

Perception of Visual Realism



With material from Jim Ferwerda and Patrick Cavanagh

This is not a pipe



Rene Magritte (1928): "The treason of images"

This is not a pipe either



SuAnne Fu (1999): "The treason of image synthesis"

Three Varieties of Realism

Physical Realism – image provides the same visual stimulation as the scene

Photo-realism -- image produces the same visual response as the scene

Functional Realism – image provides the same visual information as the scene

Physical Realism



same visual stimulation

Measure the light



Radiometric comparison

simulated



measured



difference

Benefits of physical realism

- images can be physically accurate representations
- can be used quantitatively for simulation and analysis
 - illumination engineering
 - manufacturing
 - remote sensing

Limitations

- physically-based rendering is computationally expensive
- typically overkill if the goal is to make visual images
- doesn't take advantage the limits/abilities of vision
- most images can't be displayed accurately

“fool you” realism

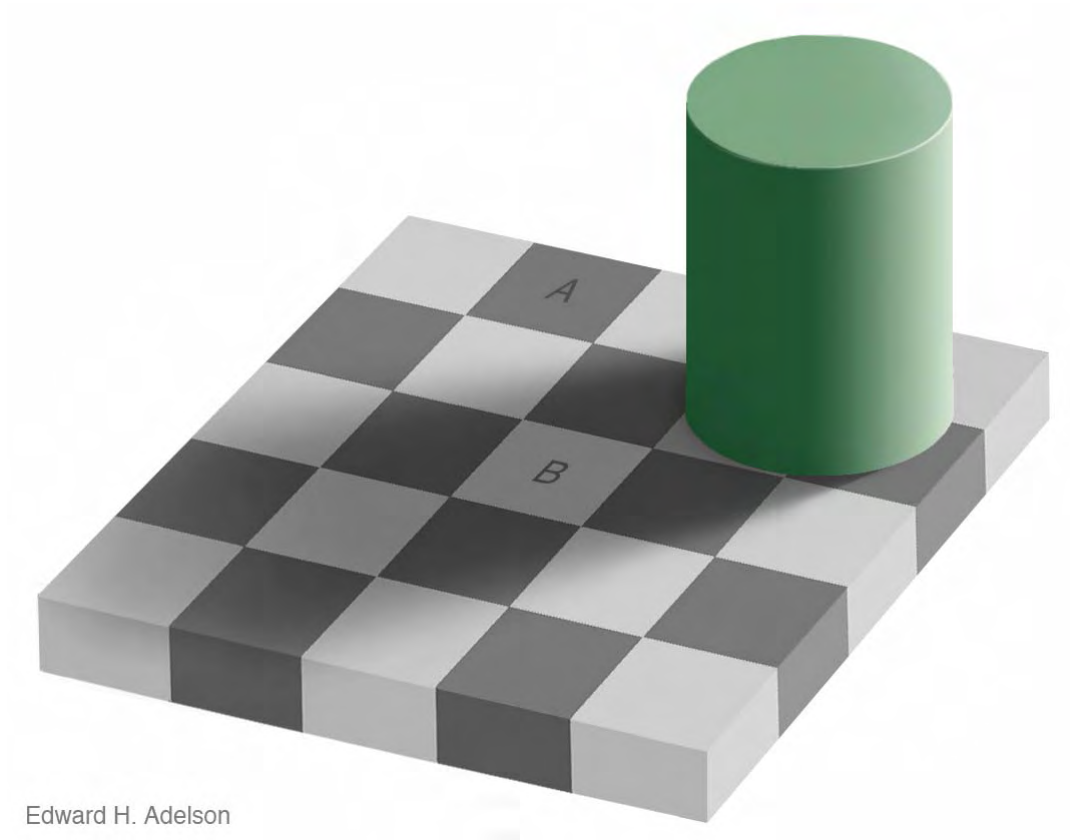


J. Beever

Photo-realism

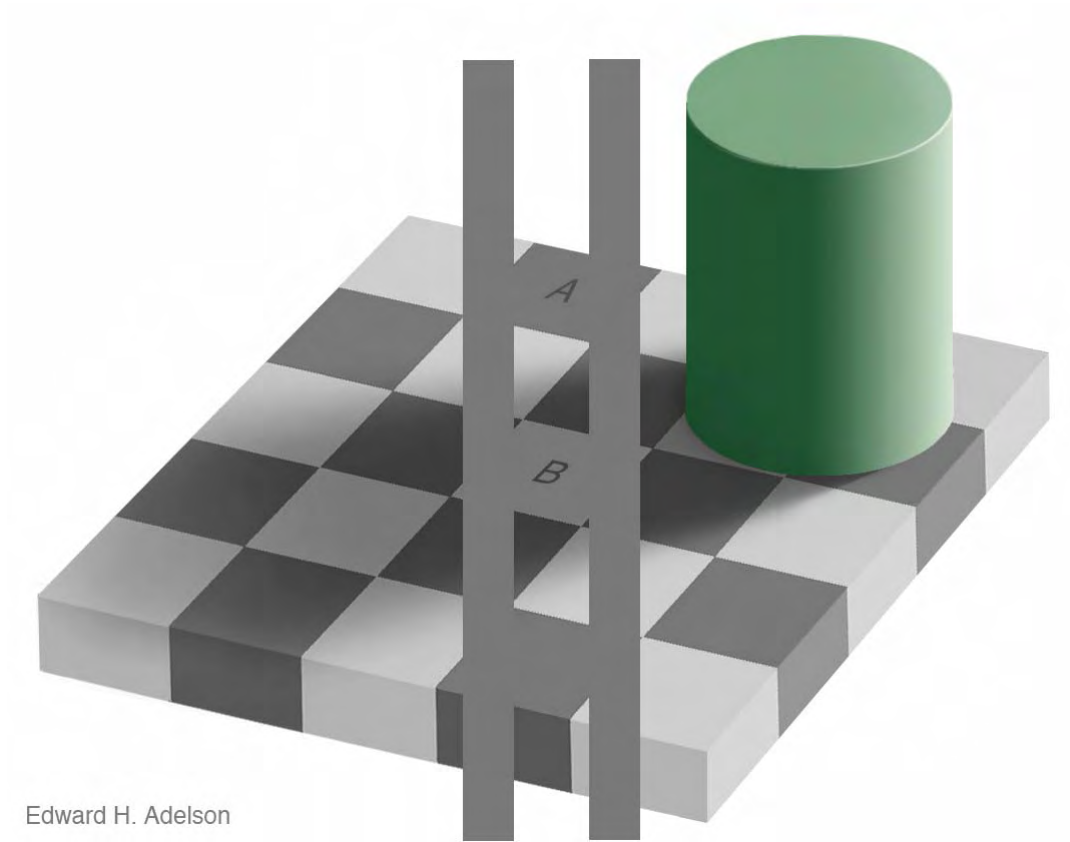
- def: image is visually indistinguishable from a photograph of the scene
- what makes a photograph realistic?
- image produces the same visual response as the scene

Brightness: Measurement vs. Perception



Edward H. Adelson

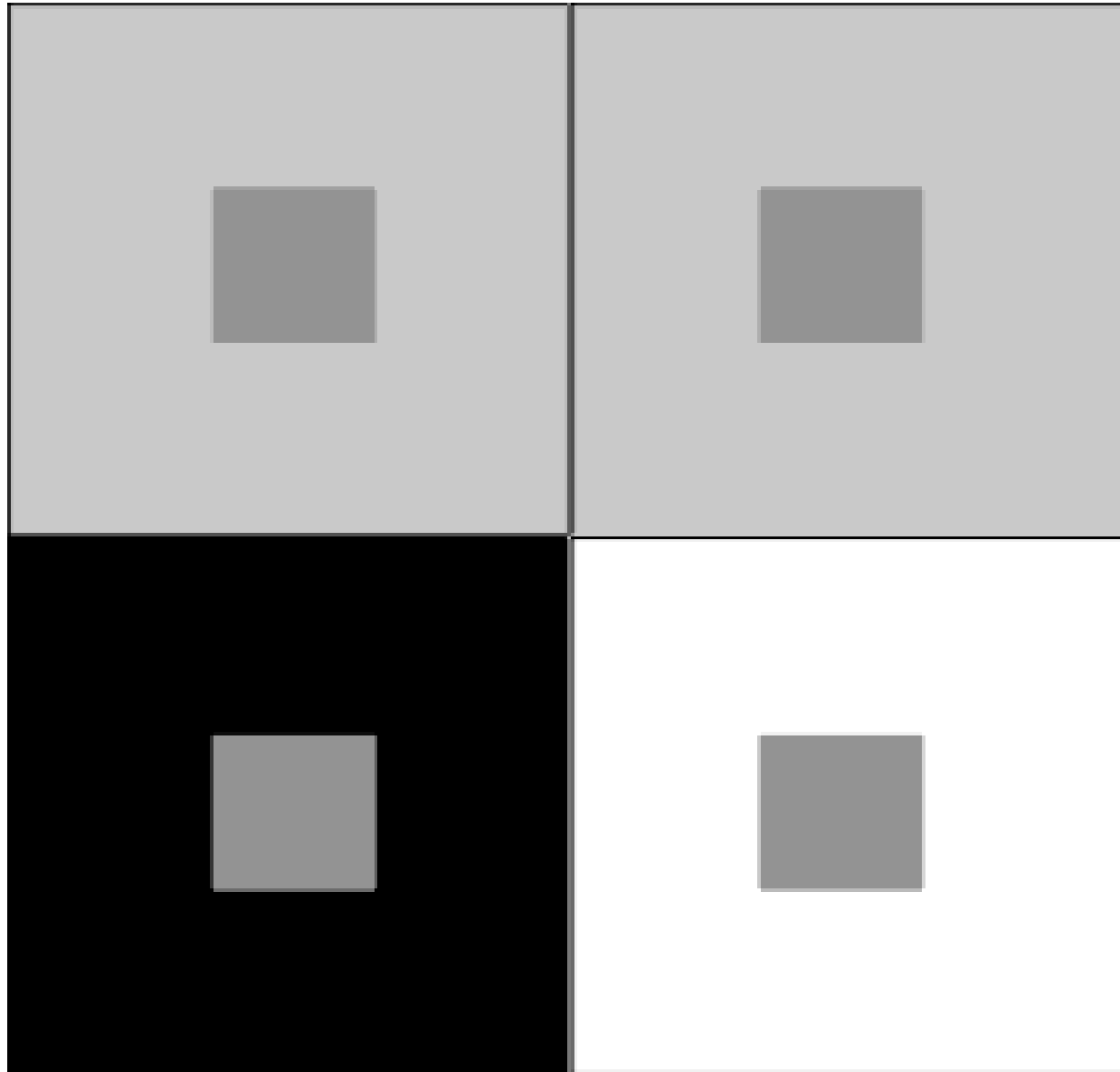
Brightness: Measurement vs. Perception



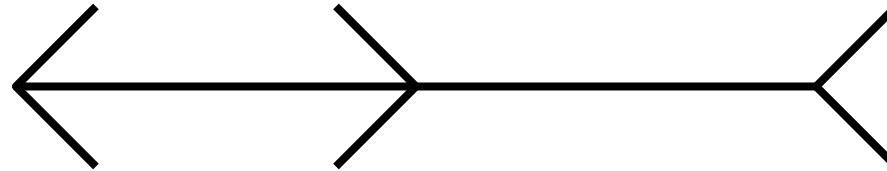
Edward H. Adelson

Proof!

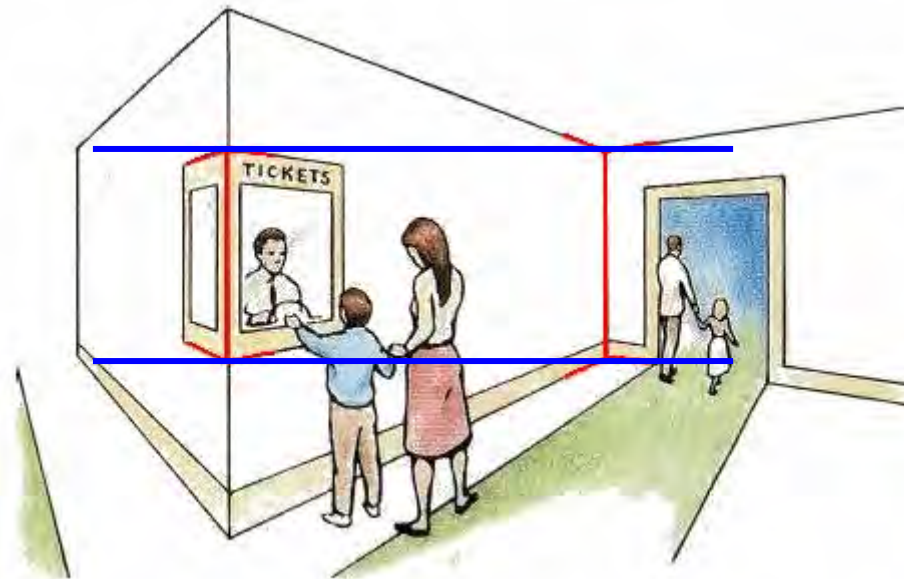
Simultaneous contrast



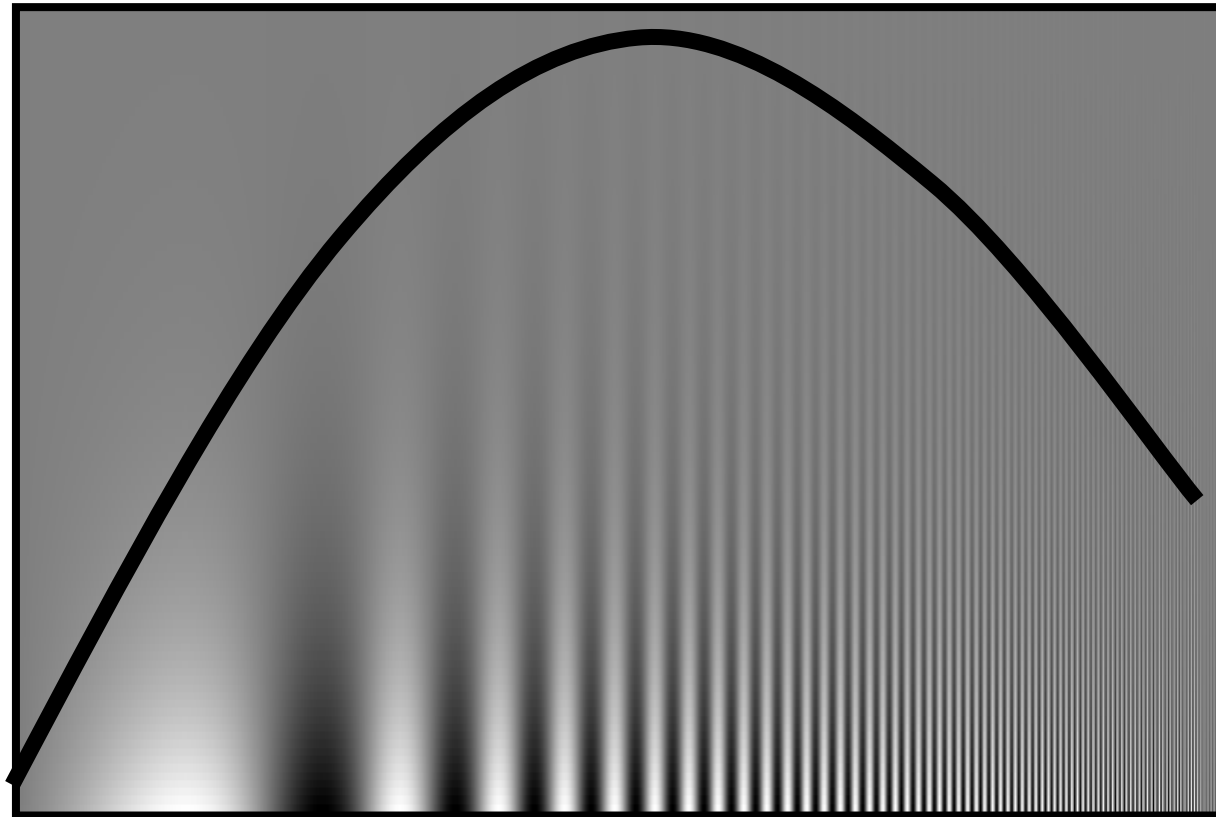
Lengths: Measurement vs. Perception



Müller-Lyer Illusion



Campbell-Robson contrast sensitivity curve



Depends on Color



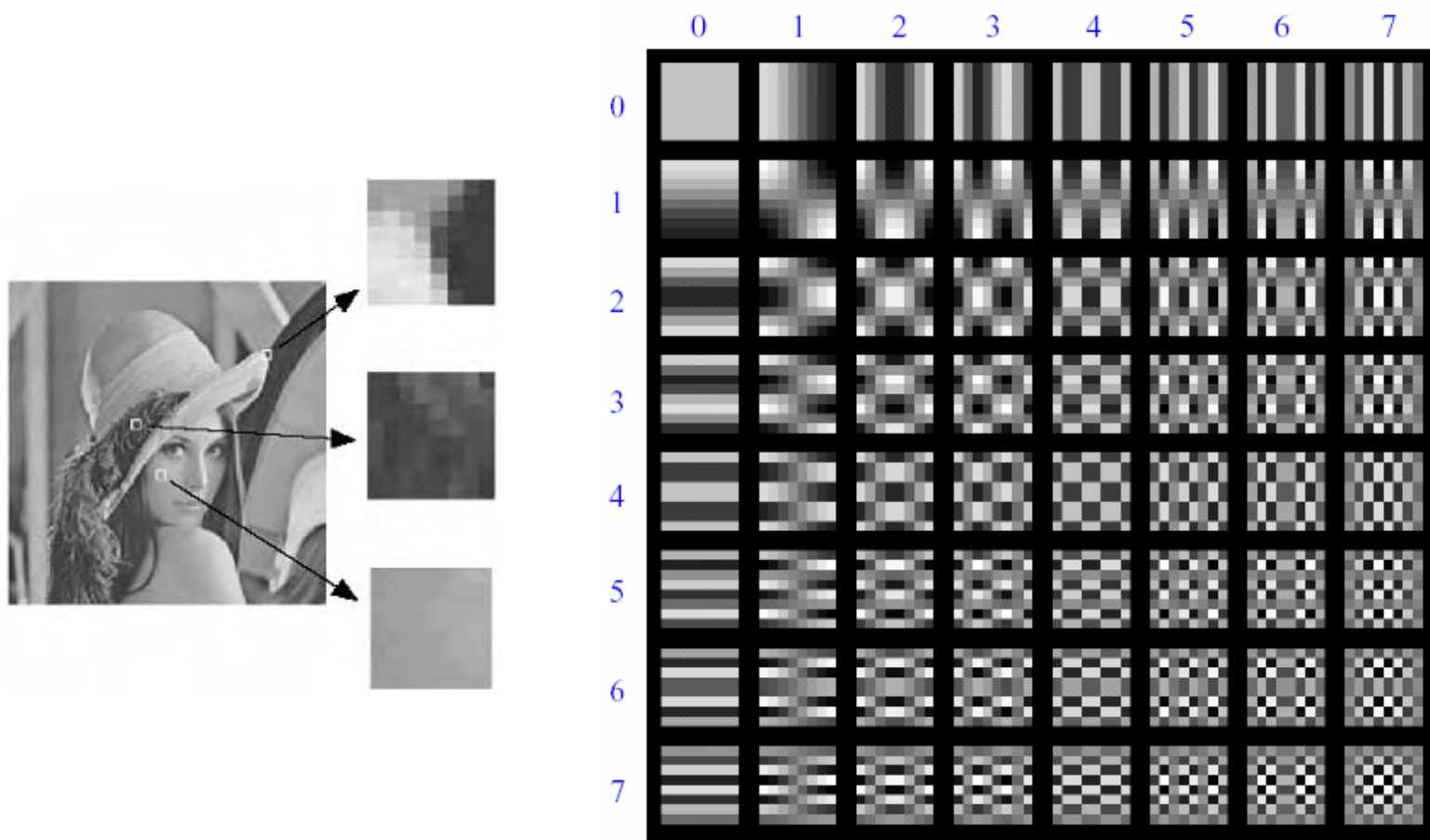
R

G

B



Lossy Image Compression (JPEG)



Block-based Discrete Cosine Transform (DCT)

Using DCT in JPEG

A variant of discrete Fourier transform

- Real numbers
- Fast implementation

Block size

- small block
 - faster
 - correlation exists between neighboring pixels
- large block
 - better compression in smooth regions

Using DCT in JPEG

The first coefficient $B(0,0)$ is the DC component, the average intensity

The top-left coeffs represent low frequencies, the bottom right – high frequencies

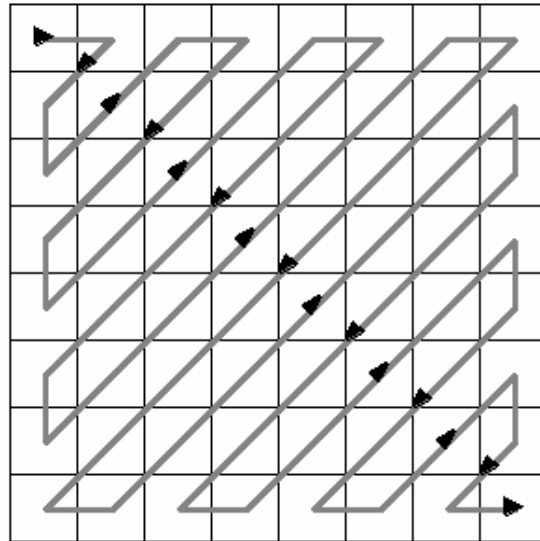


Image compression using DCT

DCT enables image compression by concentrating most image information in the low frequencies

Loose unimportant image info (high frequencies) by cutting $B(u,v)$ at bottom right

The decoder computes the inverse DCT – IDCT

•Quantization Table

3	5	7	9	11	13	15	17
5	7	9	11	13	15	17	19
7	9	11	13	15	17	19	21
9	11	13	15	17	19	21	23
11	13	15	17	19	21	23	25
13	15	17	19	21	23	25	27
15	17	19	21	23	25	27	29
17	19	21	23	25	27	29	31

JPEG compression comparison



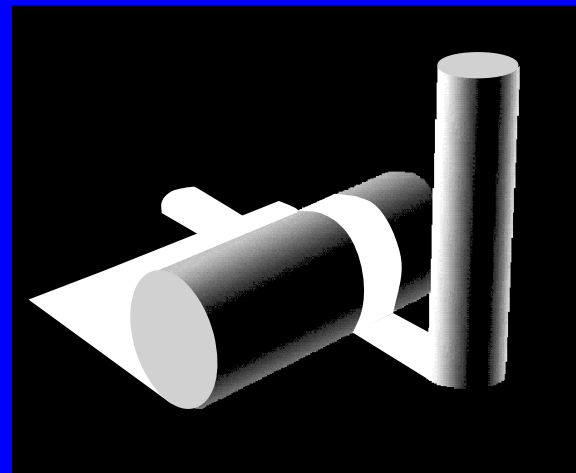
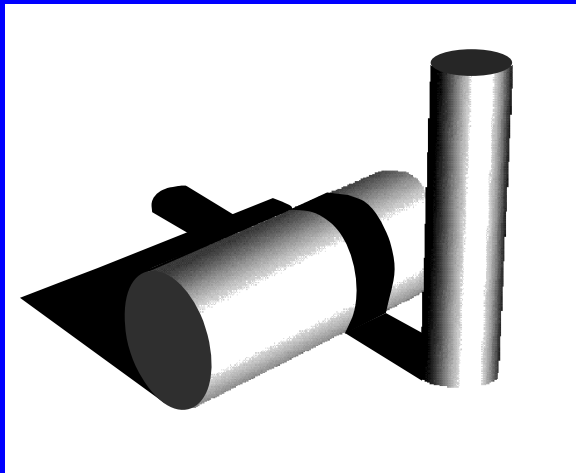
89k



12k

Shadows

- Have to be darker than surround
- Do not have to have right shape or color
- Consistent illumination not required



Weird Shadows (300 CE)



Renaissance 1400-1450



Good perspective



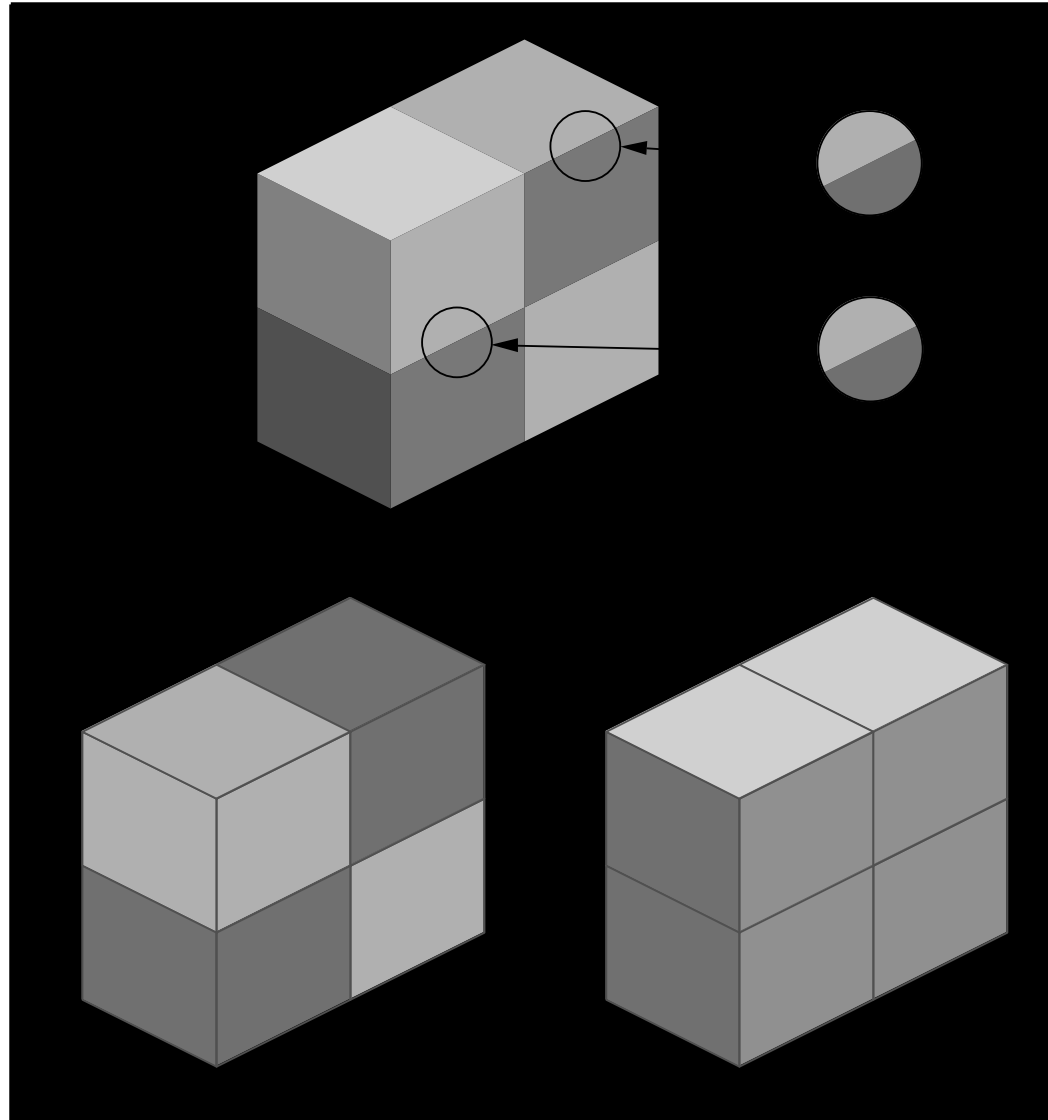
But lots of lighting errors



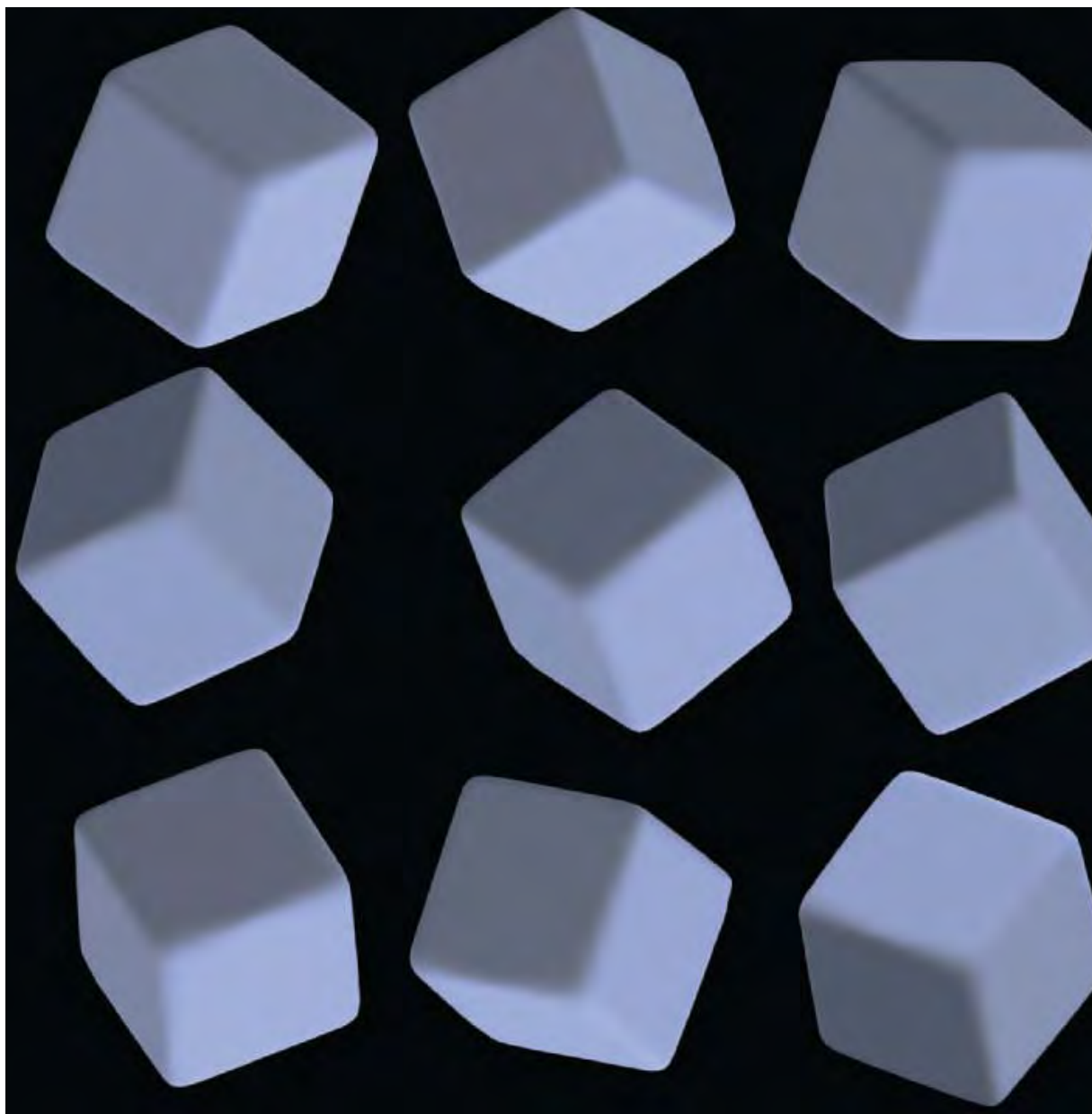
Shadows give depth cues

Kersten movies

Importance of Geometry



Shading – no pop-out



Reflections

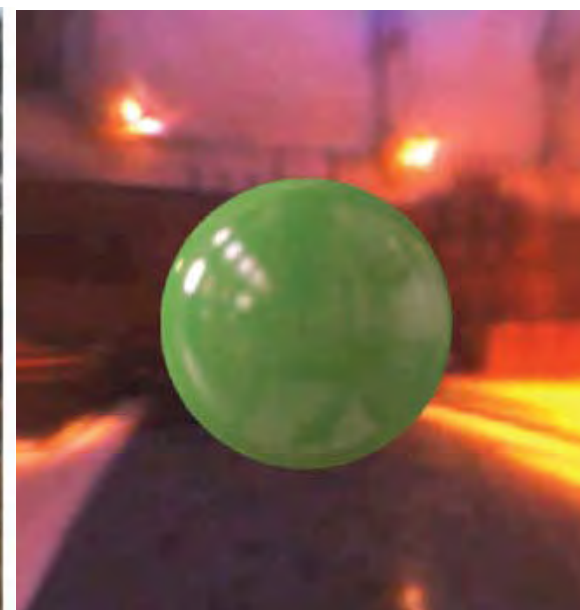
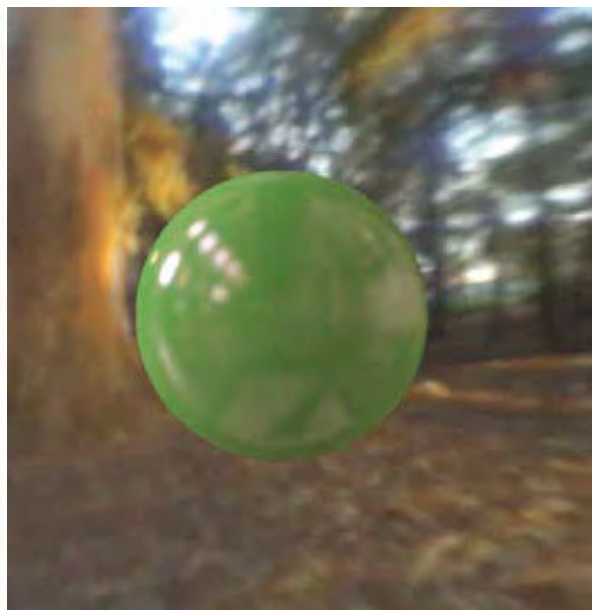


THE ROKEBY VENUS BY VELASQUEZ





Environment maps



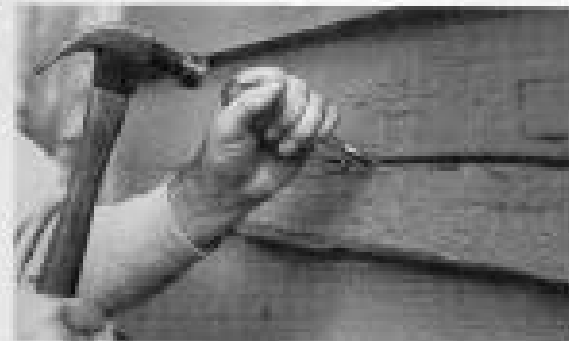
Functional Realism



How to replace clapboard

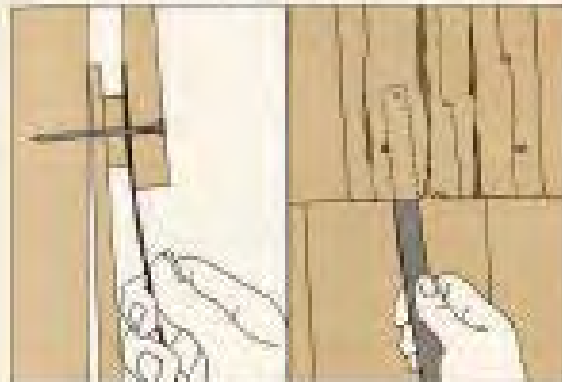


Cut out damaged section with hand saw. Avoid damaging the good board below by using point of saw for final cut.

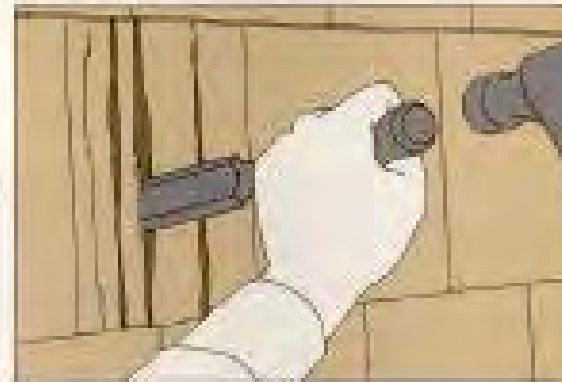


Use sharp chisel and hammer to remove chunks of the cut board. Be careful not to cut the building paper or felt paper below.

Replacing wood shingles

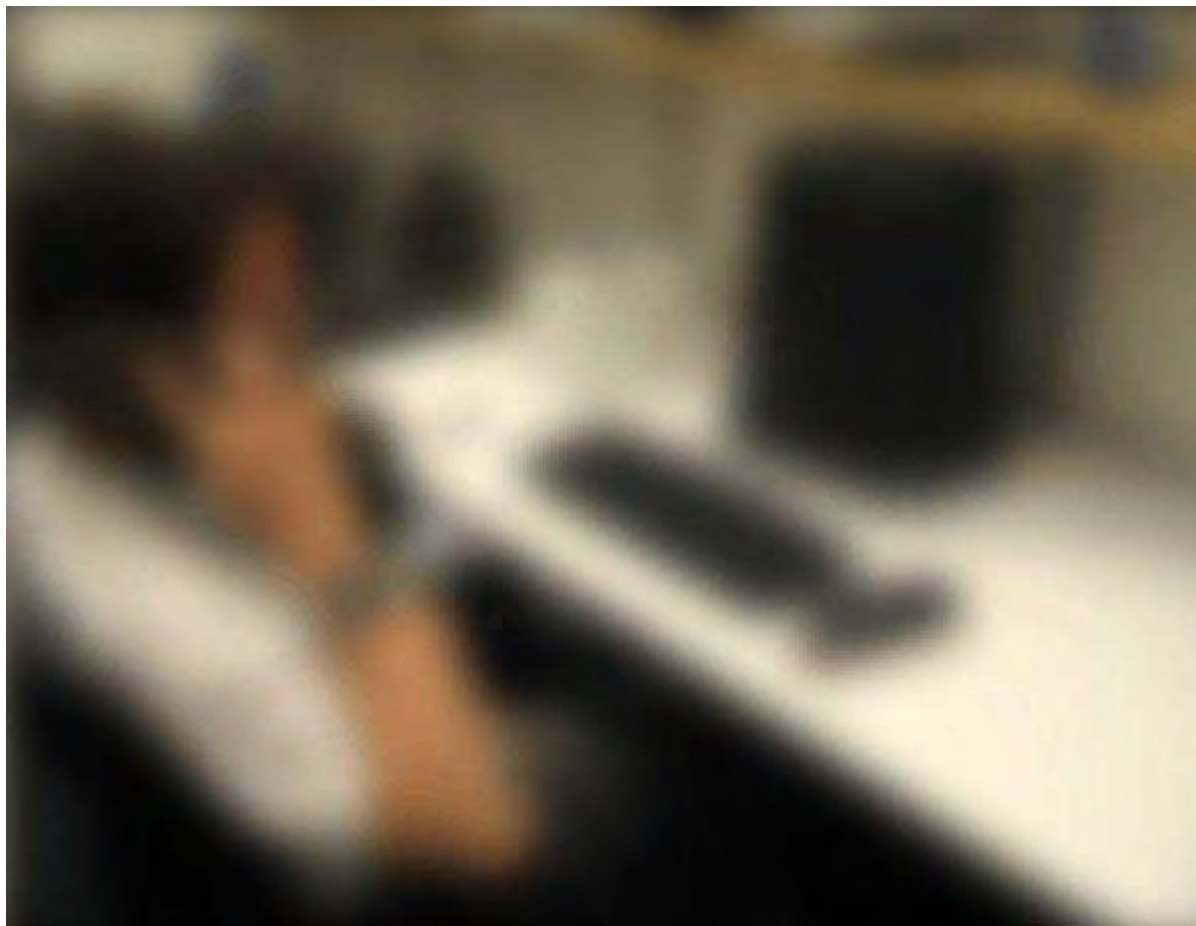


Put a prybar blade under the bottom of the good shingle and cut the nails that hold the top of the damaged shingle. As the pry bar is cut back at bottom of the damaged shingle.



To remove the damaged shingle, it is necessary that to soften it. Then remove nails or pry out nails with a claw hammer or with prybar.

Rob Fergus working (Torralba, 2006)





Change Blindness

Visual Neglect















