What is rendering?

Generation of a 2D image from a 3D scene

Applications

- virtual reality - a city
- invented reality - plastic molecules
- visual metaphor - 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

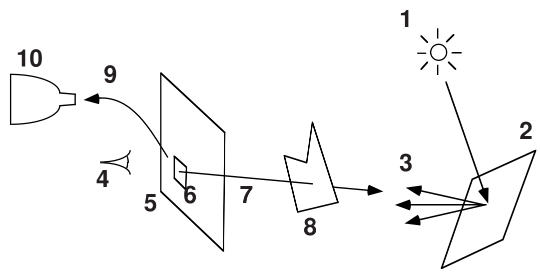
The rendering pipeline

modeling
↓
visibility
↓
shading
↓
display

The discrete rendering pipeline

modeling		modeling
↓		↓
sampling		visibility
↓		↓
visibility	- or -	**sampling**
↓		↓
shading		shading
↓		↓
display		display

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	2
Practical antialiasing	2
Texture mapping	2
Light transport and the rendering equation	1
Local illumination (i.e. reflection models)	3
Spectral representations	1
Global illumination (e.g. ray tracing, radiosity)	4
Participating media, volume rendering	1
Non-photorealistic rendering, image-based rendering	1
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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