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CDTec
centro de desenvolvimento tecnológico

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Computer Graphics
Today: Graphic Pipeline

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Pipeline

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Graphic Pipeline

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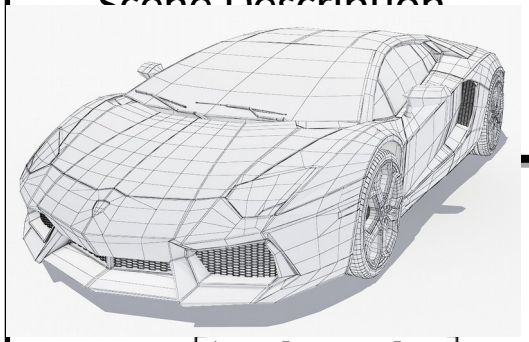
You know this?

You know this!

Black Box



Input

Processing

Output/Input

Image

$$R_x(\theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix}$$

$$R_y(\theta) = \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix}$$

$$R_z(\theta) = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}.$$

Vectors and Matrixes

Render Overview

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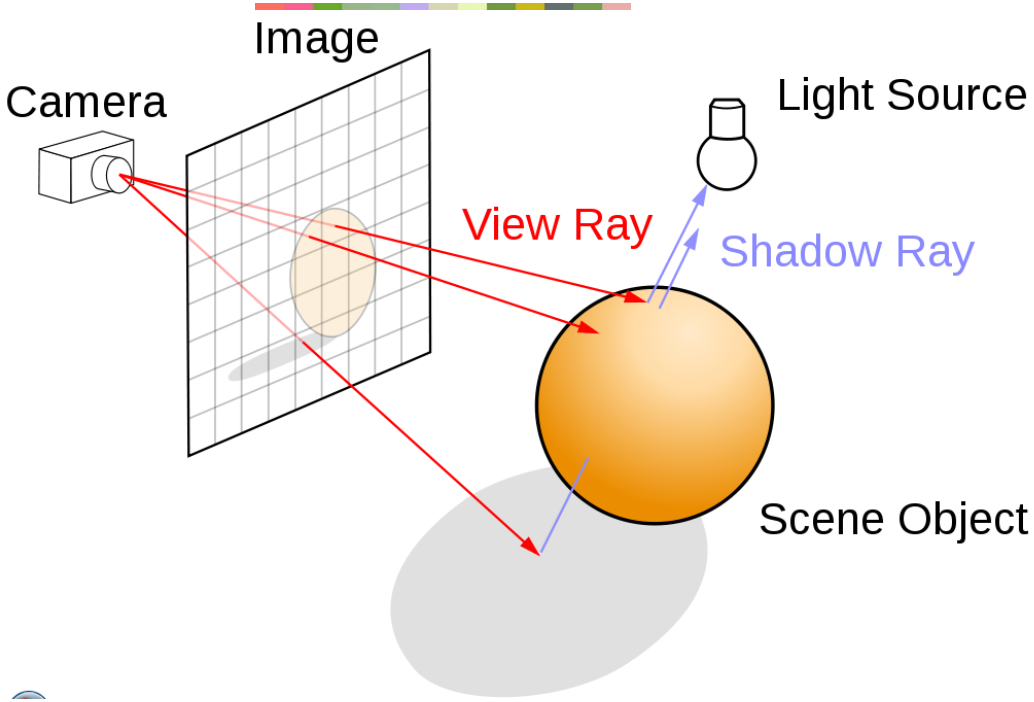

The color must come from somewhere

Scene (Objects, Lights, Camera)

How we describe a scene?

Common ways to describe an object

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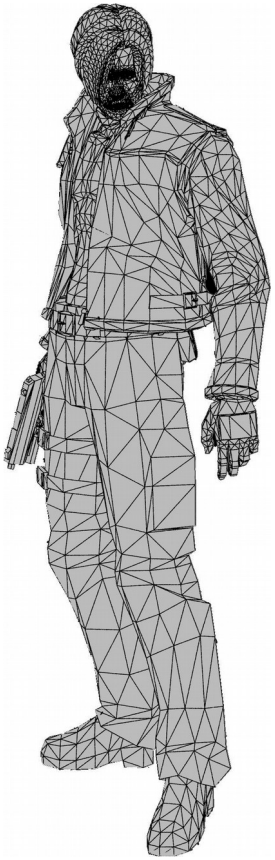

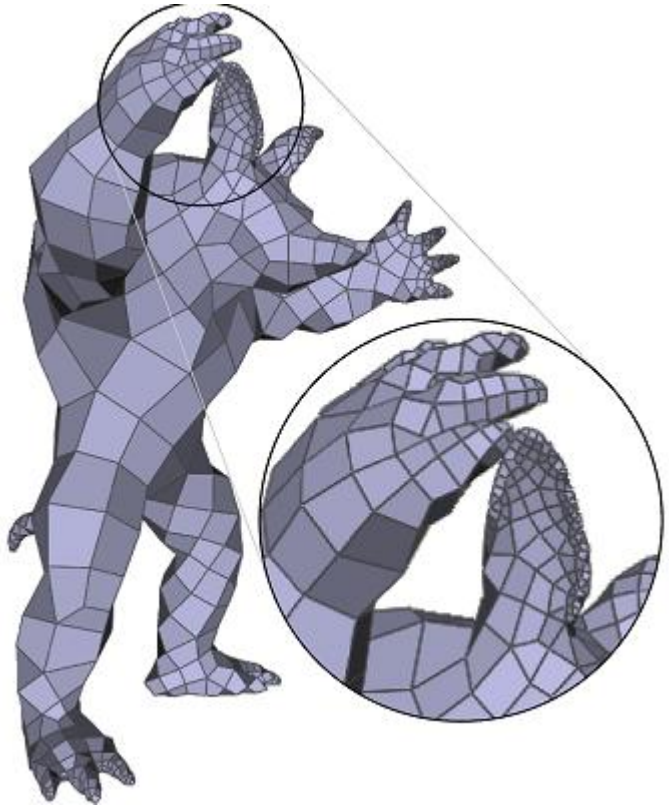

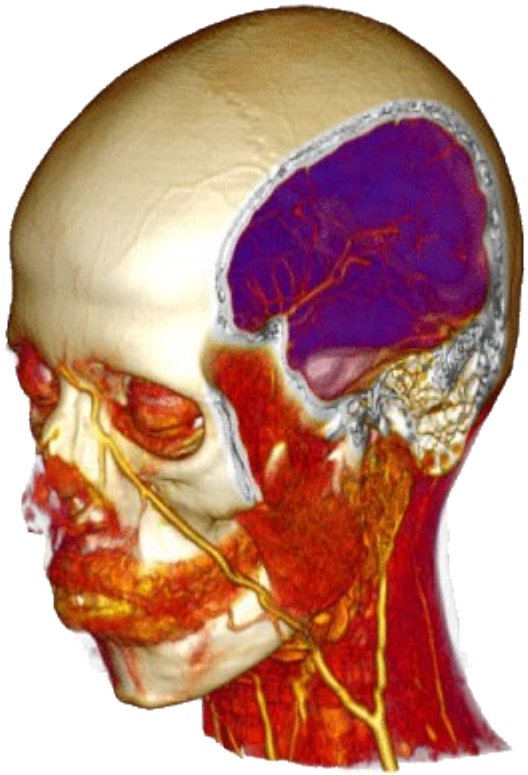

Triangle Mesh

Quad Mesh

Volume

Surface only

Common ways to describe an object

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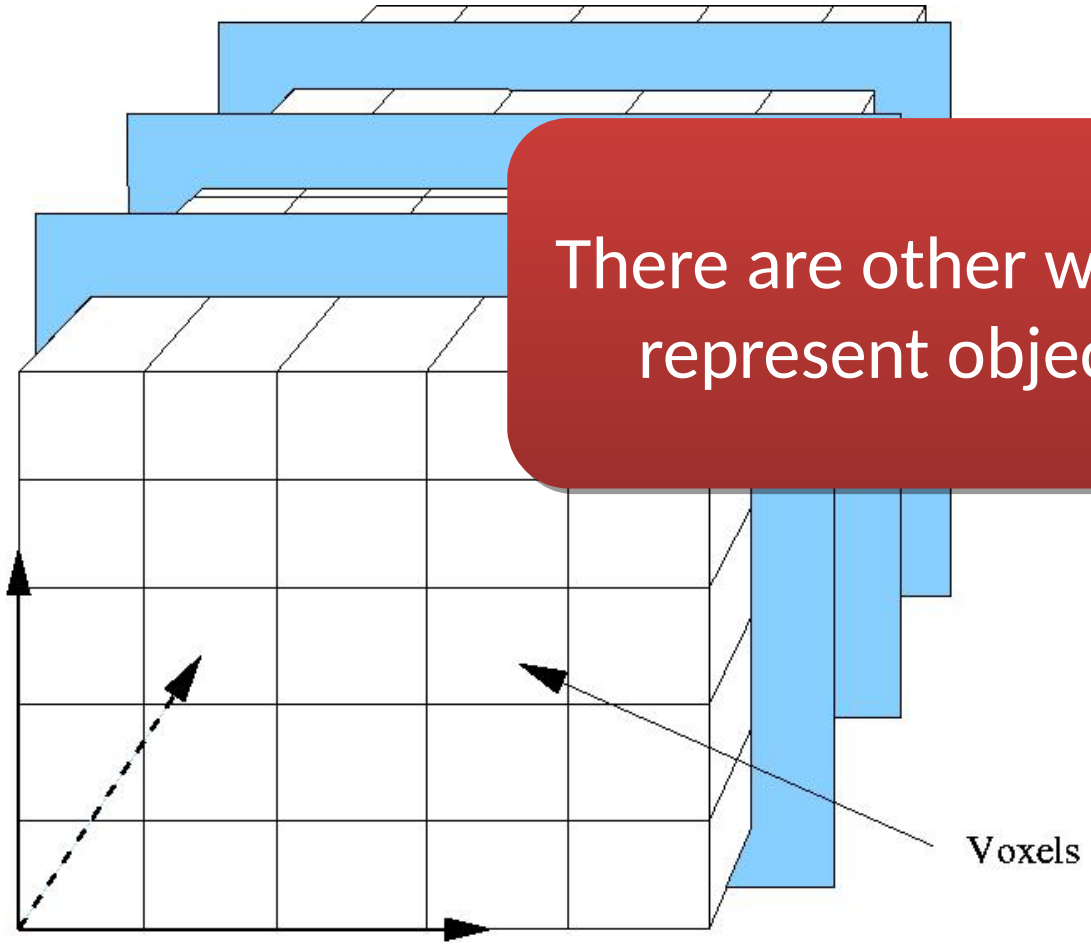
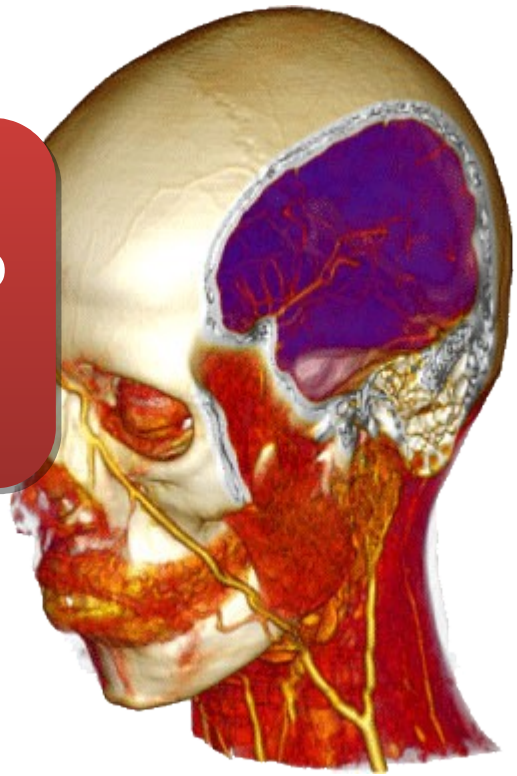


There are other ways to represent objects!



Volume

Triangle Mesh 2D

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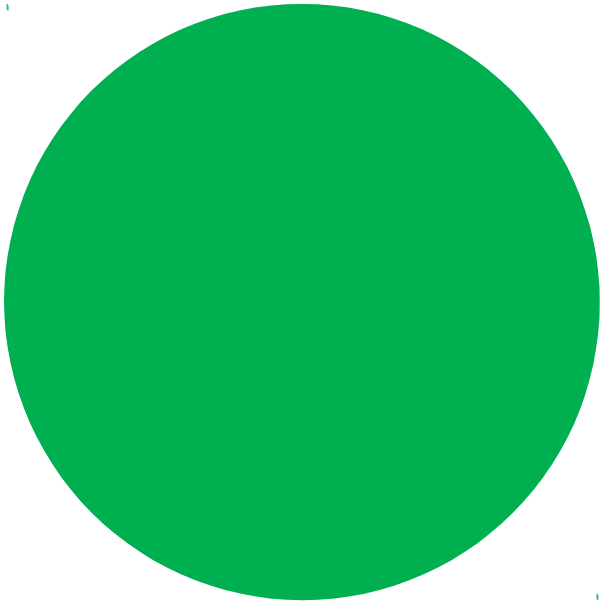
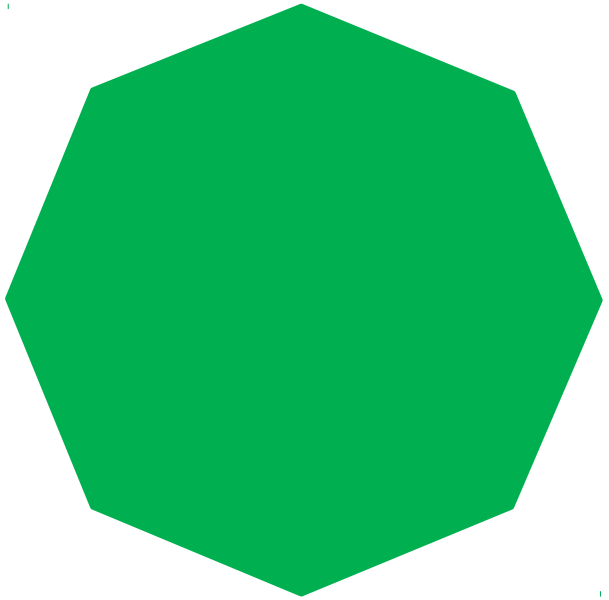
- Discretization
- Connection





Approximation, but we can increase the resolution!

Why Triangles?

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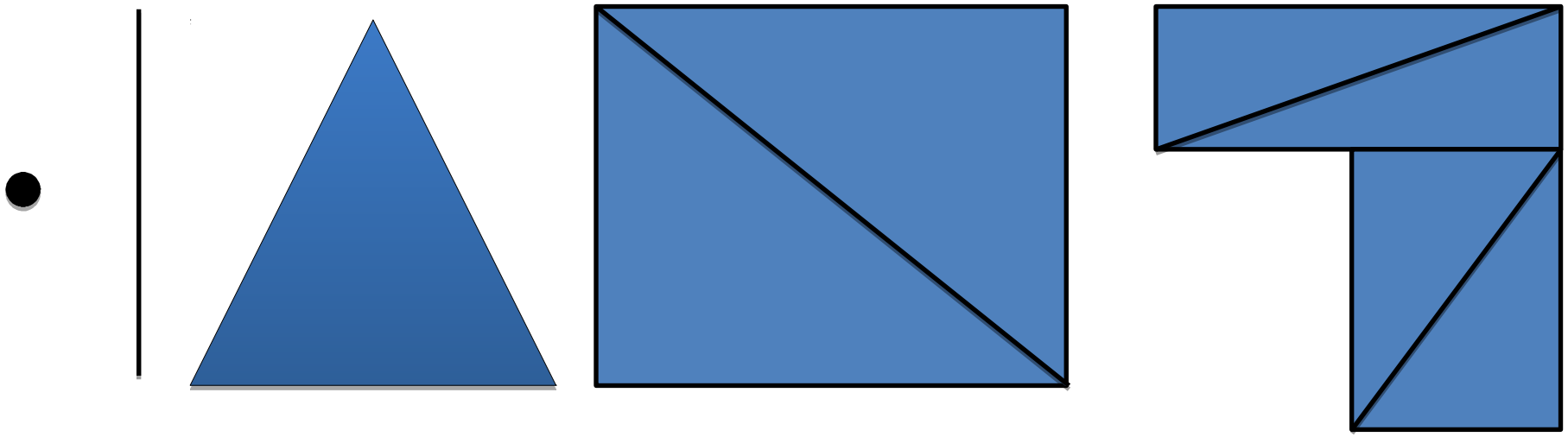
- The simplest polygon that has area
- Any polygon can be represented by triangle**s**
- Always planar



Triangle Mesh 3D

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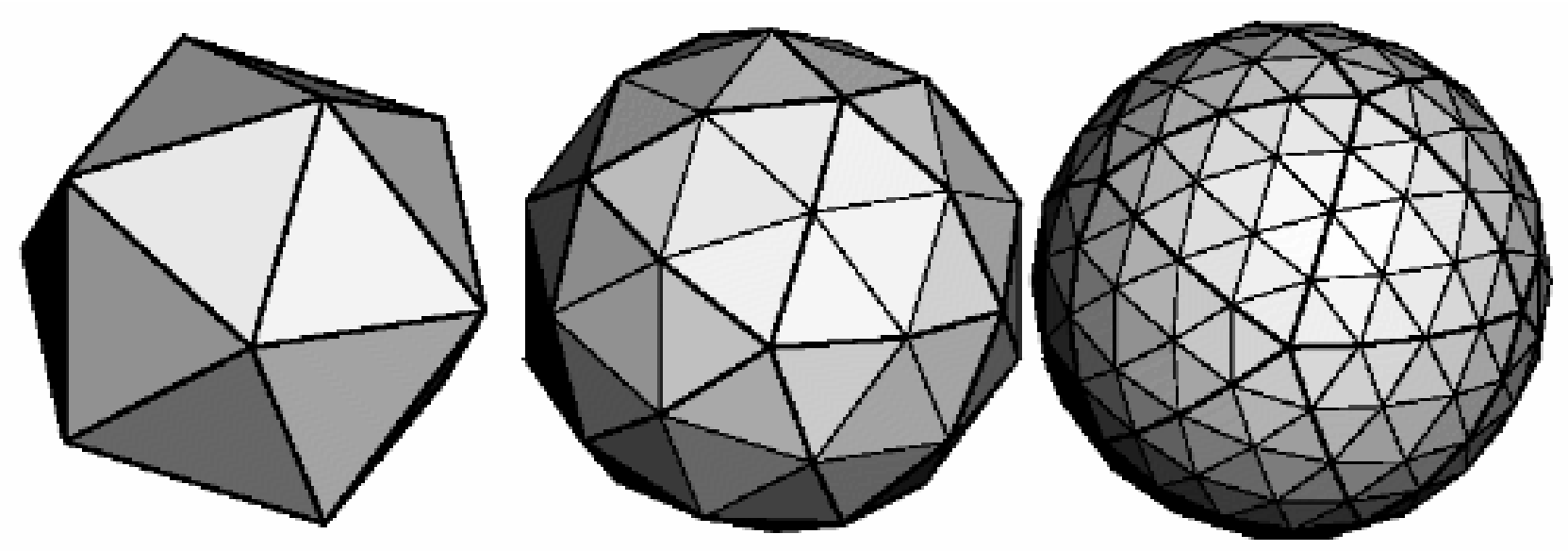

Empty shell!

Resolution

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Level of detail - LOD

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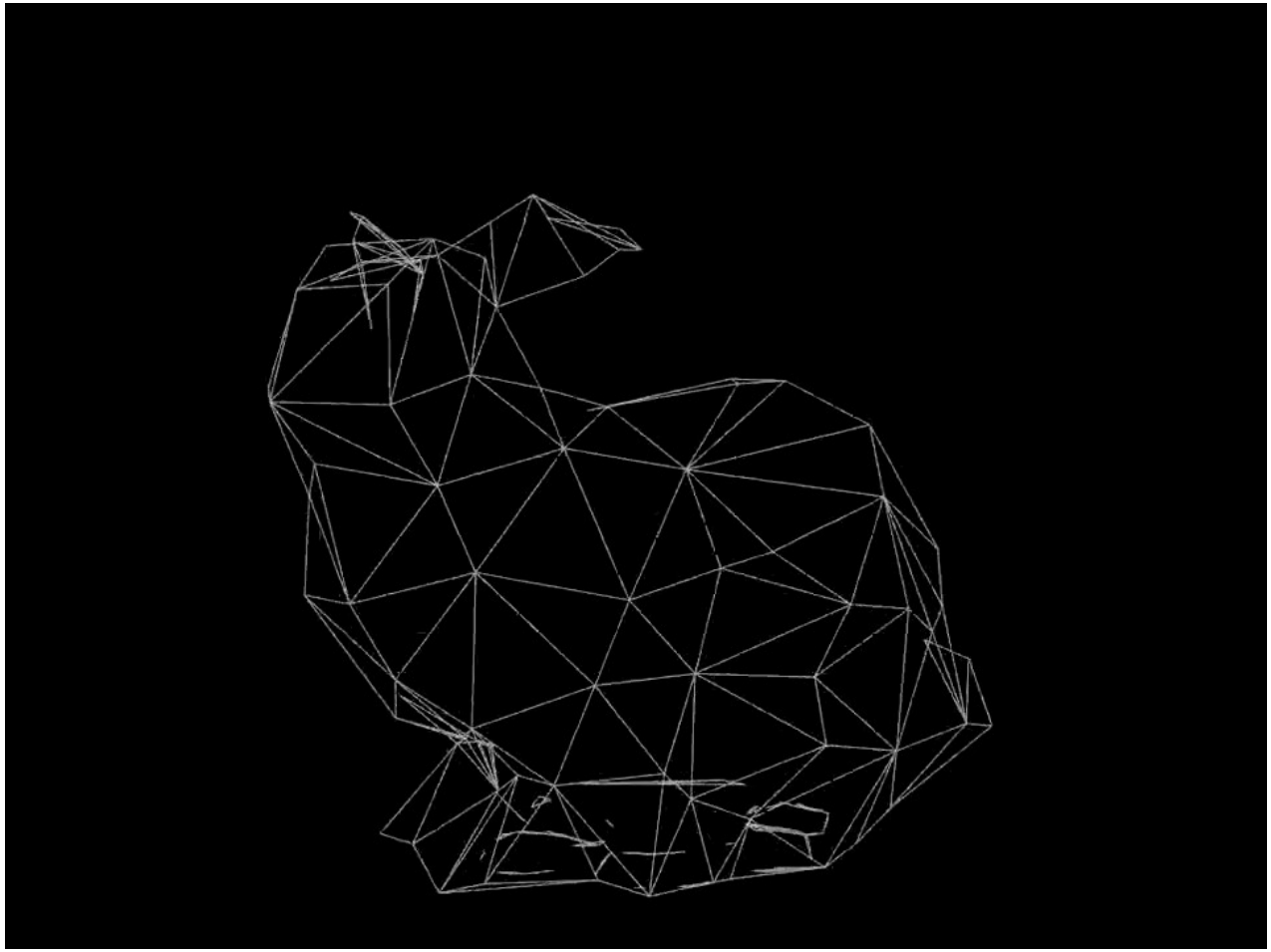
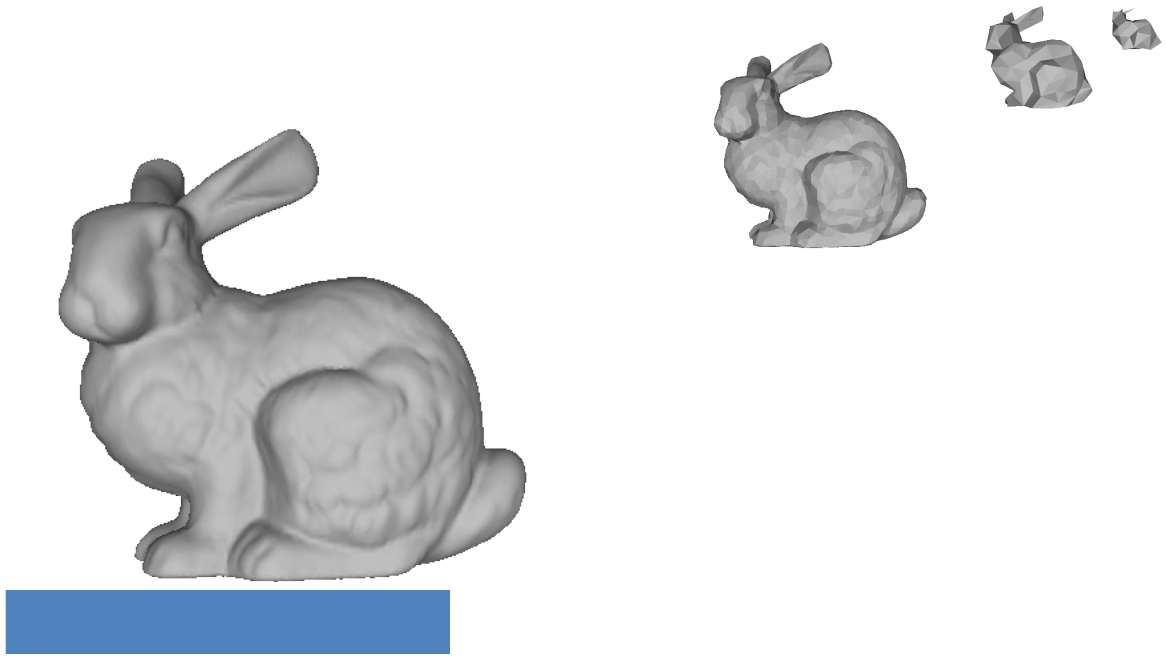


Distant objects use coarser LODs



Error vs Size

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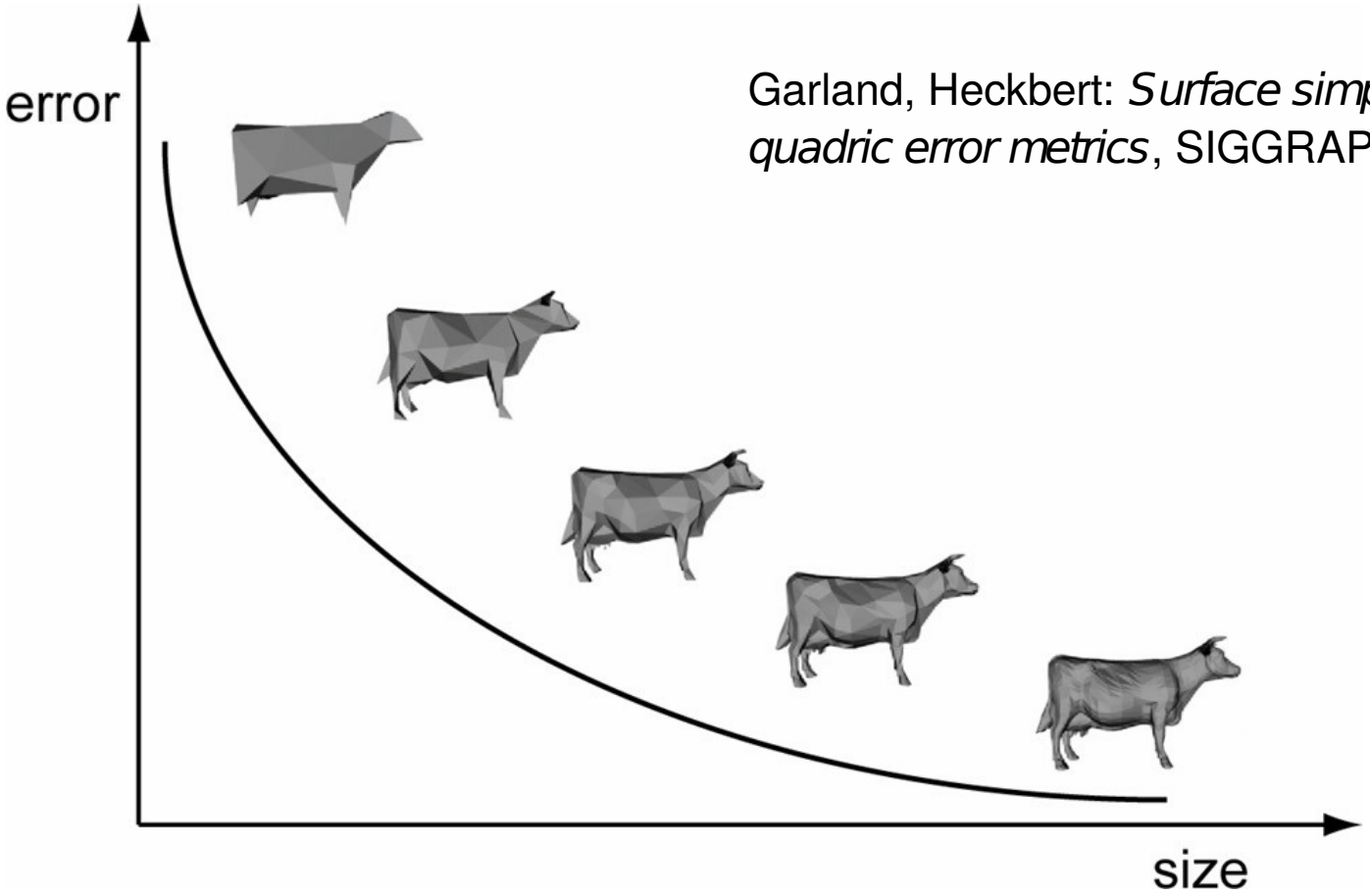
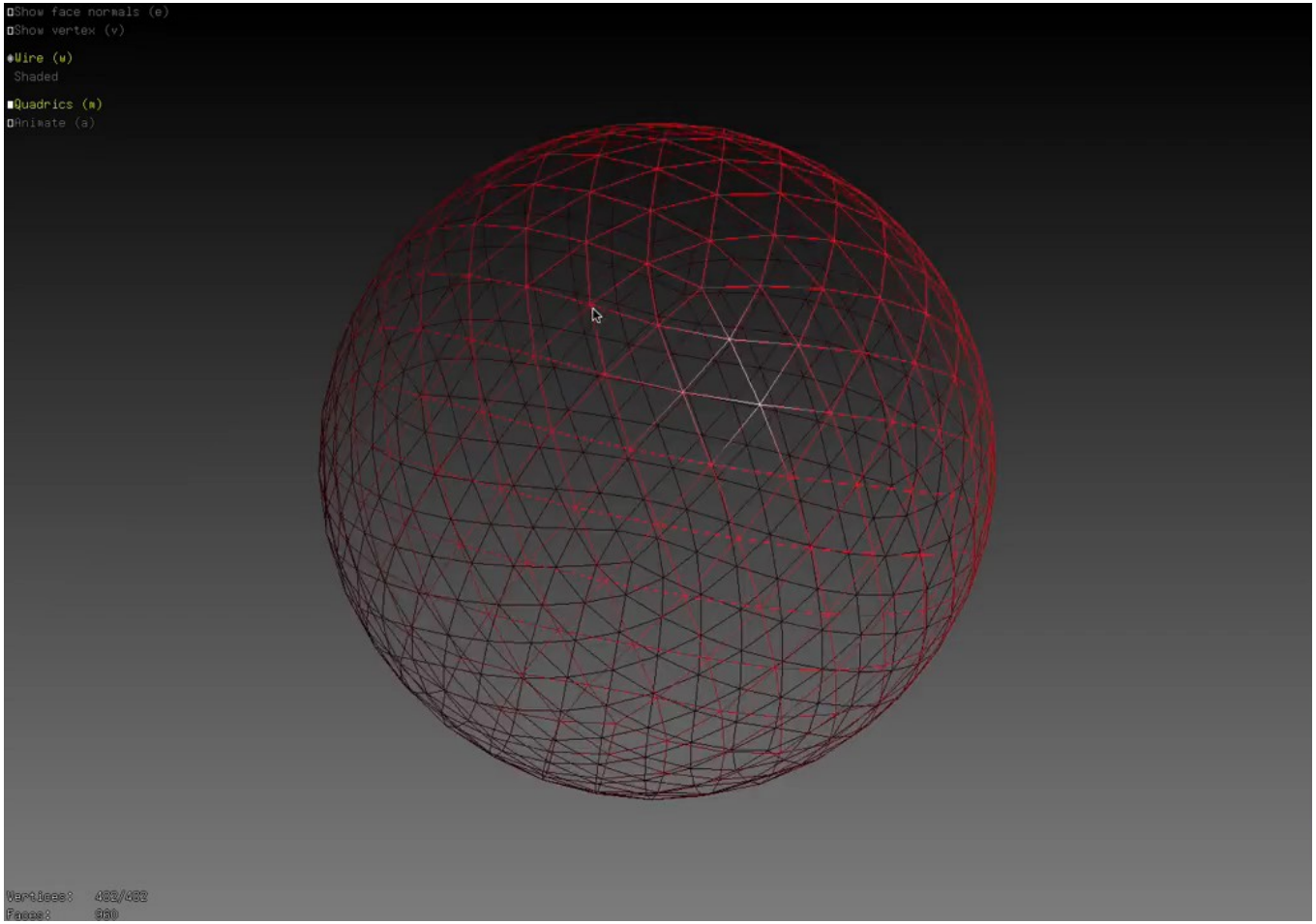


Garland, Heckbert: *Surface simplification using quadric error metrics*, SIGGRAPH 1997


Show face normals (e)
Show vertex (v)
Wire (w)
Shaded
Quadrics (m)
Animate (a)
Vertices: 482/482
Faces: 960

Vertex removal

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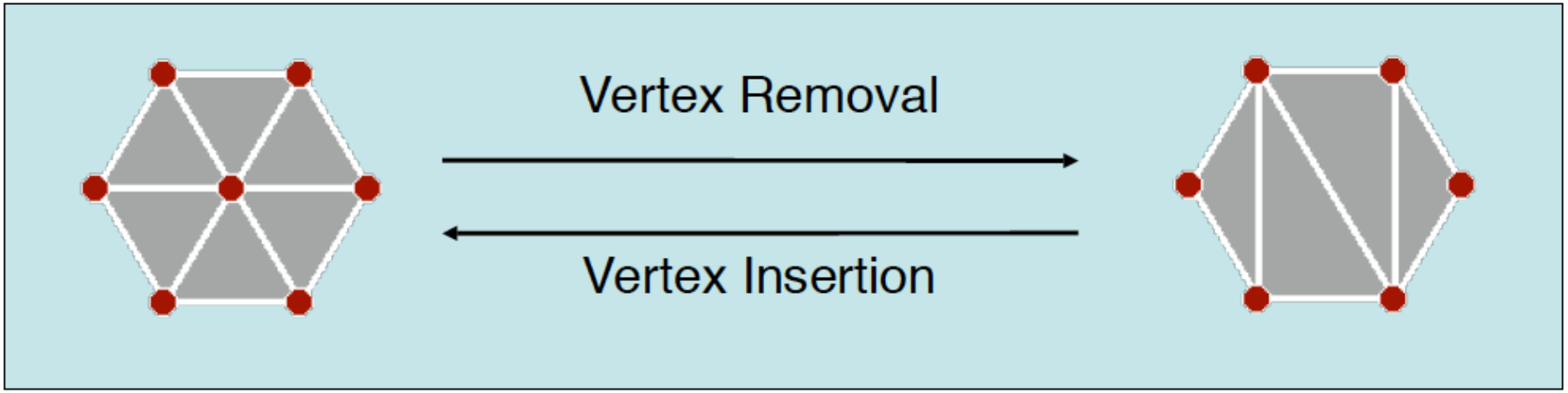
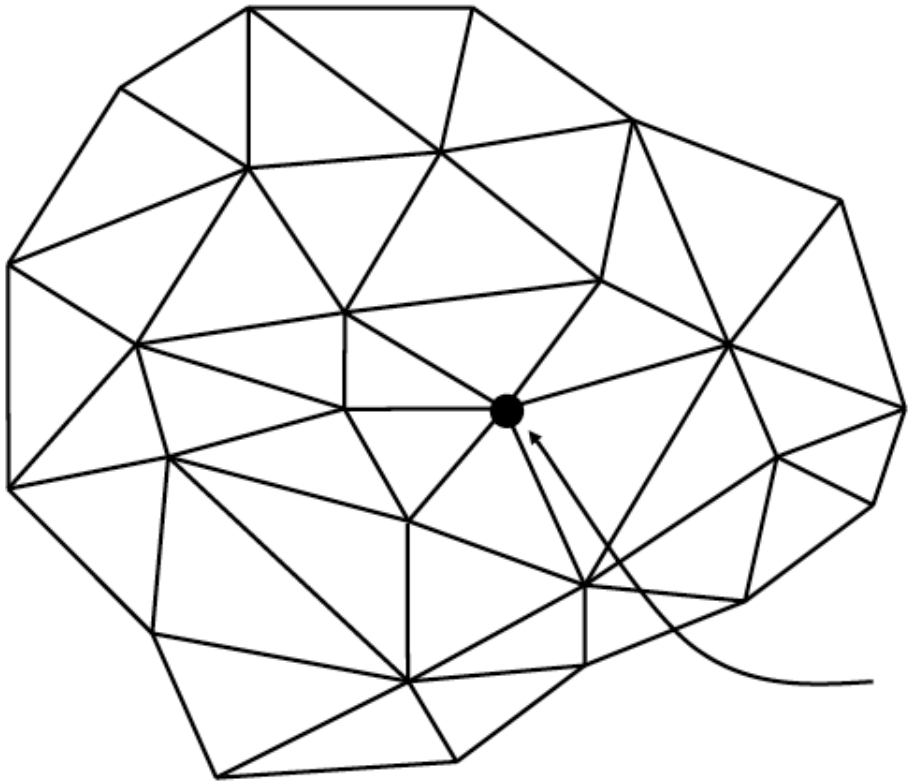
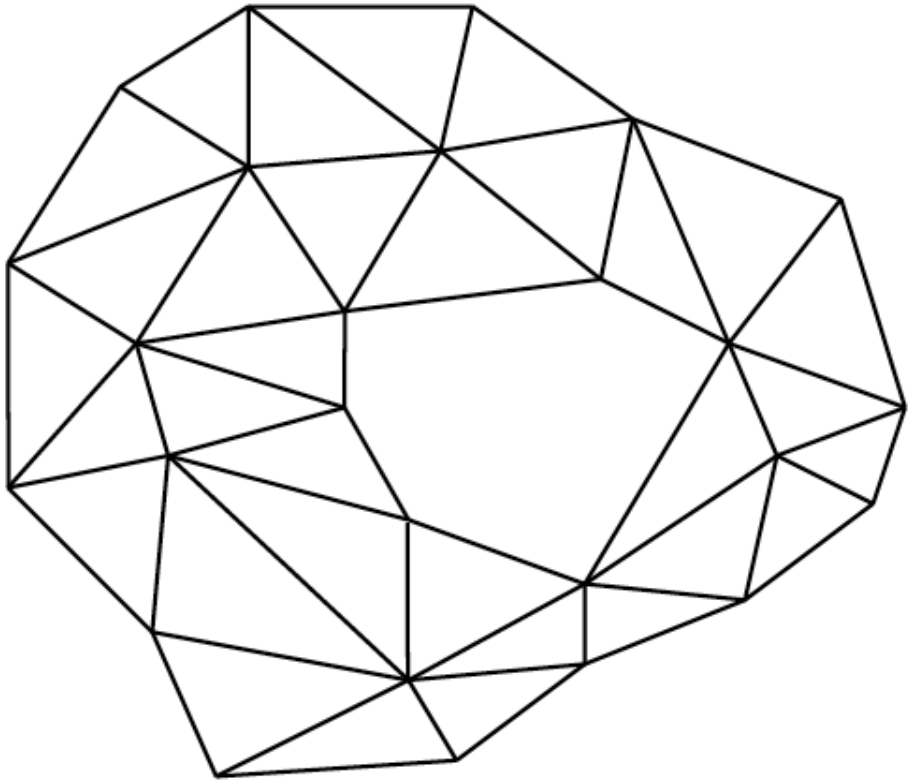


Algorithm overview

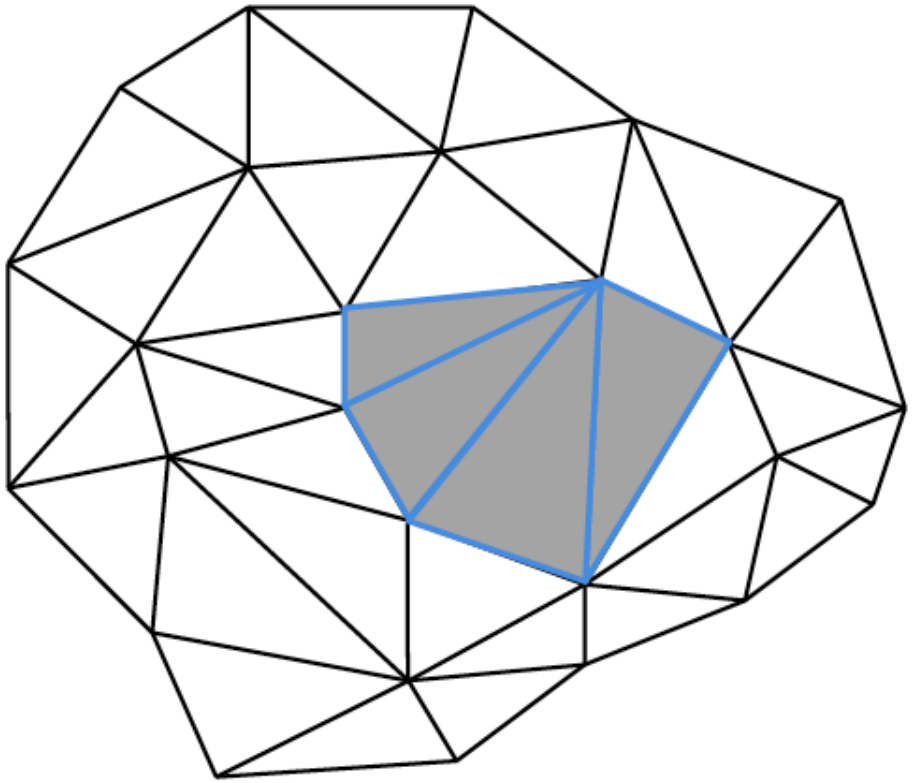
1 – Select a vertex to remove (Priority queue)
2 – Remove the vertex
3 – Re-triangulate the hole



Select an element
to be eliminated



Remove the selected triangles, creating the hole



Fill the hole
with triangles

References

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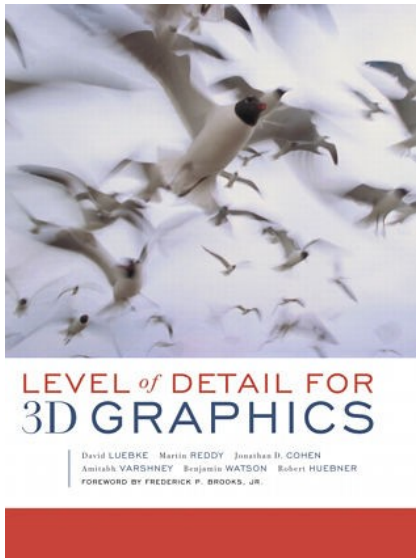
- **Geometric Modeling Based on Polygonal Meshes**
  Mario Botsch, Mark Pauly, Leif Kobbelt, Pierre Alliez, Bruno Levy, Stephan Bischoff, Christian Rössl
  Eurographics 2008 Course Notes

Moodle: course notes and slides

Read: section 2 and 9



http://lodbook.com/
http://lodbook.com/course/2003/
http://lodbook.com/models/

The Origin

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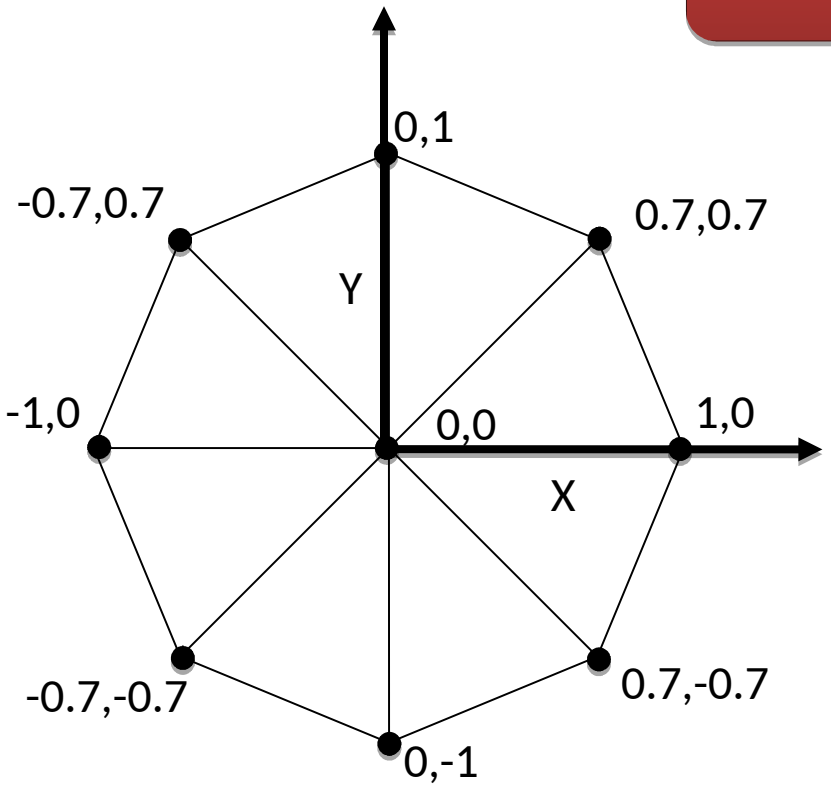
The origin can be any point!



Virtual Space

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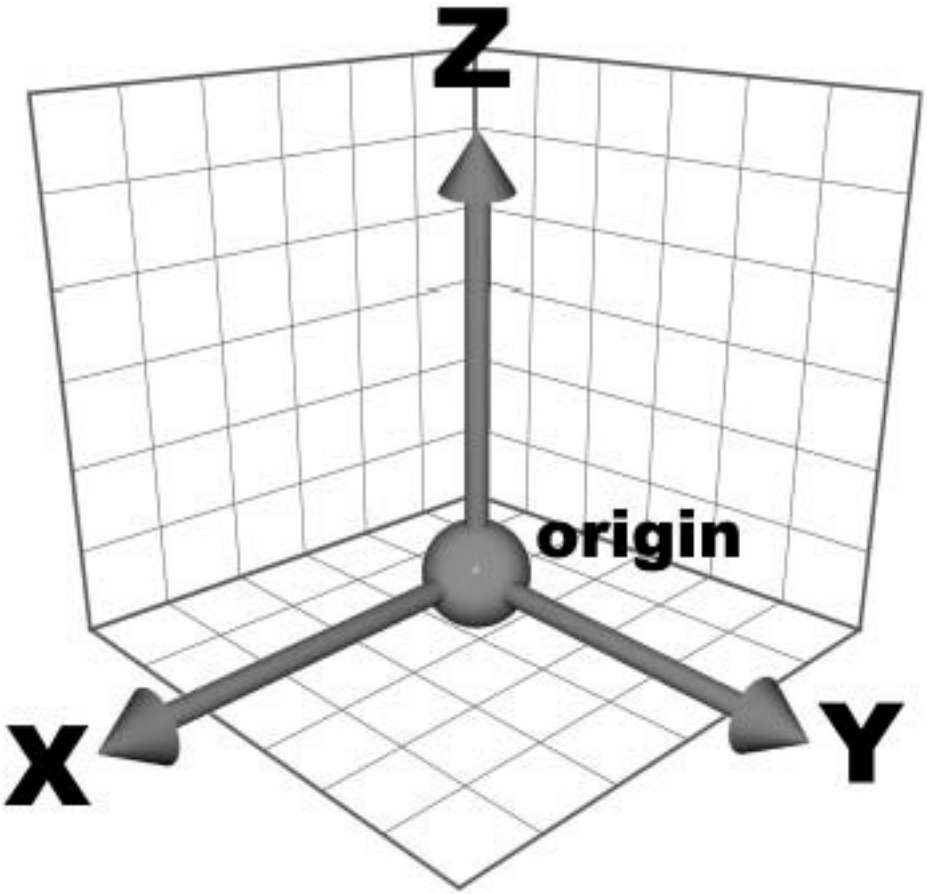

Transformations

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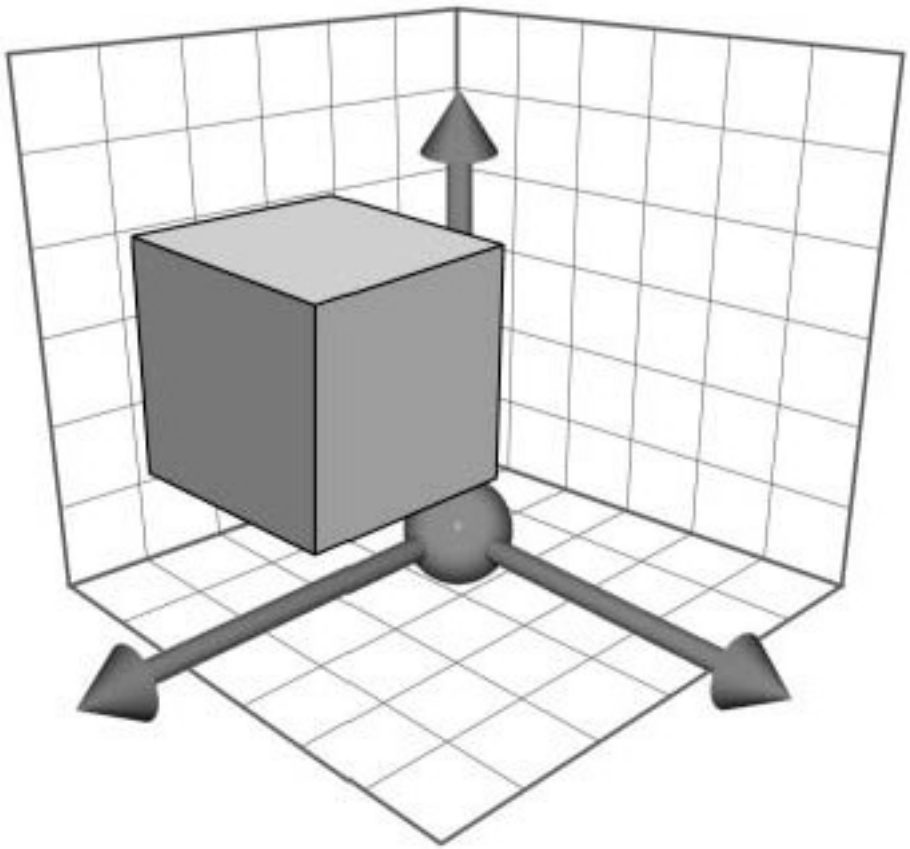
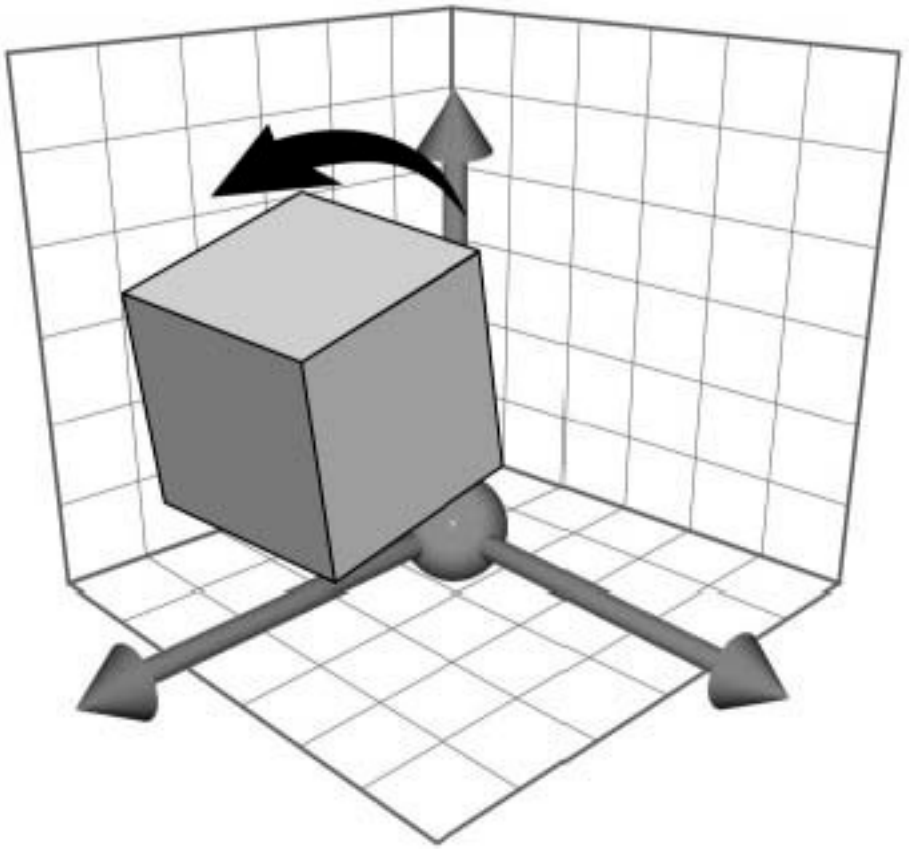


Translation



Rotation

Hierarchical Transformations

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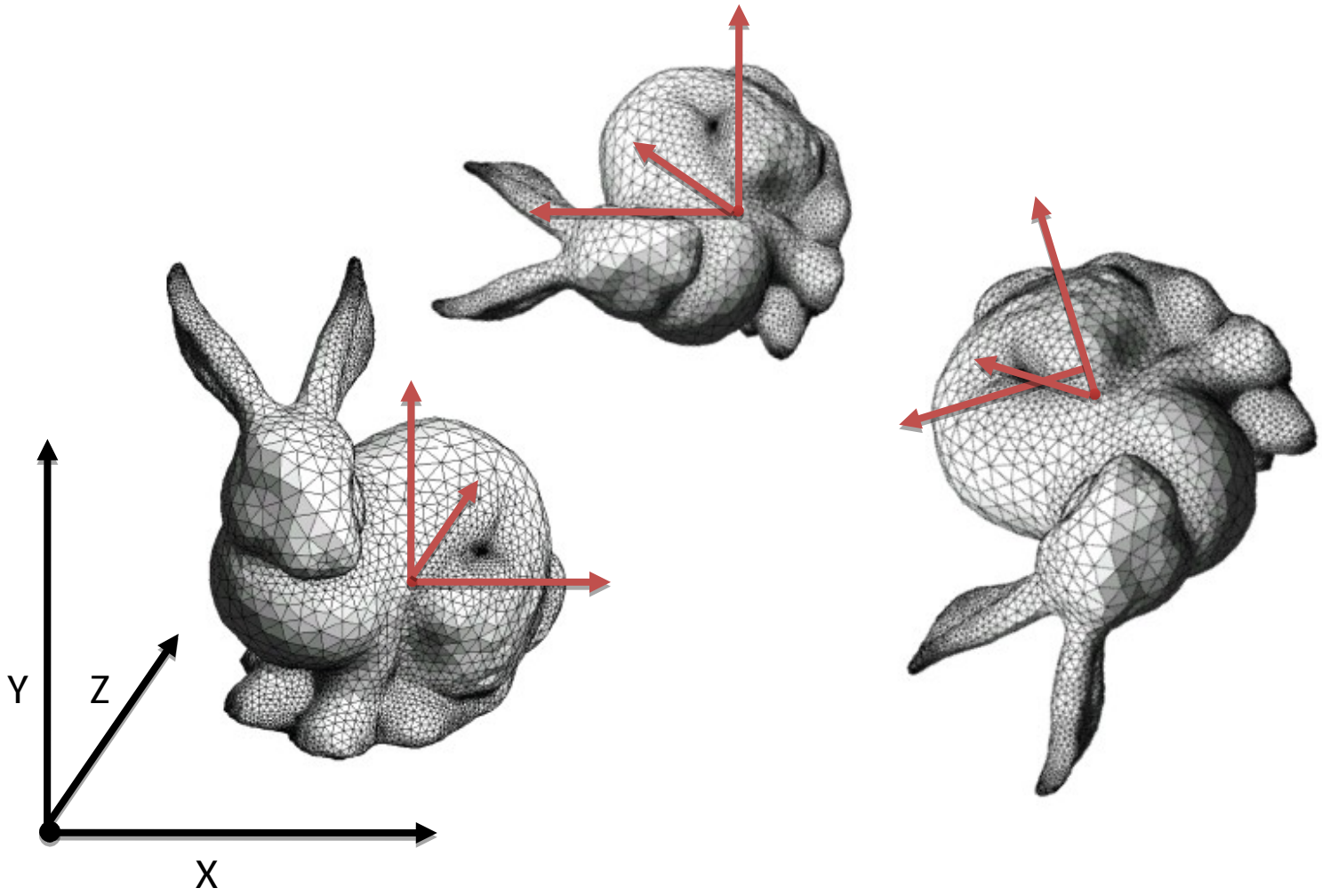

Hierarchical Transformations

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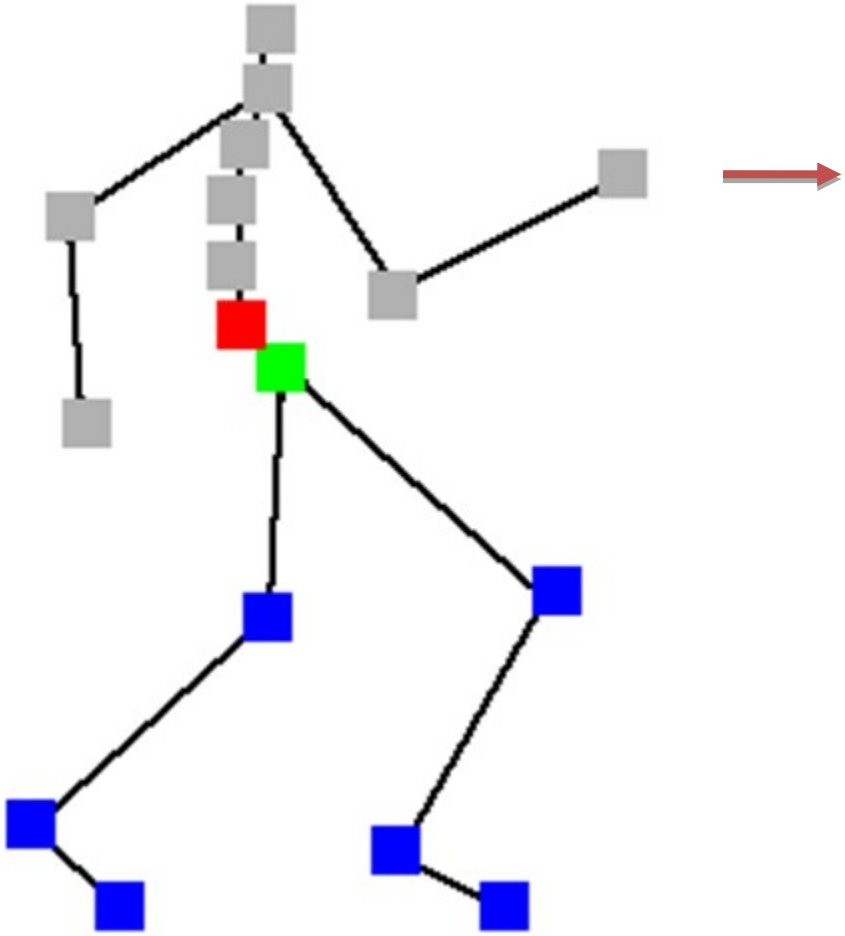

Surface vs. Light vs. Color

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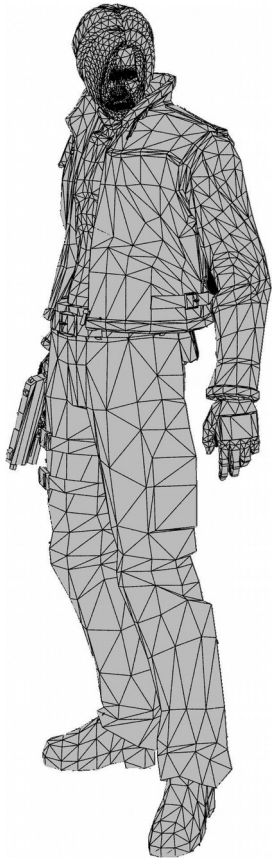

Surface Description

Light

Color

We will see this in a few weeks

Blender

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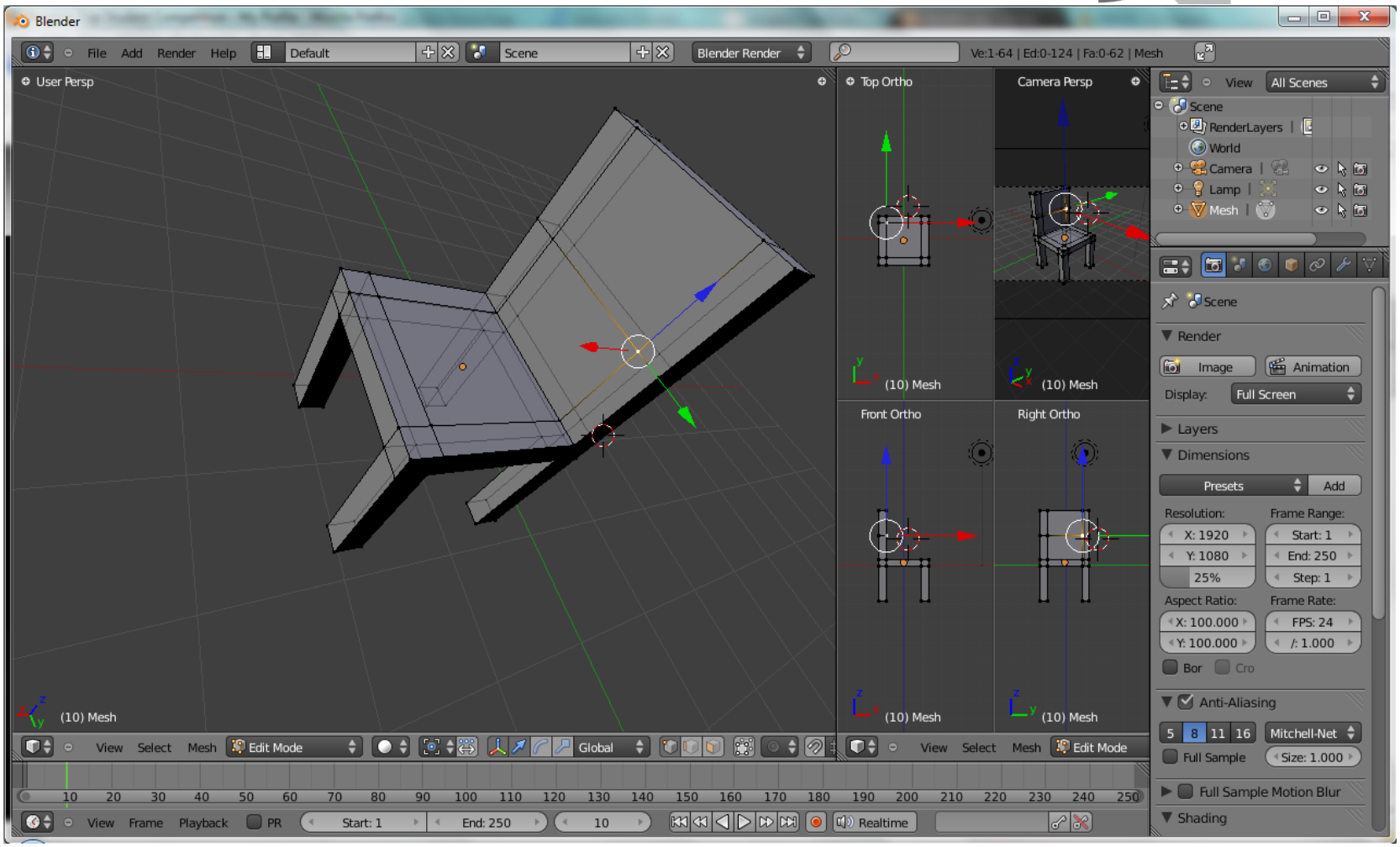


Home-Work: Find a tutorial about Blender (Youtube)

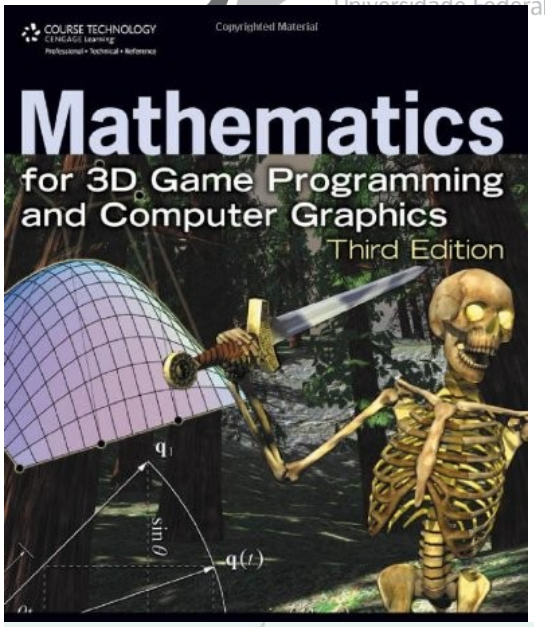
You need to know

- Planes
- Lines
- Points
- Vectors
- Matrixes

Álgebra Linear e Geometria Analítica

↓

Computação Gráfica



Overview

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http://www.gamedev.net/page/resources/_/technical/graphics-programming-and-theory/introduction-to-the-graphics-pipeline-r3344