CS 428: Fall 2009

Introduction to Computer Graphics

Realism (overview)

Topic overview

- Image formation and OpenGL

- Transformations and viewing

- Polygons and polygon meshes
  - Programmable pipelines

- **Modeling and animation**
  - **Parametric curves (and surfaces)**
  - **Procedural modeling**
  - **Traditional and procedural animation**

- Rendering

Topic overview

- Image formation and OpenGL

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- Polygons and polygon meshes
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- Modeling and animation

- **Rendering**
  - **Object space hidden surface removal, bump mapping and other texture tricks**
  - **Raytracing and radiosity**

Next few lectures…

- Visibility (a.k.a. hidden surface removal)
  - Object space algorithms: BSP trees, traversal, etc.

- Illumination and shading (recap, etc.)
  - Bump mapping, shadows, reflection, refraction, antialising, etc.

- Rendering for realism
  - Raytracing (forward, backward, distributed)
  - Radiosity (gathering, shooting)

Methods for *realism*

- Ensure properties of images of visual scenes are enforced → **many categories!**
  - Computational models of lighting + illumination (shadows, reflections, caustics)
  - Computational models of surface properties (color, texture, fuzziness, roughness)
  - Geometric representations (surfaces)
  - Behavior (simulation, motion capture)
  - Consistency of scene (global illumination)
  - Interaction (frame rate lag, etc.)

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Temporal and spatial anti-aliasing
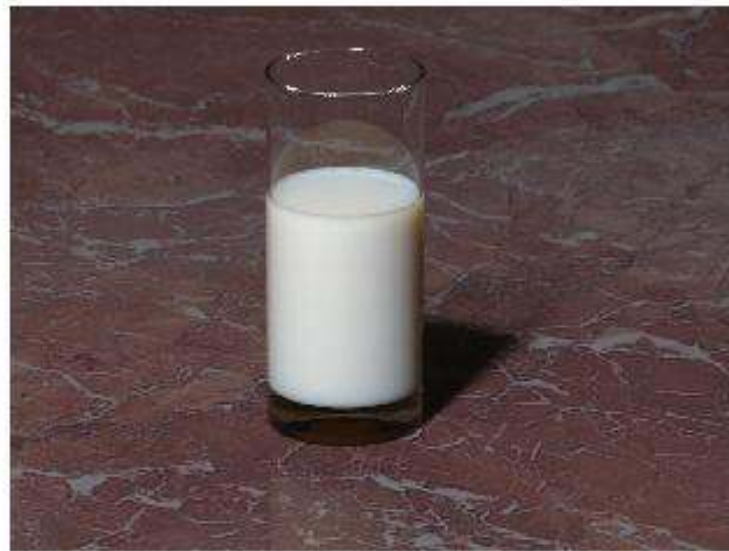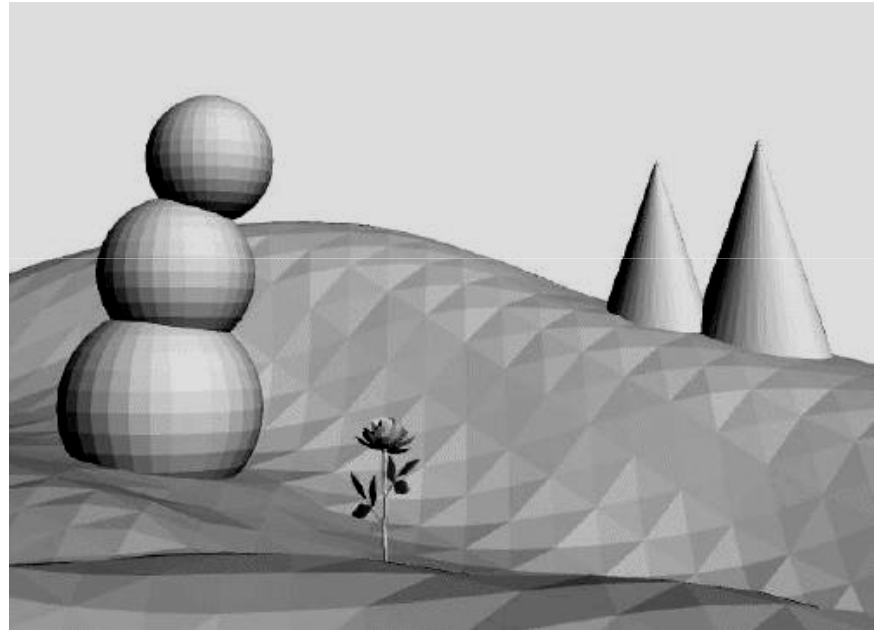
Photorealism

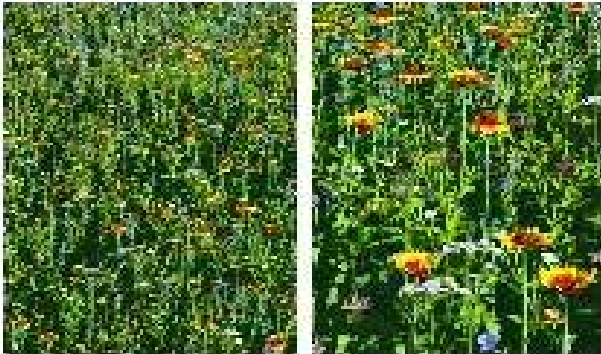# Photorealism

Photorealism

Non-photorealism

Polygons vs. Smooth surfaces

Level of detail

Level of detail

Texture mapping
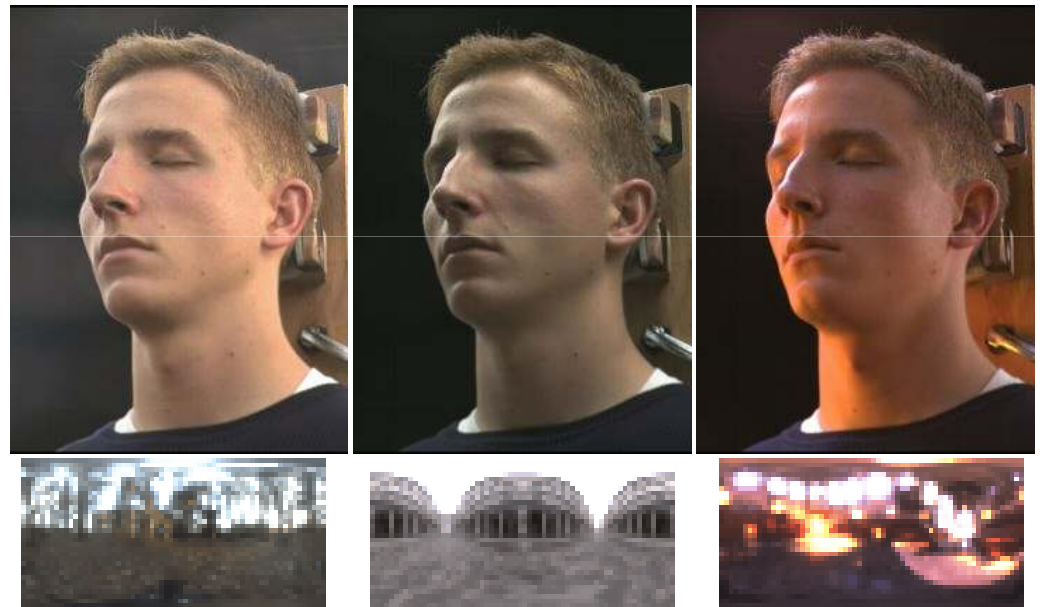
Environment mapping

Bump mapping

Image-based rendering

Motion capture

Simulation

Trade-off(s)

- **Lots** of computation to do

- Trade-off(s)
  - Quality vs. computation time
  - Quality vs. [cost, staff of artists, etc.]
  - Quality vs. [**insert some resource here**]

- **Real-time** vs. **off-line**
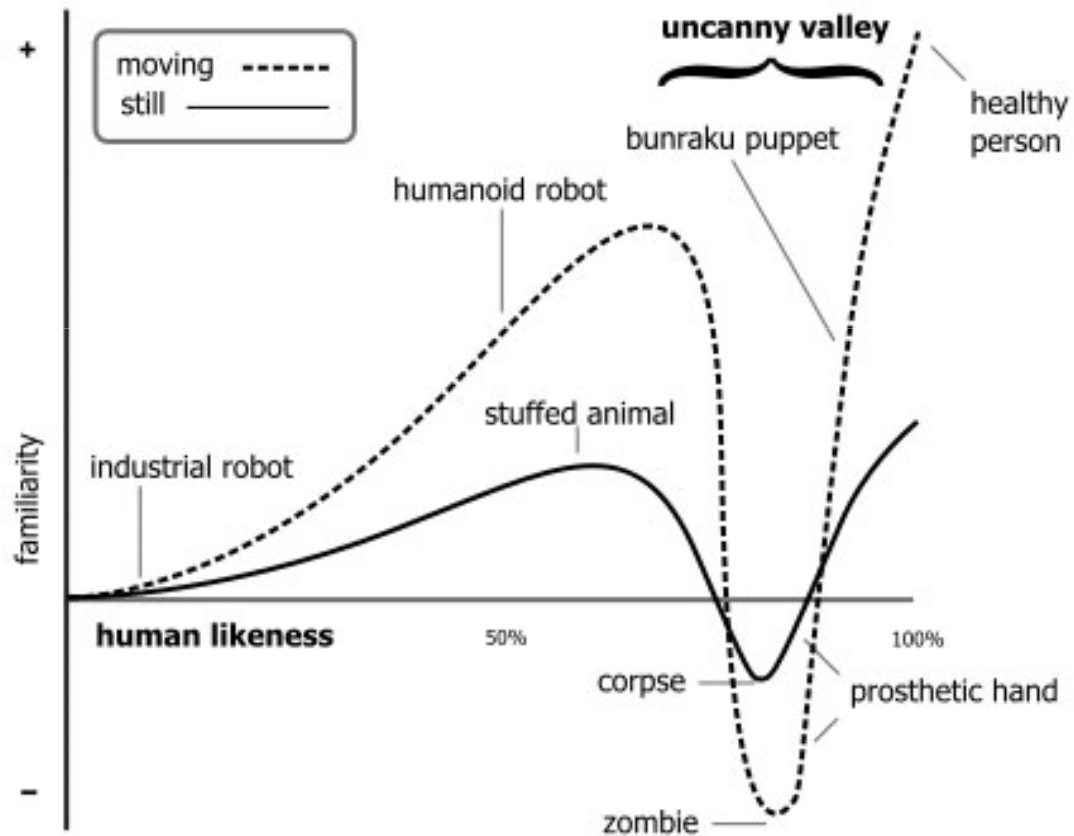
Sweet spot

- Highly application dependent
    - Special effects
    - Games
    - Virtual reality
    - Computer aided design (CAD)

- Desired effect
    - "non-photorealistic" rendering

(Extreme) visual abstraction
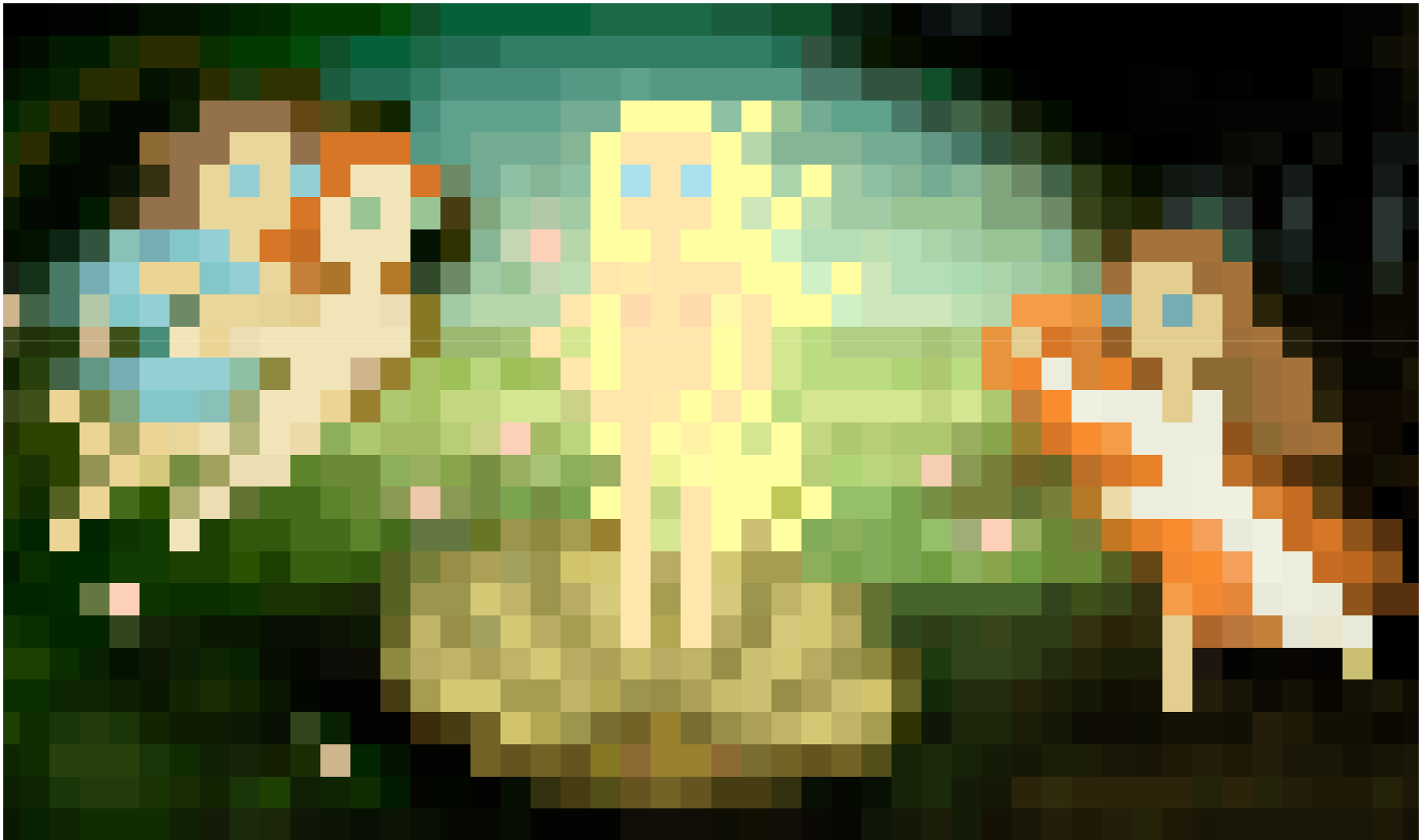
Uncanny valley

Bukimi no tani The uncanny valley. Masahiro Mori 1970

Uncanny valley
Solved?

Uncanny valley

Solved?

Uncanny valley

- Still images are continuously improving
  - Just a matter of time. **Potentially solvable.**
- Problem is exacerbated in human animation
  - Motion capture works for film.
    Infeasible for physical interaction in games.
  - Much research effort. **Potentially solvable.**

- **But what about digital interaction?**

Historical development
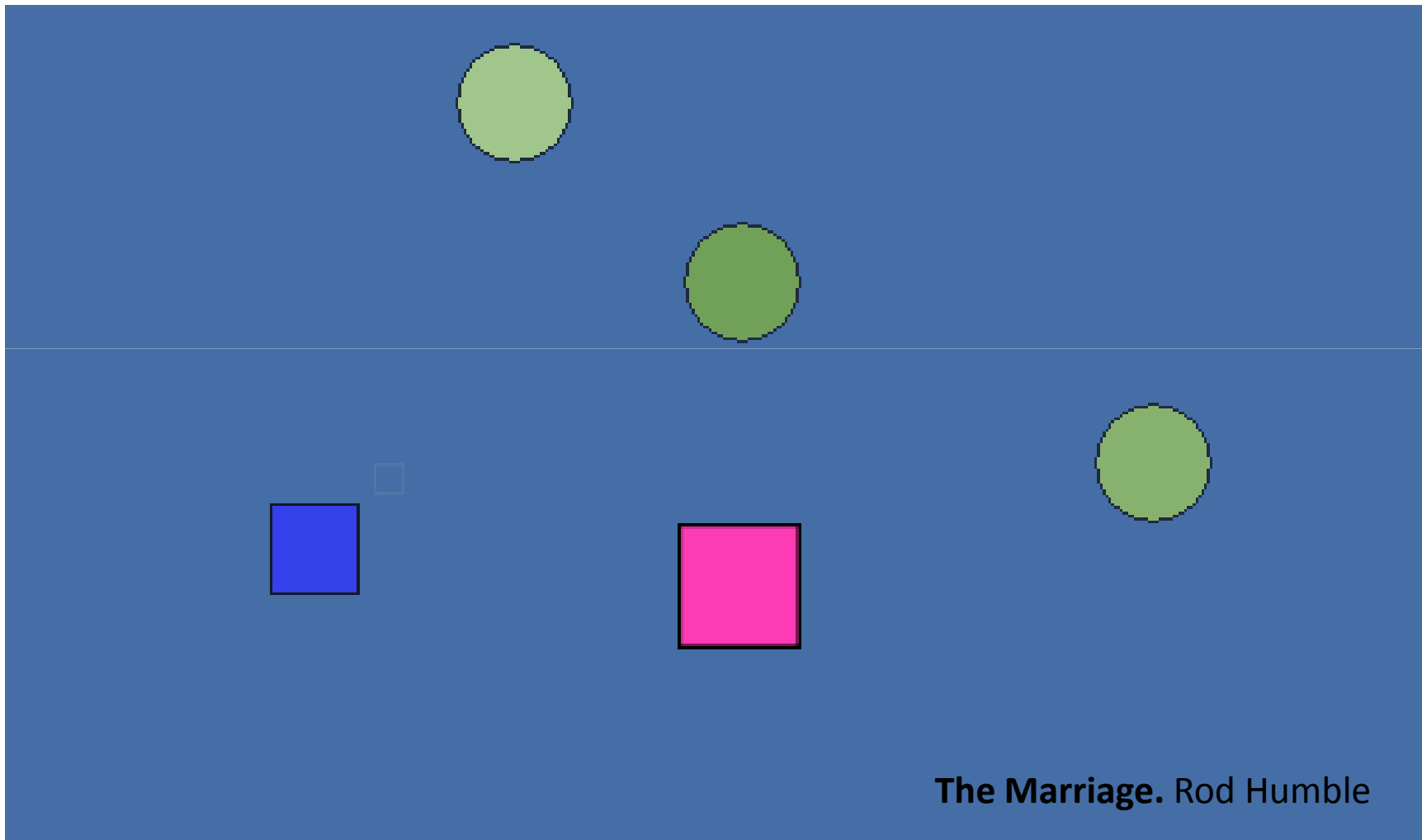

[Rendering.] **[Animation.]** **[Interaction.]**

Uncanny valley of **Interaction**

- Currently, meaningful interaction in **photorealistic environments** is quasi non-existent.

- Limited to. Destruction. Shooting. Etc.

- Notable example. **Exploration.**
  - Sense-pleasure as a goal is possible.
    Explicit interaction goals other than the most primitive kind are generally **absent.**

- Other Direct interactions ?
  Indirect interactions/simulations ?

Visual interaction Abstraction

The Marriage. Rod Humble

Simulated Reality Abstraction

Gravitation. Jason Rohrer

Realism

- What is **real** lies in the eye of the beholder
- In order of increasing difficulty to ***get right***
  - Still images
  - Animations
  - Interactions

- No **fixed rules**
  - It's all simulated anyway, and the sky is the limit