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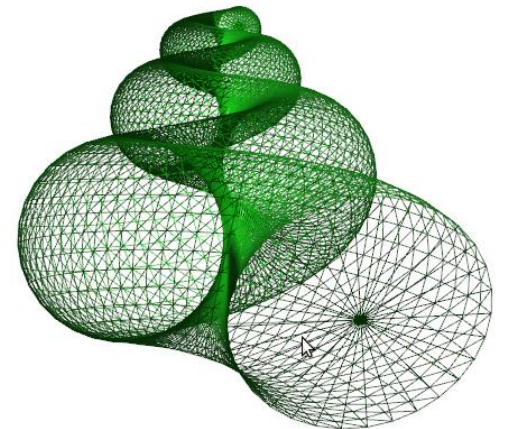
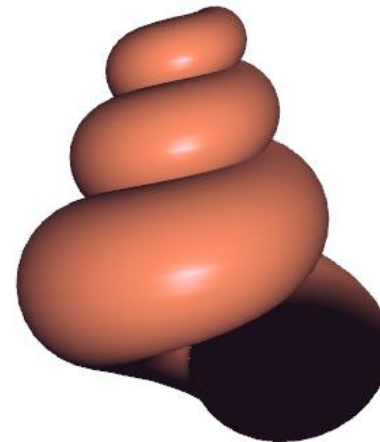
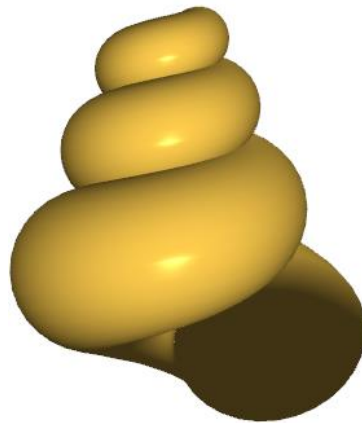
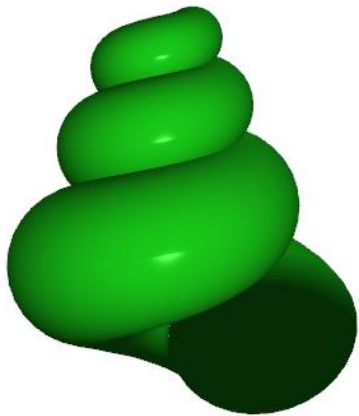


មហាវិទ្យាល័យ វិស្វកម្ម



Introduction to Computer Graphics

Department of IT Engineering



Administrivia

❖ Class

- ☐ Theory: T002

 - ✓ Tuesday: 1:00pm – 2:30pm

- ☐ Lab

 - ✓ Monday: 1:00pm – 2:30pm (G1)

 - ✓ Monday: 2:30pm – 4:00pm (G2)

❖ Exams

- ☐ Final Exams: 60%

- ☐ Assignment: 20%

- ☐ Homework: 10%

- ☐ Attendance: 10%

Course Topics

- ❖ Introduction to CG, history, and applications
- ❖ Vector Tools for Graphics
- ❖ Coordinate Systems
- ❖ Transformation
- ❖ Raster Graphics
- ❖ Clipping
- ❖ Three-Dimensional Viewing

Contents

- ❖ Introduction
 - ❑ What is Computer Graphics?
- ❖ Applications
 - ❑ What is it good for?
- ❖ History
 - ❑ How does it evolve?
- ❖ Literature

Introduction

❖ What is Computer Graphics?

Computer Graphics is concerned with all aspects of producing pictures or images using a computer

- Hardware
- Software
- Applications

❖ Scope

- ☐ Industry
- ☐ Art
- ☐ Entertainment
- ☐ Education
- ☐ Medicine

Example

- ❖ Where did this image come from?



- ❖ What hardware/software did we need to produce it?

Basic Elements

❖ Modeling

- ❑ Shape (Geometry)

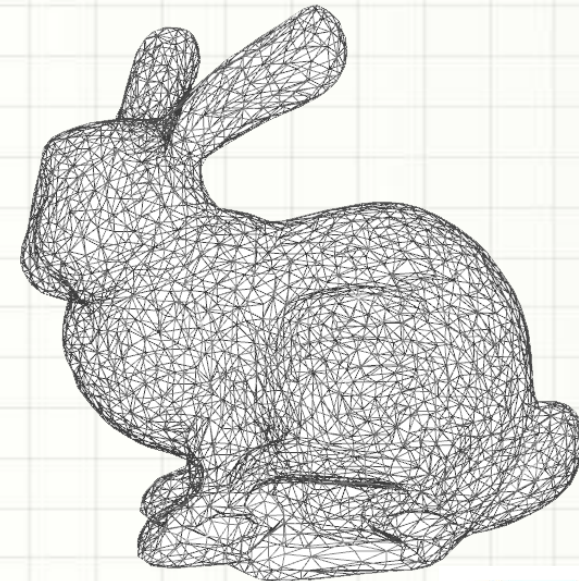
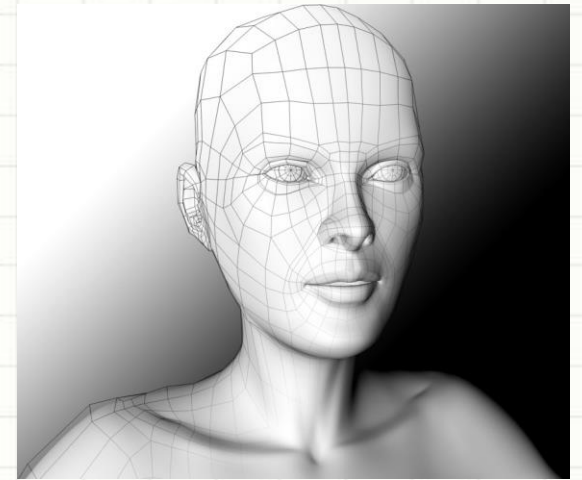
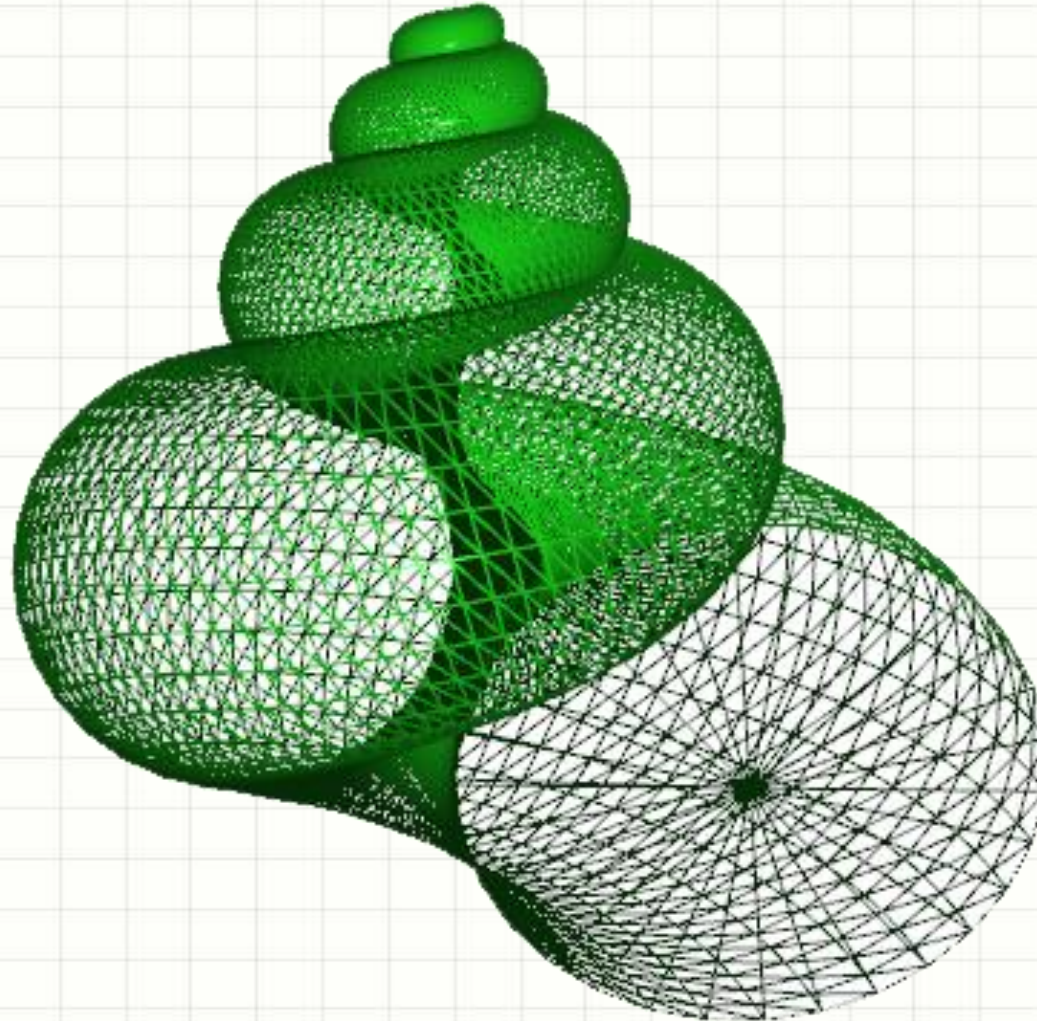
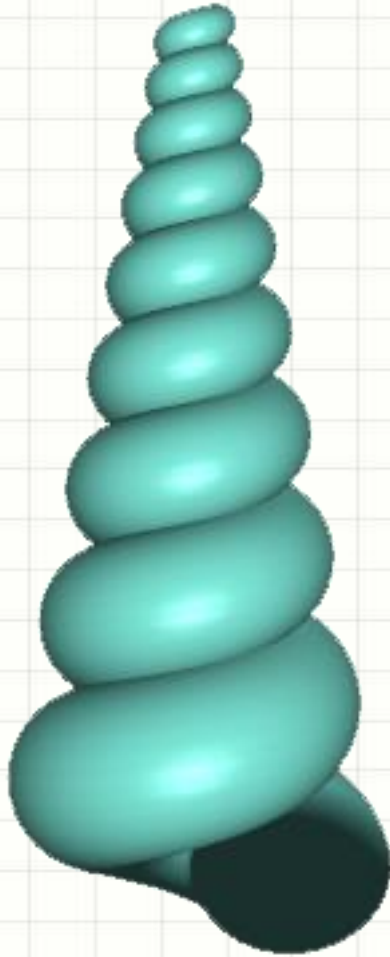
❖ Rendering

- ❑ Display (Shading, illumination, color, texture . . .)

❖ Animating

- ❑ Movement (dynamics)

Modeling



Modeling

Modeling as reverse engineering



Scanner

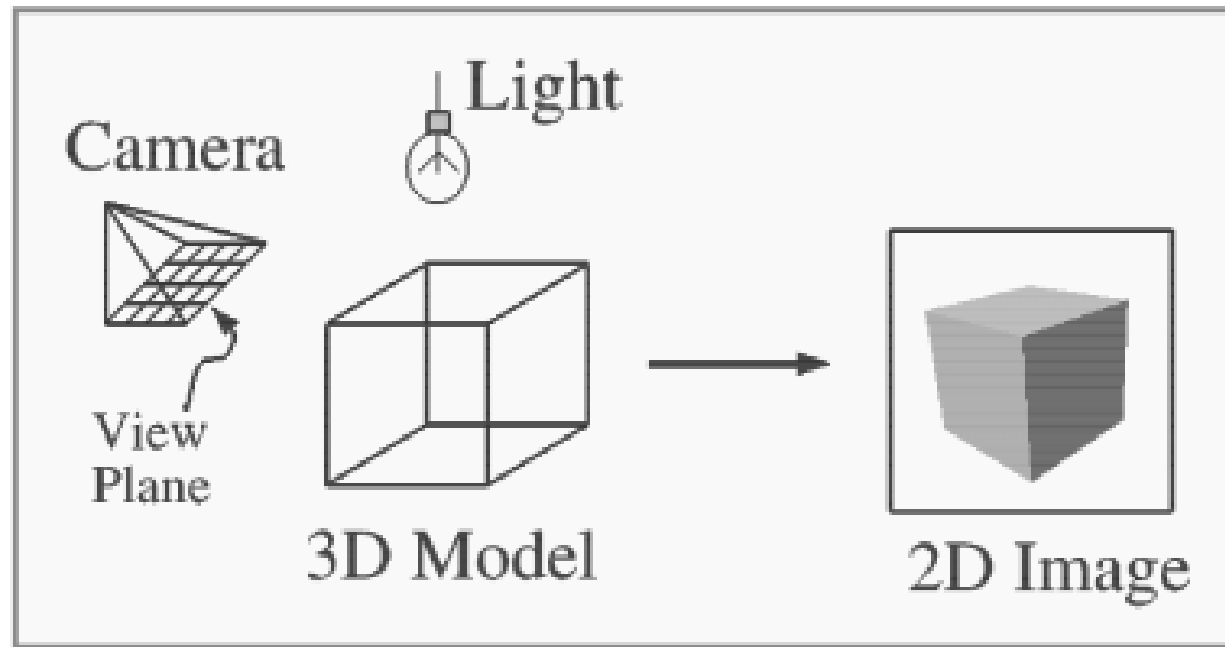


3D Geometry

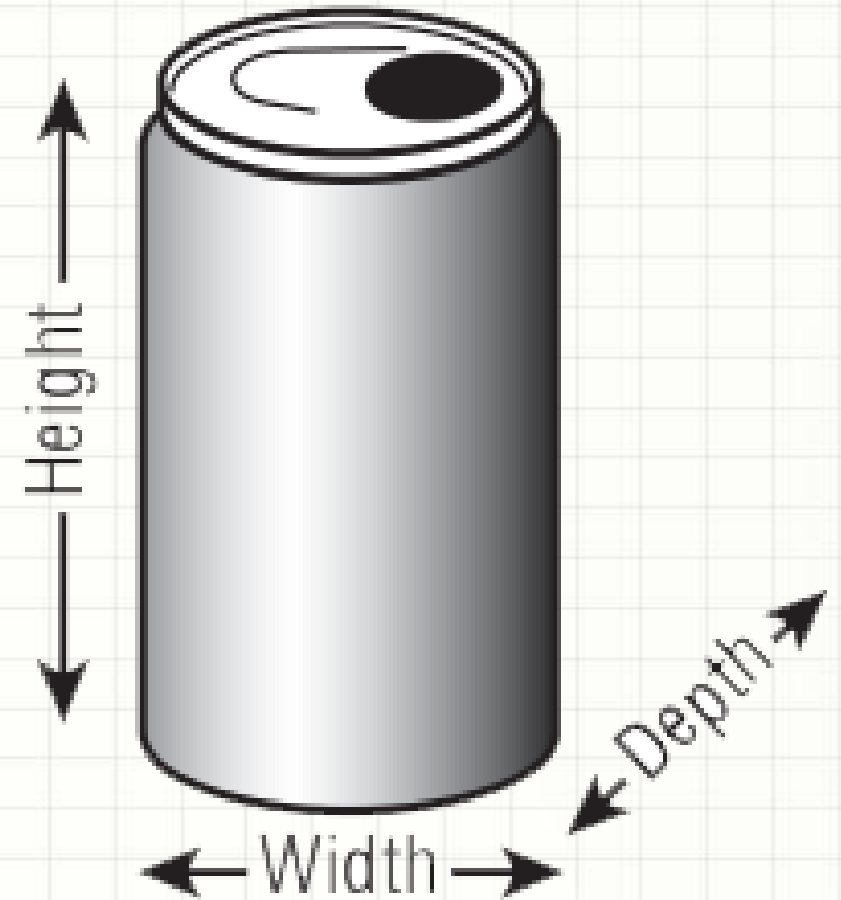
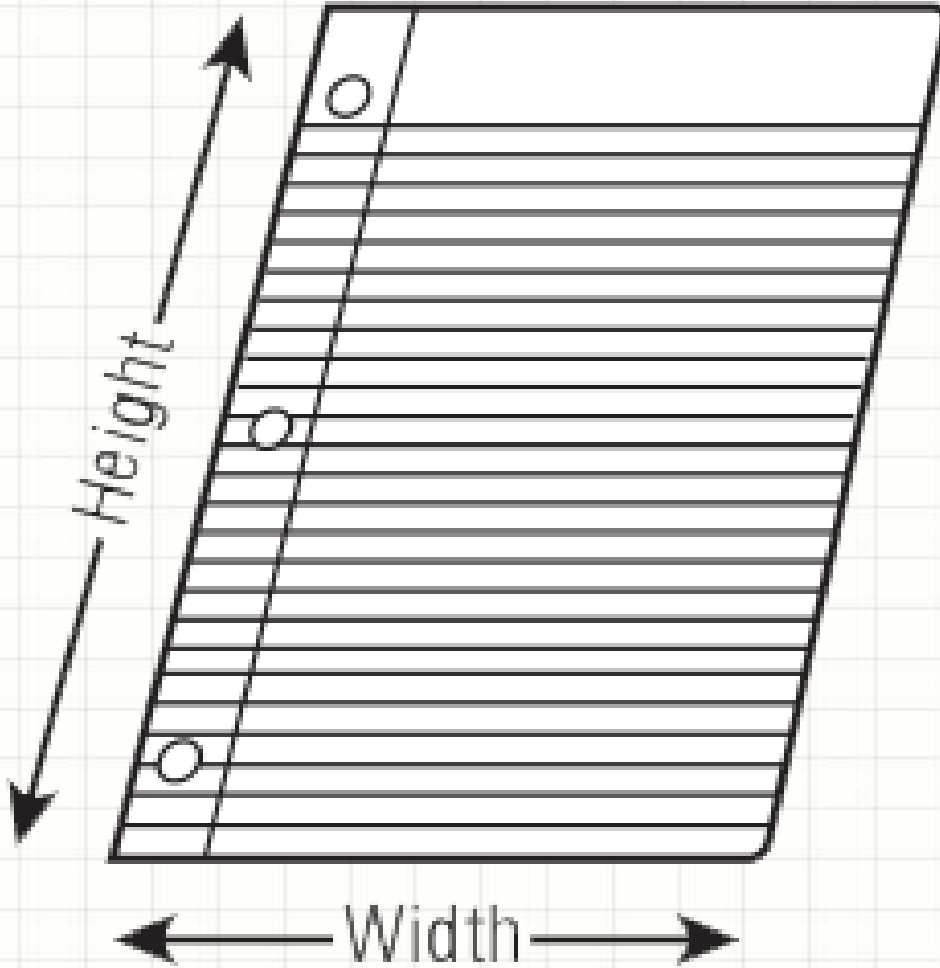
Rendering



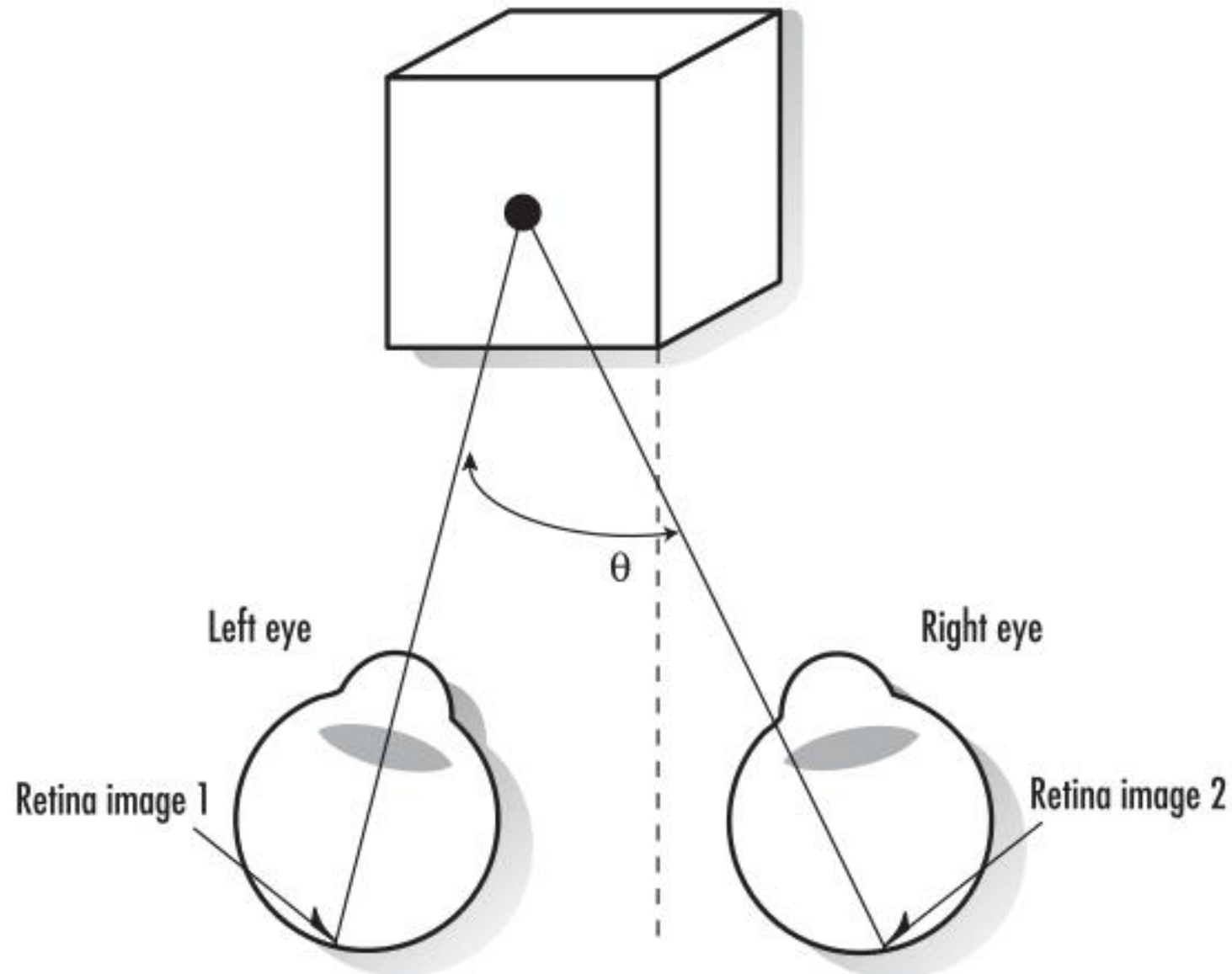
Rendering



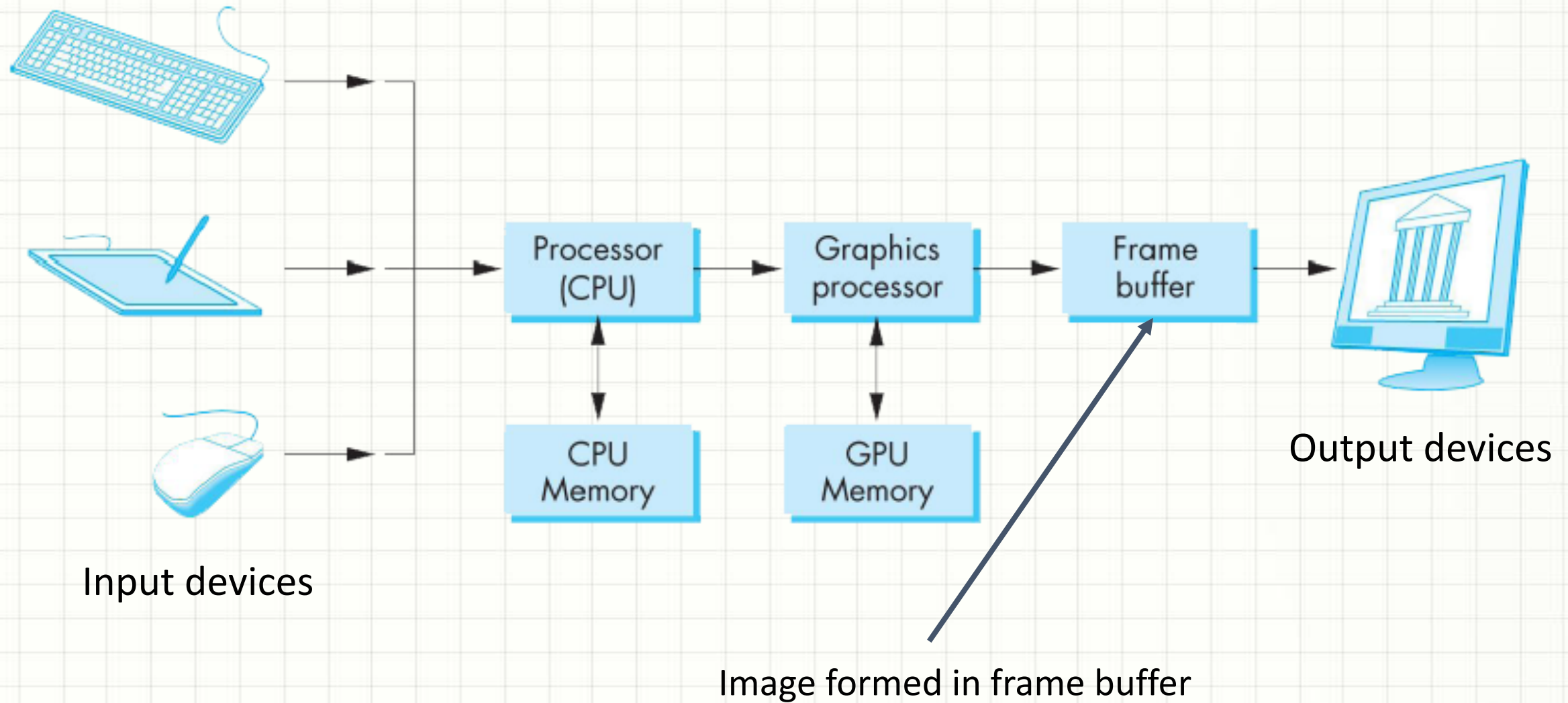
Going 3D



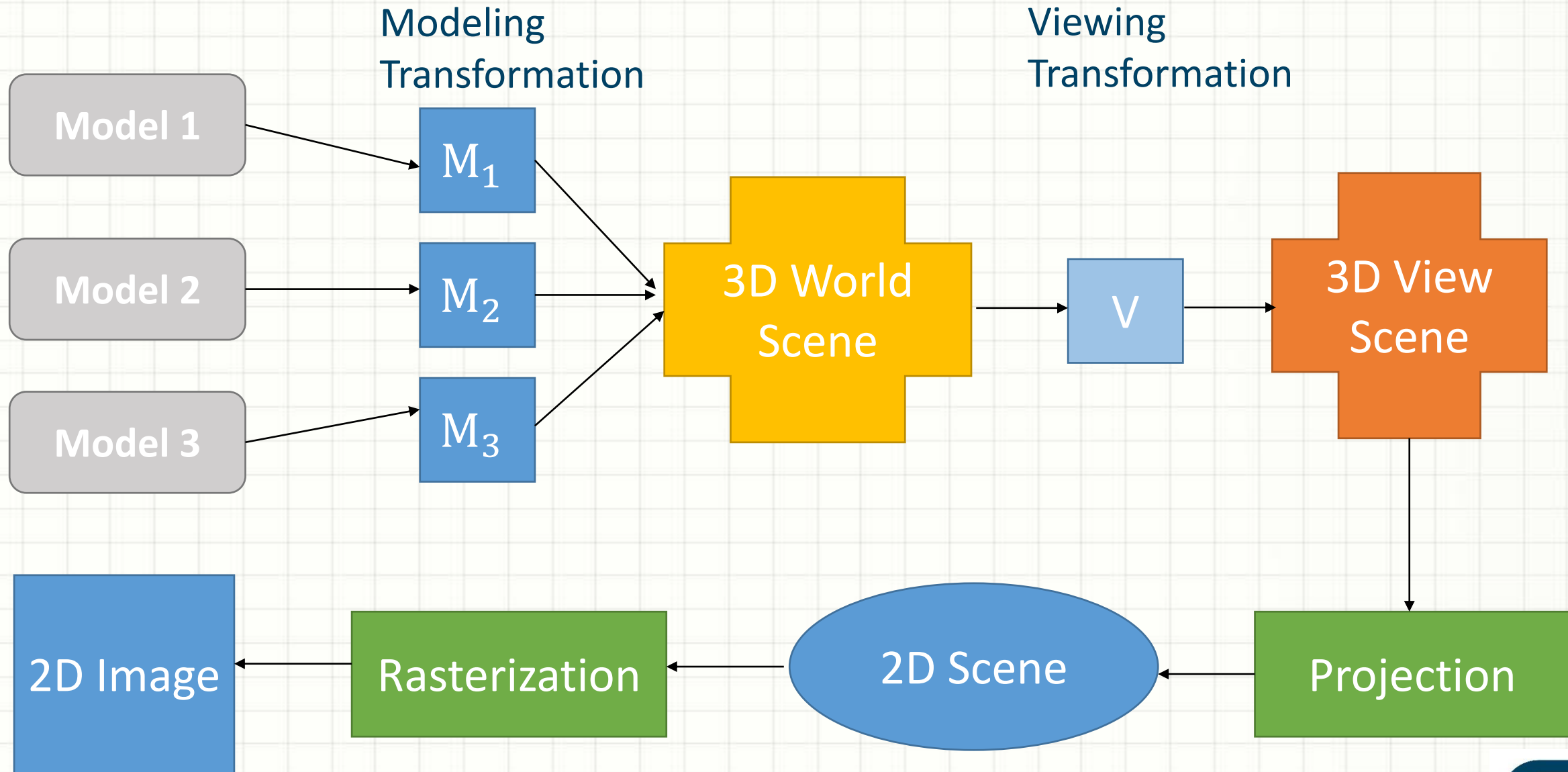
How to see three dimensions



Basic Graphic System



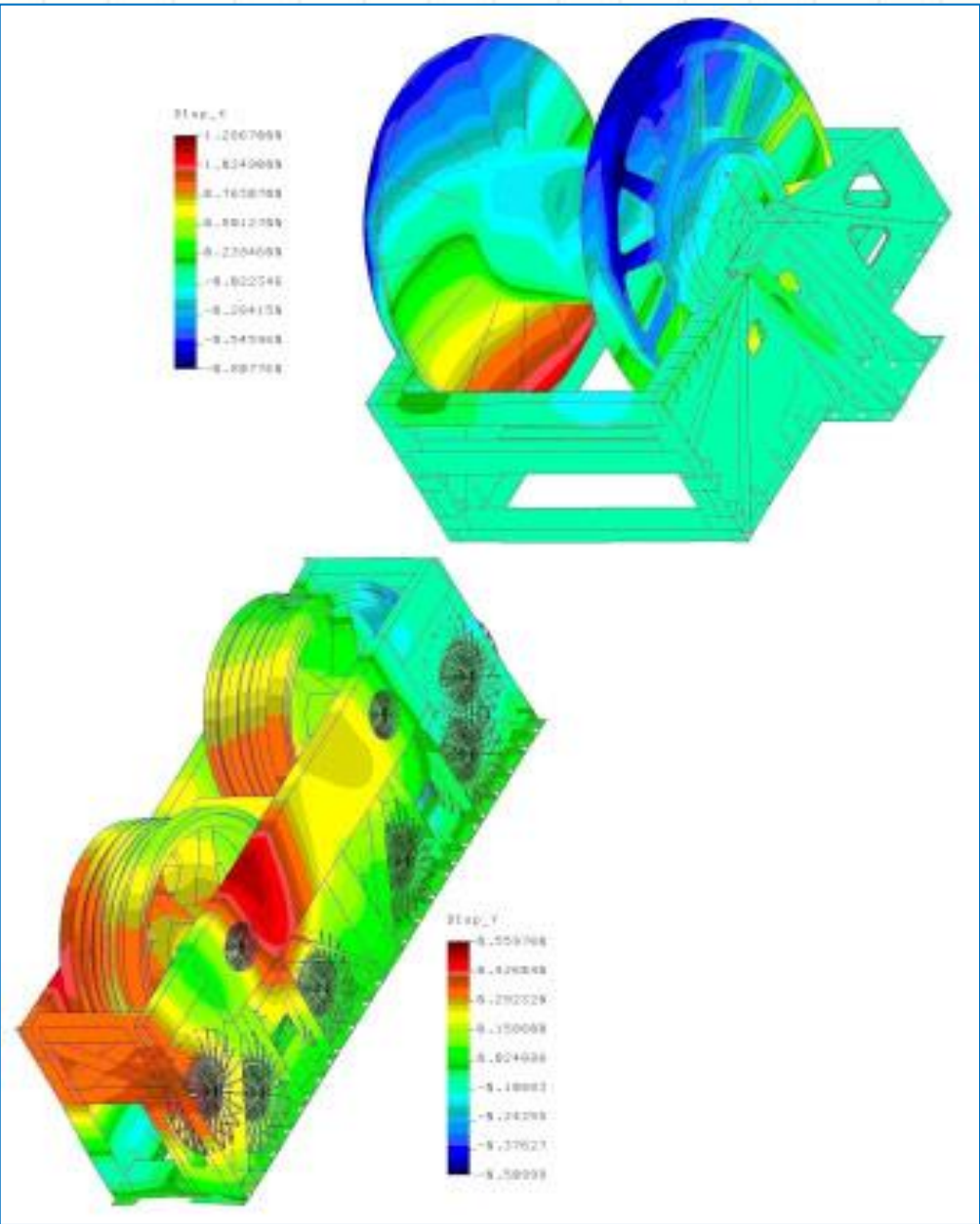
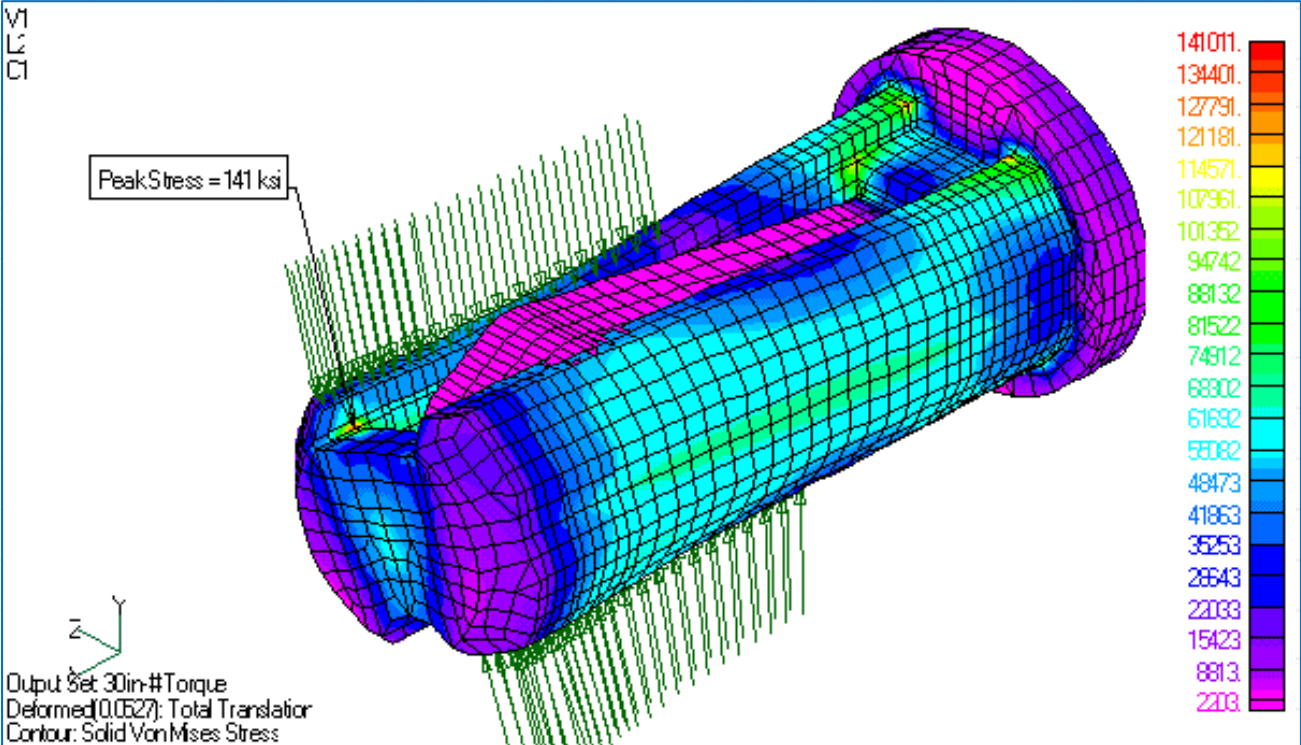
Graphic Rendering Pipeline



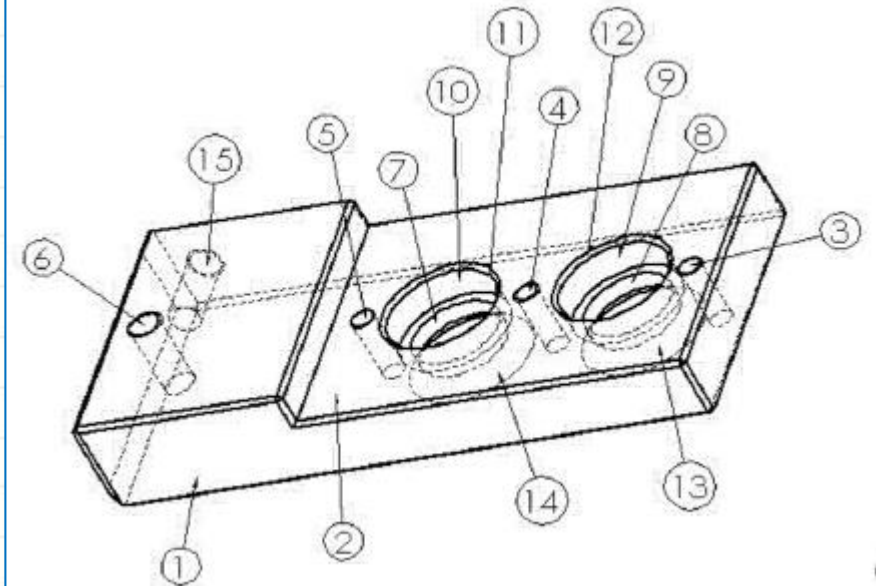
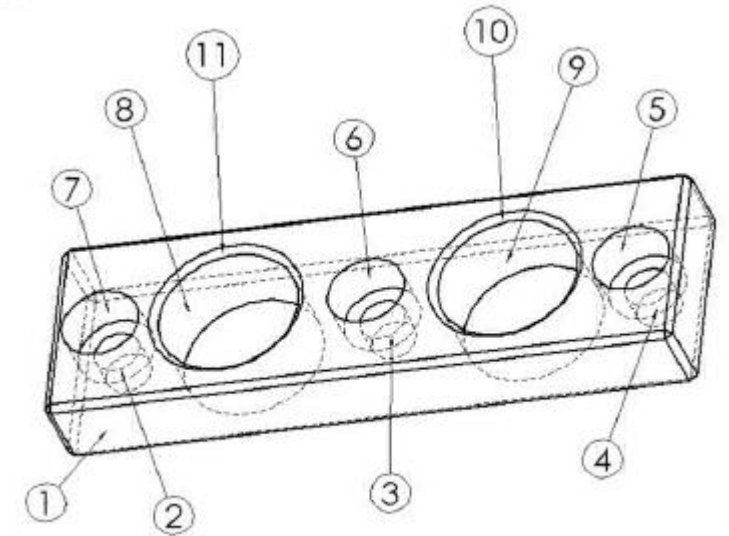
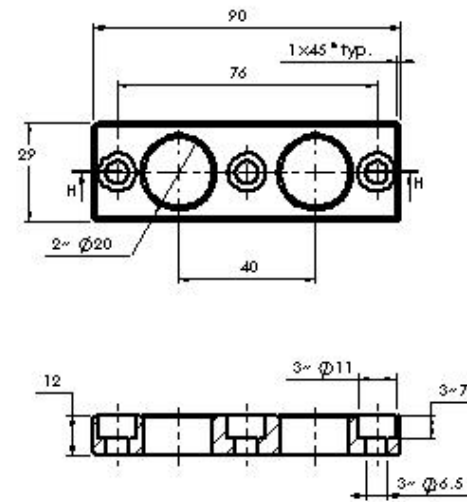
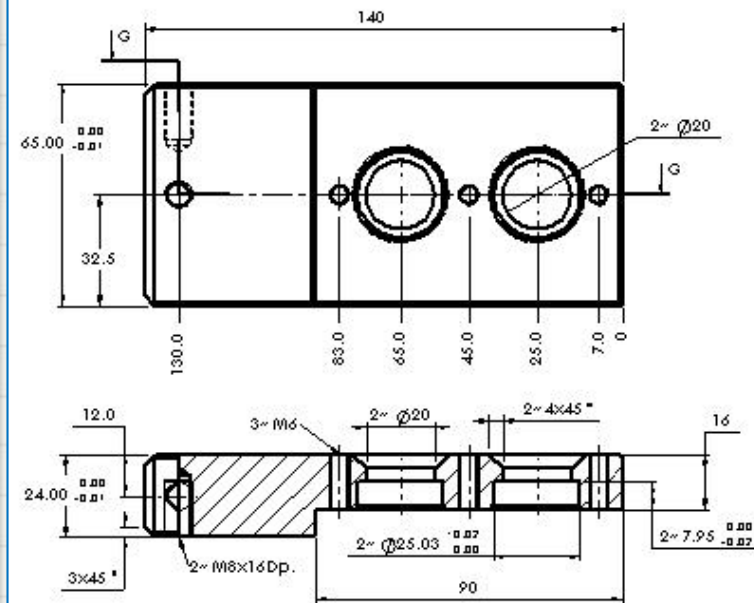
Computer-Aided Design



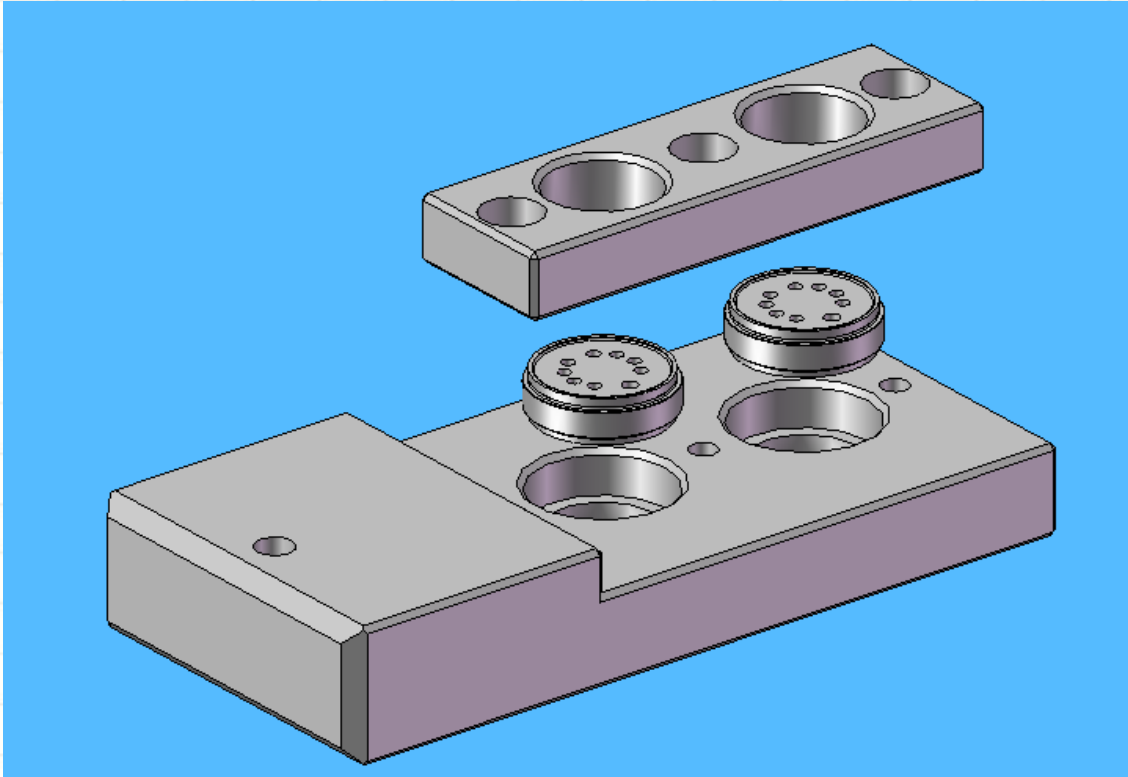
Engineering



Engineering



Engineering



Gimp

- ❖ Capture screenshot
- ❖ Crop image
- ❖ Use color picker
- ❖ Layers
- ❖ Selections
- ❖ Filters
- ❖ Color manipulation



Inkscape

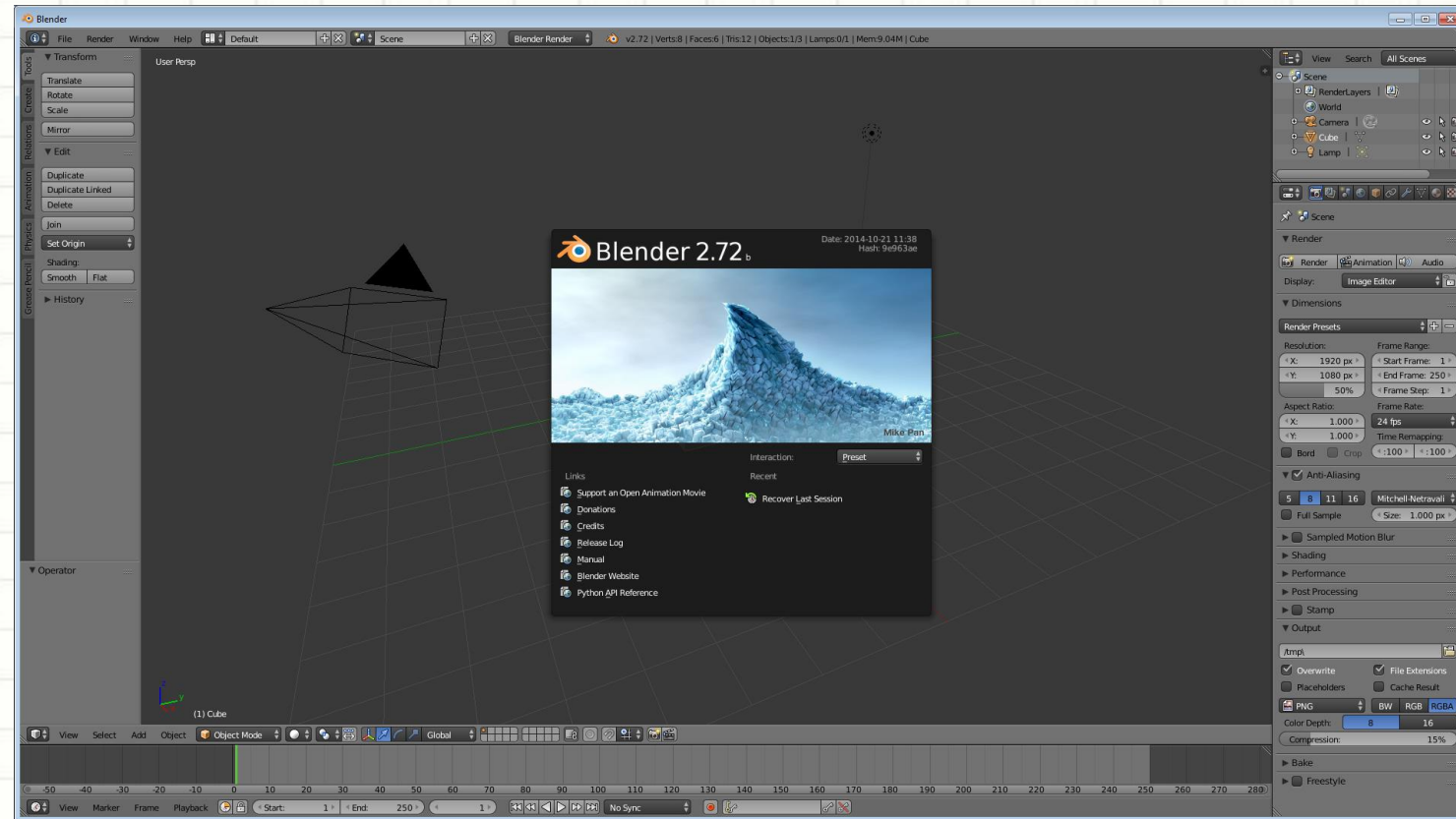
- ❖ Draw Shapes
- ❖ Transformations
- ❖ Modify paths
- ❖ Alignment
- ❖ Fill and stroke
- ❖ Vectorize bitmaps



Blender

❖ **Blender** is a professional free and open-source 3D computer graphics software product used for creating

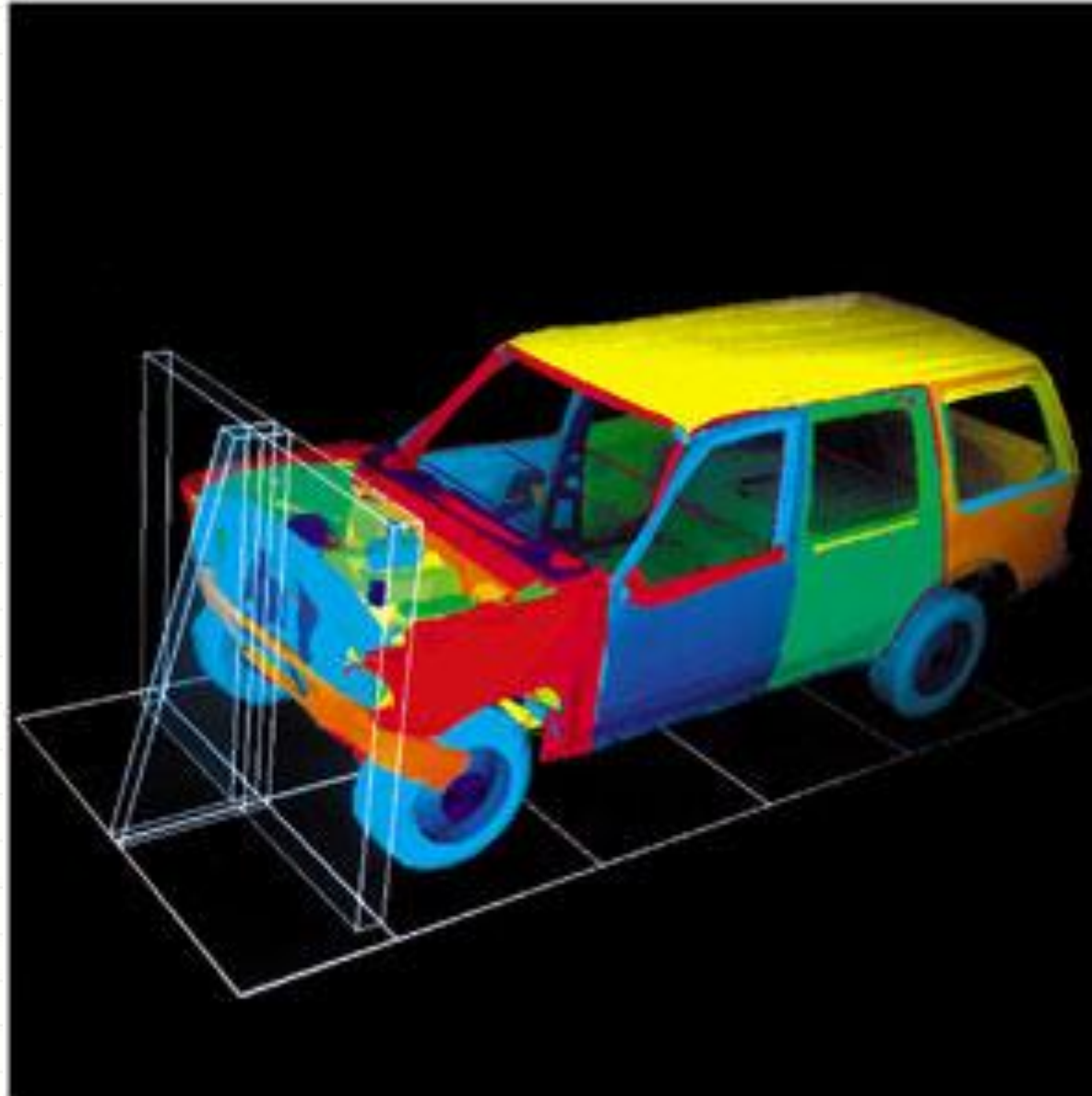
- ❖ Animated Films
- ❖ Visual effects
- ❖ Art
- ❖ 3D printed models
- ❖ Interactive 3D applications
- ❖ Video games



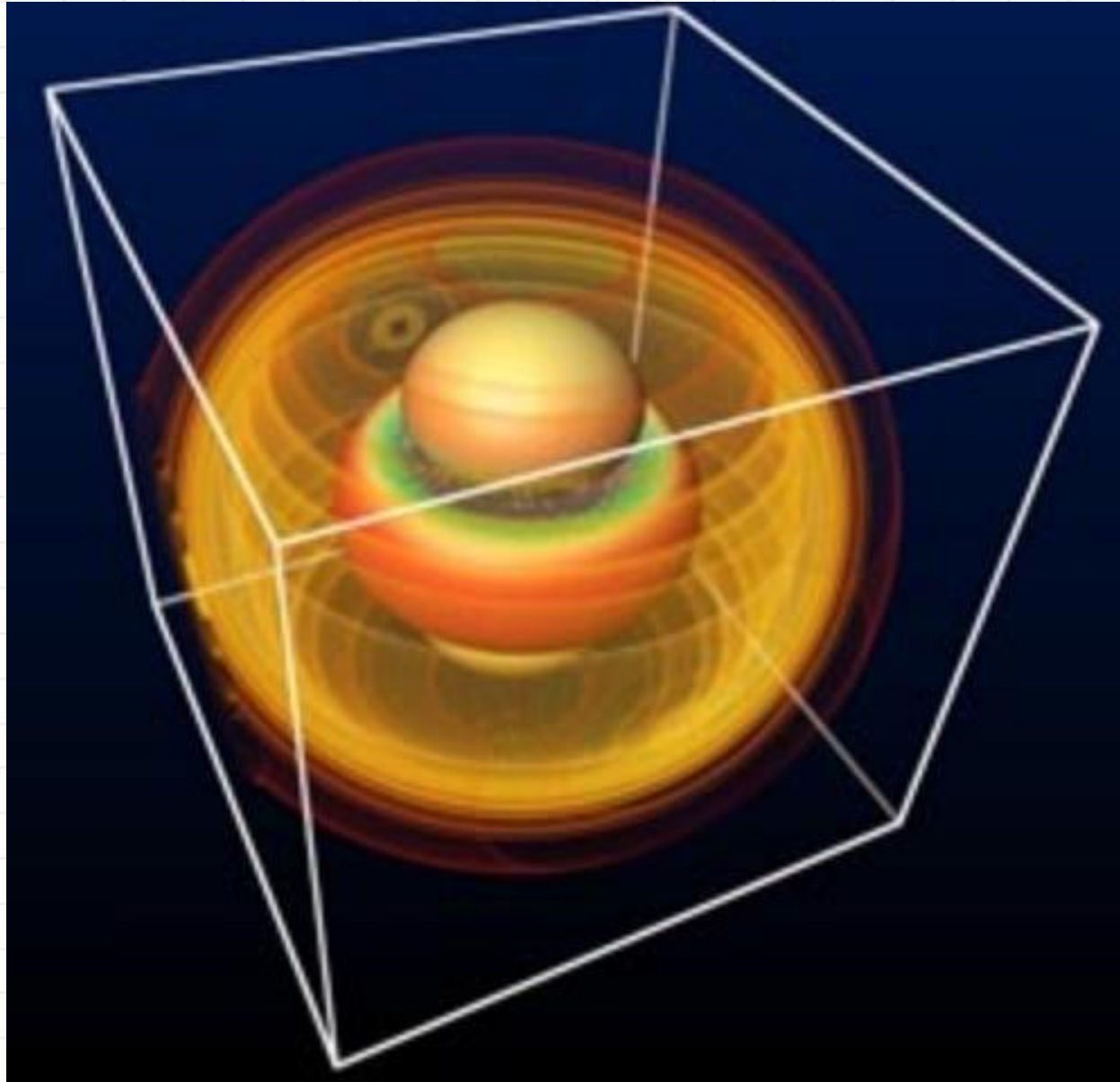
Virtual Reality



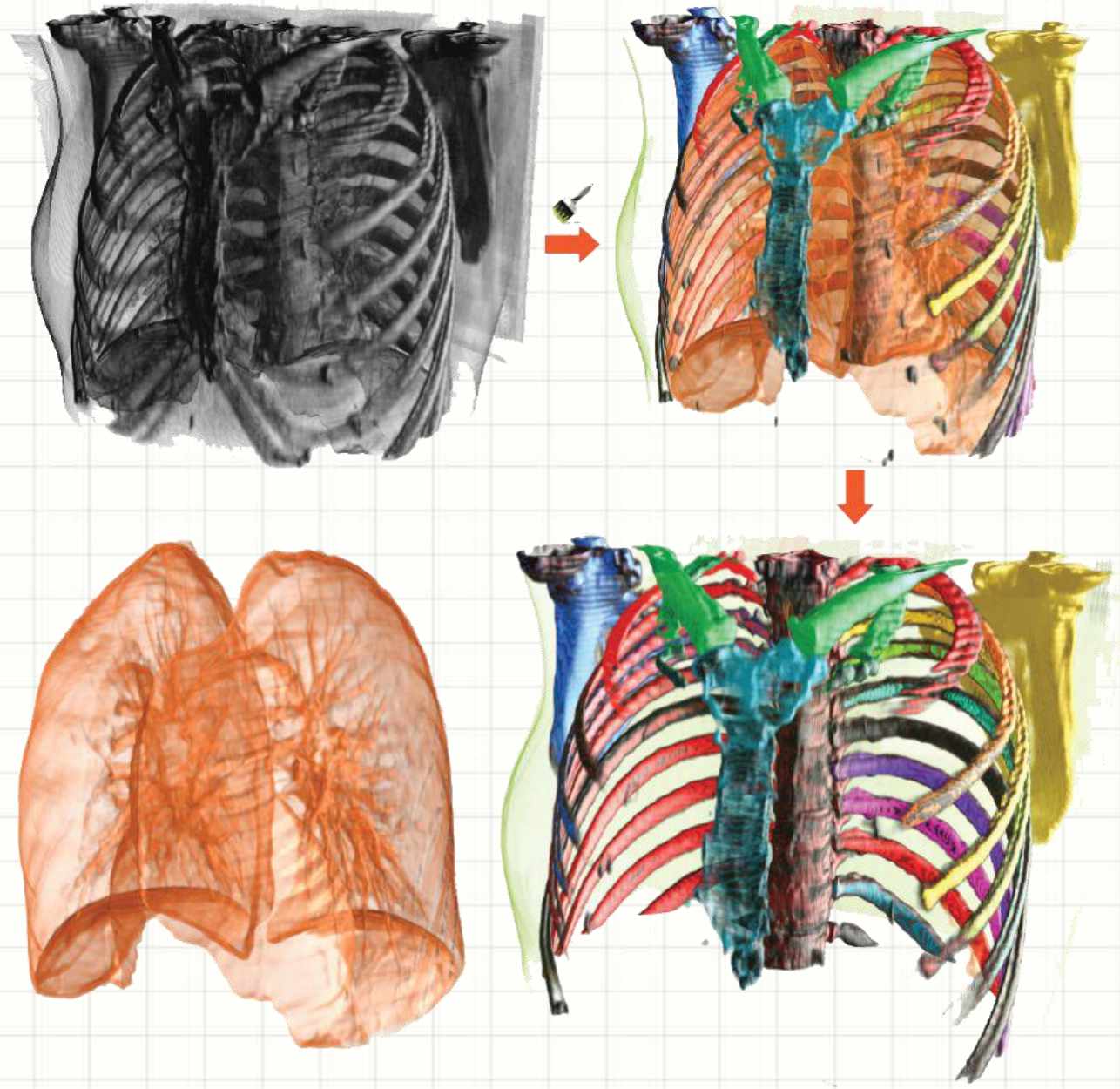
Simulation



Scientific Visualization



Volume Visualization



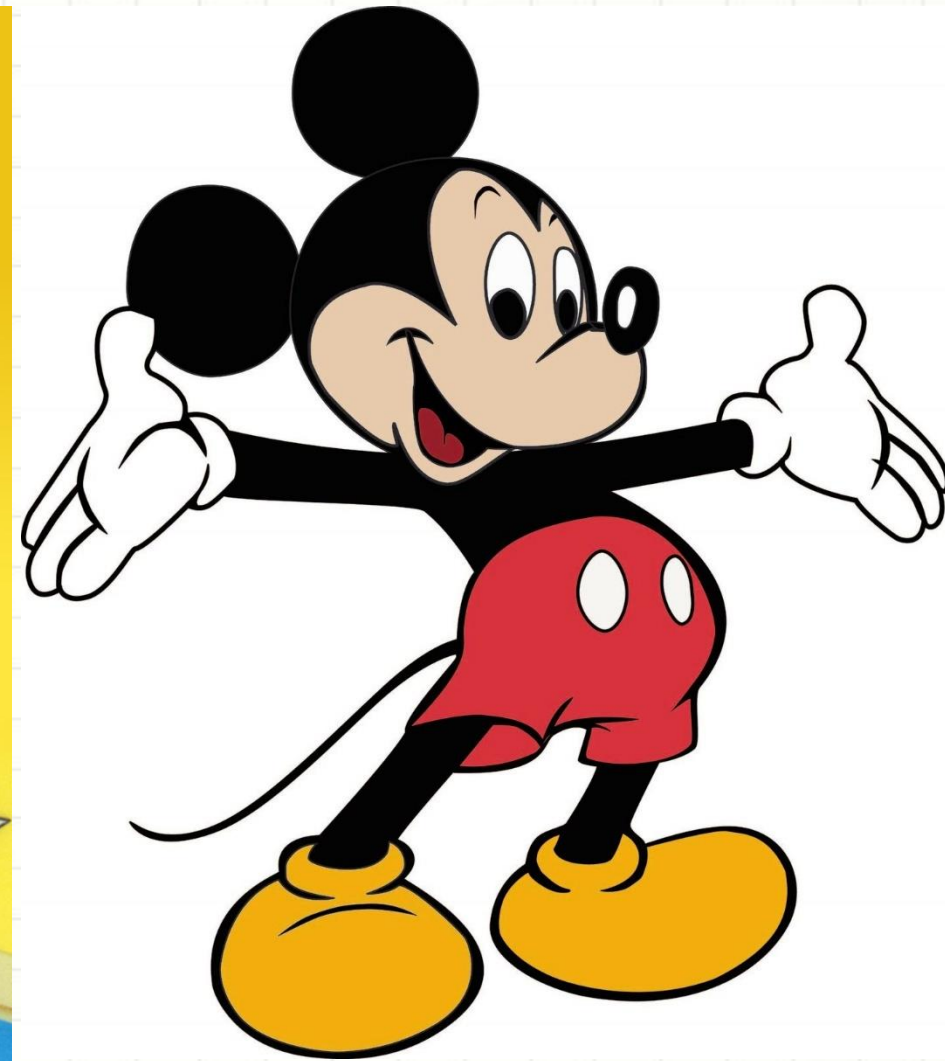
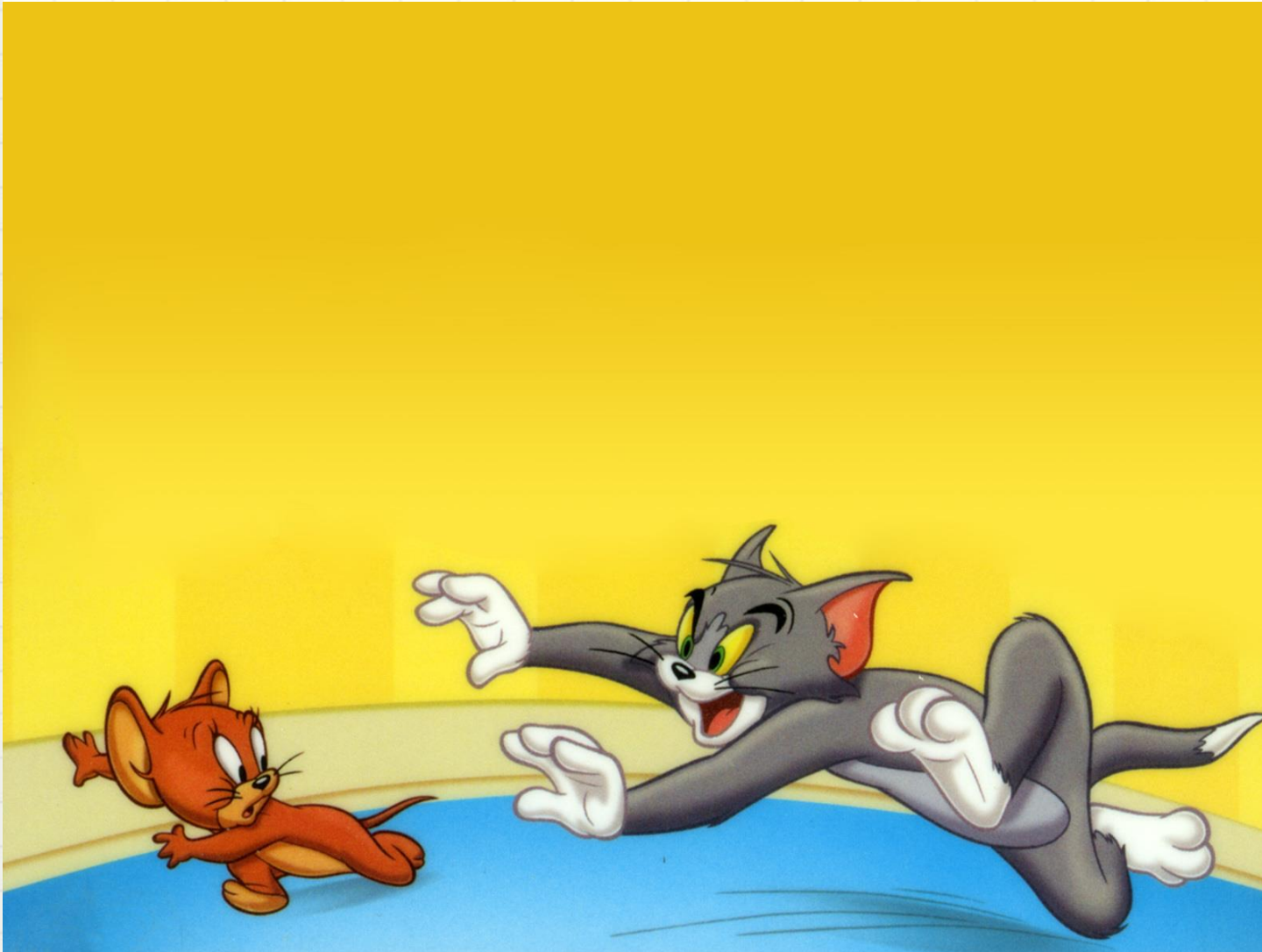
Entertainment



Education and Training



Computer Art



History

- ❖ **1950:** Cathode Ray Tube (CRT) at **Massachusetts Institute of Technology**
- ❖ **1955:** CRT is used for military purposes
- ❖ **1963:** Begin of modern computer graphics with PhD thesis of Ivan Sutherland at MIT:
Sketches and Systems
- ❖ **1966:** Computer-Aided Design (CAD) in aircraft industry
- ❖ **1968:** Founding of Evans & Sutherland
- ❖ **1969:** First SIGGRAPH (ACM)

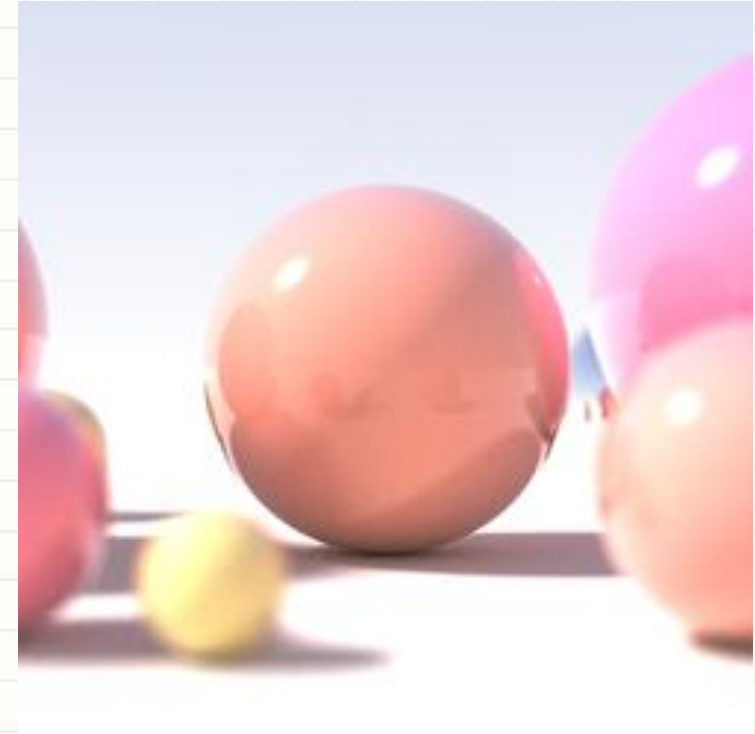
Ivan Sutherland

❖ (*1938 -)

- ❖ Studied electronic engineering at Carnegie Institute of Technology
- ❖ Master's degree from Caltech
- ❖ PhD from MIT in 1963, supervisor Claude Shannon
- ❖ **1962:** Invented the Sketchpad
- ❖ **1968-74:** Professor at University of Utah
- ❖ **1968:** Foundation of Evans and Sutherland
- ❖ Fellow and vice president of SUN microsystems

History

- ❖ **1971:** Gouraud shading, Phong shading, z-buffer
- ❖ **1977:** Graphical Kernel System (GKS)
- ❖ **1980:** Ray tracing for reflections
- ❖ **1982:** X-window system at MIT (first standards)
- ❖ **1984:**
 - ❖ Silicon Graphics International (**SGI**)
 - ❖ Integrated Raster Imaging System Graphics Library (**IRIS GL**)
- ❖ **1985:** Programmer's Hierarchical Interactive Graphics System (**PHIGS**)



History

- ❖ **1986:** Foundation Lucasfilm / Pixar Lucas , Catmull
- ❖ **1988:** Volume Rendering, Levoy at Stanford; Drebin, Carpenter Hanrahan
SIGGRAPH88
- ❖ **1993:** Jurassic Park, computer generated movie sequences
- ❖ **1995:** Toy Story, first ever feature film released by Walt Disney, John Lasseter
- ❖ **1998:** Ants, A bug life
- ❖ **2001:** Monsters
- ❖ **2003:** Finding Nemo
- ❖ **2008:** WALL-E

History

- ❖ **1992:** OpenGL, Silicon Graphics Inc., Khronos Group
- ❖ **1997:** Subdivision surfaces, Geris Game
- ❖ **1998:** Game Engines, Unreal Engine
- ❖ **2000:** General Purpose Computation on Graphics Processing Units (GPGPU)
- ❖ **2003:** C for Graphics (Cg), Kilgard
- ❖ **2007:** Tesla graphics card, nVIDIA
- ❖ **2008:** CUDA (by nVIDIA) vs OpenCL (by Khronos Group)
- ❖ **2009:** First implementation of OpenCL API

Literature

- ❖ Foley, J. D., Van Dam, A., Feiner, S.K., Hughes, J. F., & Phillips R. L. (1996). *Introduction to Computer Graphics*.
- ❖ Watt A. H. (1990). *Fundamentals of three-dimensional computer graphics*. Addison-Wesley.
- ❖ D.H. Eberly, *3D game engine design, a practical approach to real-time computer graphics*, Academic Press, Morgan Kaufmann, 2001
- ❖ Hughes, J. F., Van Dam, A., Foley, J. D., & Feiner, S. K. (2013). *Computer graphics: principles and practice*. Pearson Education.
- ❖ Dunn, F., & Parberry, I. (2011). *3D math primer for graphics and game development*. CRC Press.
- ❖ ARB, Dave Shreiner, editor,
 - ❑ *OpenGL programming guide (RED)*