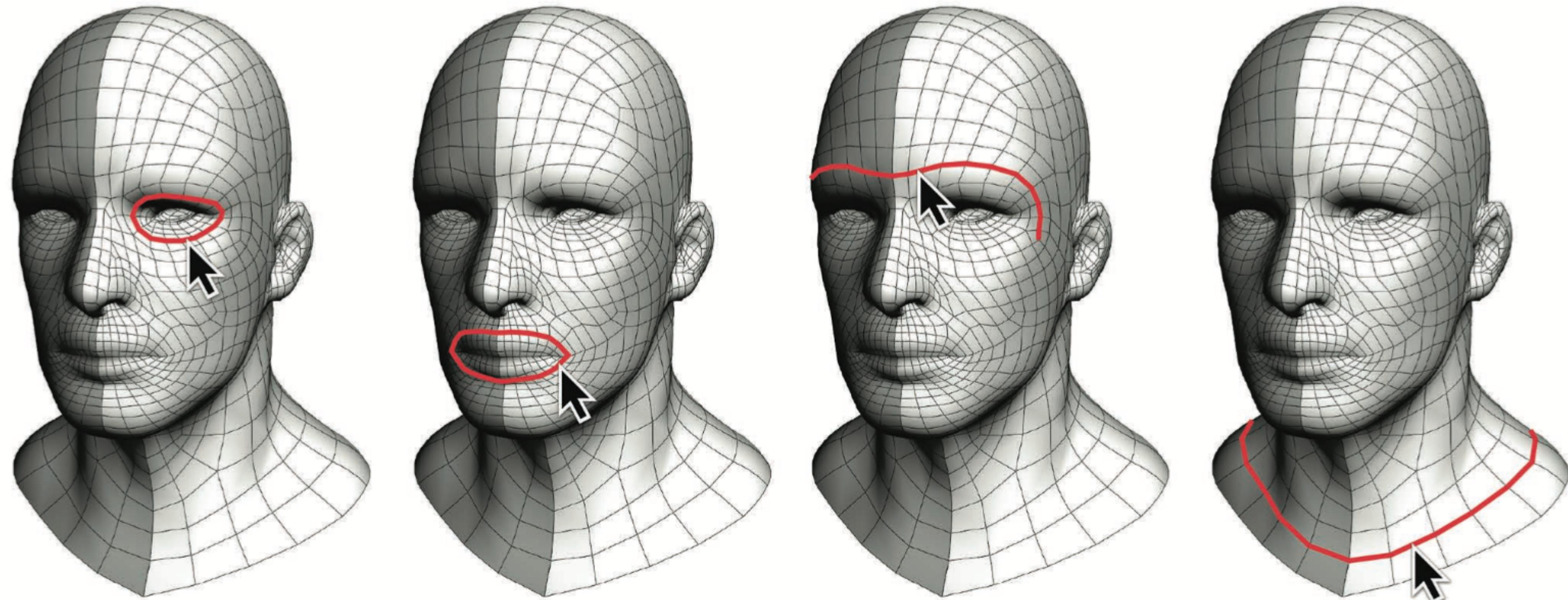


Introduction to Computer Graphics

What is Computer Graphics?

- In a broad sense is the use of a computer to create and manipulate images
 - It involves a combination of hardware (input, processing, output) and software
 - It can be 2D or 3D
 - It is used in most electronic devices

Graphic Areas



Modeling

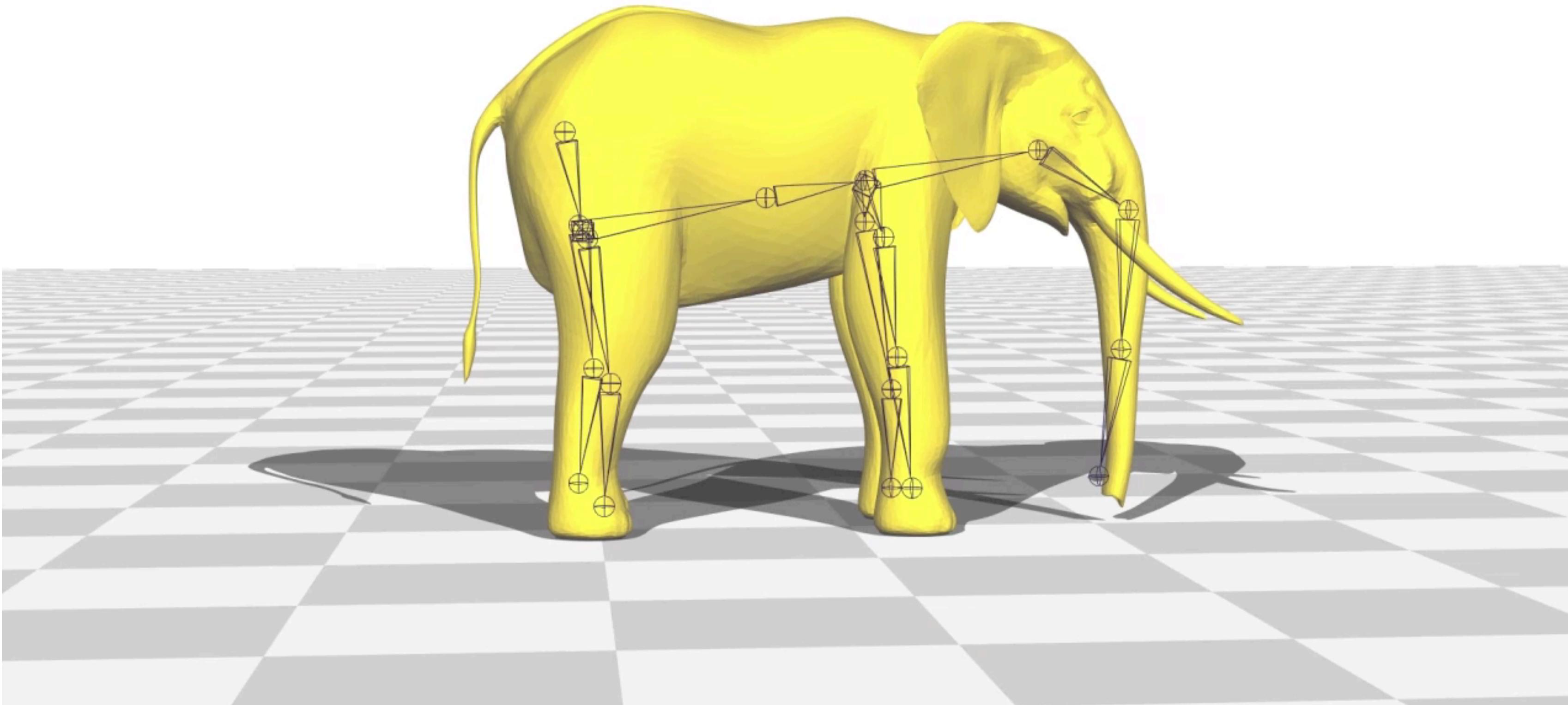
<https://www.youtube.com/watch?v=Udno6EA5lXY>

Graphic Areas



Rendering

Graphic Areas



Animation

Graphic Areas



Copyright: Andrew Guyton

User Interaction

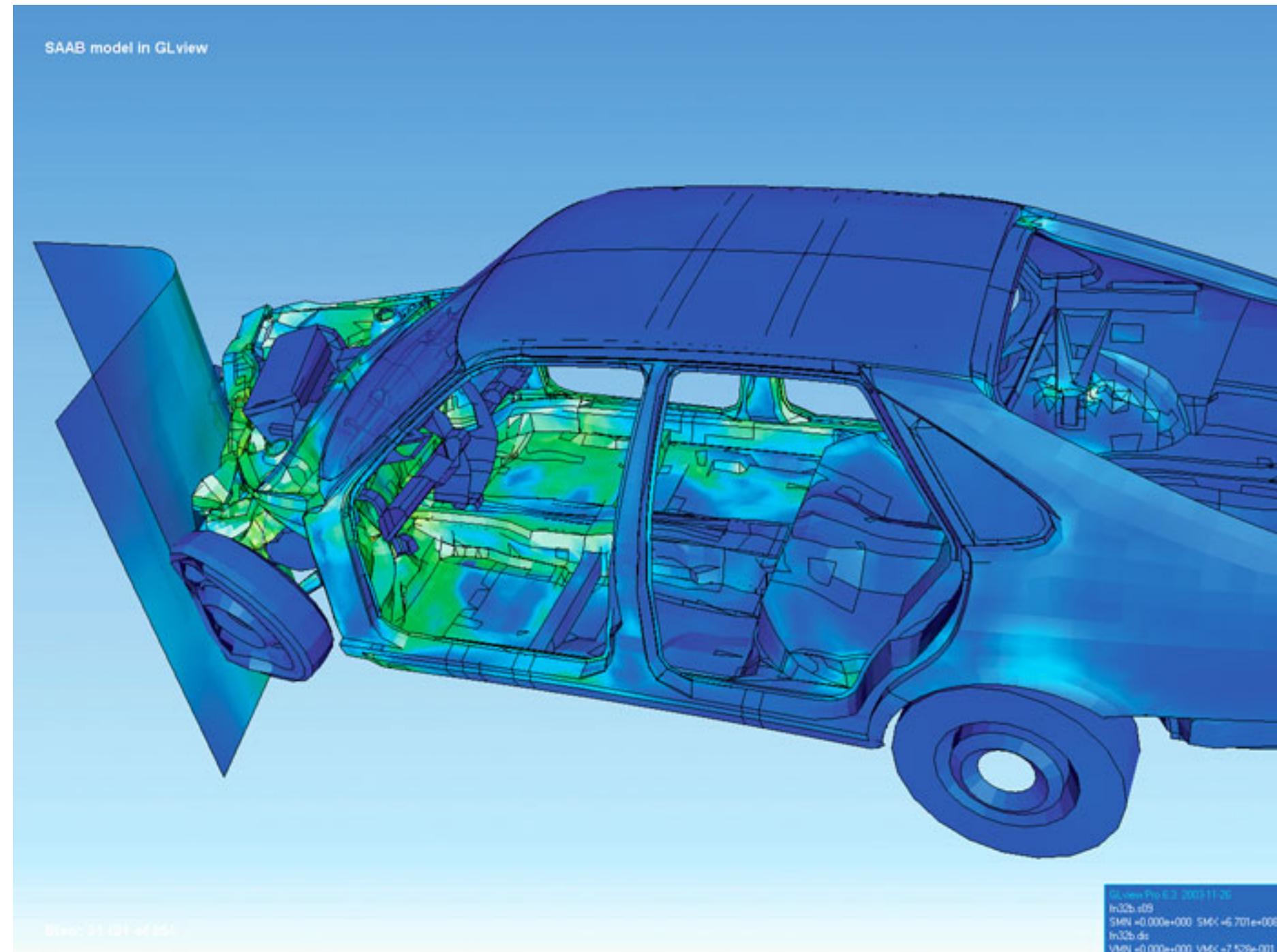
Graphic Areas



Copyright: Maurizio Pesce

Virtual Reality

Graphic Areas



Visualization

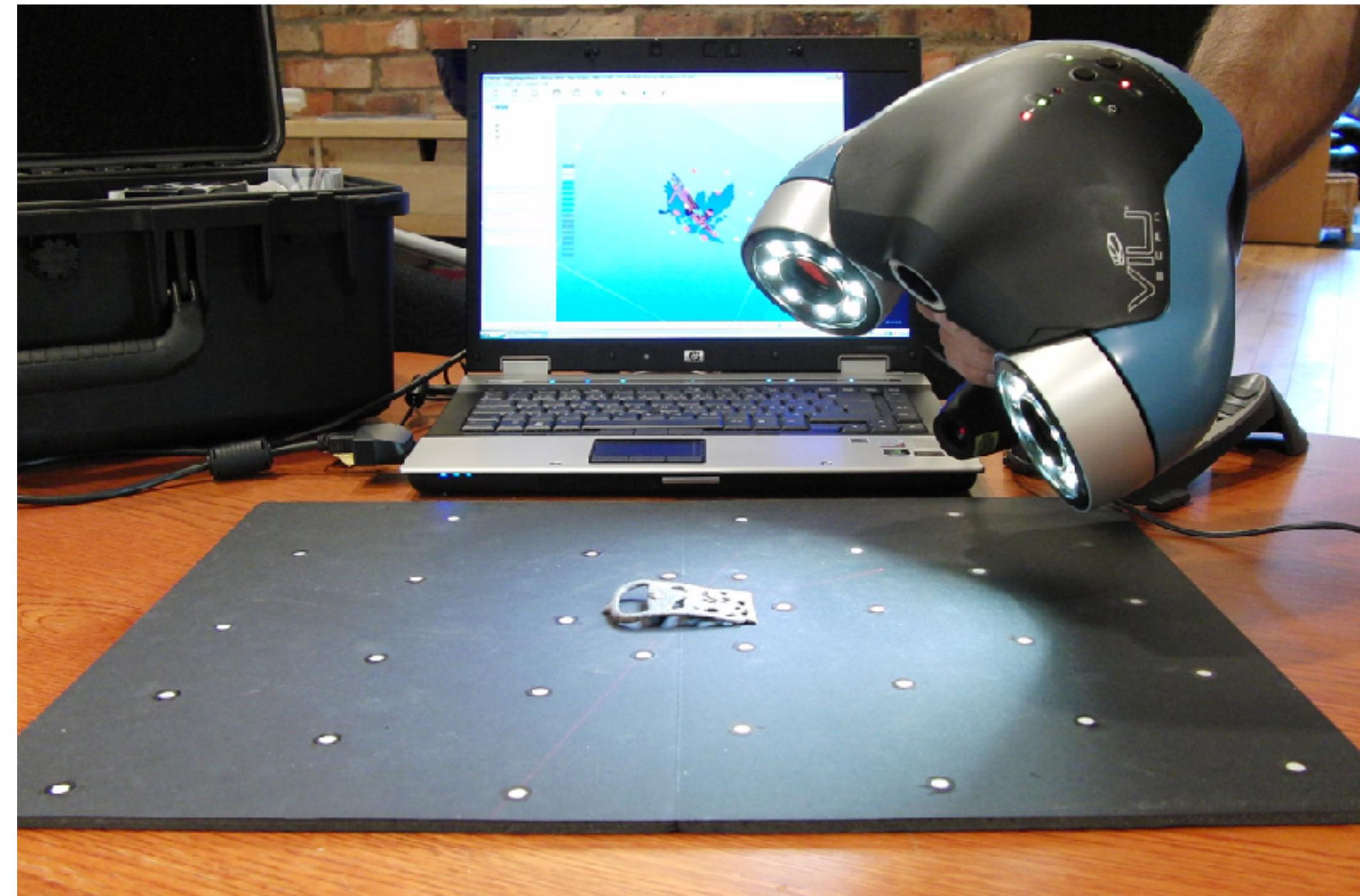
Graphic Areas



By IkamusumeFan - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=41790217>

Image Processing

Graphic Areas



By Creative Tools from Halmstad, Sweden - CreativeTools.se - VIUscan - Laser-scanned - ZPrinter - 3D printed -
Viking Belt Buckle 24, CC BY 2.0, <https://commons.wikimedia.org/w/index.php?curid=12419129>

<http://www.agisoft.com>

Geometry Acquisition



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Applications

Video Games



Copyright: Nintendo

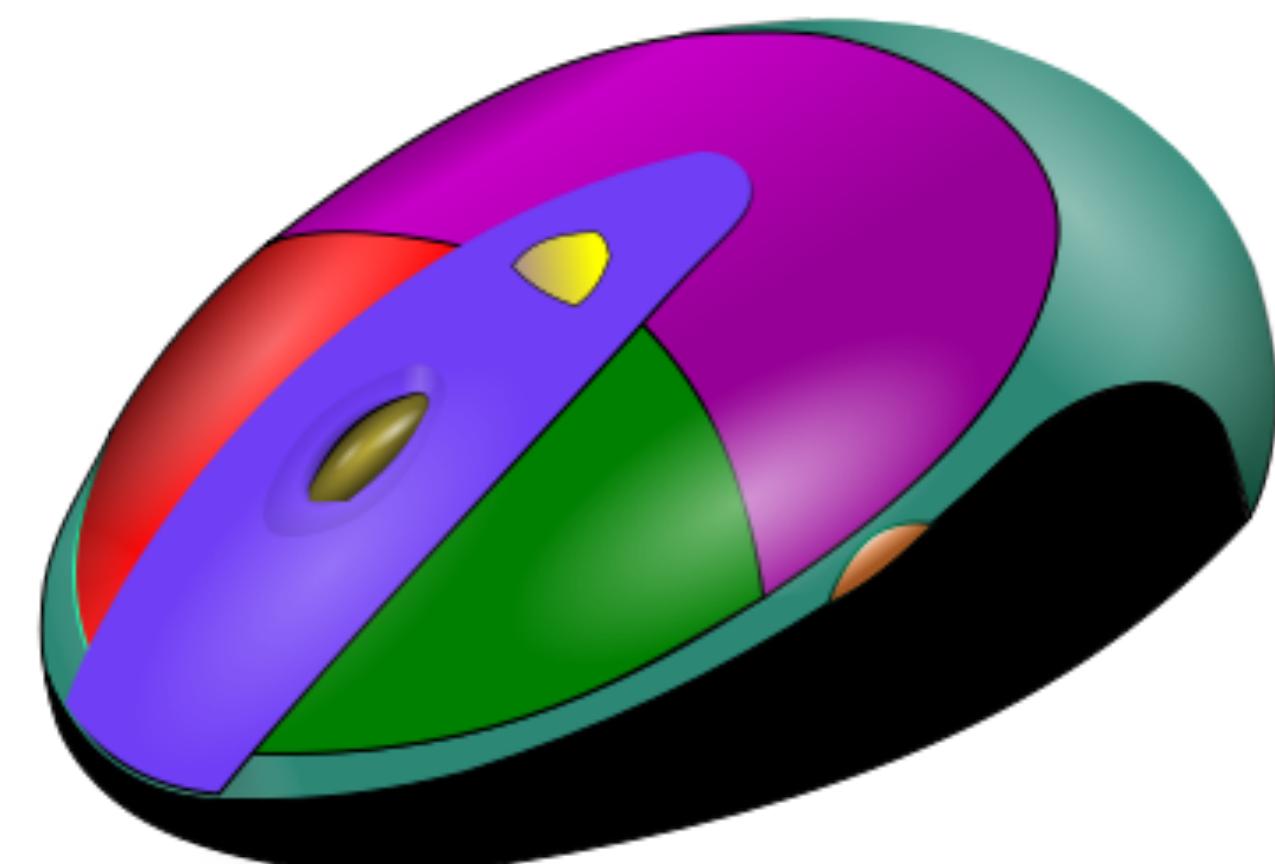
Cartoons/Visual Effects/Films



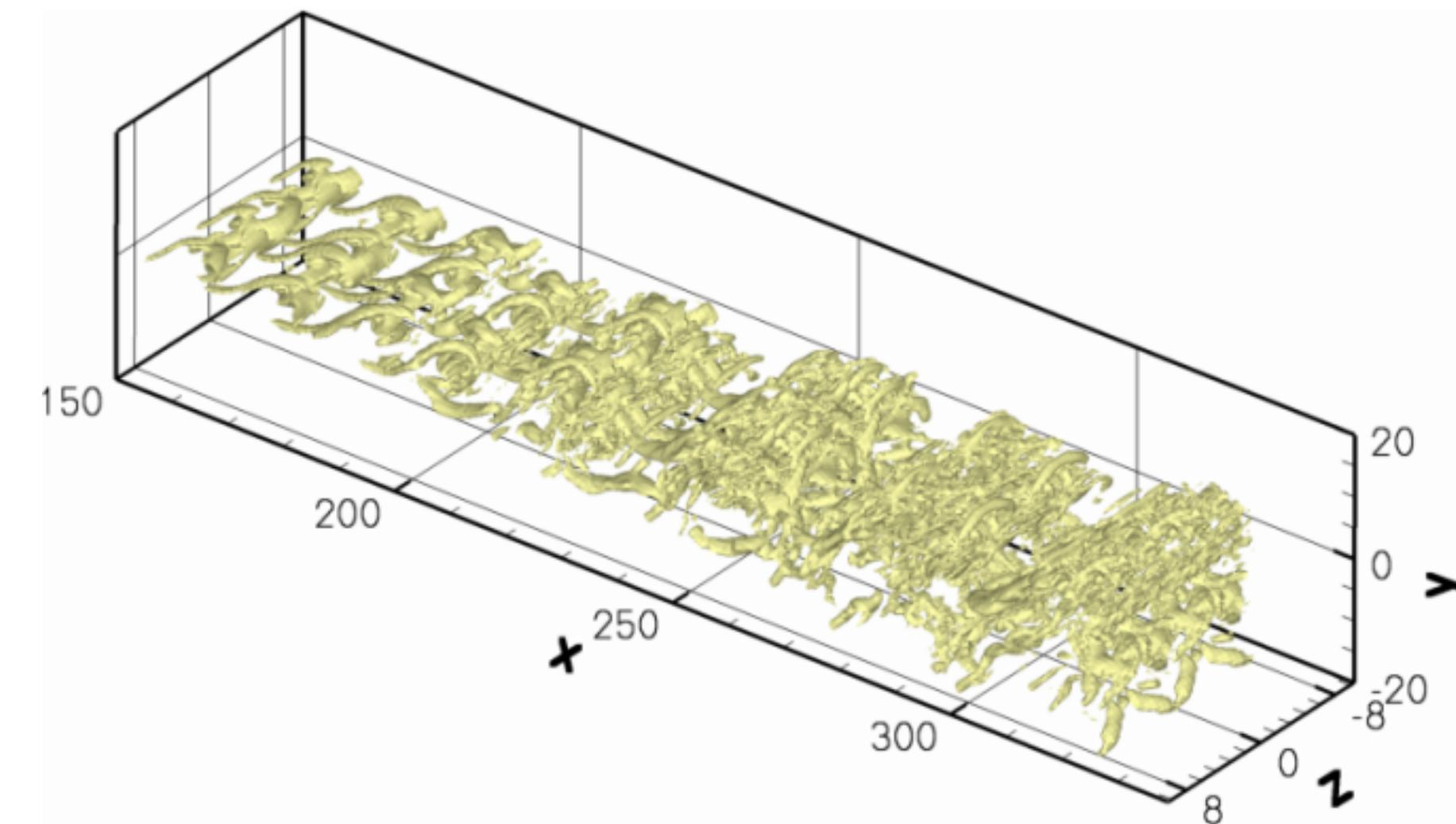
Copyright: Blender Foundation

Applications

CAD/CAM



Simulation



By Andreas Babucke - self made with EAS3, original upload at http://de.wikipedia.org/wiki/Bild:Lambda2_scherschicht.png, CC BY 3.0 de, <https://commons.wikimedia.org/w/index.php?curid=2999003>

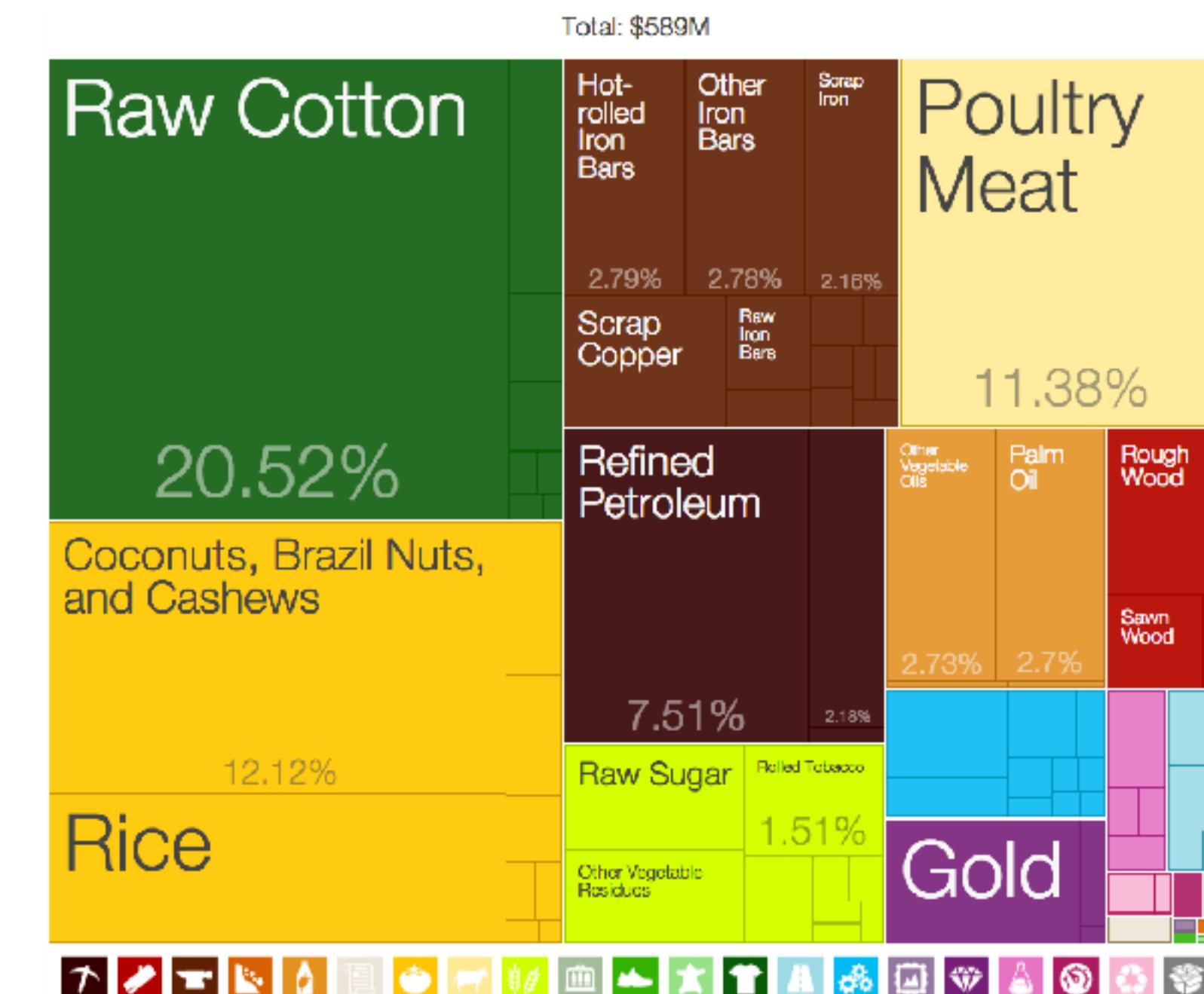
Applications

Medical Imaging



By Etan J. Tal - Own work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=12743250>

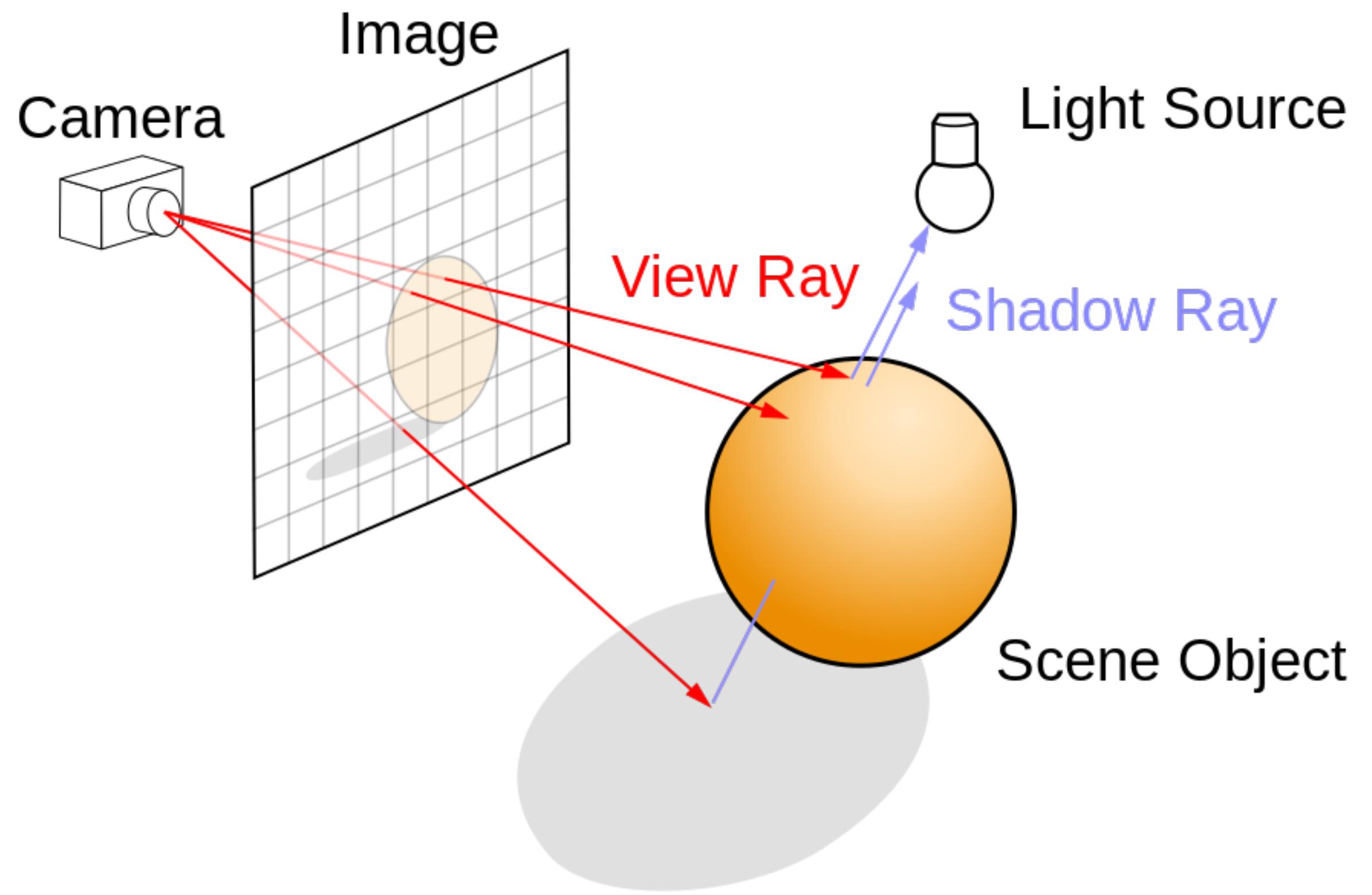
Information Visualization



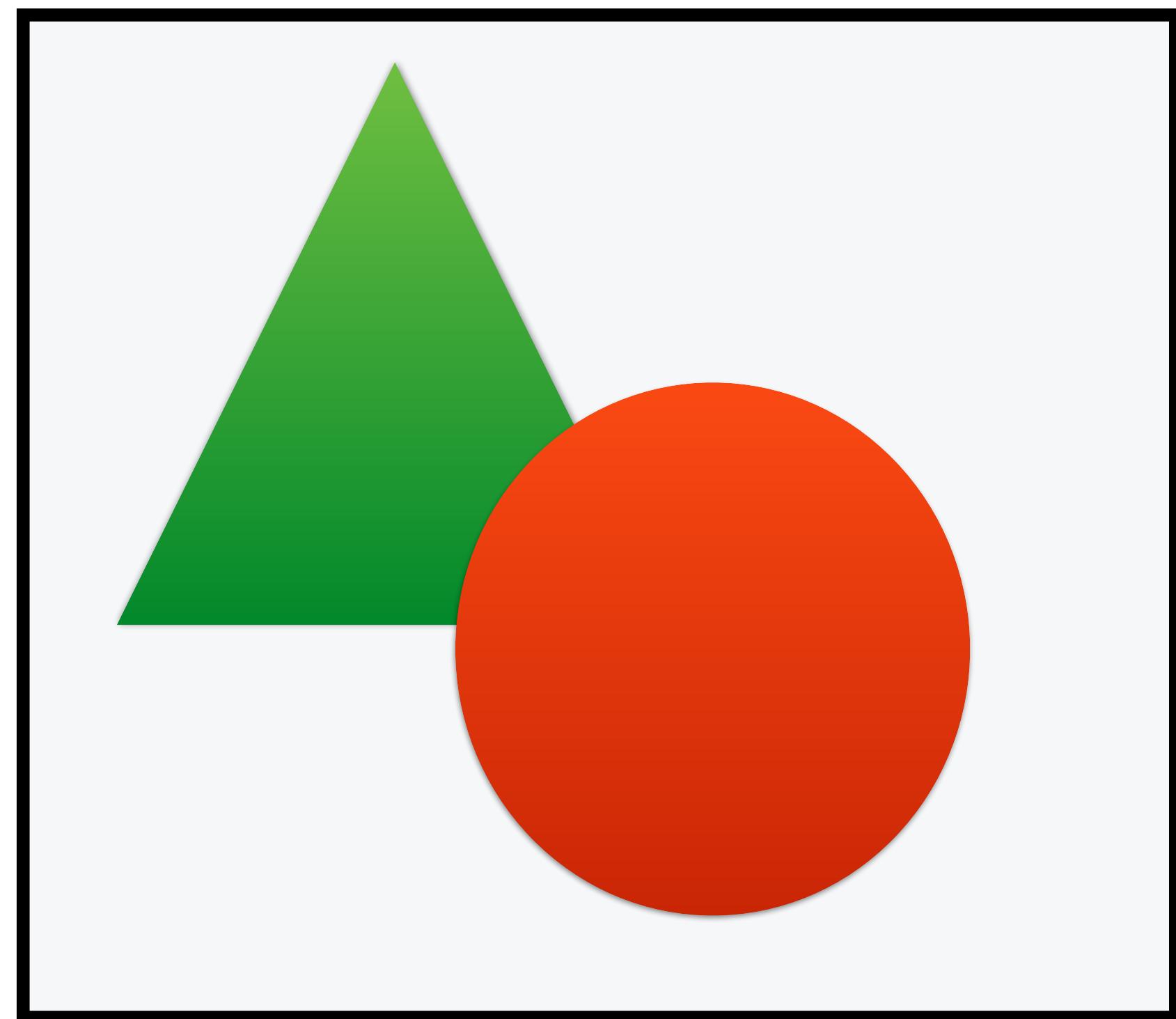
By Mcstol - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=18553353>

Two major approaches

Per-pixel - "Raytracing"

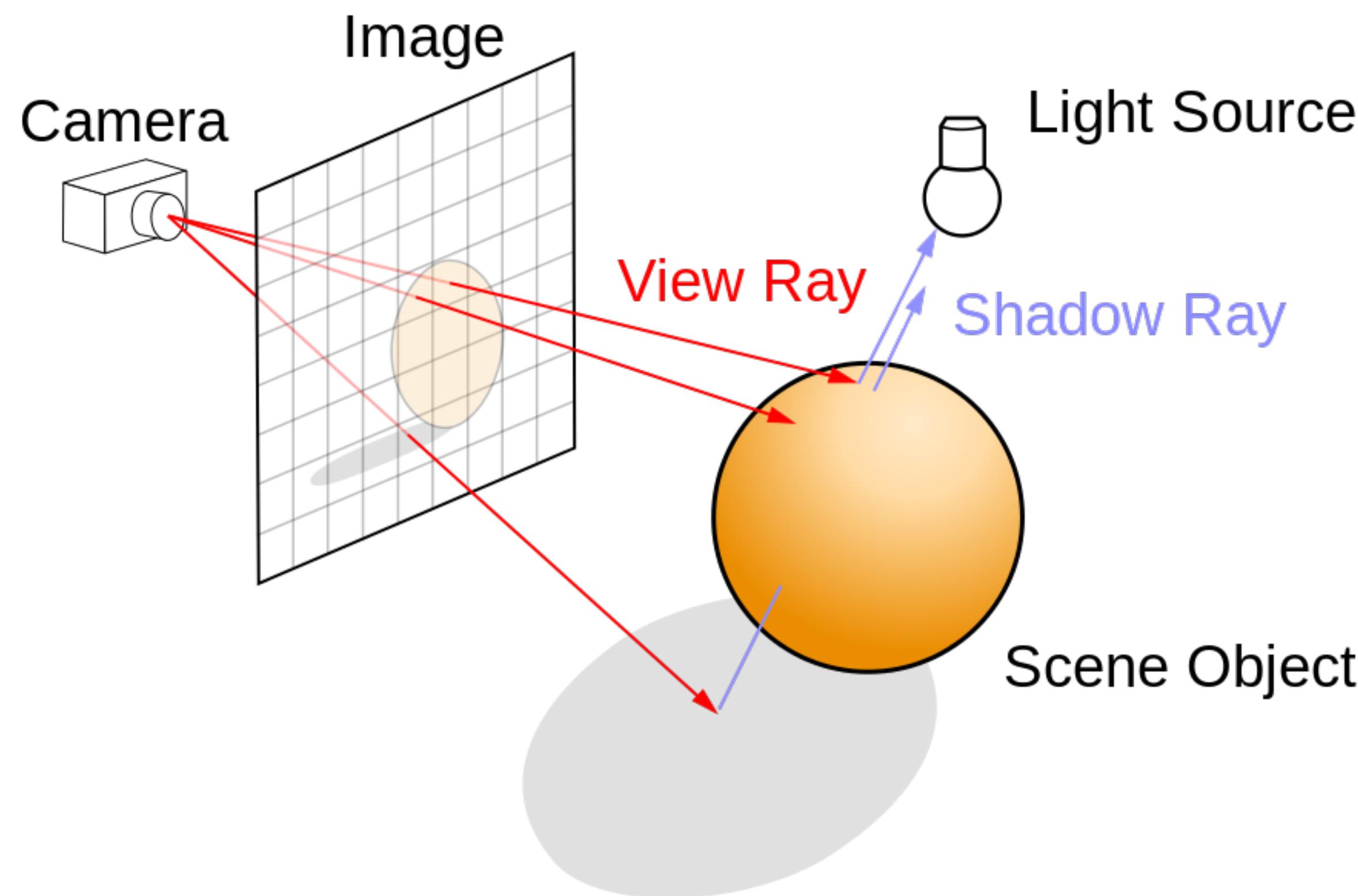


Per-object - "Rasterization"



By Henrik - Own work, GFDL, <https://commons.wikimedia.org/w/index.php?curid=3869326>

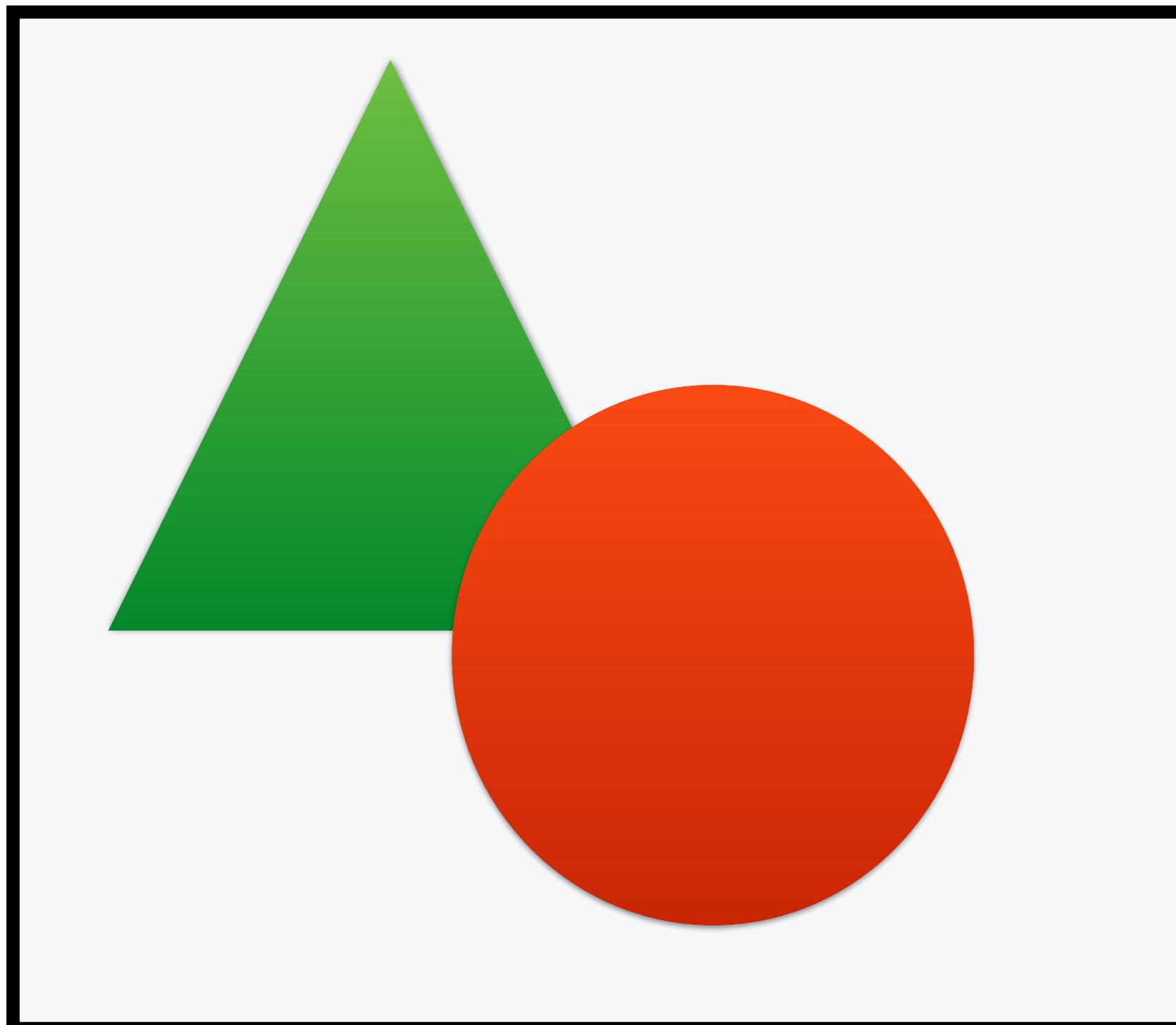
Per-pixel



- Easy to parallelize but hard to map to hardware
- Expensive!
- It can be extended to model many physical phenomena such as internal scattering, diffraction, reflections, etc.
- Used to obtain high quality images

By Henrik - Own work, GFDL, <https://commons.wikimedia.org/w/index.php?curid=3869326>

Per-object



- Easy to map to hardware
- While it cannot model directly complex effects, we can approximate them
- Used in interactive applications (mostly)

Course Goals

- Study the fundamental mathematical concepts used in image synthesis algorithms
- Implement a rendering system based on ray tracing
- Implement a rendering system based on object-order rendering (rasterization)

Prerequisites

- Linear Algebra
- We will quickly review the concepts that you need, if you are not familiar with basis, points, vectors, matrices and linear systems, please review it on the textbook (Chapter 2, 5)
- C++
 - We will review the basic concepts of C++, comparing them with Java. Keep this reference at hand <http://www.cppreference.com>
 - Why C++?

Organization

- Communication through the course repository/website:
<https://github.com/teseoch/CG-Spring-2023>
- Brightspace
- Weekly lecture
- Microsoft Teams



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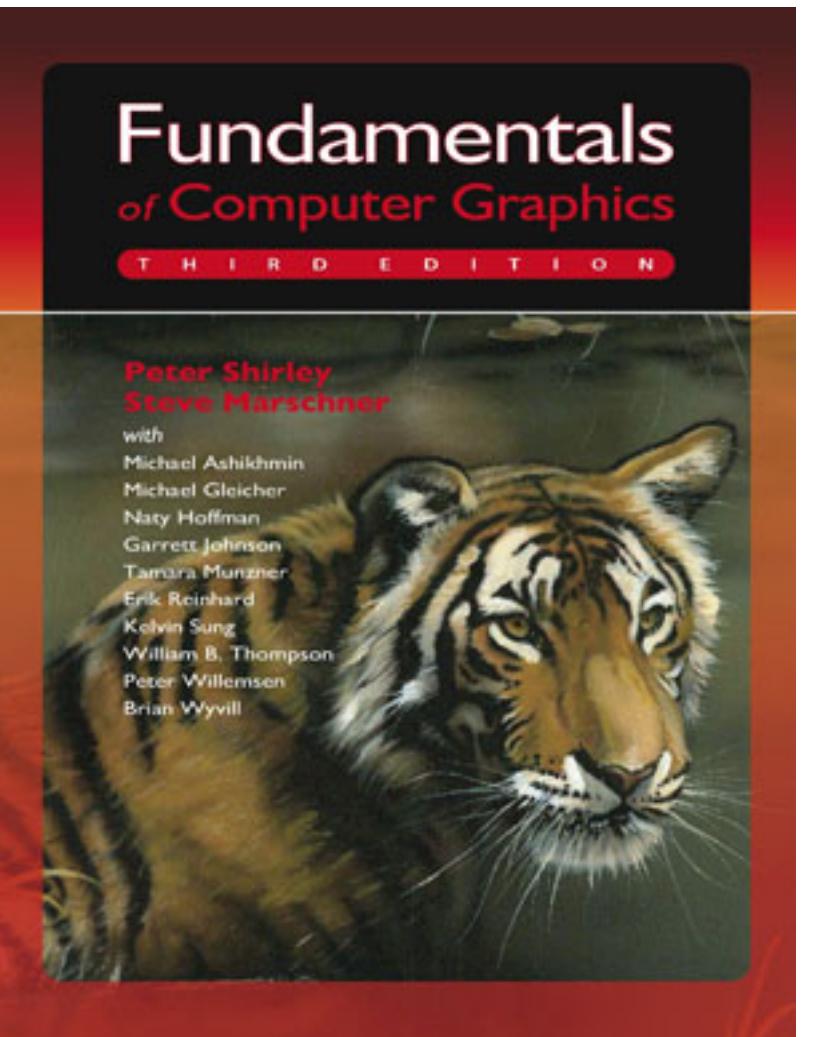
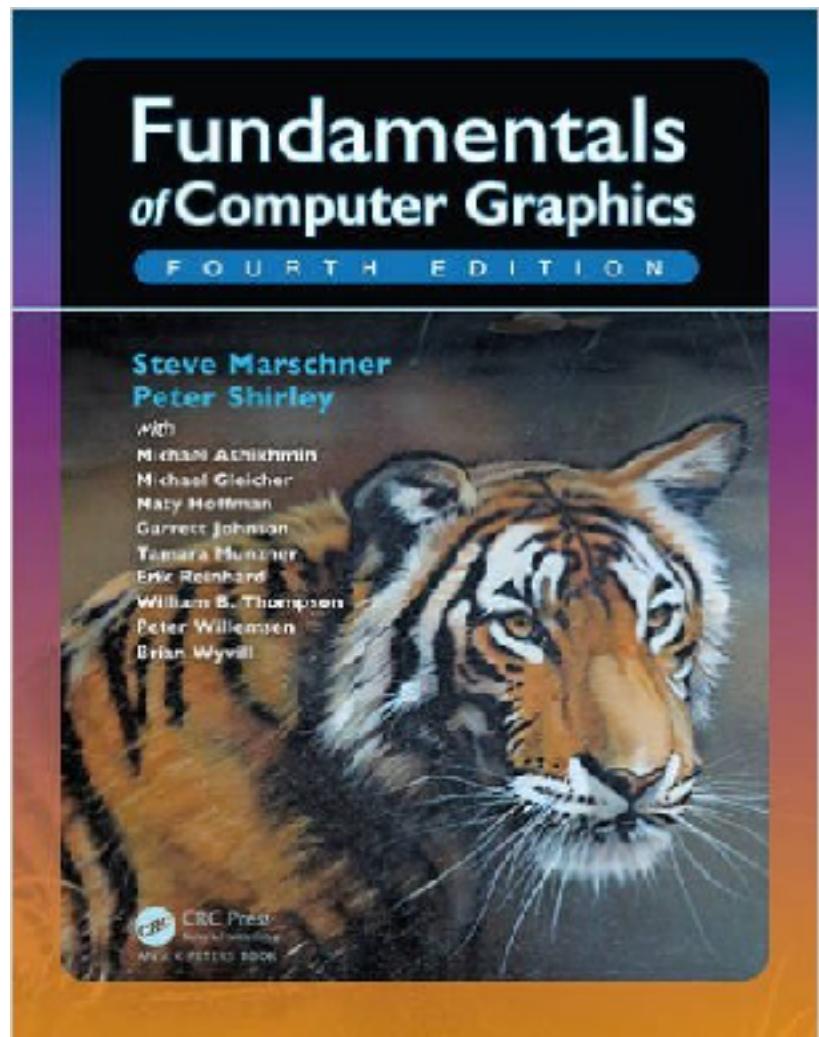
Lectures

- I will upload the slides on the website before the class, so that you can directly annotate them
- For every class, I will always add references in the end to the textbook and/or external resources
- At the end of every lecture, I will quickly introduce the topic of the next lecture and give you pointers — you are encouraged to take a look at the material **before** I present it in class

Lectures

- Please interrupt me at any time to ask questions

Material



<https://www.wikipedia.org>

Fundamentals of Computer Graphics, Fourth Edition
4th Edition by Steve Marschner, Peter Shirley

Policy

- You are encouraged to consult with your classmates/friends but collaboration in the assignments is **not allowed**
- You are **not allowed** to copy code online
- You are **not allowed** to use external libraries (except those provided in the assignments)
- We will use plagiarism tools to validate all homework

Basic Math

- Sets
- Functions/Maps
- Intervals
- Logarithm
- Solving Quadratic Equations
- Trigonometry
- Basic Linear Algebra

If you are not familiar with some of these topics,
refresh them before the next class.