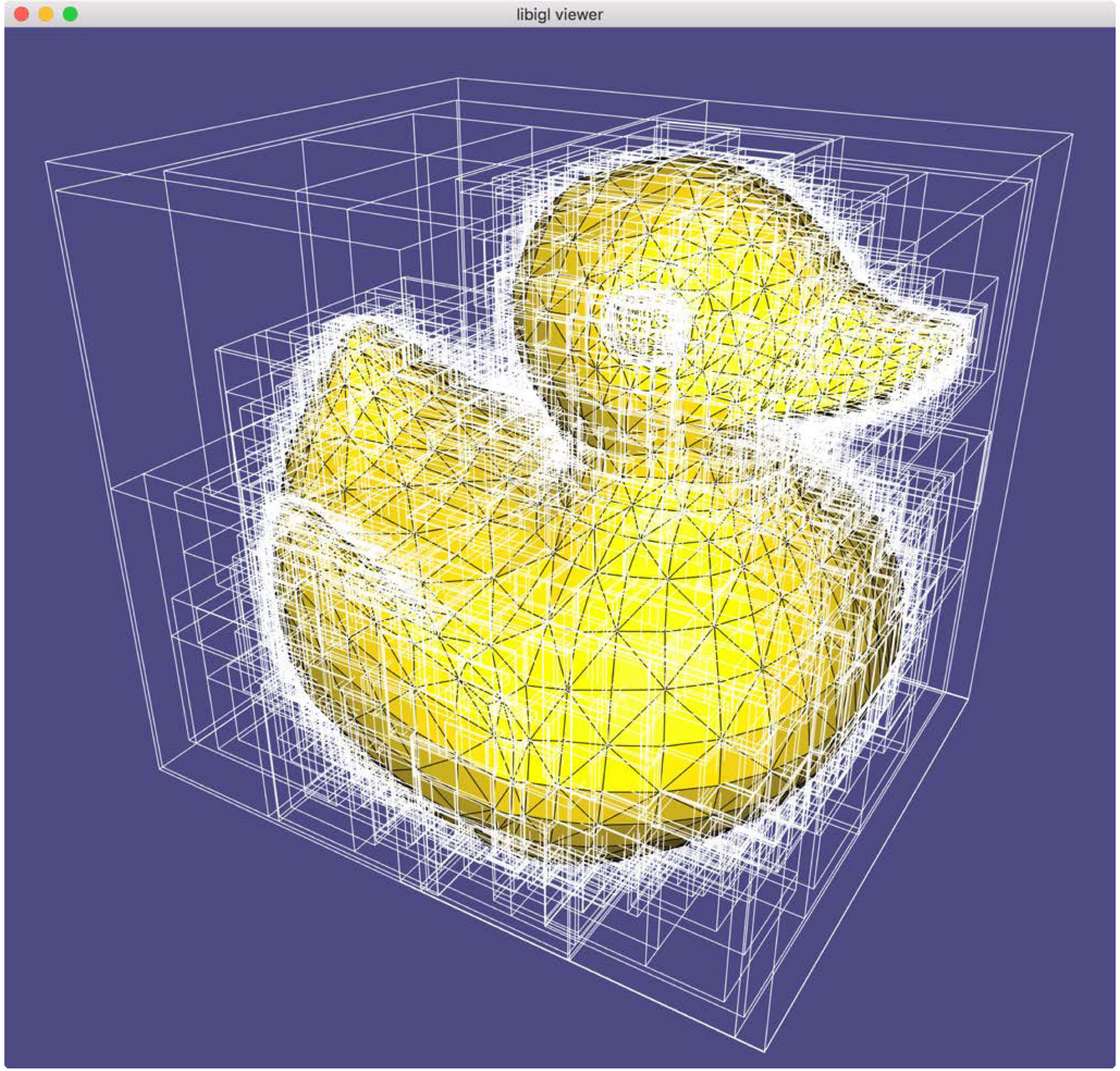
Ray Casting



Ray Tracing

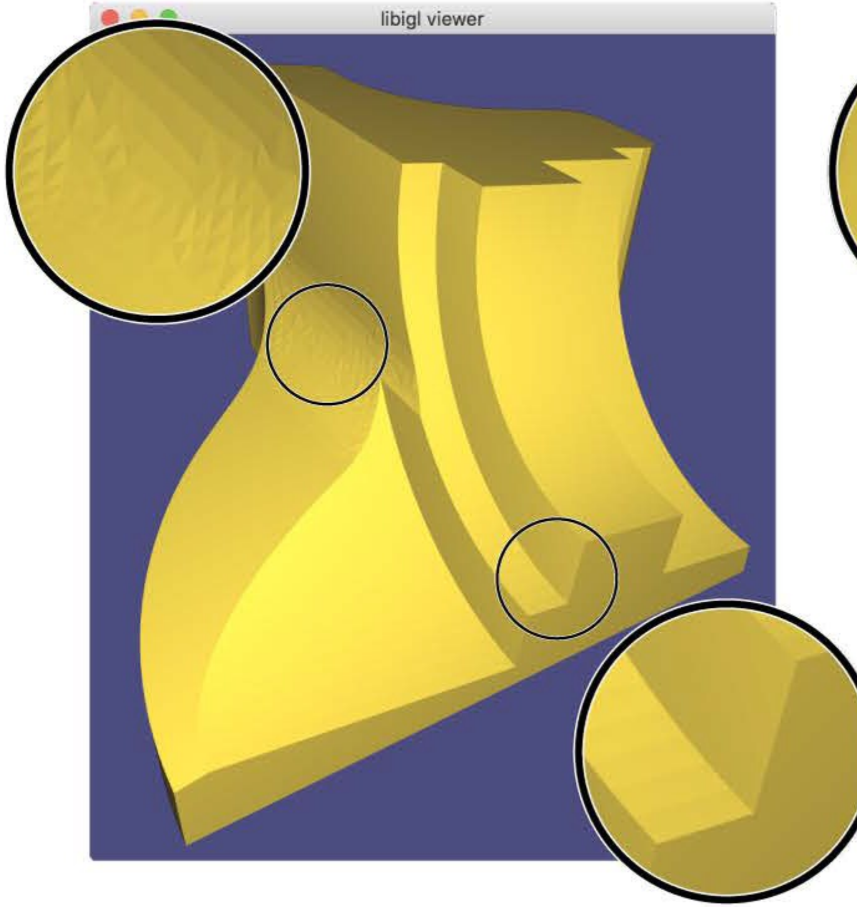


Boundary Volume Hierarchies

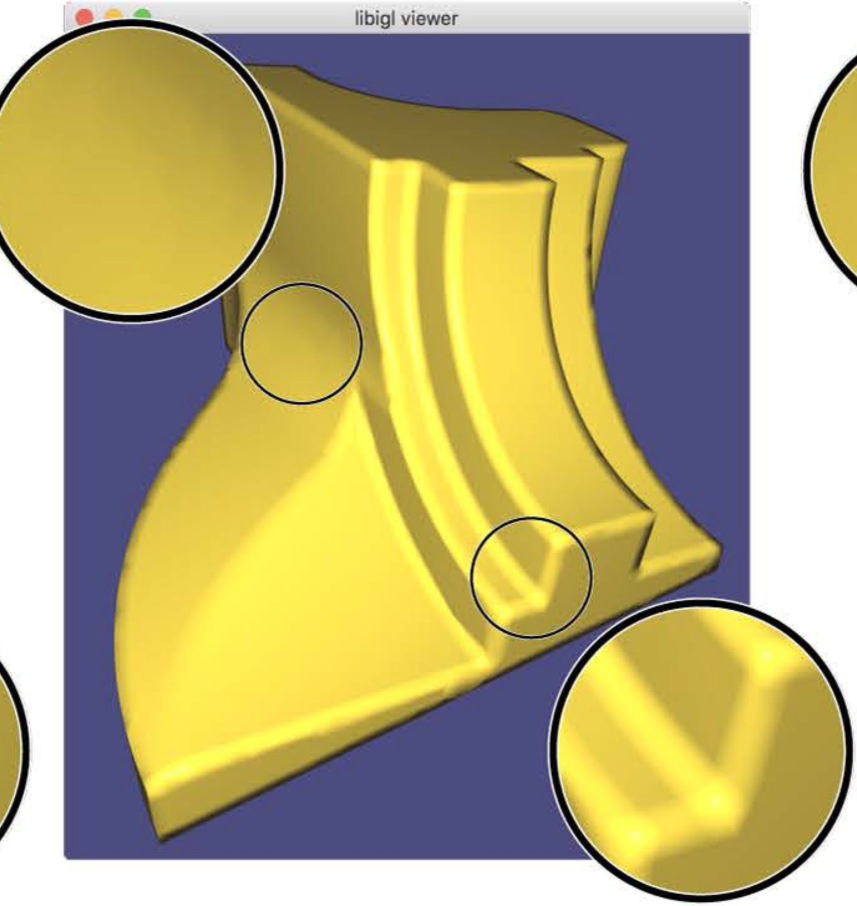


Meshes

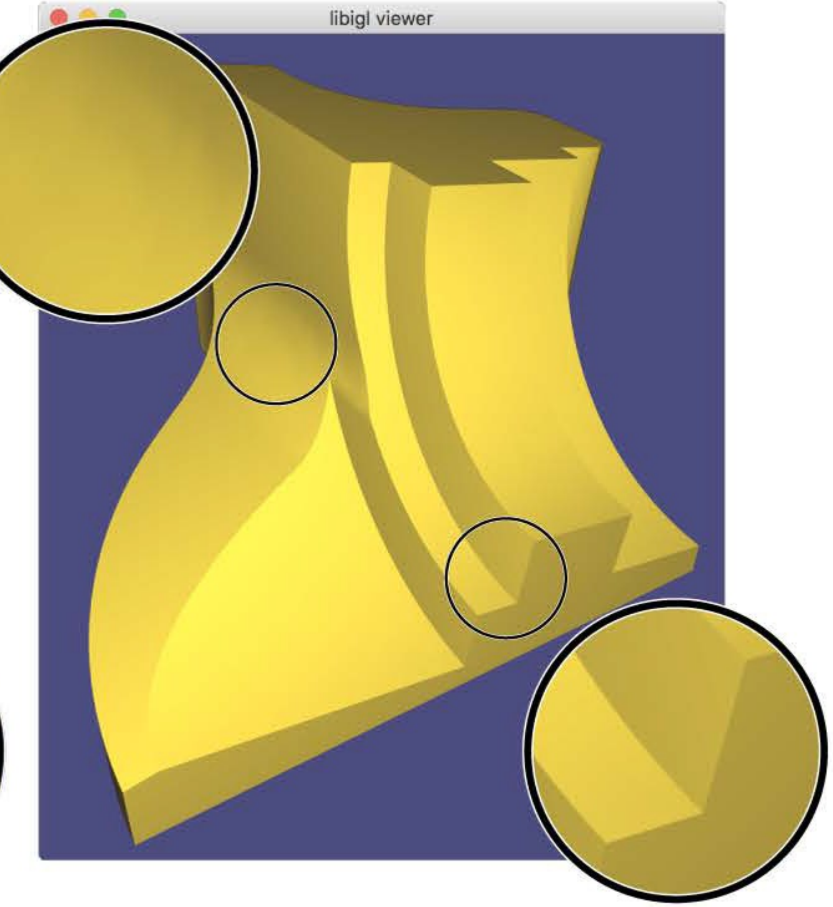
Per-face normals



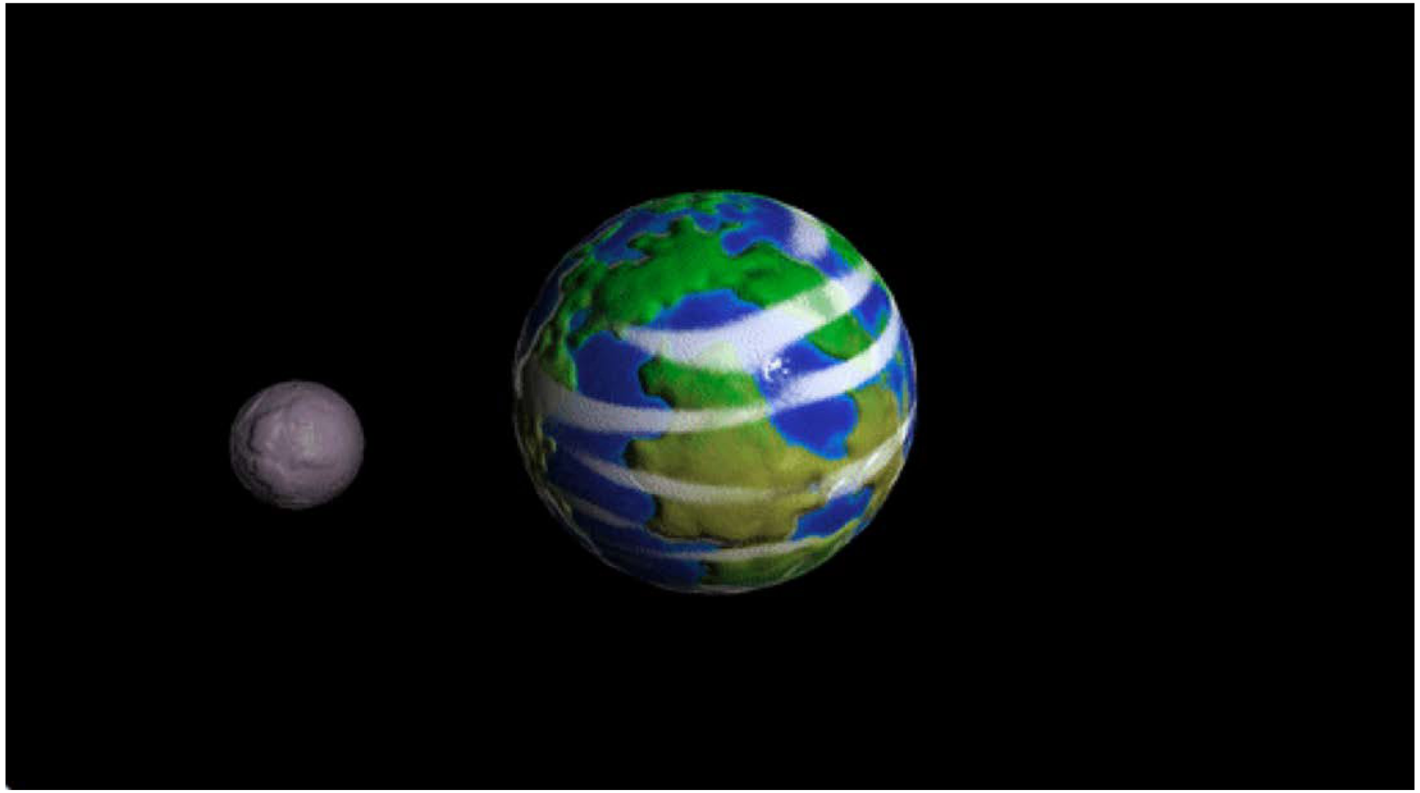
Per-vertex normals



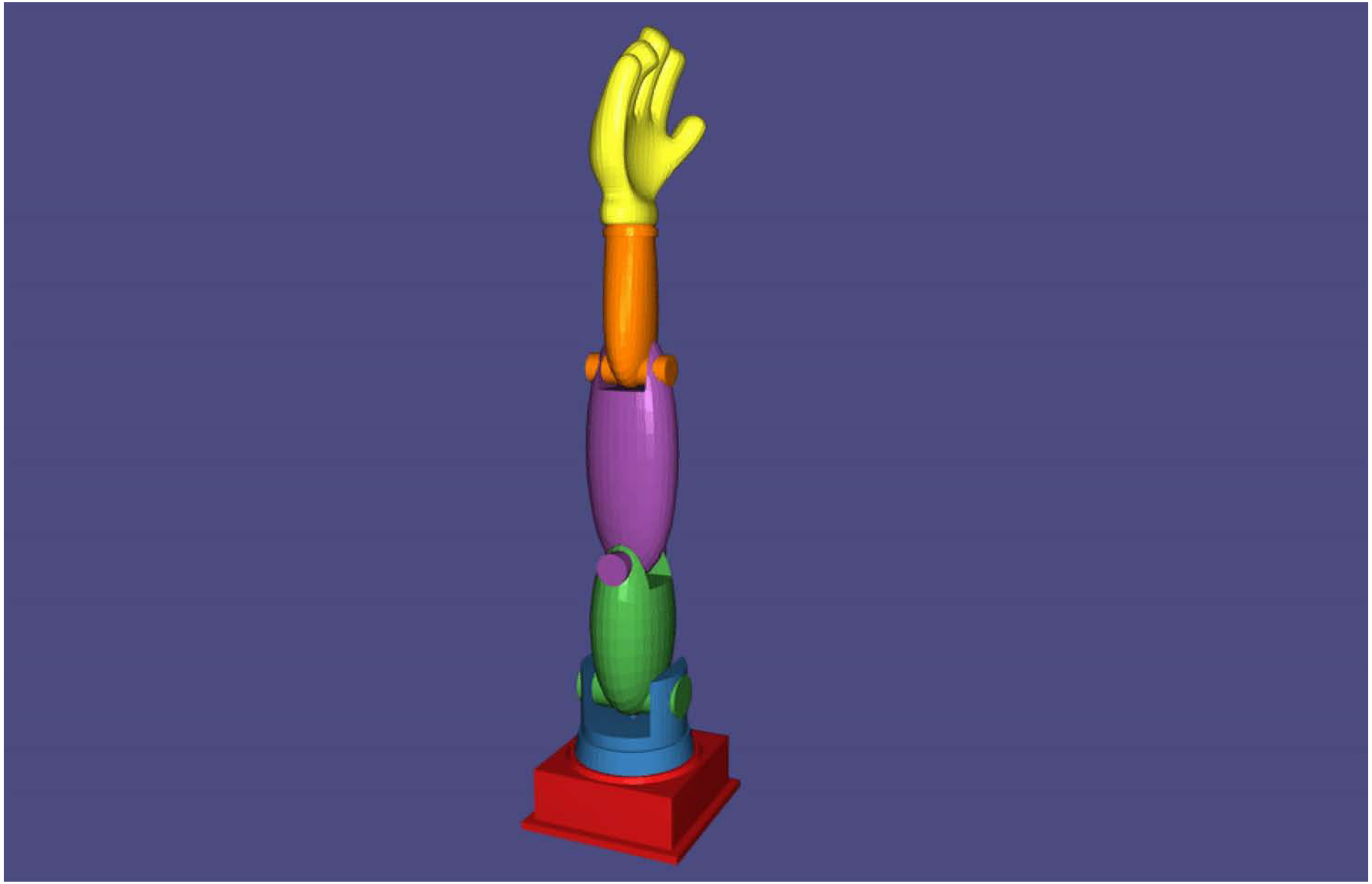
Per-corner normals



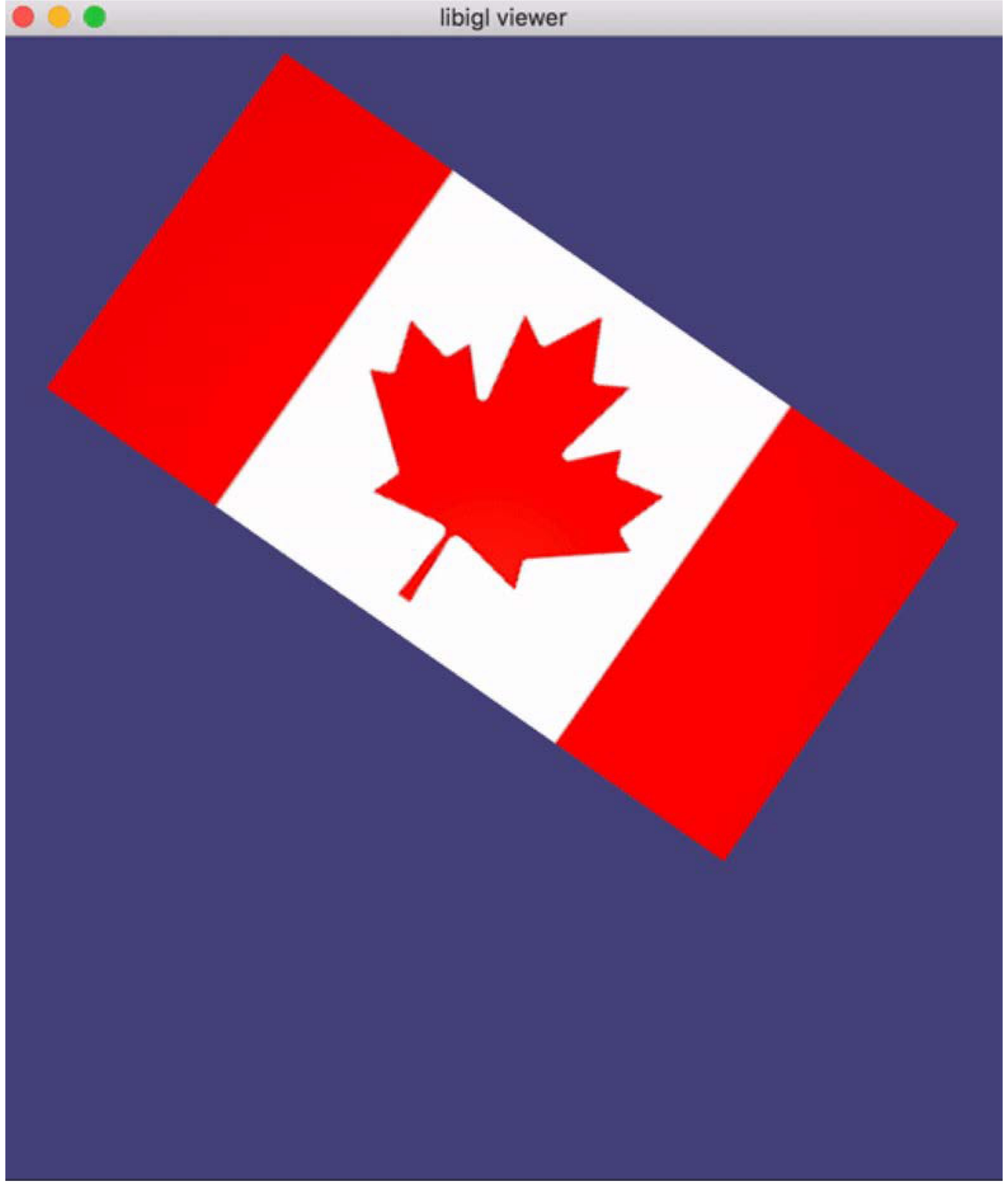
Shaders



Kinematics



Mass-Springs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