What is rendering?

Generation of a 2D image from a 3D scene

Applications

- virtual reality - a city
- invented reality, a.k.a visual metaphor
  - plastic molecules, medical scan as colored jello

Realism is important!

- 3D -> 2D involves loss of information
- 2D image must convey 3D scene
- plausible and familiar scene
- plausible and familiar illumination
- realistic rendering

Visual cues for realism

Occlusion

Transparency

Perspective and foreshortening

Aerial perspective: desaturation, blurring

Shading

Shadows

Stereopsis

Kinetic depth effect

Head motion parallax

The rendering pipeline

modeling

↓

visibility

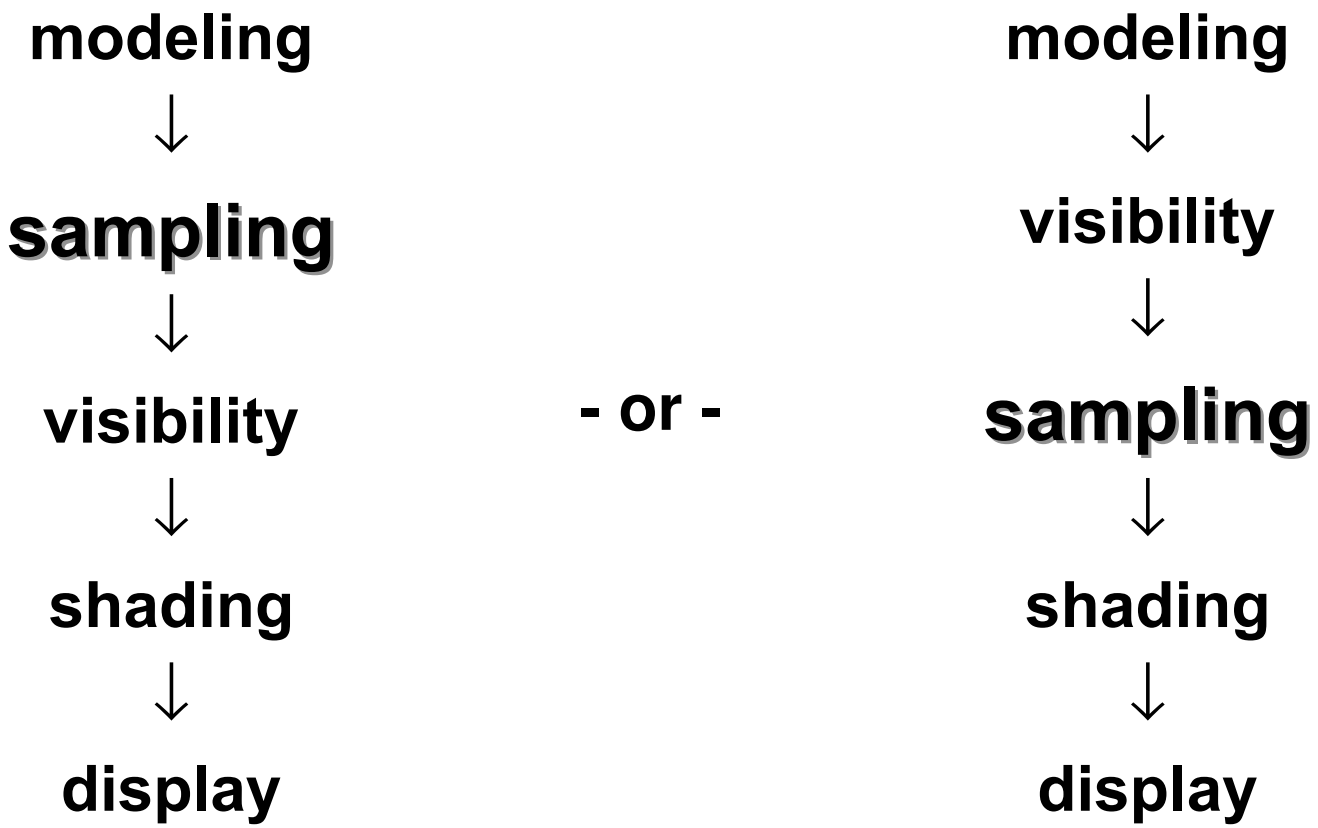
↓

shading

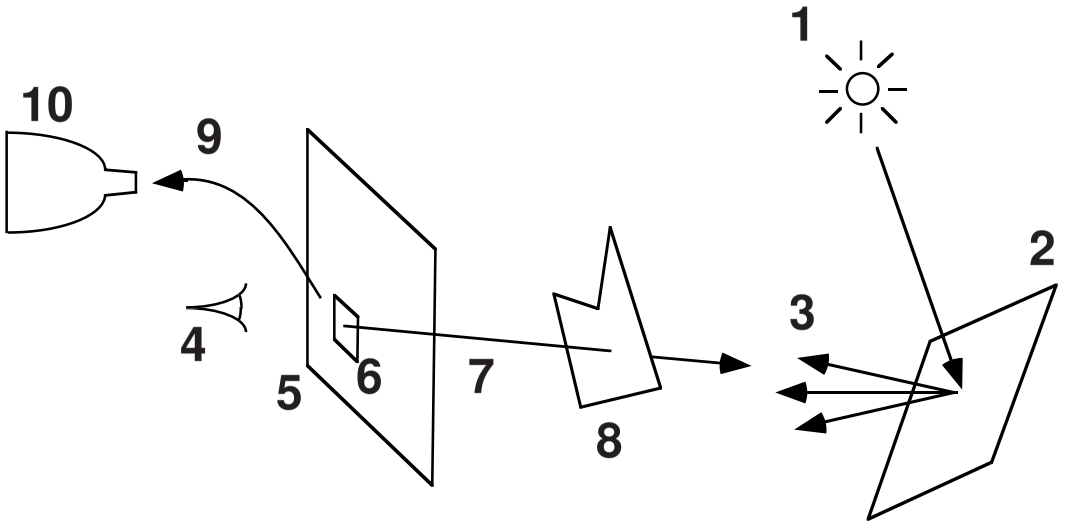
↓

display

The discrete rendering pipeline



Rendering a surface



1. light source
2. surface
3. reflection
4. observer
5. image plane
6. pixel
7. viewing ray
8. occluder
9. reproduction
10. CRT

Theoretical foundations

Interaction between light and surface

- physics
- material sciences

Drawing enough samples

- sampling theory
- statistics

Intersection of viewing rays and objects

- analytic geometry
- computational geometry

Display on CRT

- human psychophysics
- display engineering

Lectures

What is rendering?	1
Basics of ray tracing	1
Sampling theory	1
Practical antialiasing	2
Textures and texture mapping	3
Light transport and the rendering equation	1
Local illumination (i.e. reflection models)	3
Spectral representations	1
Global illumination (e.g. ray tracing, radiosity)	3
Participating media, volume rendering	1
Non-photorealistic rendering, image-based rendering	2
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Rendering engines

1st generation (1985), e.g. SGI 3000	**10,000**
• transformation and rasterization of lines	
2nd generation (1988), e.g. SGI GT	**100,000**
• lighting and shading of polygons	
• Z-buffered hidden surface removal	
3rd generation (1992), e.g. SGI RE	**1,000,000**
• antialiasing	
• texture mapping	
4th generation (1996), e.g. SGI IR	**10,000,000**
• flexible lighting, shading, texturing	
5th generation (2000?)	**100,000,000**
• physically-based reflection models	
• global illumination	