電腦圖學
Computer Graphics

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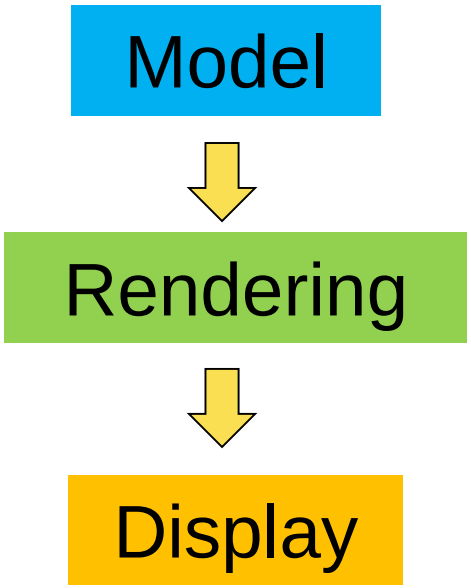
Department of Computer Science and Information Engineering

Introduction

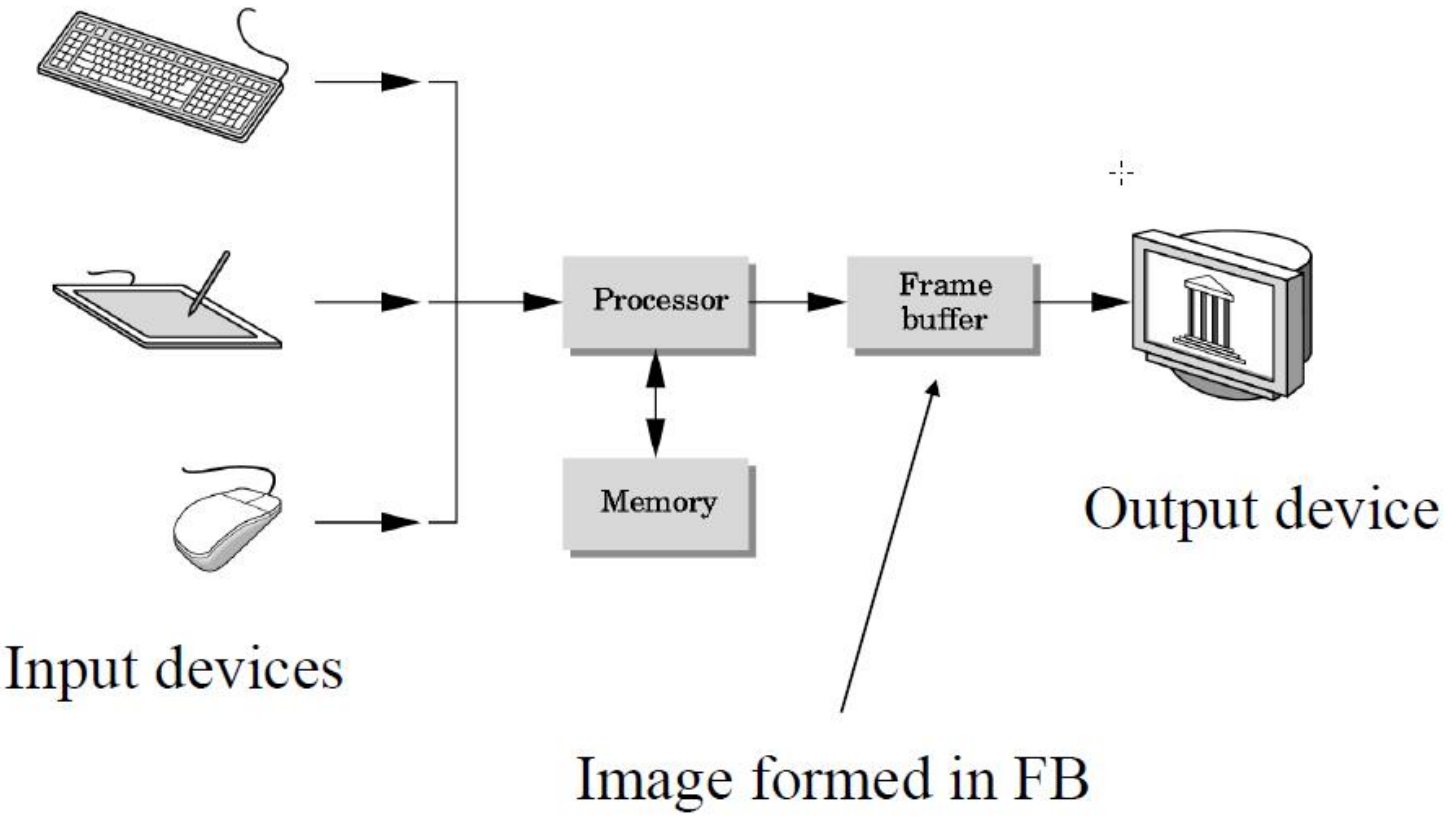
- Define Computer Graphics…

The technology associated with the use of computer technology to convert created or collected data into visual representations



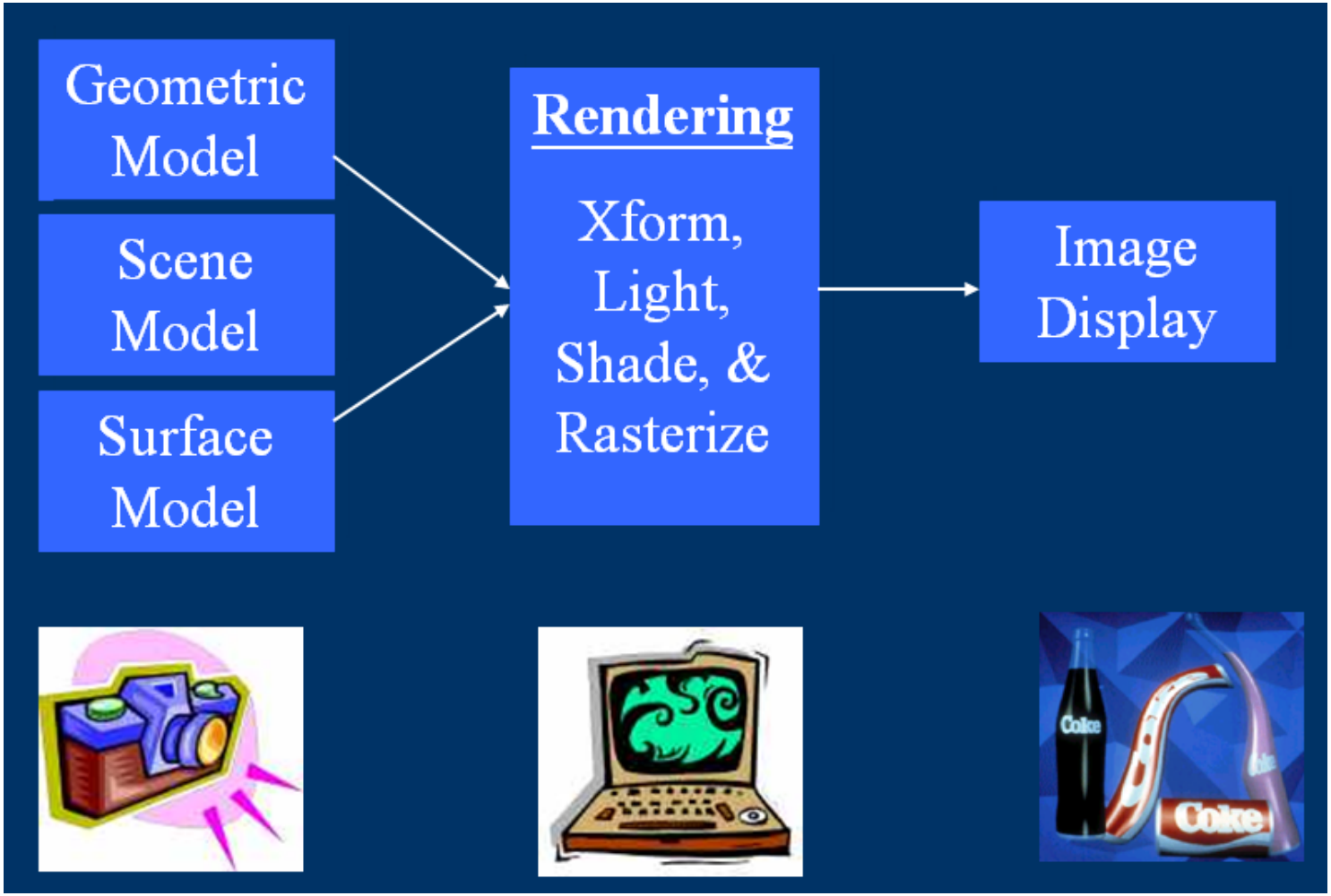
Introduction

- Graphics Process



Introduction

- Graphics Process



Geometry Modeling

- There are many ways to describe geometry
  - Explicit geometry:

    Triangle meshes, Patches, Subdivision surfaces,…
  - Implicit geometry:

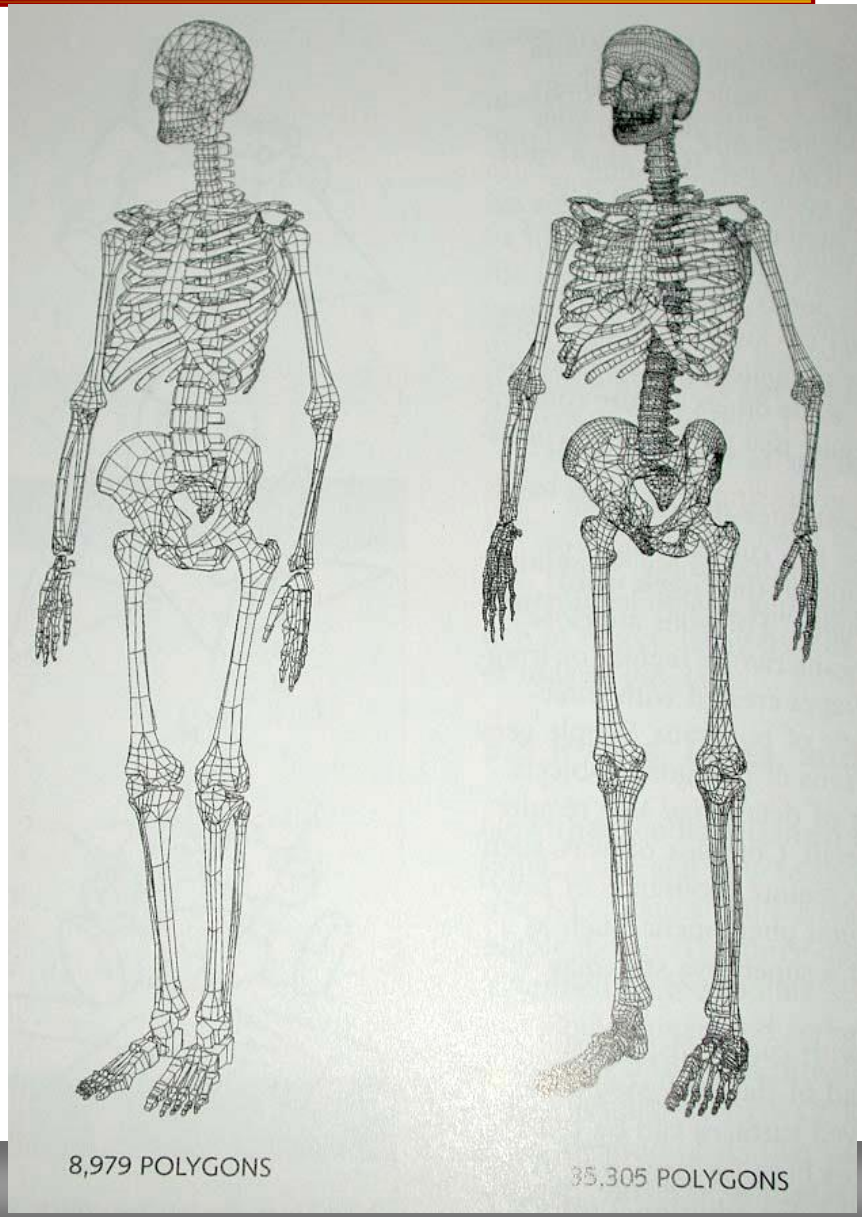
    Surface defined by $x^2 + y^2 + z^2 = 10$

    Fractal sets, procedural definition, …
  - Volume data:

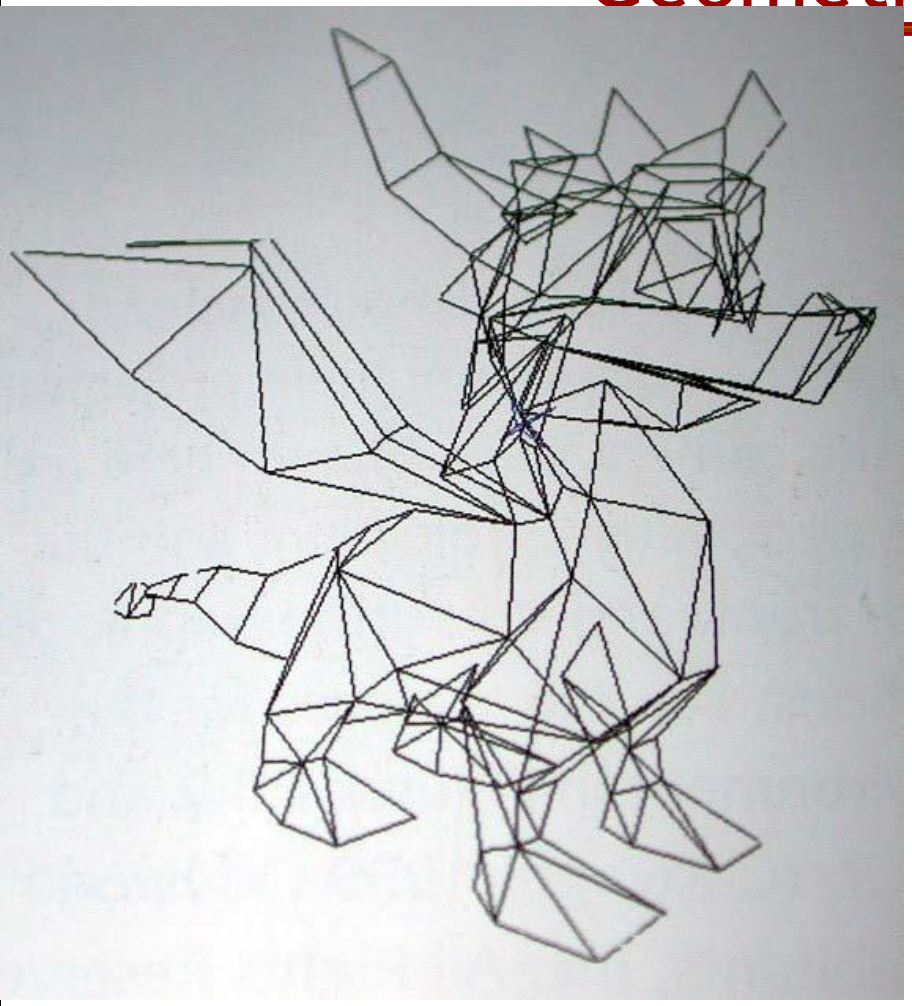
    Samples from MRI, ultra-sound, simulation…

Geometry Modeling

- Primitives
- The basic sort of primitive is the polygon
- Number of polygons: tradeoff between render time and model accuracy

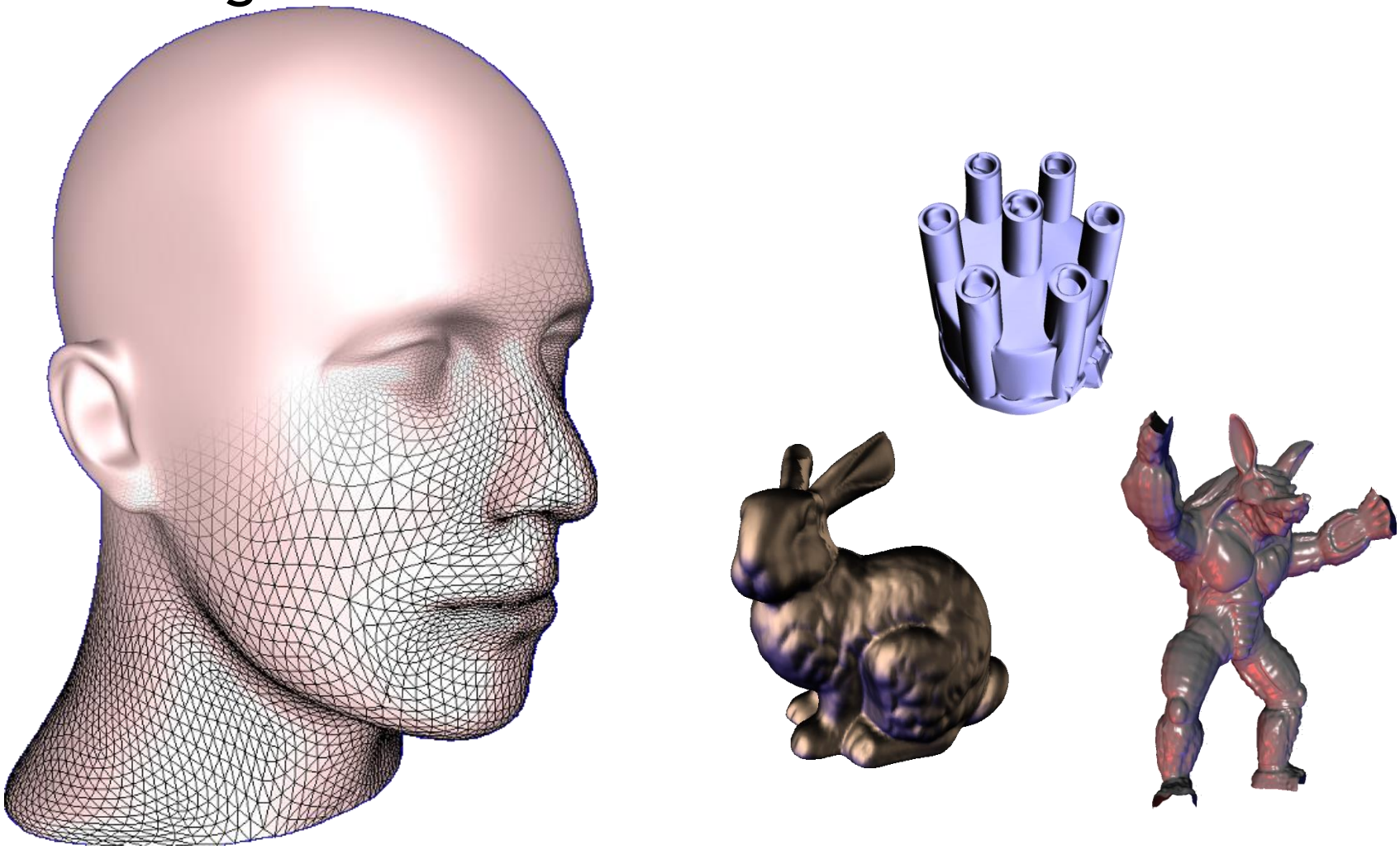


Geometry Modeling



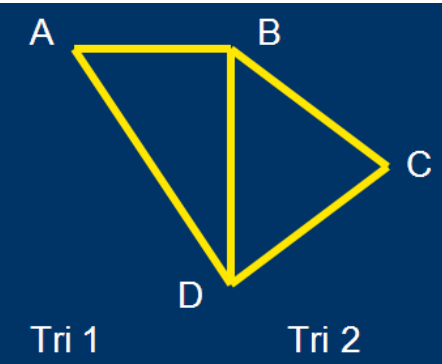
Geometry Modeling

- Triangle Meshes



Geometry Modeling

- Object or Scene Model
  - Triangles - we use vertex list per tri (or list of pointers to vertex array)



- Edge representation:
- XYZ_A XYZ_B
- XYZ_B XYZ_D
- XYZ_D XYZ_A

- Or tri-strip:
- XYZ_A
- XYZ_B
- XYZ_D
- XYZ_C

» Implied edges exist between points of tris.
» Convex and concave polys are decomposed into tris.

Geometry Modeling

- Vertices
- Verts have X,Y,Z coords and other attributes like color, normal, texture coords, etc.
- Verts are where we know something about the model.
- Verts are model "sample points".
- Tris are planar approximation of “true” object geometry.
- Coords are relative to some origin and axes (e.g., *Model Space*).
- Example of tri from pot4.asc: {X, Y, Z, Nx, Ny, Nz, U, V}

triangle

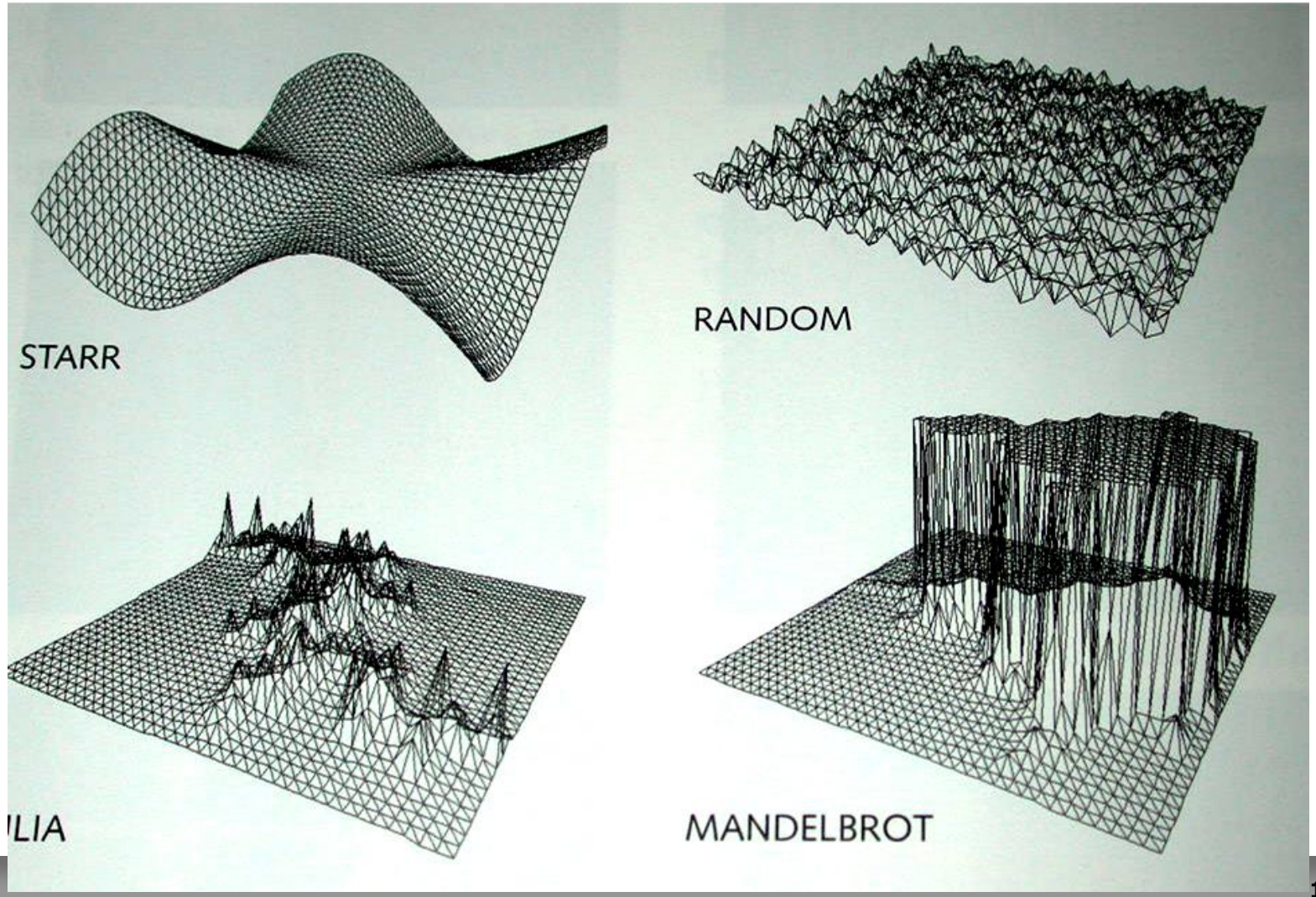
- 1.400000 2.250000 0.000000 -0.902861 -0.429934 0.000000 0.000000 0.000000
- 1.273482 2.323828 0.541834 -0.918898 0.095044 -0.382874 0.250000 0.250000
- 1.380469 2.323828 0.000000 -0.995495 0.094810 -0.000000 0.000000 0.250000

Geometry Modeling

- Mesh

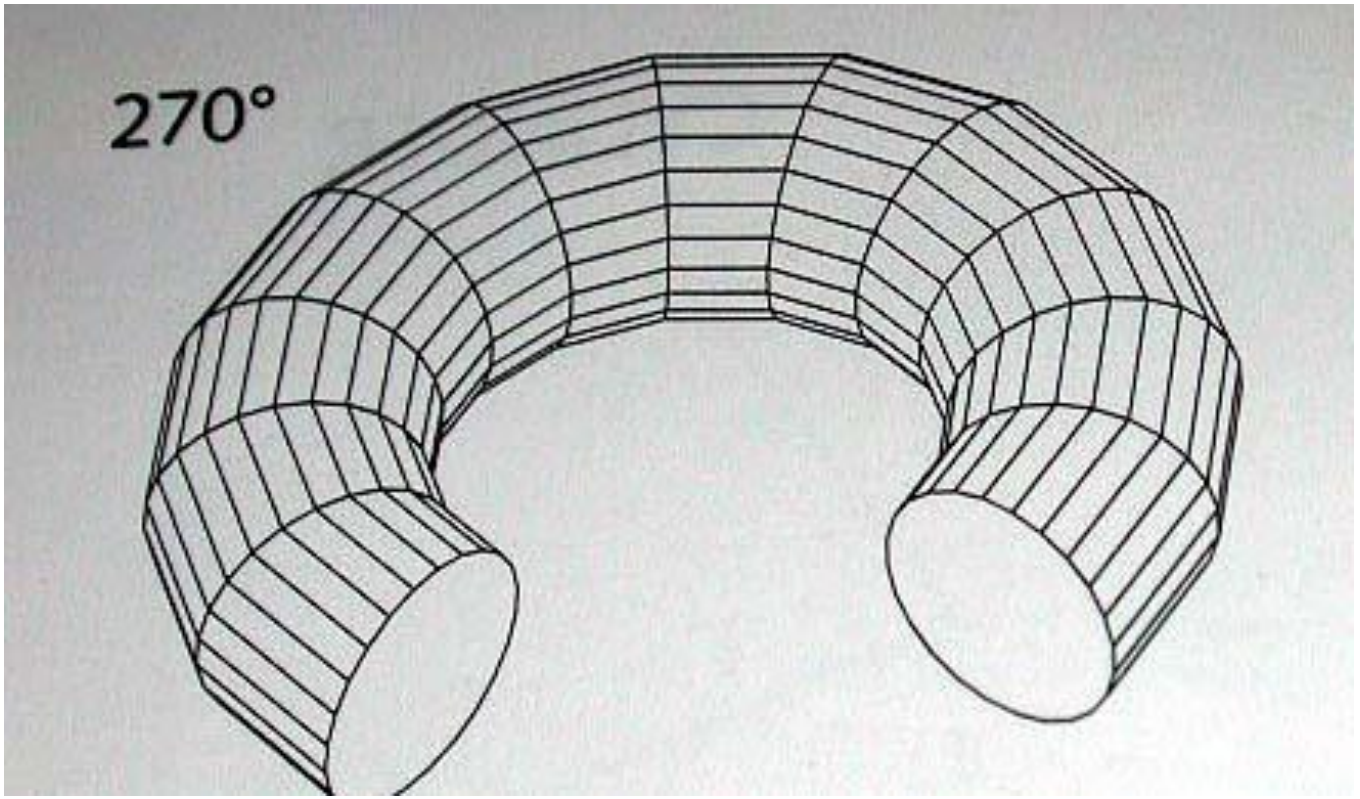
Geometry Modeling

- Mesh deformations



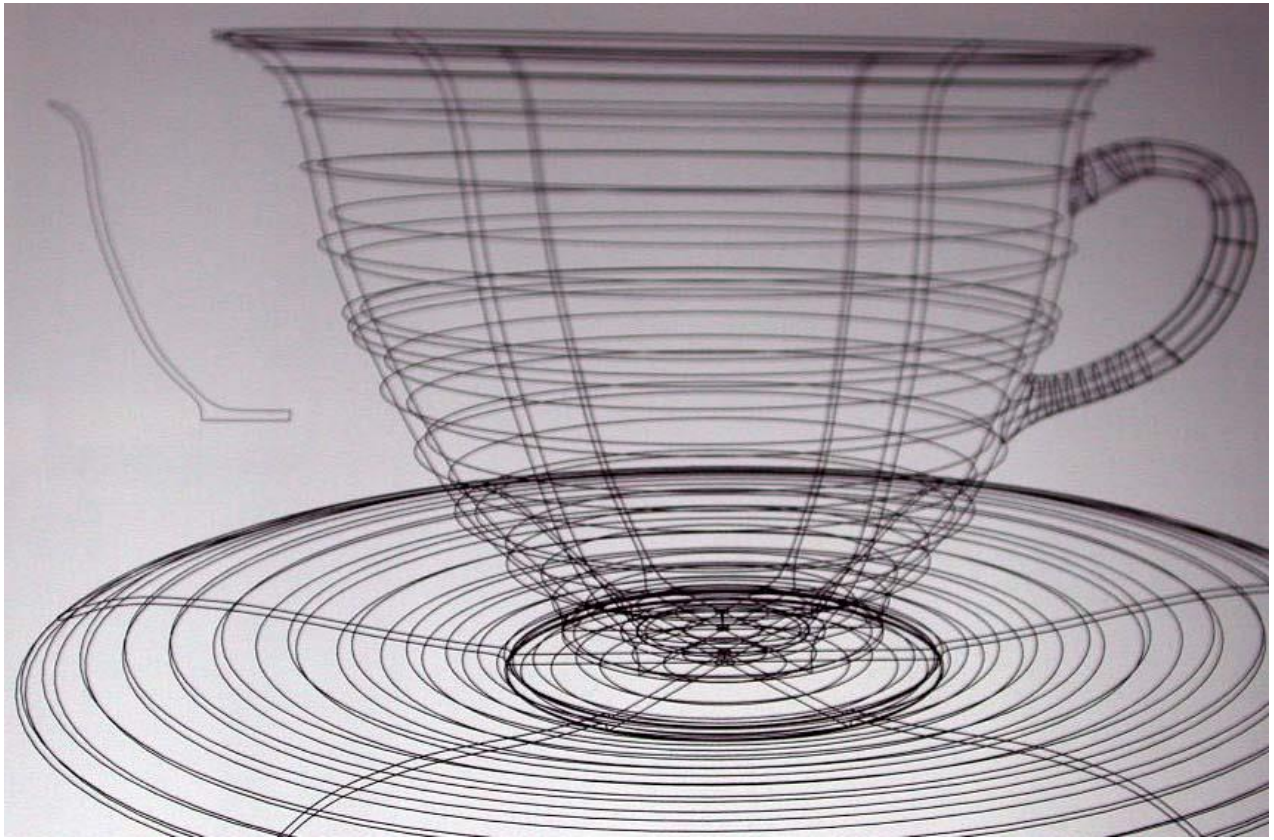
Geometry Modeling

- Sweep
  - Sweep a shape over a path to form a generalized cylinder



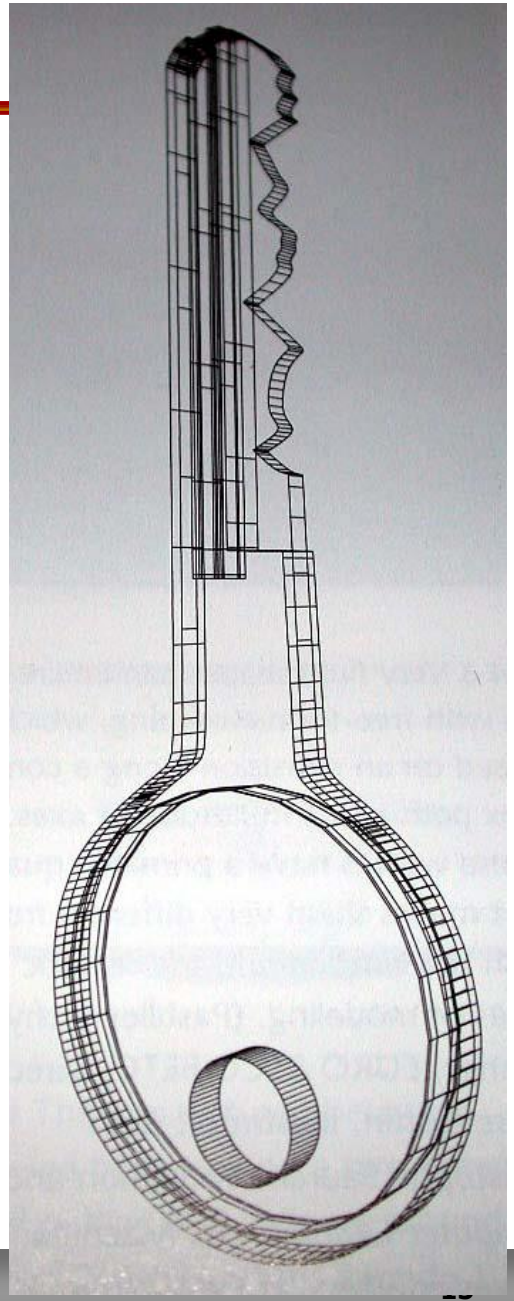
Geometry Modeling

- Revolution
  - Revolve a shape around an axis to create an object with rotational symmetry



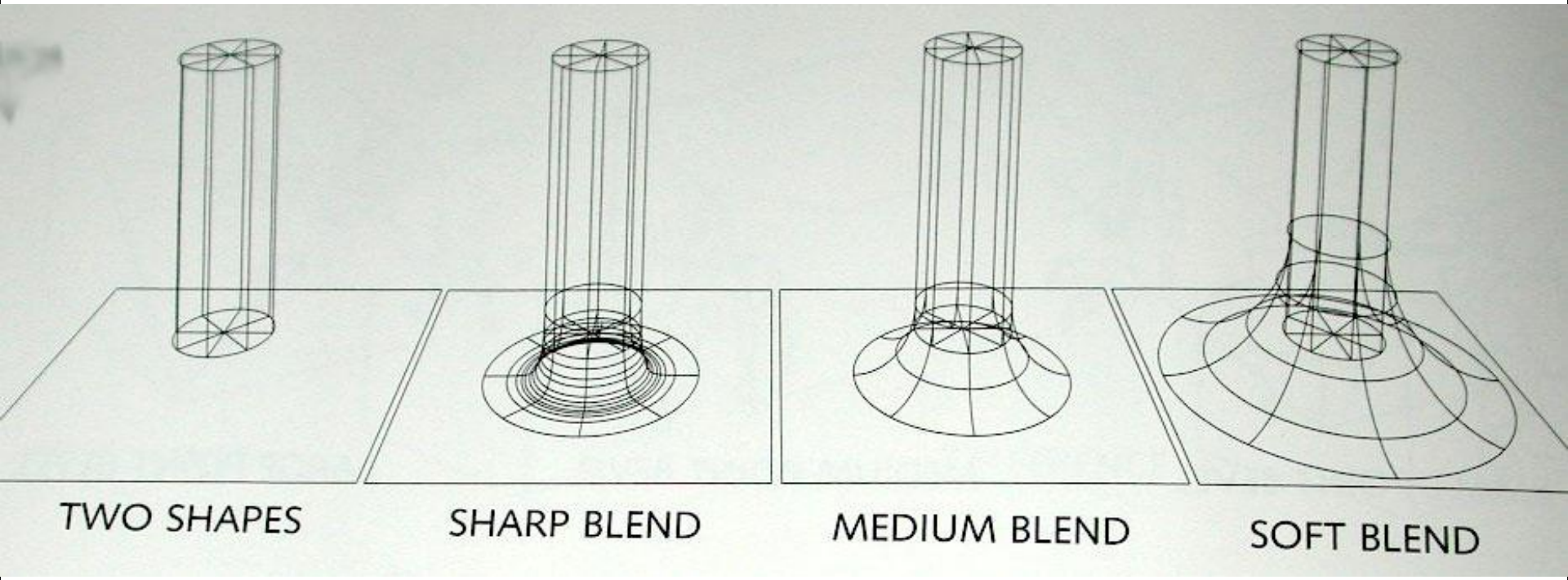
Geometry Modeling

- Extrusion
  - Extrude: grow a 2D shape in the third dimension
  - Shape is created with a (1D) b-spline curves
  - Hole was created by subtracting a cylinder



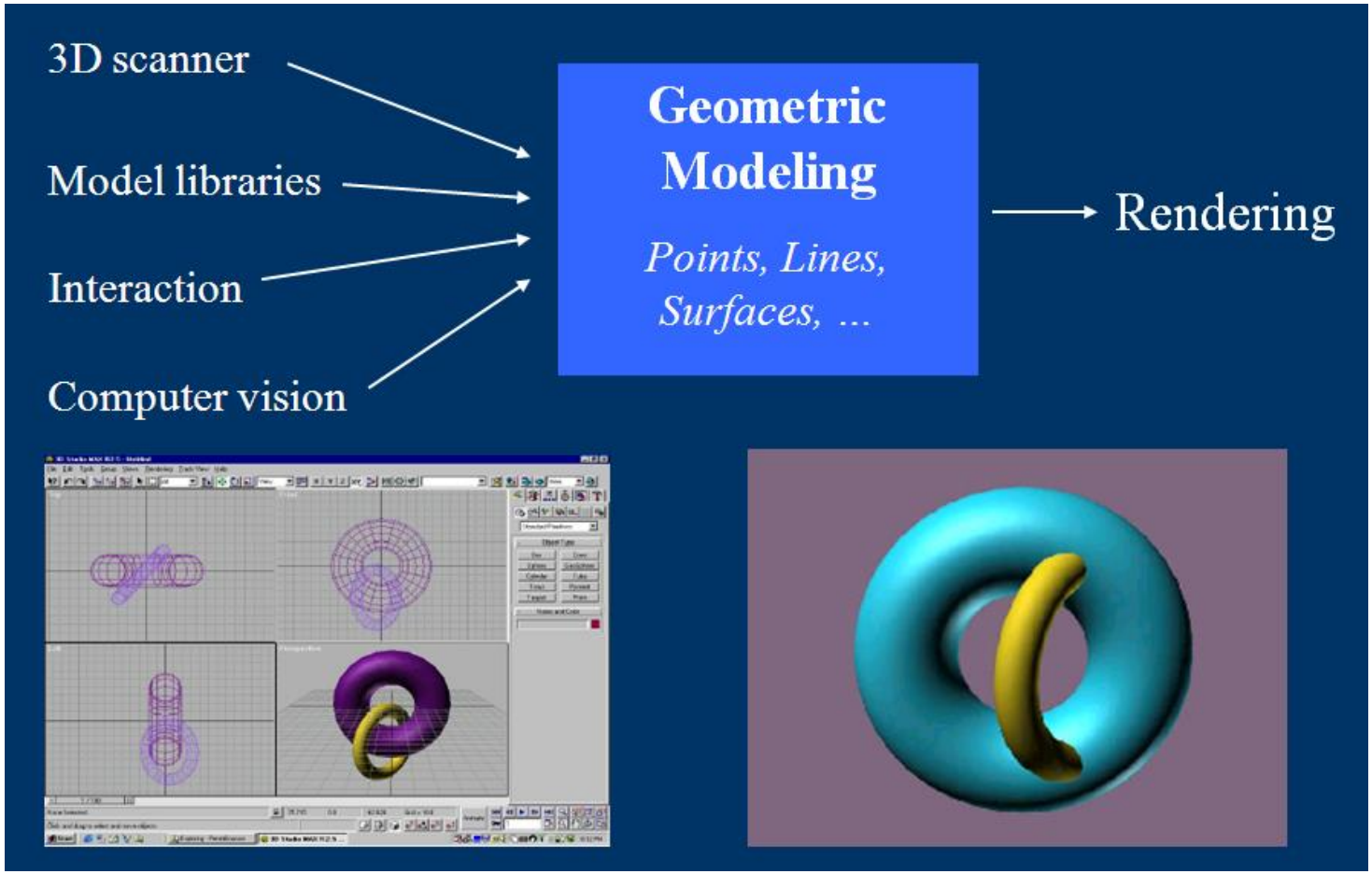
Geometry Modeling

- Joining Primitives
  - Stitching, blending



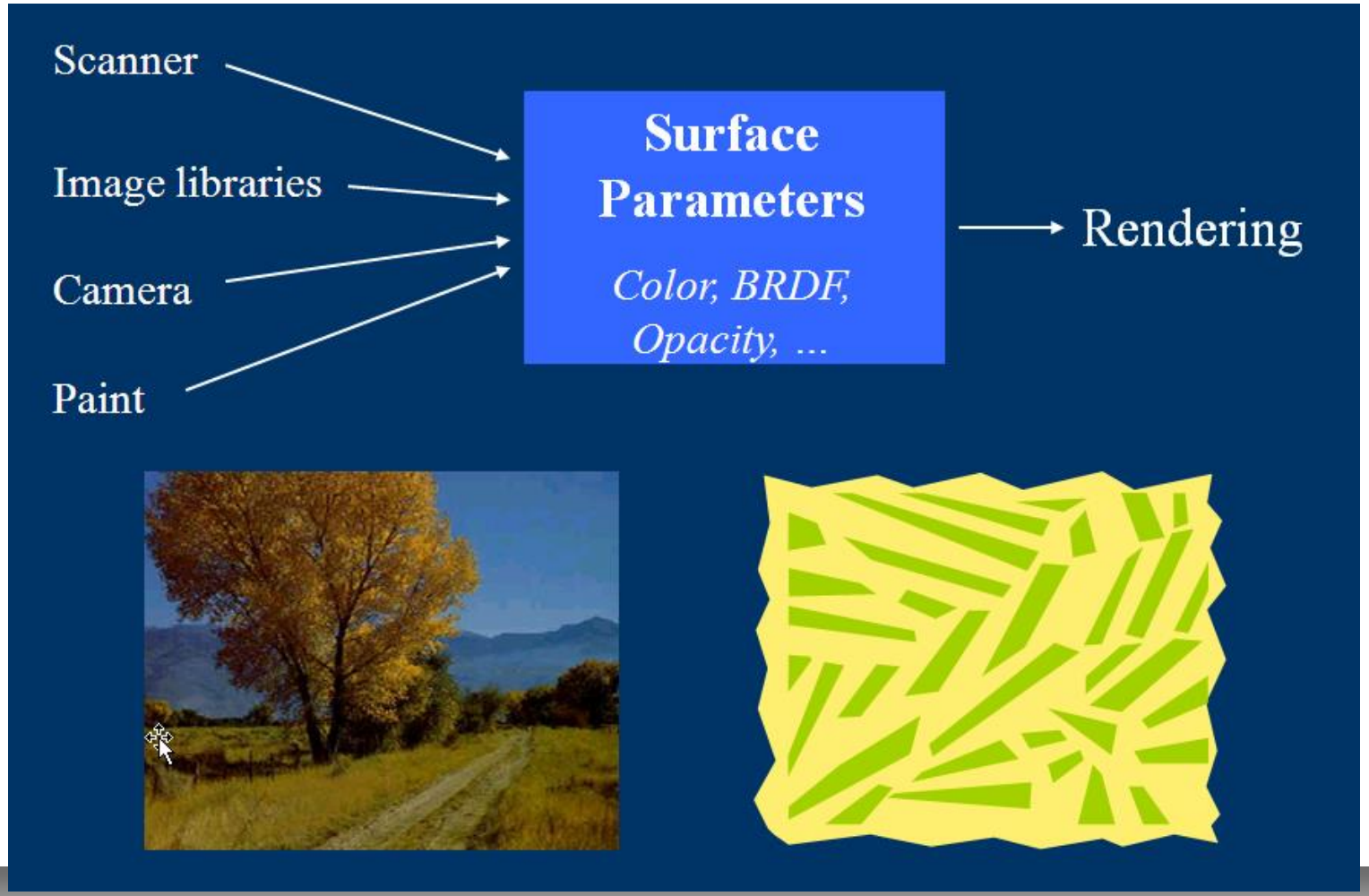
Geometry Modeling

- Making Models



Geometry Modeling

- Making Surface Models



Rendering

- Rendering

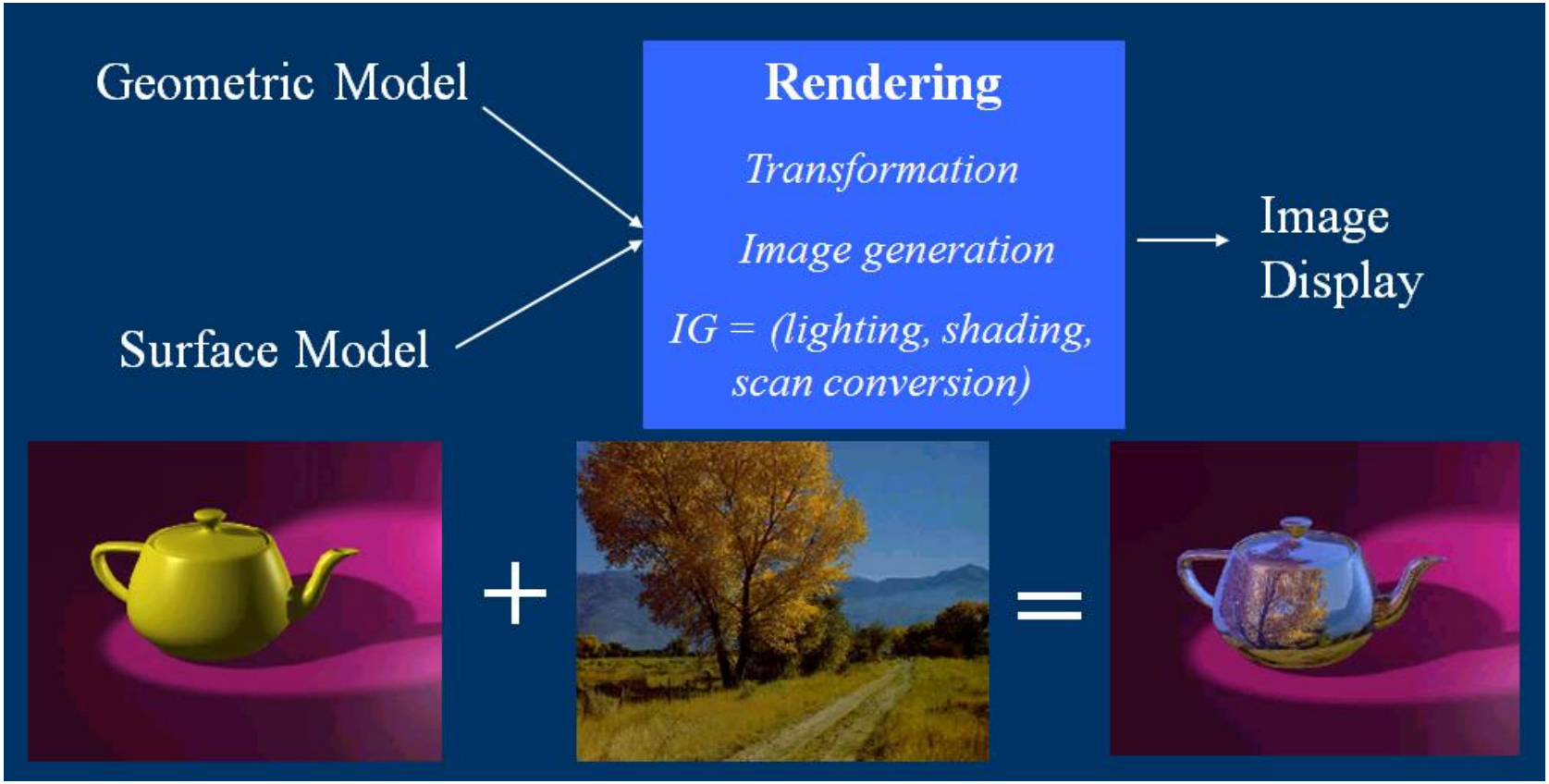


Image Display

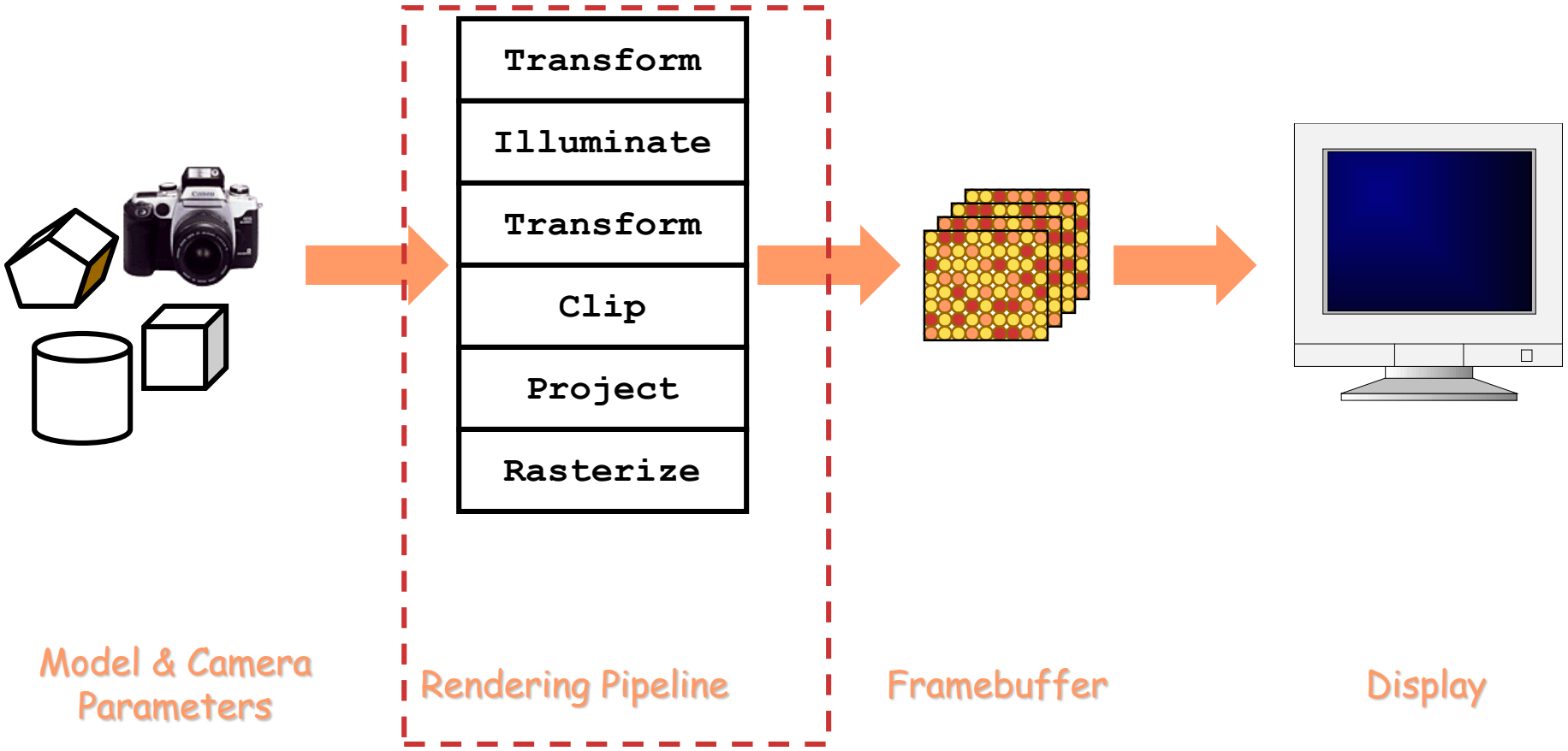
Rendering → **Image Representation**

Pixel array,
Stroke list, NC cut list,
…

→ **Optical Modulation**

CRT, LCD, Plasma,
Ink, Solid material

The Rendering Pipeline



2-D Rendering: *Rasterization*