Visual Computing

CS 211A

The Course

- Introductory Graphics, Vision and Image Processing course
- Prerequisite for Advanced Graphics and Vision courses
- Visual Computing concentration

Course Format

- Lecture Format
  - No textbooks
  - References in class website
  - Notes will be online before class
- 4 Programming Assignments
  - IP, Vision, Graphics, Final project
- 2 Midterms and Final
- Use the noteboard effectively
- Schedule is online

Grading and Office hours

- Do not worry about grades
- Learning is the priority
- Tentative Policy
  - Each Programming Assignment – 7.5%
  - Each Midterm – 15%
  - Final – 40%
- Office hours
  - Right before class on Wed

Course Motivation

- What is Visual Computing?
  - Use of computing to perform the functions of the human visual system
- Traverses within several traditional domains
  - Computer Vision
  - Computer Graphics
  - Image Processing
- Addresses converging domains

Course Organization

- Image-based visual computing
- Geometric visual computing
- Radiometric visual computing
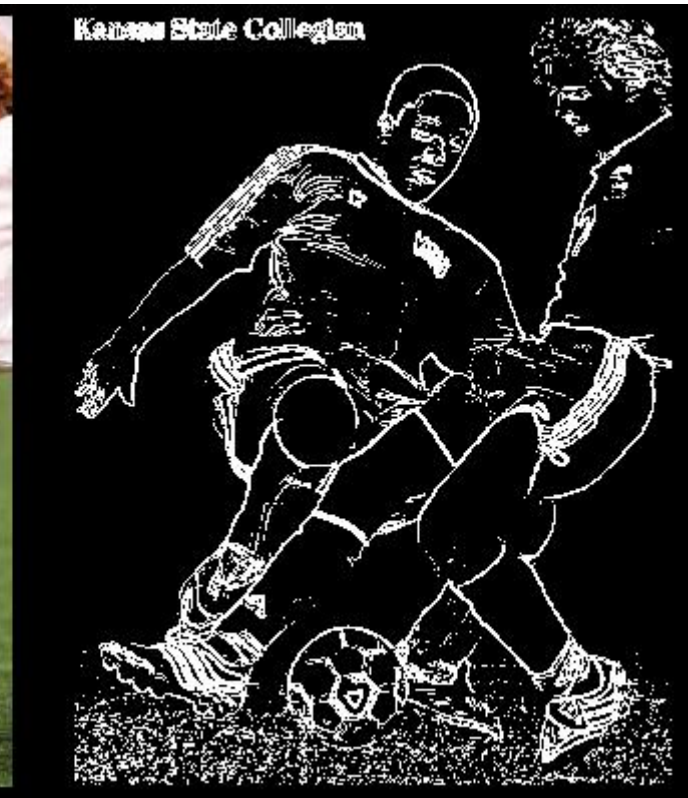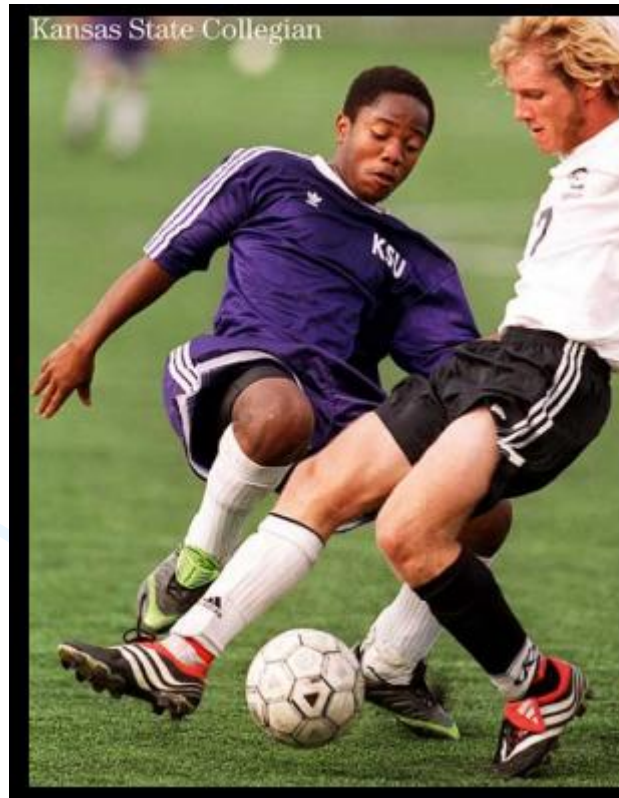- Visual content synthesis

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How do we detect features?

- Edges, corners etc
- Cells in retina and brain

How do we understand details?

- Detectors that detect different resolutions
    - Can be also called spatial frequency
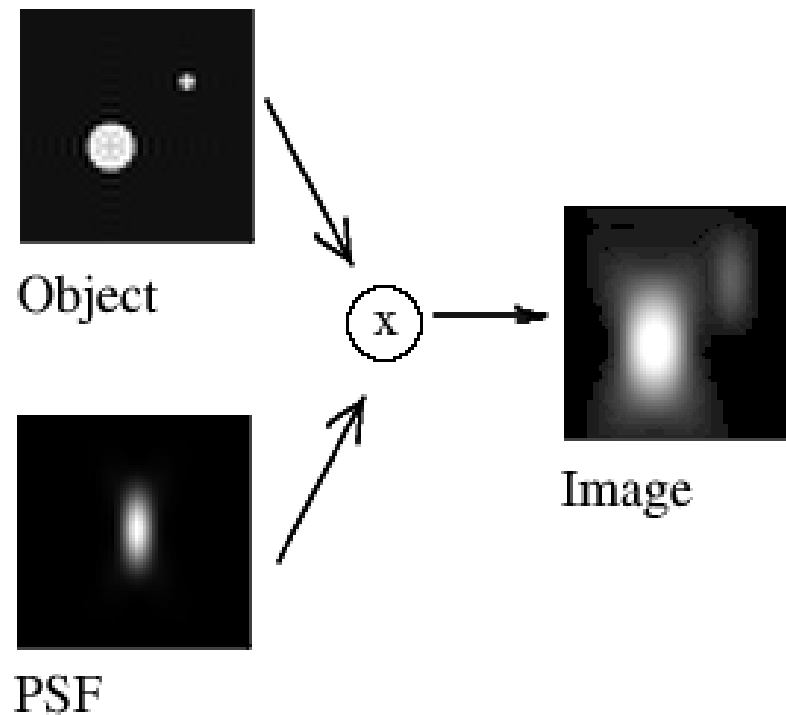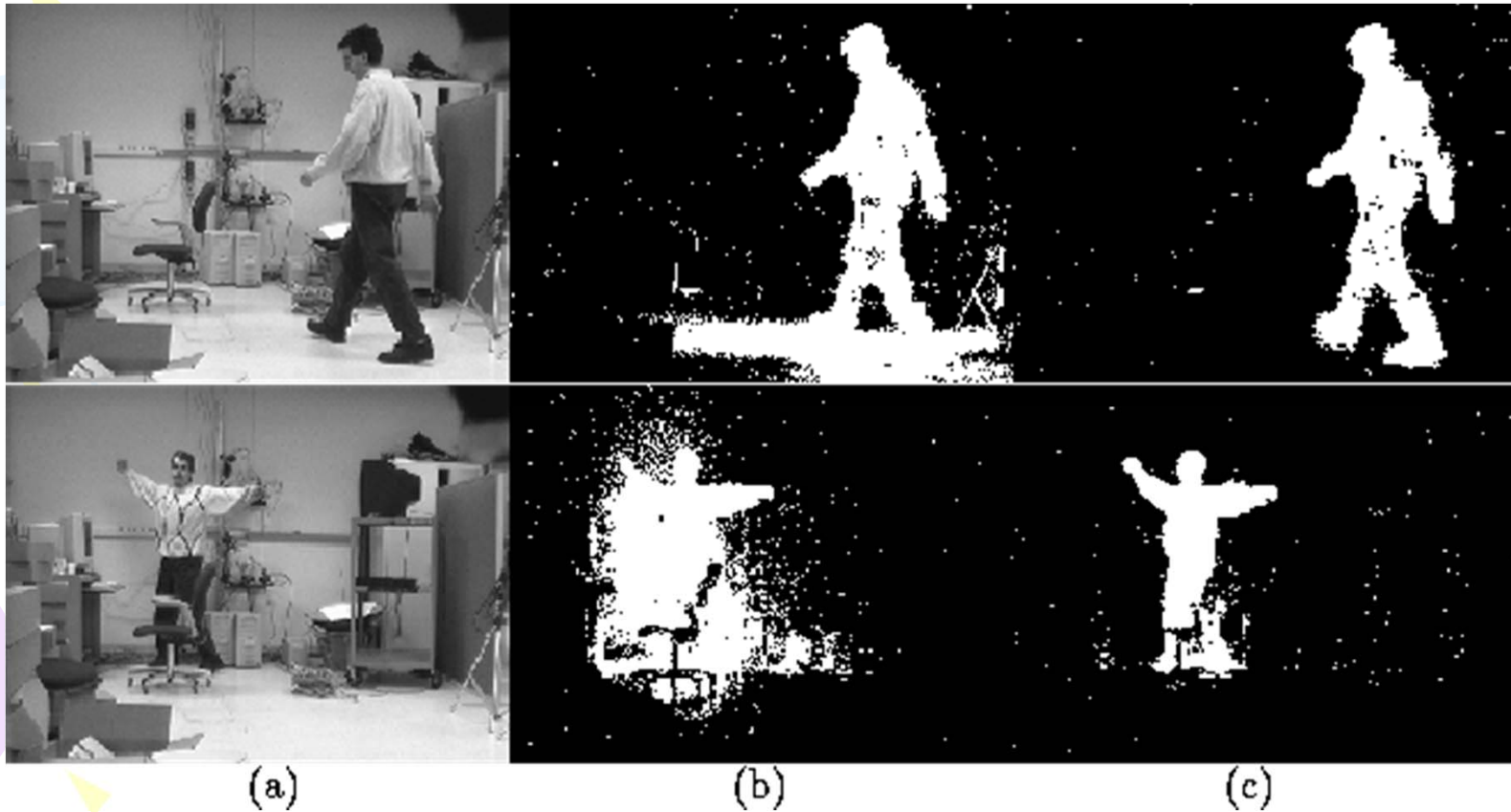

512   256   128   64   32   16   8

Convergence

- Cells that averages information from a neighborhood of receptors
- Convolution

Object

PSF

x

Image

Foreground Background

- Background subtraction

(a)　　　　　　　　(b)　　　　　　　　(c)

Image Segmentation

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How do we detect shape?

- Many cues
  - Monocular
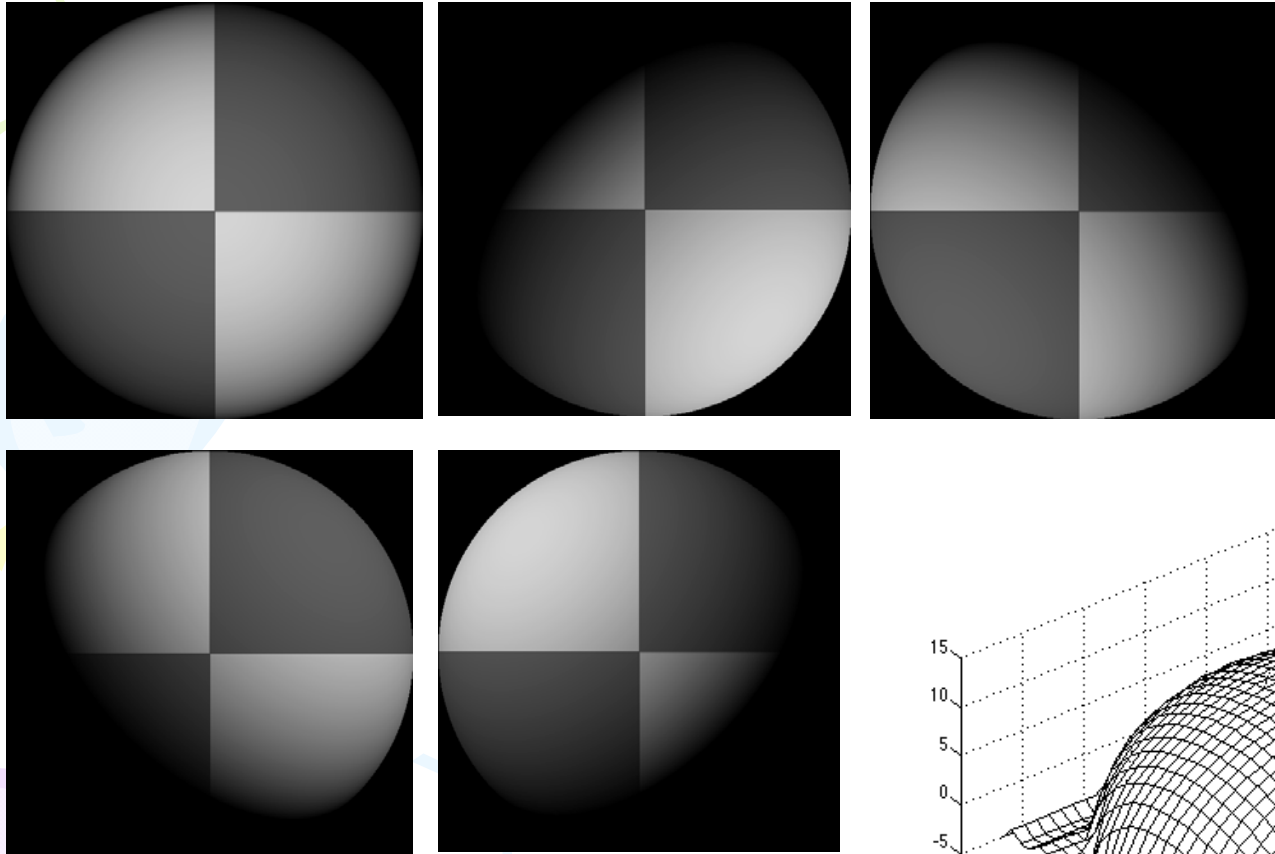 - Binocular
  - Shading
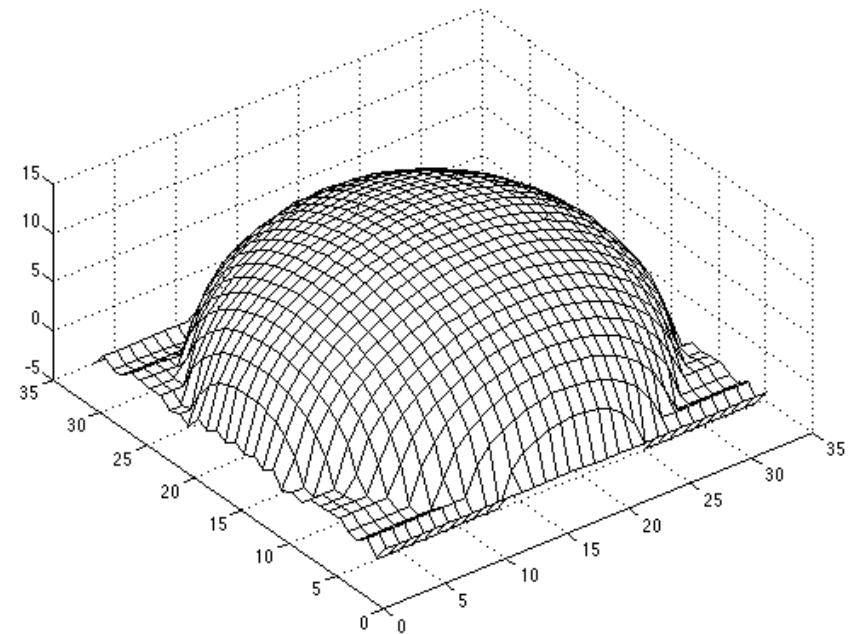 - Motion
  - Texture

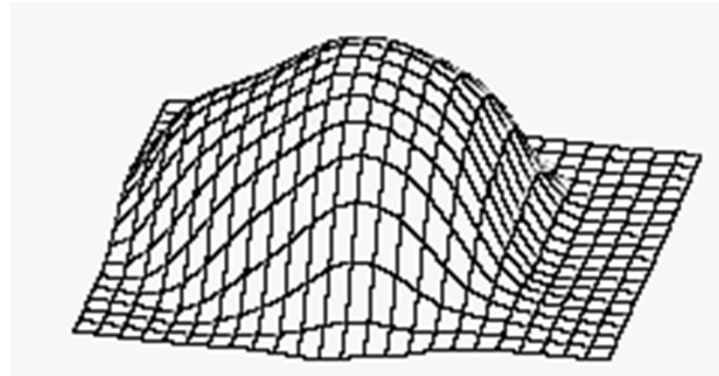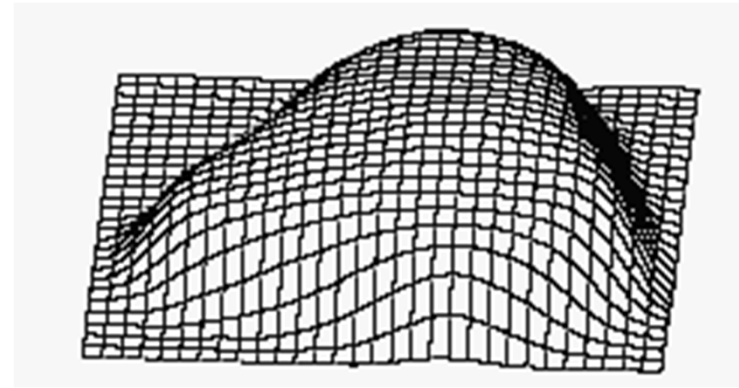# Binocular Cues

Left
Eye

Right
Eye
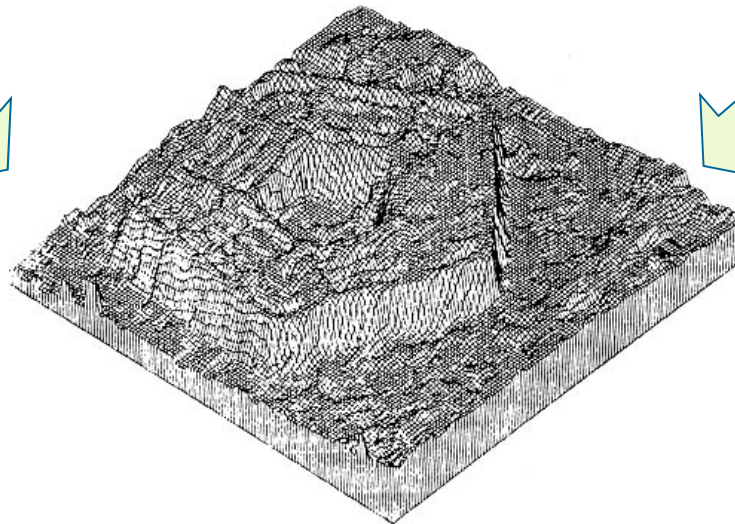
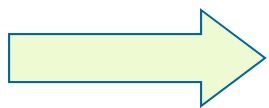# Shading Cues

Pictures with Different light Sources
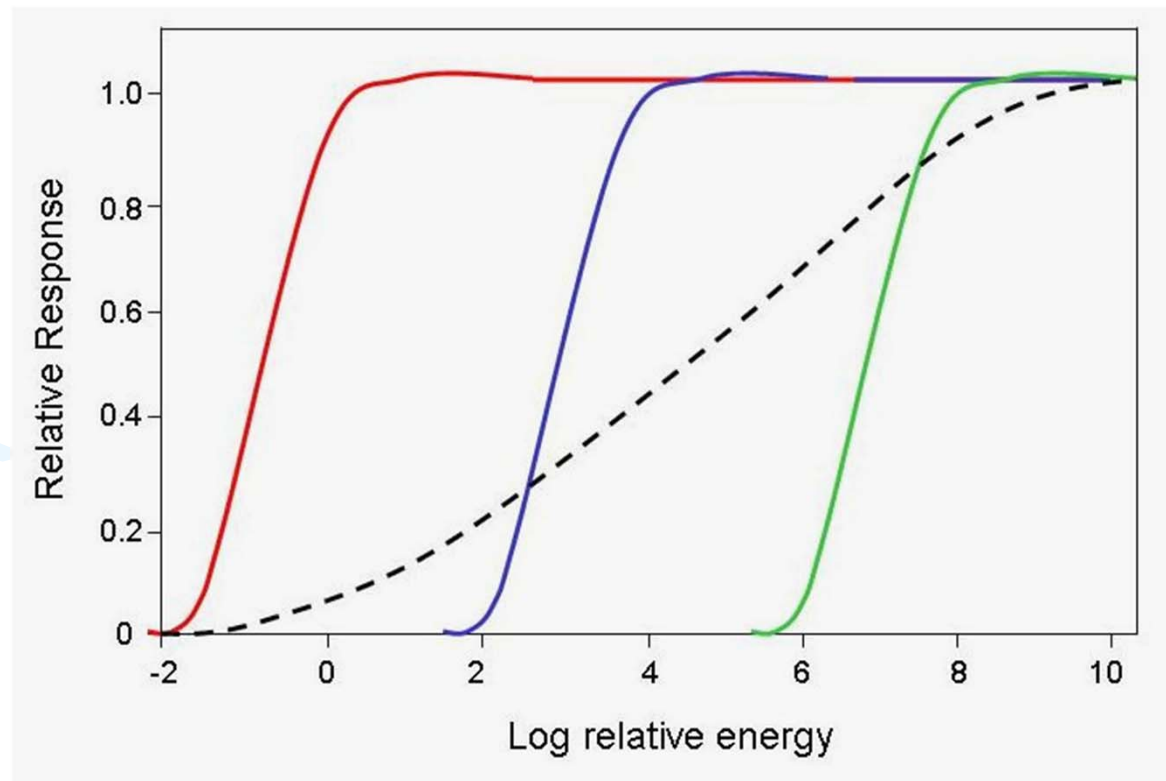
Texture Cues

Motion Cues
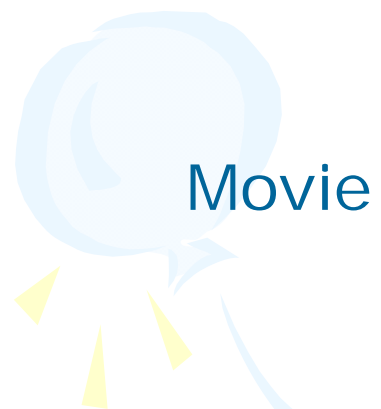
Movie →

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How do we see contrast?

- 10,000:1
- Only a small band at a time

How do we see contrast?

- High Dynamic Range Imaging

Sky oversaturated   Ground undersaturated   HDR image

How do we see reflectance?

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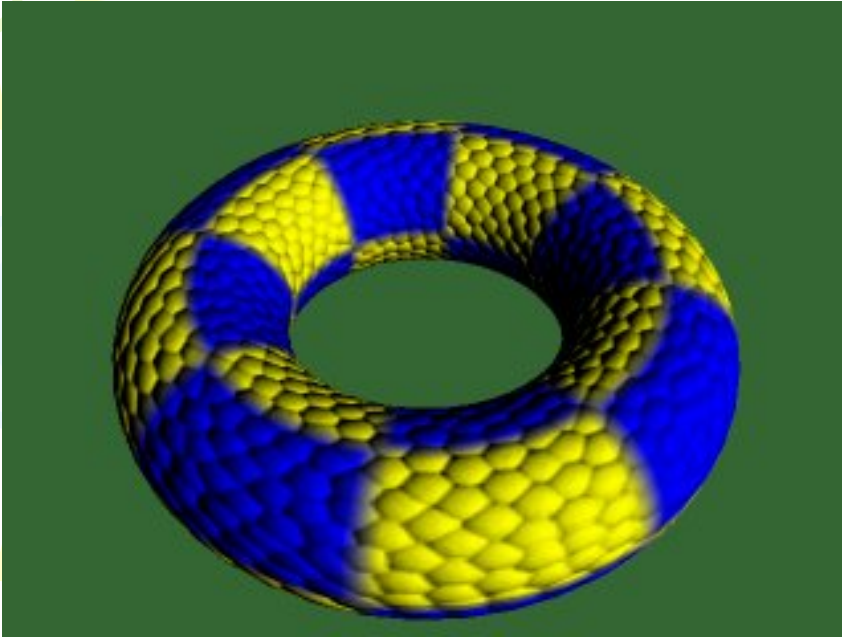
Can we reverse engineer?

- How realistic can we get?
- Can we fool the eye
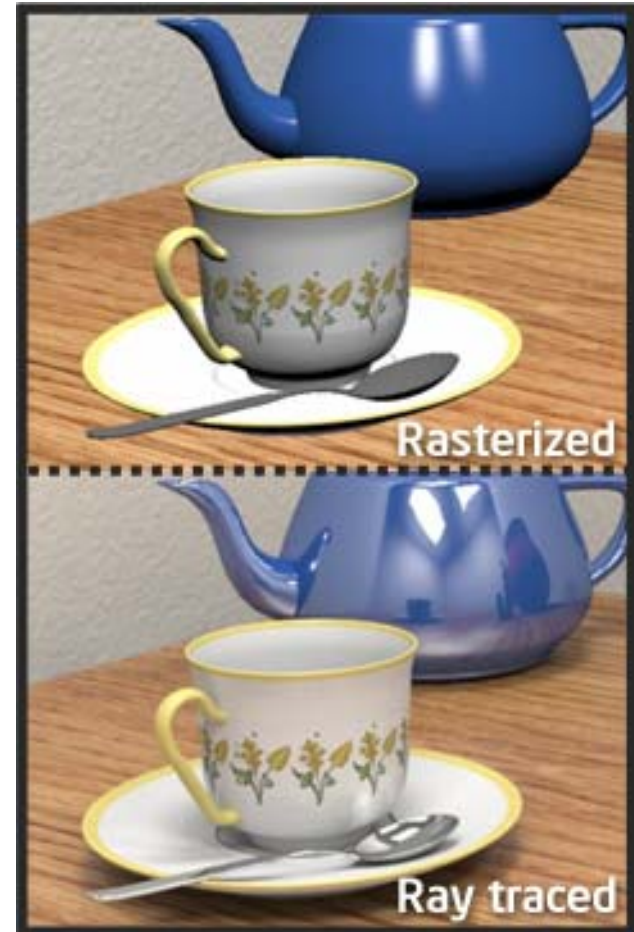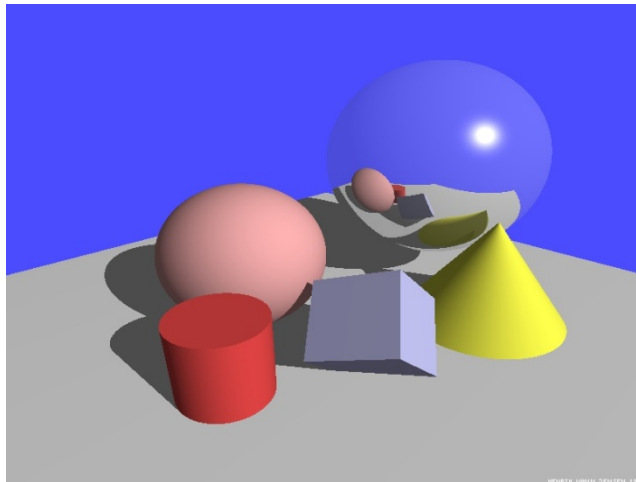 - Digital instead of real
  - E.g. Perfect storm

Effects

- Geometry
- Lighting
  - Shadows, inter-reflectance, refraction, specularities
- Material property
- Animation
- Tradeoff between speed and accuracy
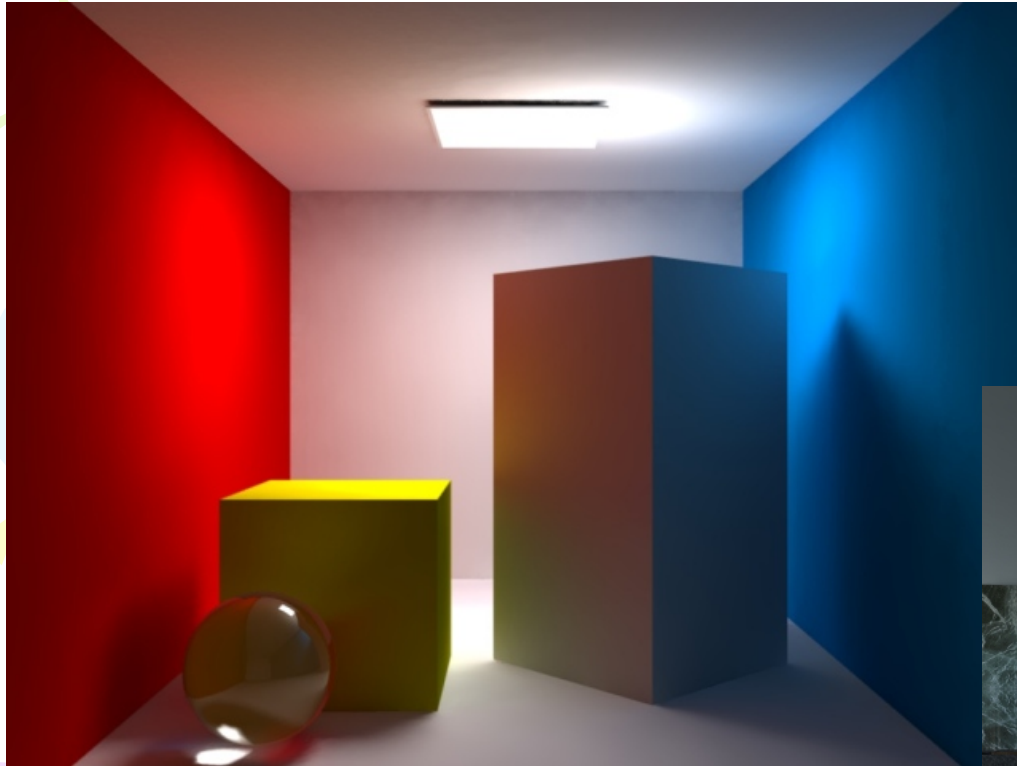 - Games (30fps) vs movies (hours per frame)

Basic

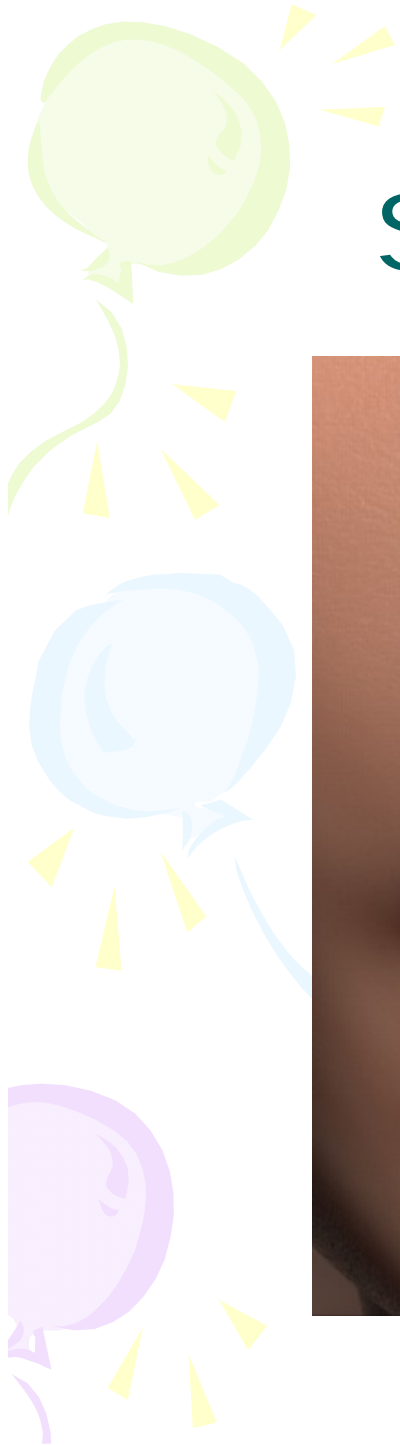- No inter-reflections, plastic like appearance

Much more time is spent

Rasterized

Ray traced

Global Illumination

RENDERED USING DALI - HENRIK WANN JENSEN 2000

Subsurface Scattering

RENDERED BY HENRIK WANN JENSEN - 2001

Transluscency

Different levels of subsurface scattering (increasing from left to right) on Venus

Can we merge real and synthetic?

Show Fiat Lux
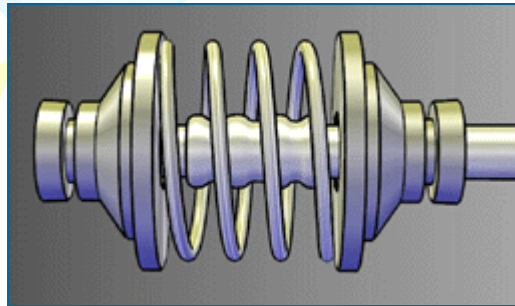
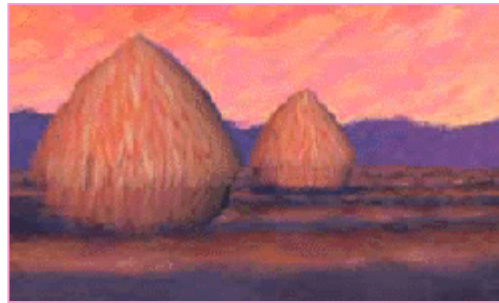# Simulation

Non Photorealistic Rendering

Photorealistic

Painterly Rendering

Illustrations

Dithering

Pen and Ink

Engraving

Fur and Grass

This class

- We will NOT learn ALL of these
- Provide you with the fundamentals so that you can learn all of these