CS3241 Computer Graphic

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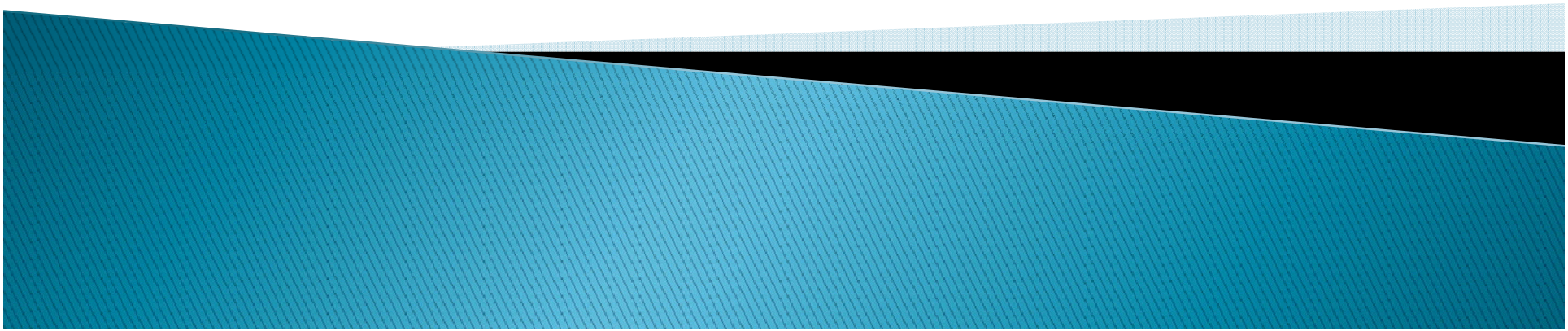
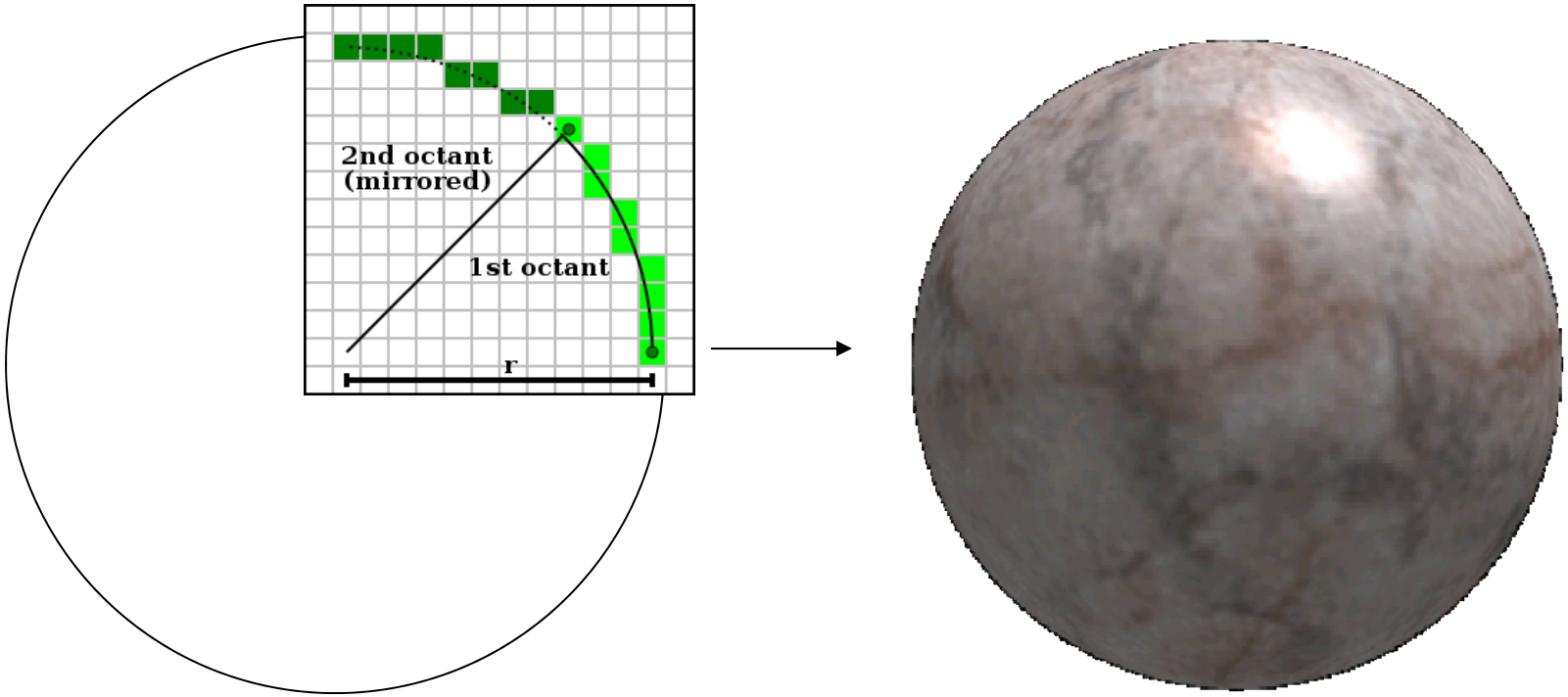


About this course

What is this course about

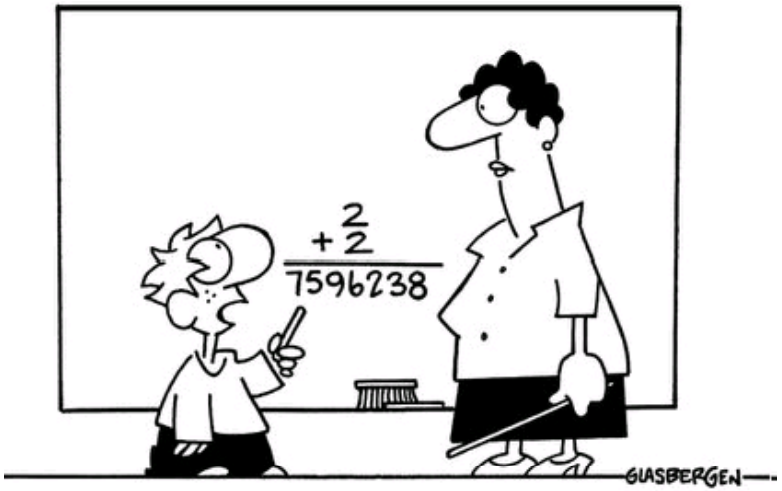
- How to draw with computer
  - …… err… algorithms



Outline of the Course

- 2D Graphics
  - Transformation
- Object modeling
- 3D Graphics
  - Transformation and viewing
- Hidden surface removal
- Scan convert algorithm
- Lighting model
- Texture mapping
- Ray tracing
- Some fun topics

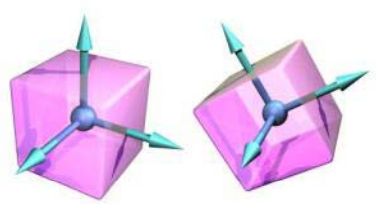
Maths…

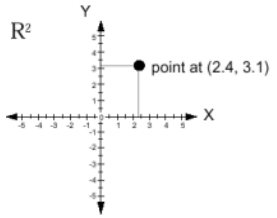


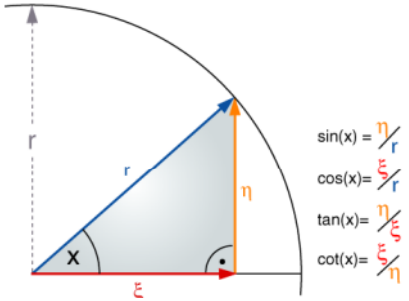
"In an increasingly complex world, sometimes old questions require new answers."

What math do we need?

- Euclidian Geometry and Cartesian Coordinates (E)
- Trigonometry and Polar Transforms (T)
- Vector/Matrix Manipulation (M)
  - Vector math
  - Matrix multiple
- Basic Calculus (C)
  - Basic Non-linear functions and derivatives







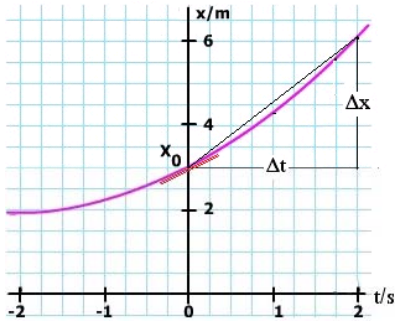
$$\mathbf{p}_1 = \mathbf{M}\mathbf{p}_0$$

$$\begin{bmatrix} x_1' \\ y_1' \\ w_1' \end{bmatrix} = \begin{bmatrix} m_0 & m_1 & m_2 \\ m_3 & m_4 & m_5 \\ m_6 & m_7 & 1 \end{bmatrix} \begin{bmatrix} x_0 \\ y_0 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} x_1'/w_1' \\ y_1'/w_1' \end{bmatrix}$$

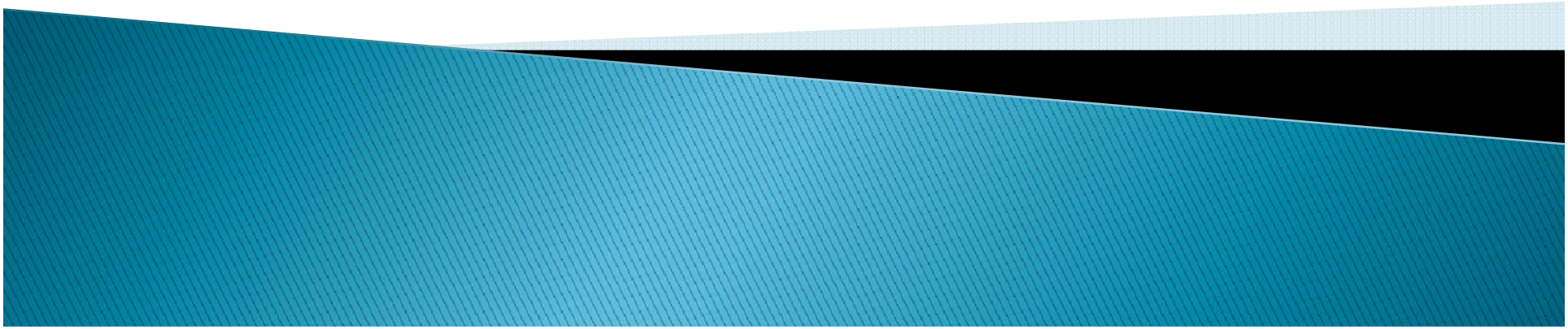
$$x_1 = \frac{m_0 x_0 + m_1 y_0 + m_2}{m_6 x_0 + m_7 y_0 + 1}$$

$$x_2 = \frac{m_3 x_0 + m_4 y_0 + m_5}{m_6 x_0 + m_7 y_0 + 1}$$



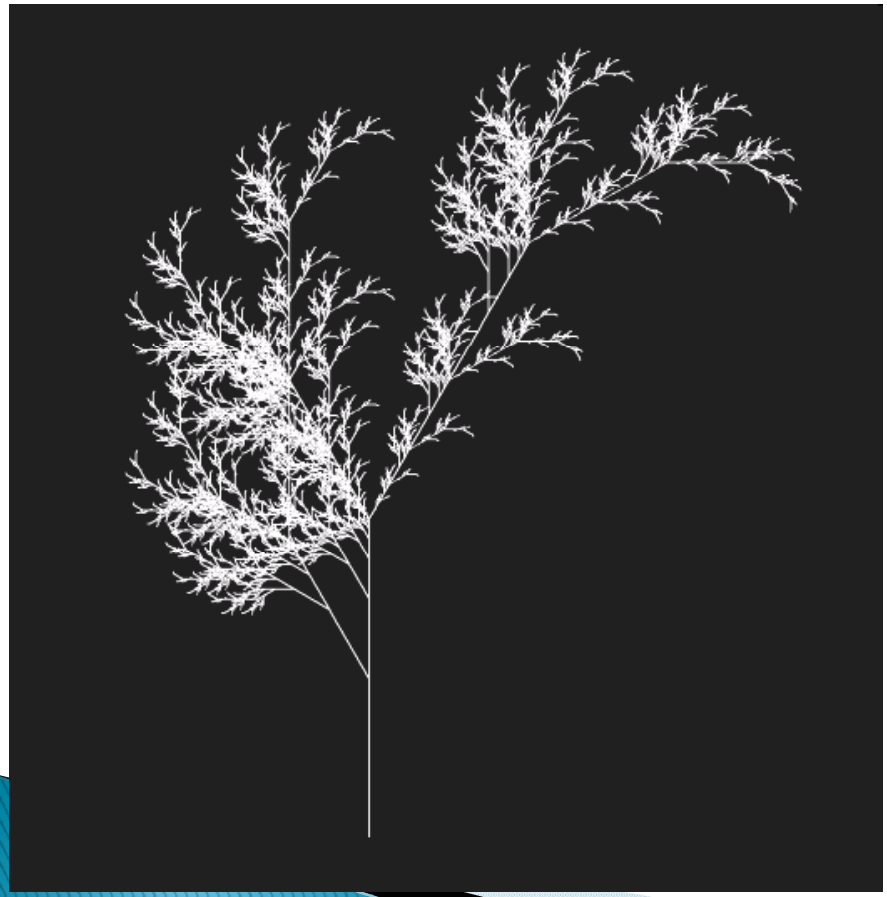
An Intuitive Overview of Syllabus

(There is something called the graphic pipeline)



2D Graphics

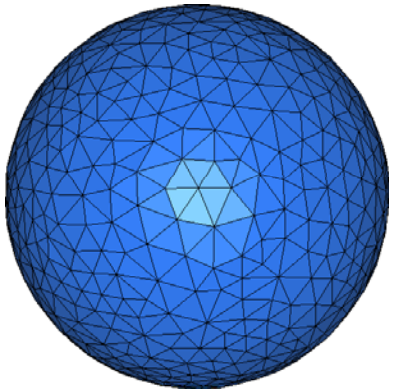
- Transformation (M,E)

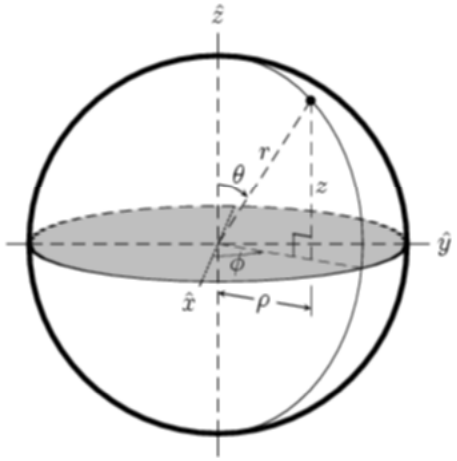


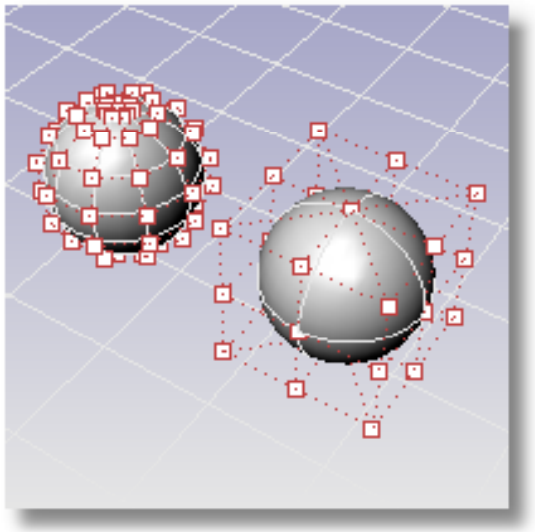
3D Graphics

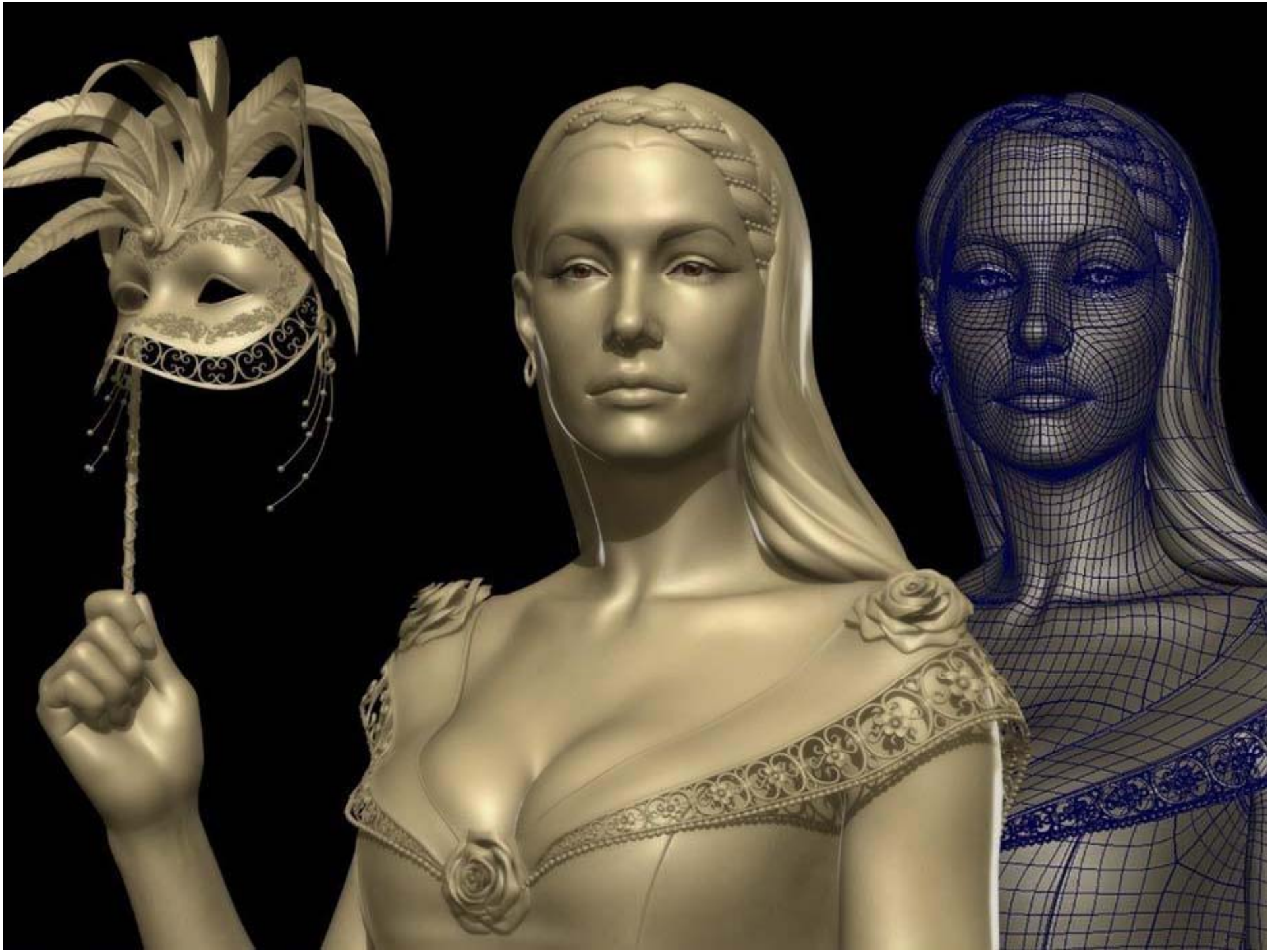
- Object modeling (M,E)
  - Object Representations
    - Using different data structure/format to represent objects
    - Geometric models
  - To **represent** a sphere by
    - Mesh
    - Implicit equation $x^2 + y^2 + z^2 - r^2 = 0$
    - Explicit equation

      $$(r\cos\theta, r\sin\theta\cos\phi, r\sin\theta\sin\phi)$$
    - Piecewise parametric surfaces
    - Etc. Etc.



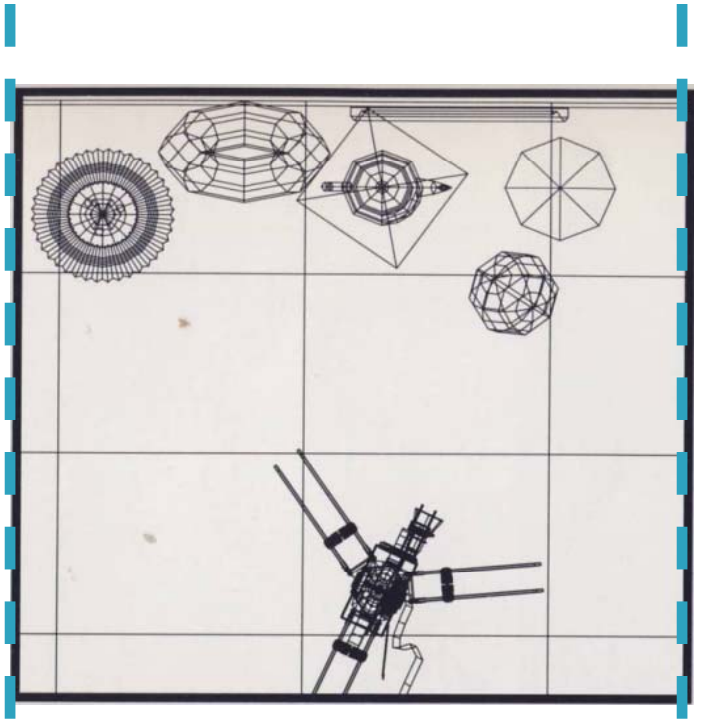


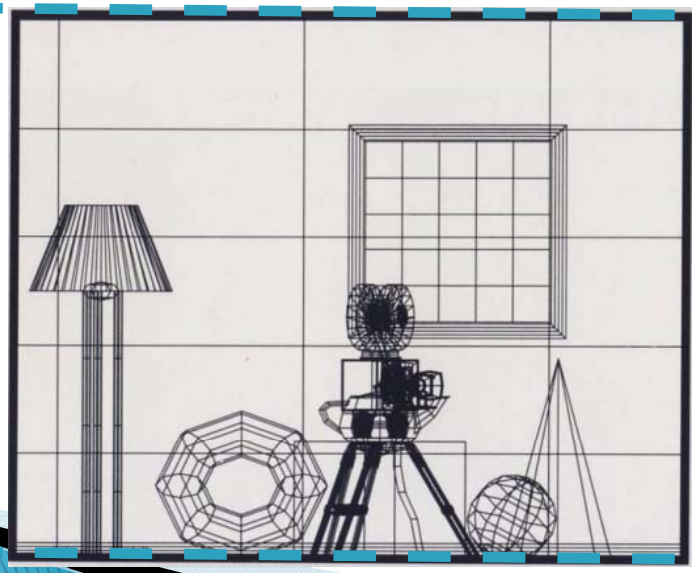


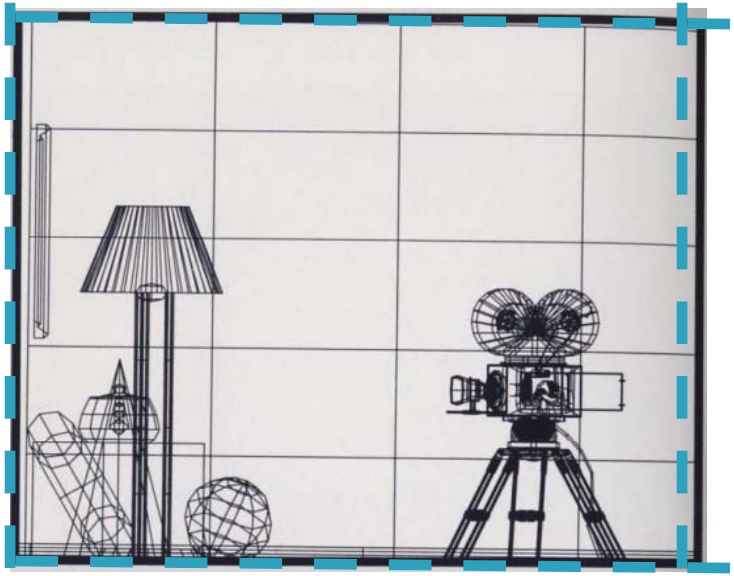


3D Graphics

- Object modeling (M,E)
  - Object Representation
    - Using different data structure/format to represent objects
    - Geometric models

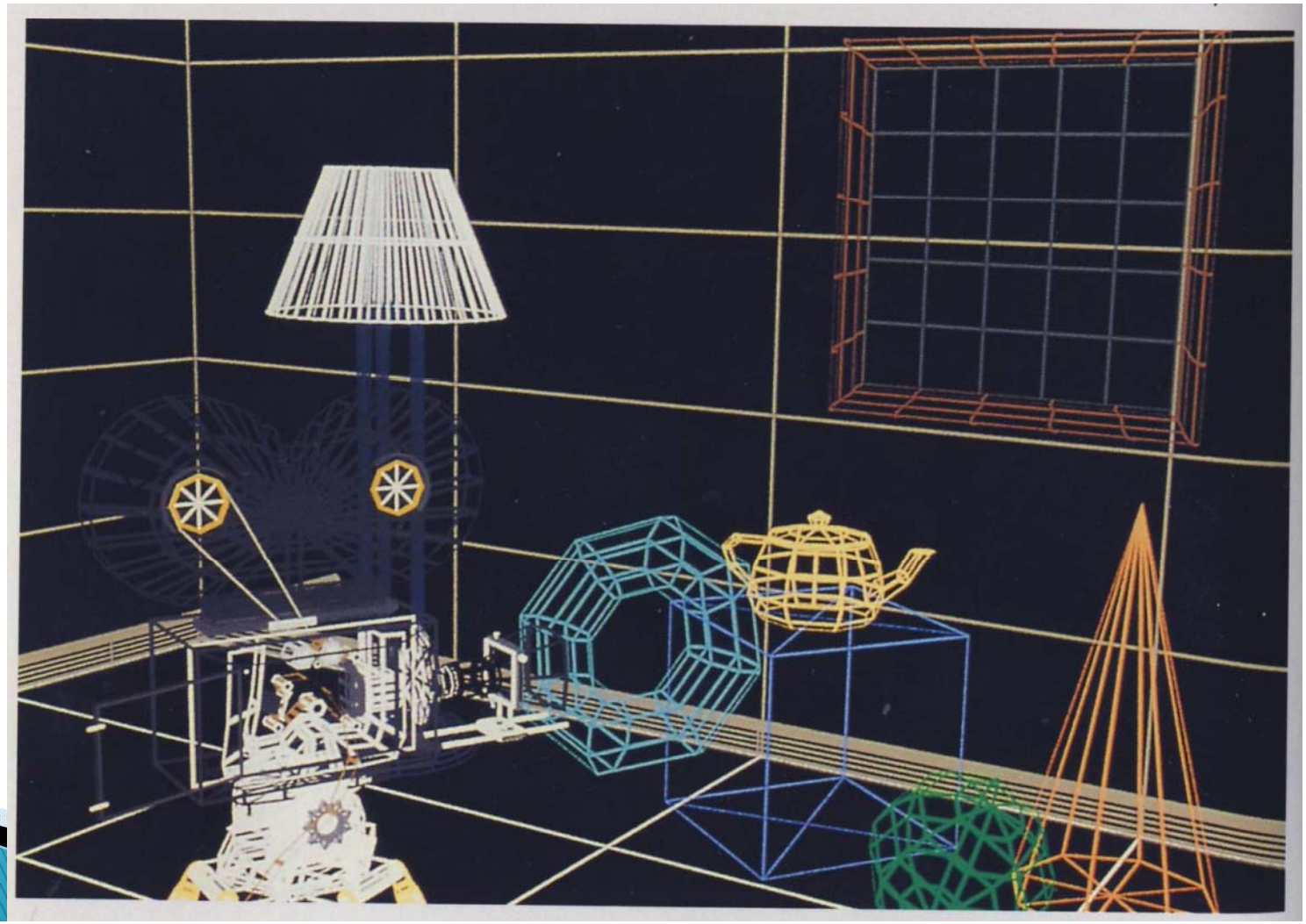






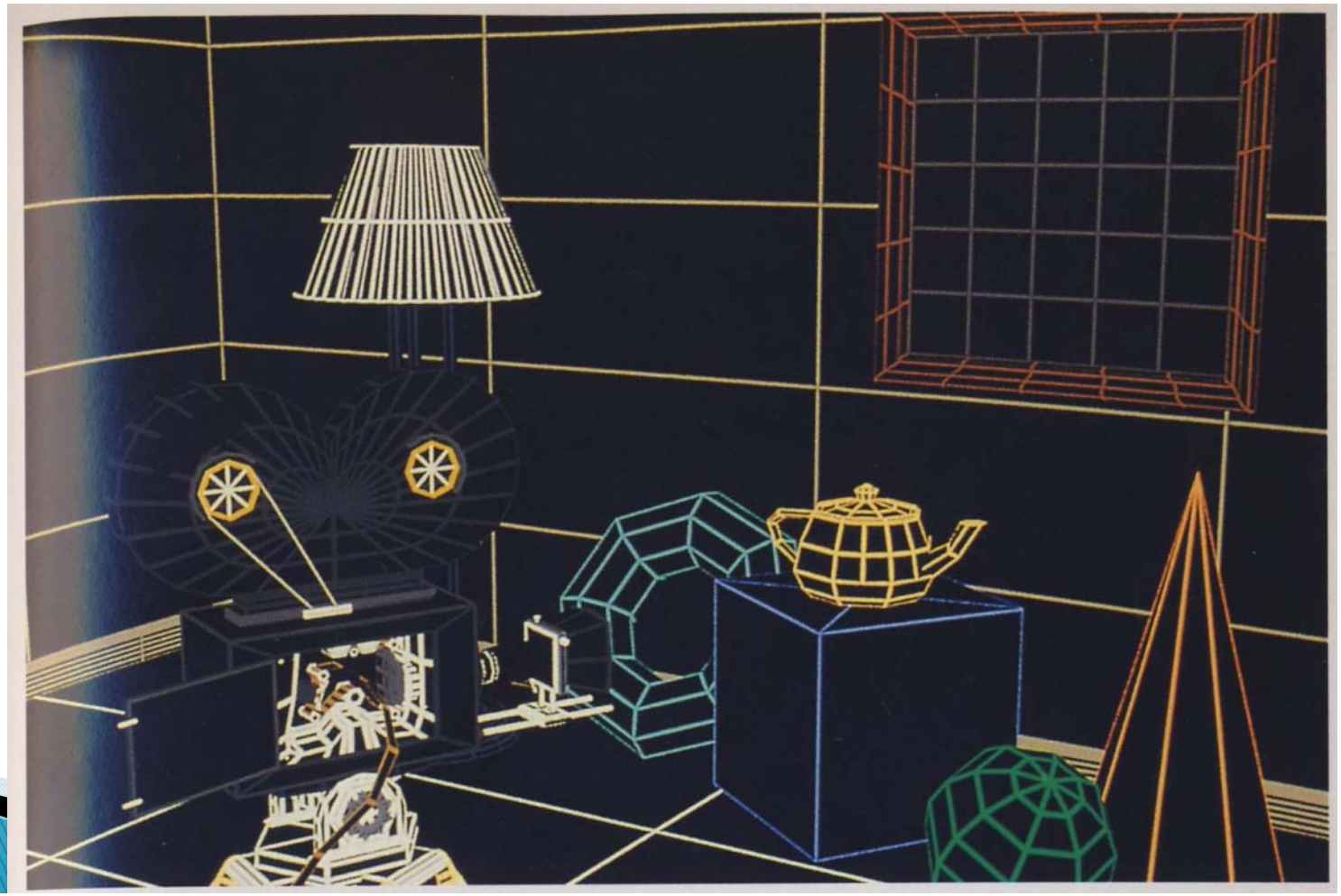
Transformation/Viewing

- Put models in front of the “camera” (M,E)



Hidden Surface Removal

- Remove “back-sides” (E,T)



Scan Convert Algorithm

- “Paint” every polygon (E)

Lighting Model (Flat)

- Shading every polygon (E,T)

Lighting Model (Gouraud)

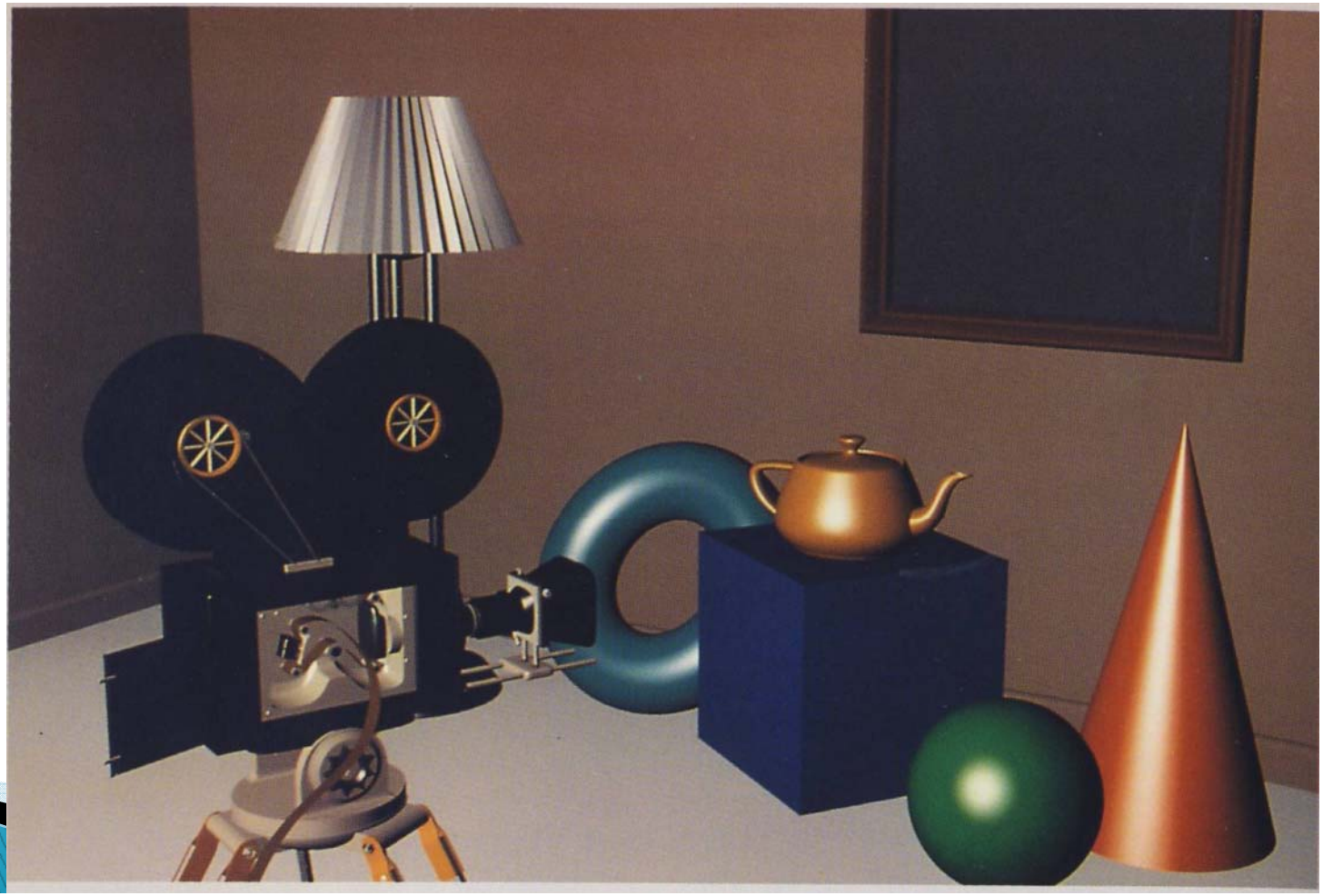
- Continuous shading (E,T)

Lighting Model (Phong)

- Highlights for reflection (E,T)

Different Object Representations

- Polygonal vs non-polygonal objects
  - Object modeling – curves surfaces (C)
  -



Texture Mapping

- Paint each face with pictures (E)

Ray Tracing

- Calculate shadows and reflections (E)

What you can do…

- After this course, you know…
  - How graphic works in games, movies and other applications
  - How to write some graphic applications
  - How to appreciate computer arts
  - How to tell flaws and “cheating” in movies/games
  - Proceed to your graphic career