CS130 : Computer Graphics

Lecture 10: Texture Mapping (cont.)

Tamar Shinar
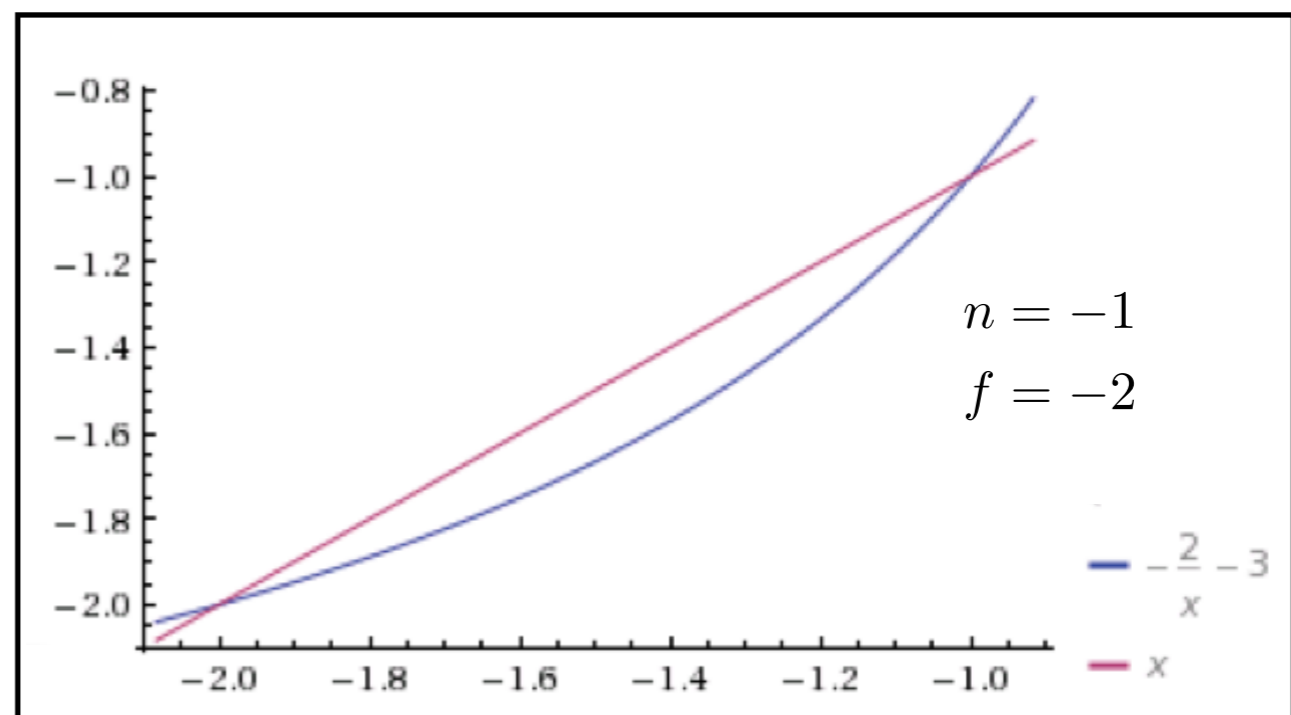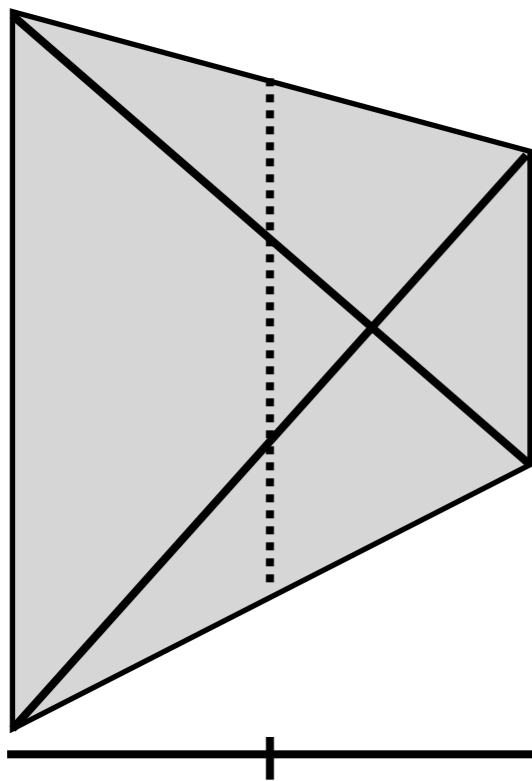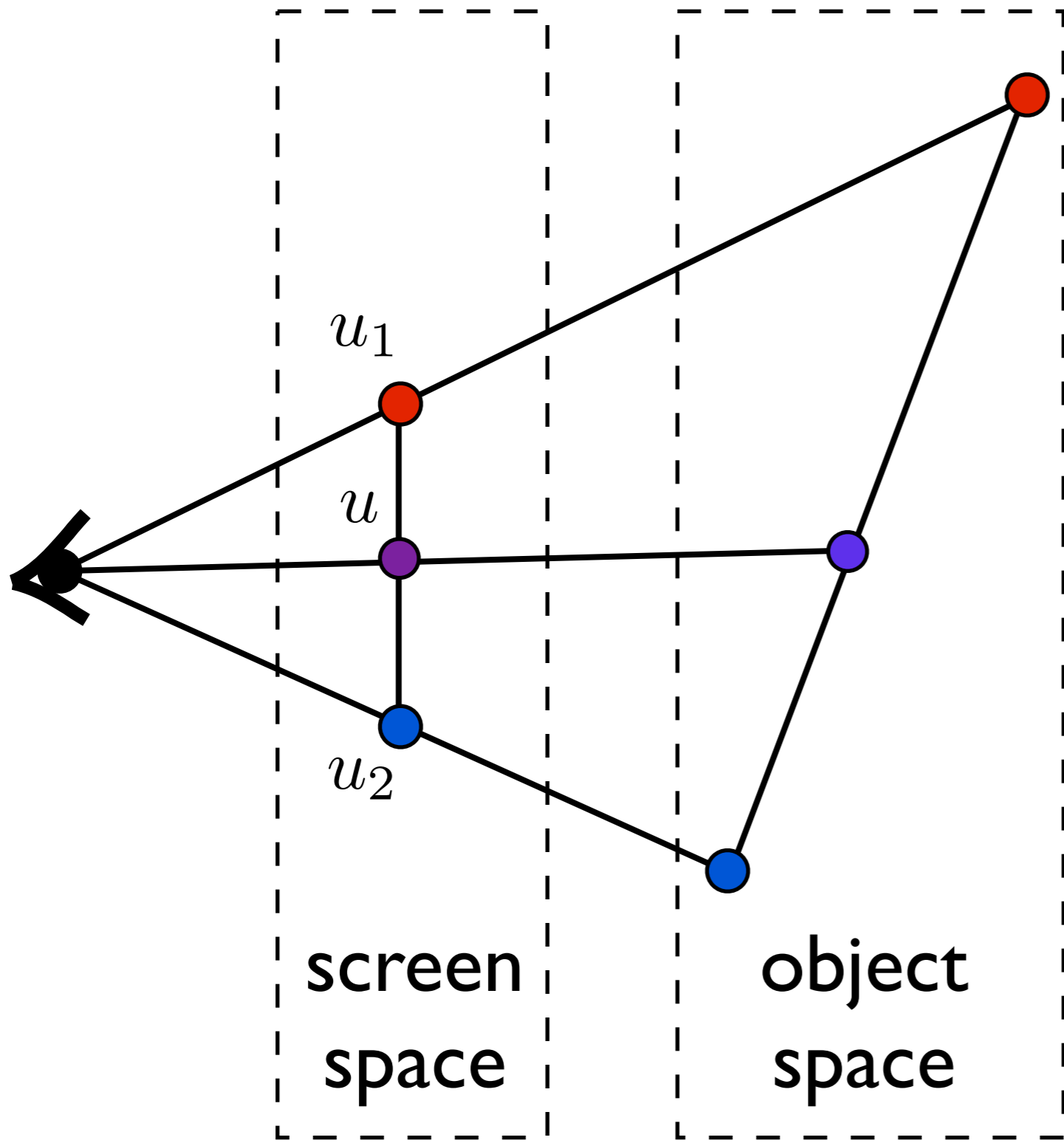
Computer Science & Engineering

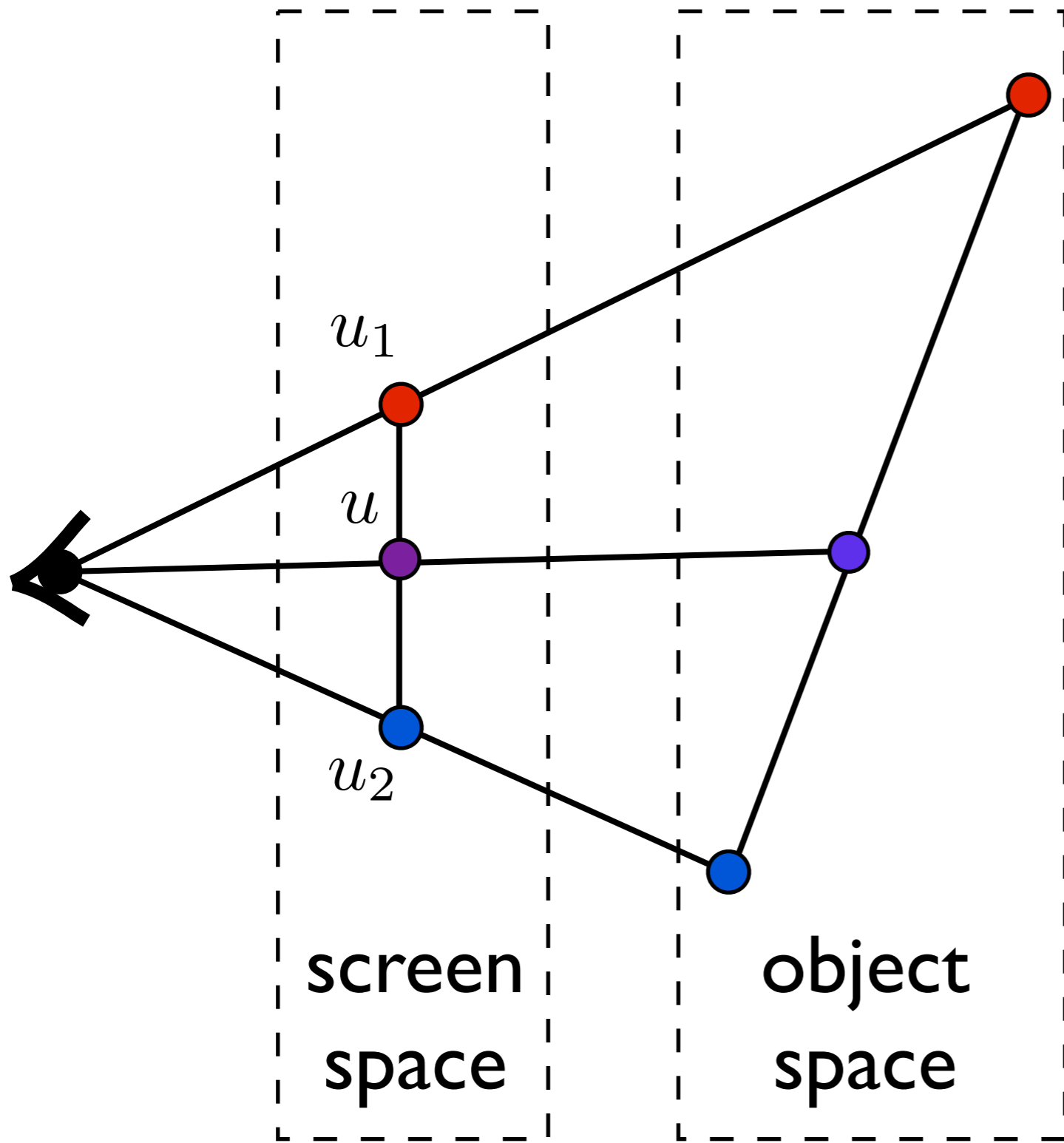UC Riverside

Perspective correct interpolation

Perspective correct interpolation

- In assignment 1, we found barycentric coordinates in 2D screen space

  - but not the correct object space barycentric coords

 - these coordinates were okay for z-buffer test

$n = -1$
$f = -2$

$-\dfrac{2}{x} - 3$

x

u_1

u

u_2

screen space

object space

$$u = \frac{1}{2}u_1 + \frac{1}{2}u_2$$

u_1

u

u_2

$$u = \frac{1}{2}u_1 + \frac{1}{2}u_2$$

screen
space

object
space

Issue: to shade a fragment which is part of a textured triangle
we need the barycentric coordinates of the fragment
These will be the weights for the weighted average of the vertex texture coordinates.
However, after a perspective transformation, the relative distances inside the triangle have
been distorted due to foreshortening.
I need to get my weights based on object or world space coordinates.
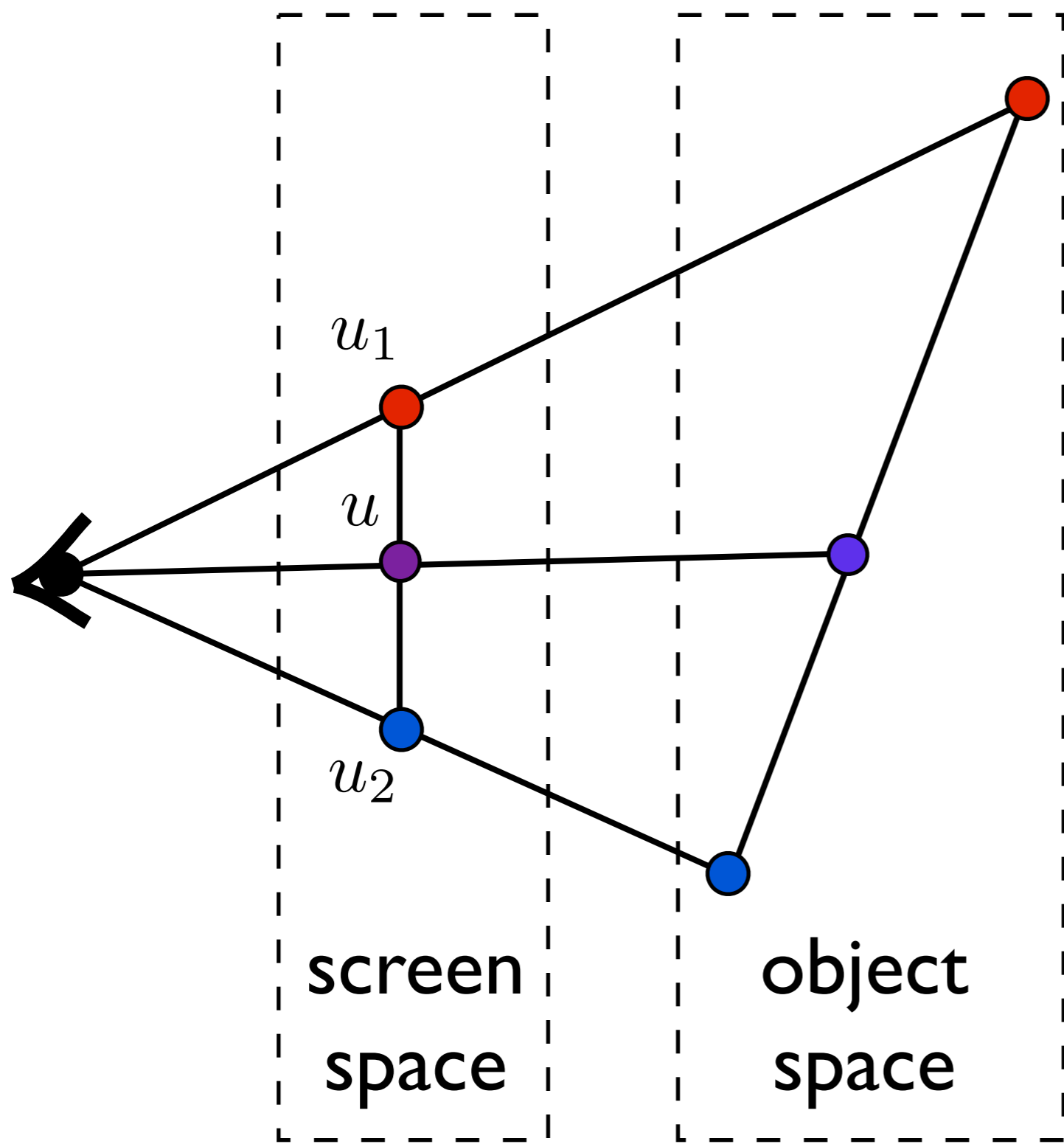
Interpolation with screen space weights is incorrect
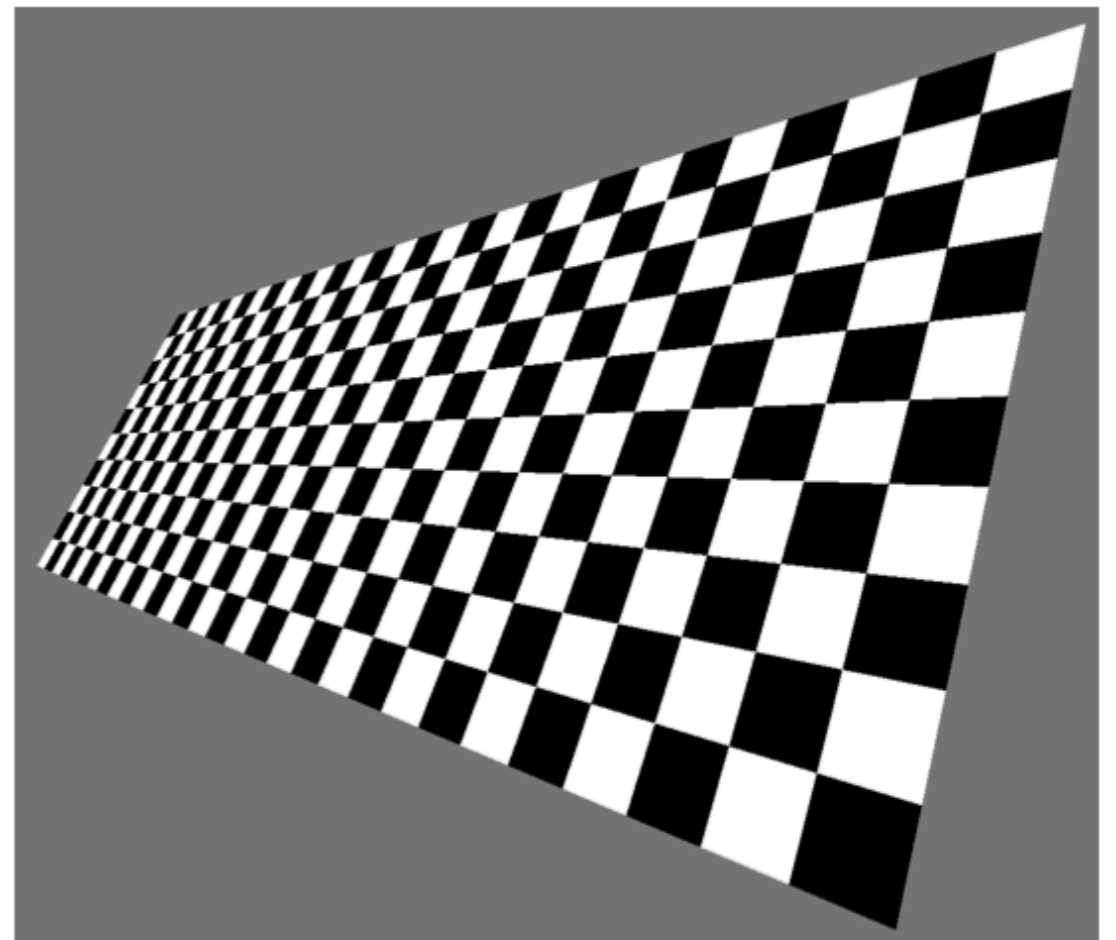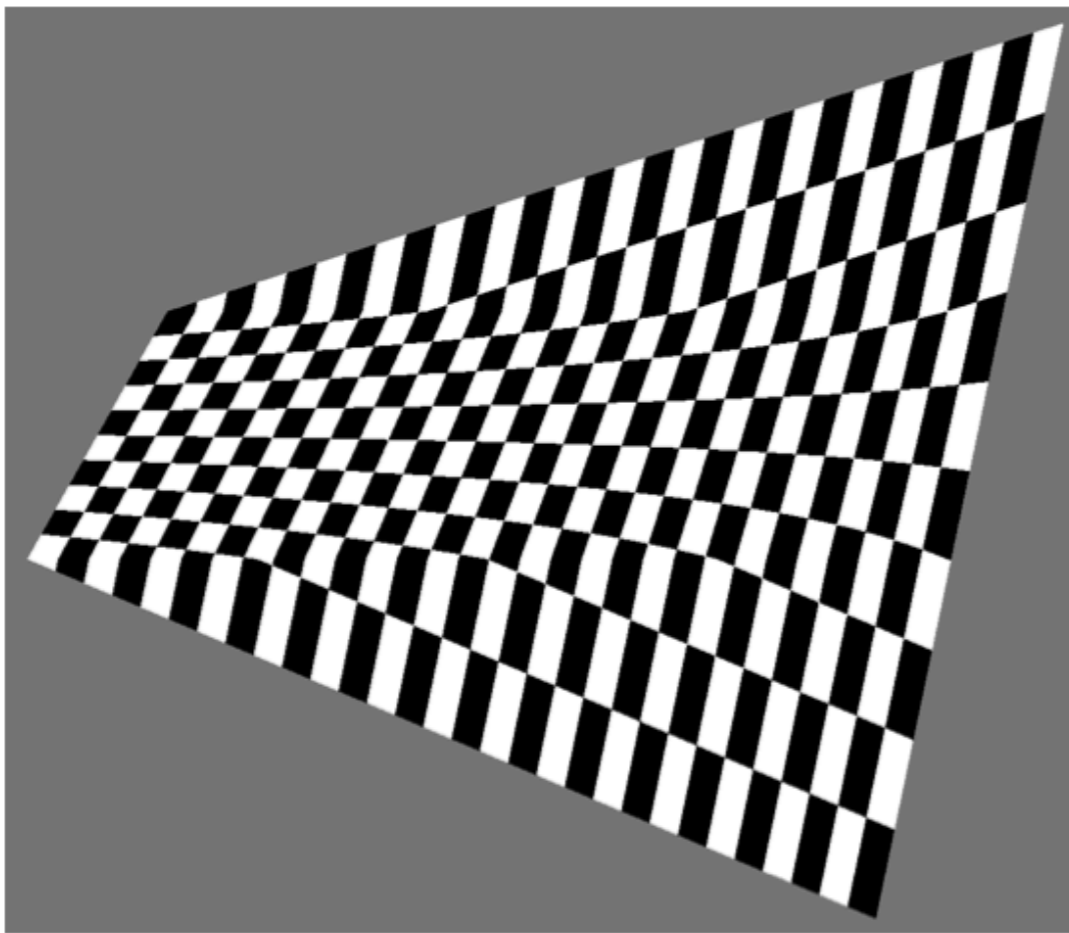
$$u = \frac{1}{2}u_1 + \frac{1}{2}u_2$$

u_1

u
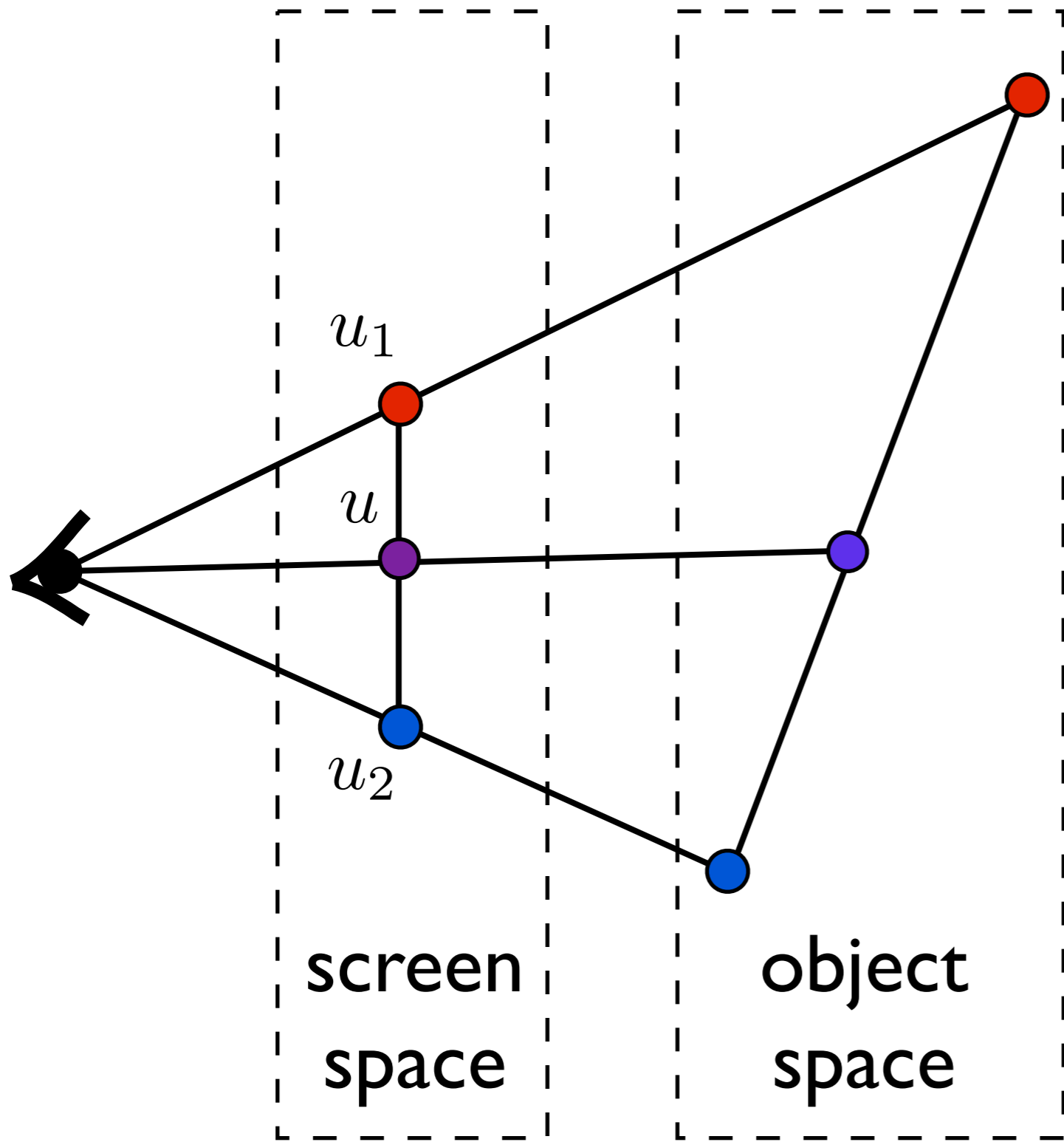
u_2

screen space
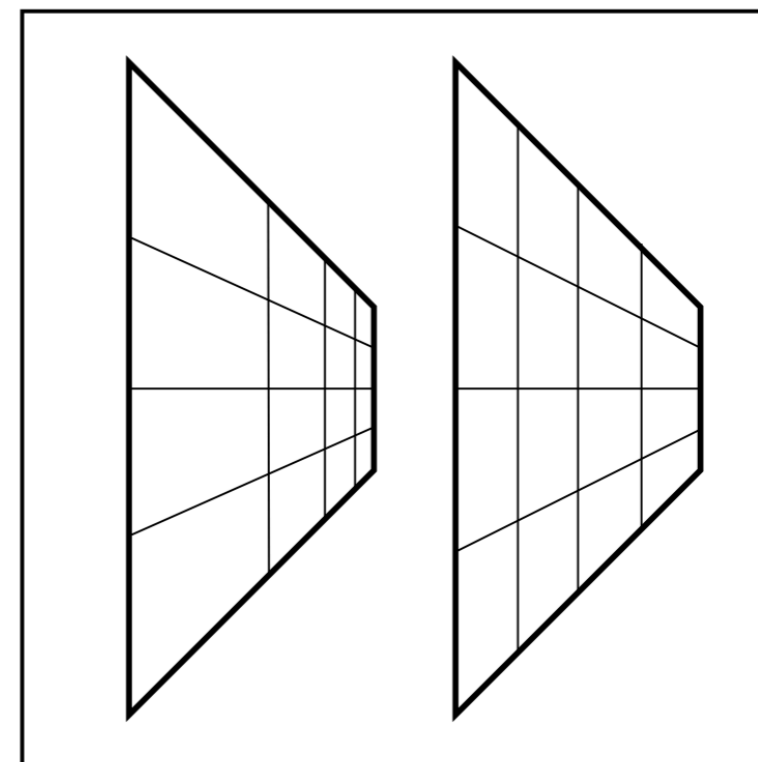
object space

correct   distorted

Perspective correct interpolation

Using screen space weights looks wrong for textures

[Heckbert and Morton, 1990]

u_1

u

u_2

screen
space

object
space
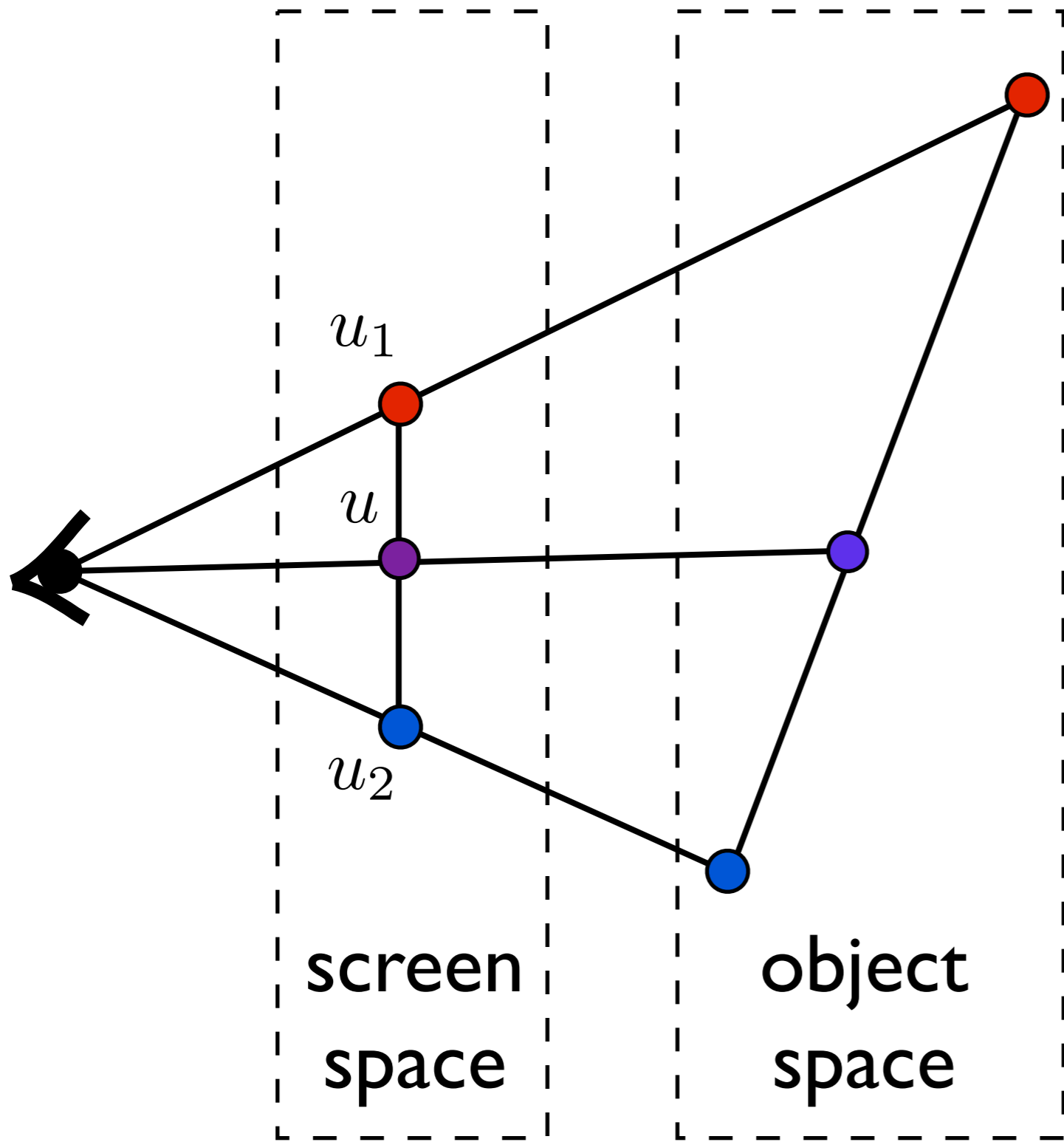
$u = \frac{1}{2}u_1 + \frac{1}{2}u_2$

Do we need to
transform back to
object space?

$\mathbf{v}_{\text{sc}} = M_{\text{vp}} M_{\text{pers}} M_{\text{cam}} \mathbf{v}$

u_1

u

u_2

screen space

object space

$u = \frac{1}{2}u_1 + \frac{1}{2}u_2$

Do we need to transform back to object space?

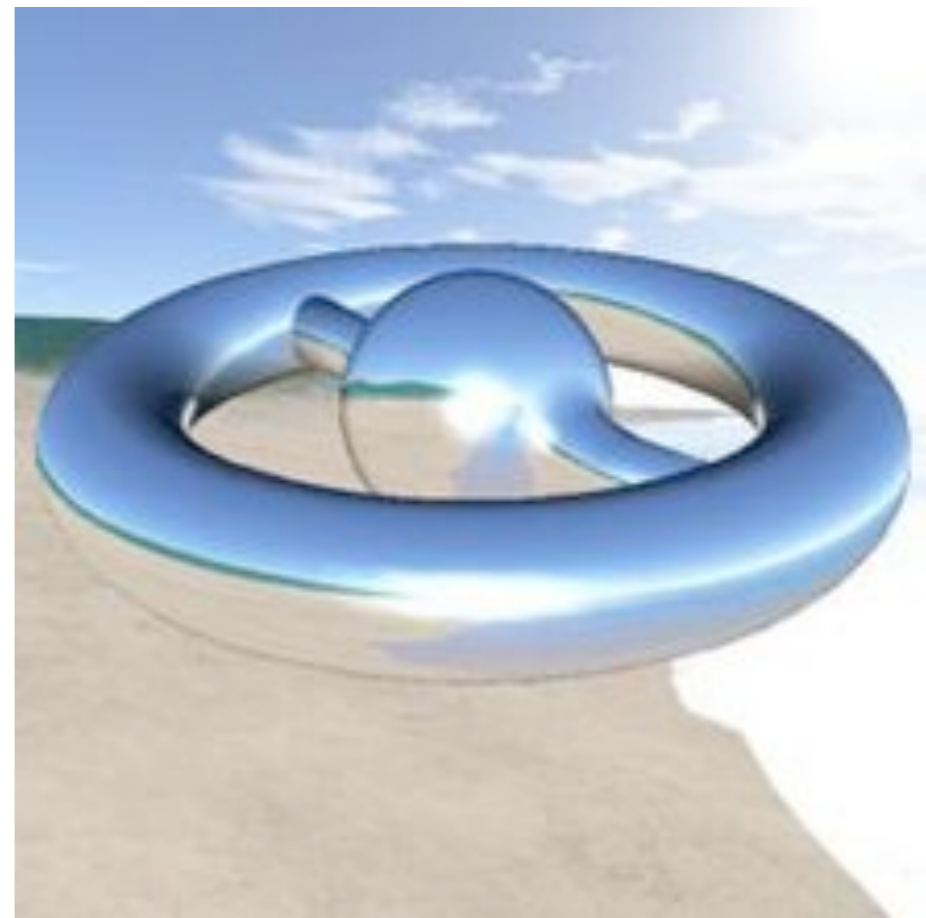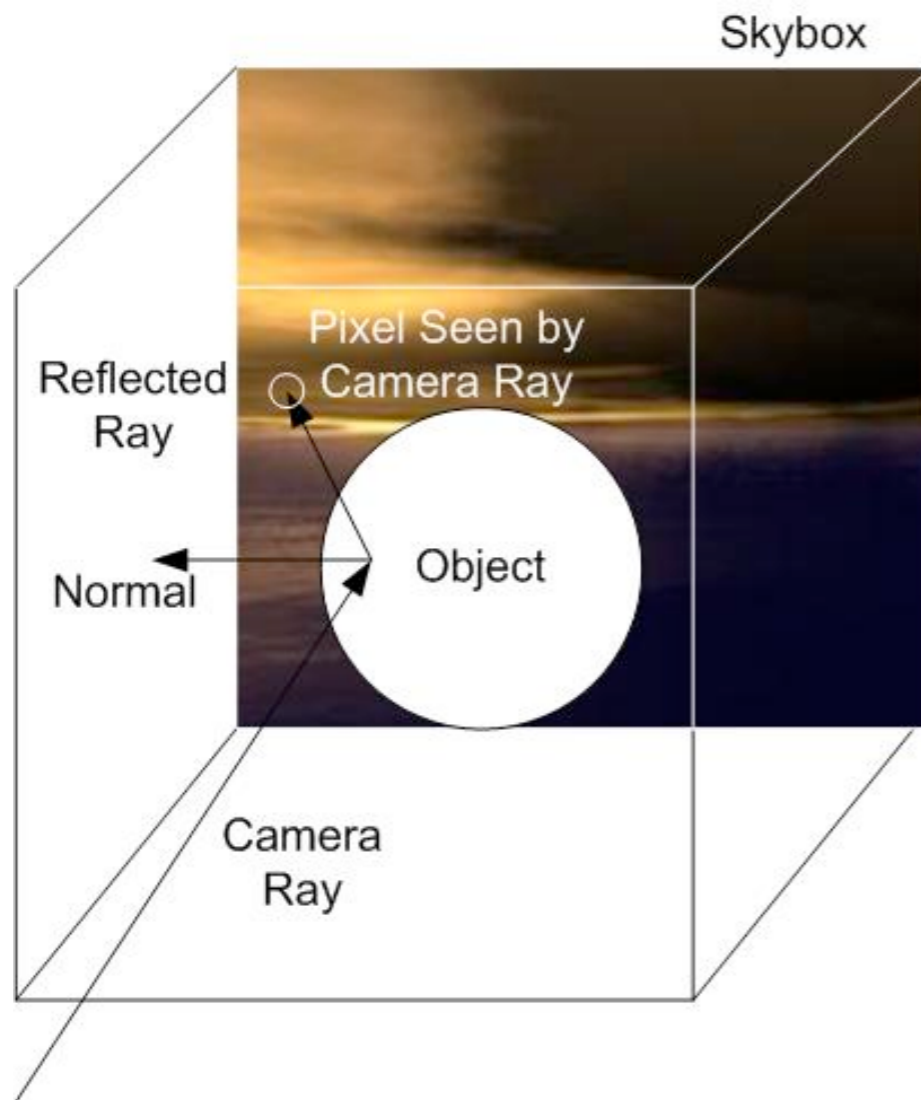NO!

<whiteboard>

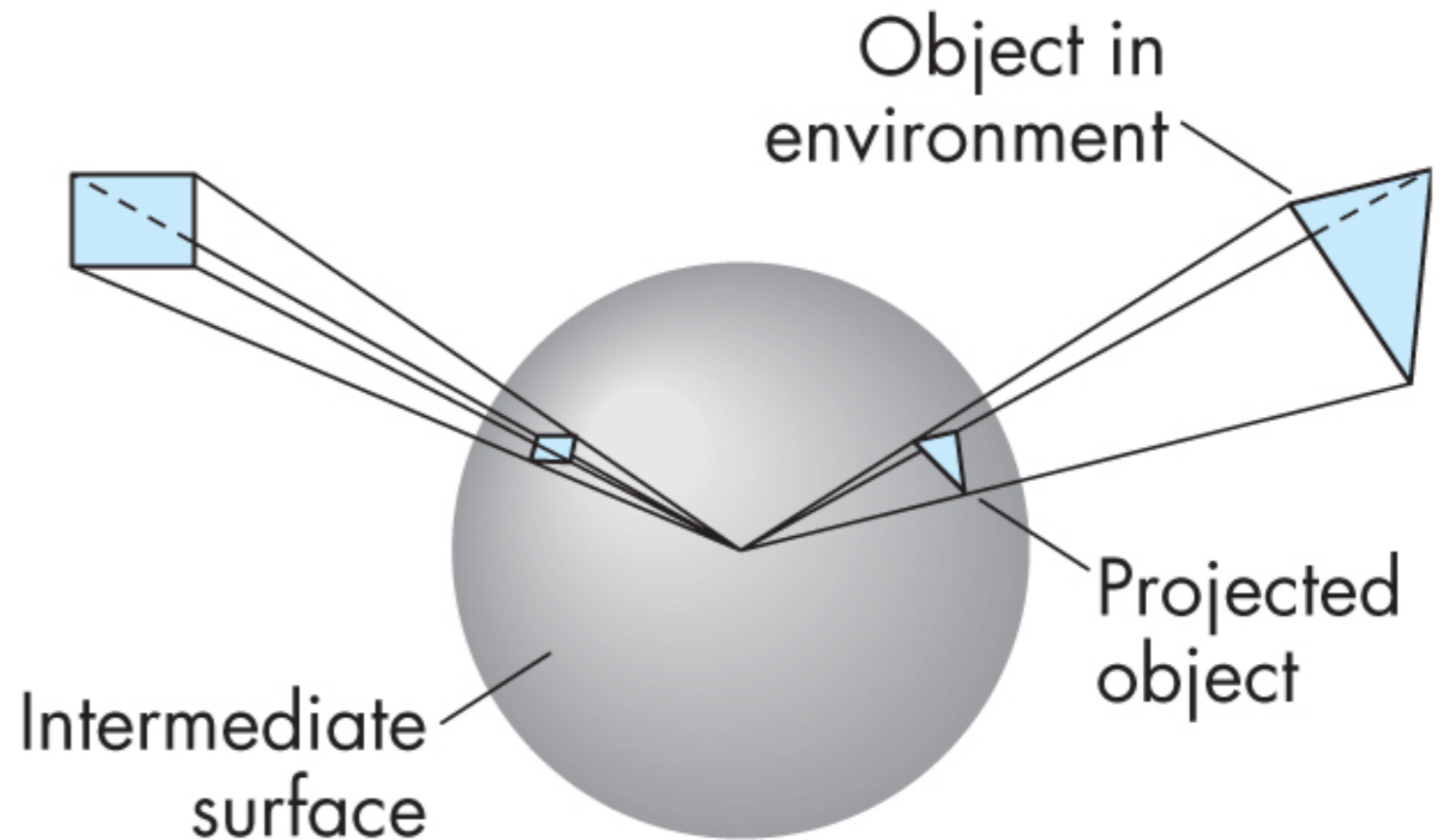# Environment mapping

Environment Mapping

Use a texture for the distant environment
simulate the effect of ray tracing more cheaply

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Sphere Mapping

•Project objects in the environment onto sphere centered at eye
•unwrap and store as texture
•use reflection direction to lookup texture value

Object in environment

Intermediate surface

Projected object

How is environment mapping different from ray tracing?
 – typically only the direction of the reflection vector is used to look up the texture value– this doesn't reproduce the true intersection of the reflected ray the the object it hits
 – Note: realism of environment map degrades as model is displaced from where the textures were generated

Cube Mapping

- Compute six projections, one for each wall
- store as texture
- use reflection direction to lookup texture value

n

r

Reflective object

v
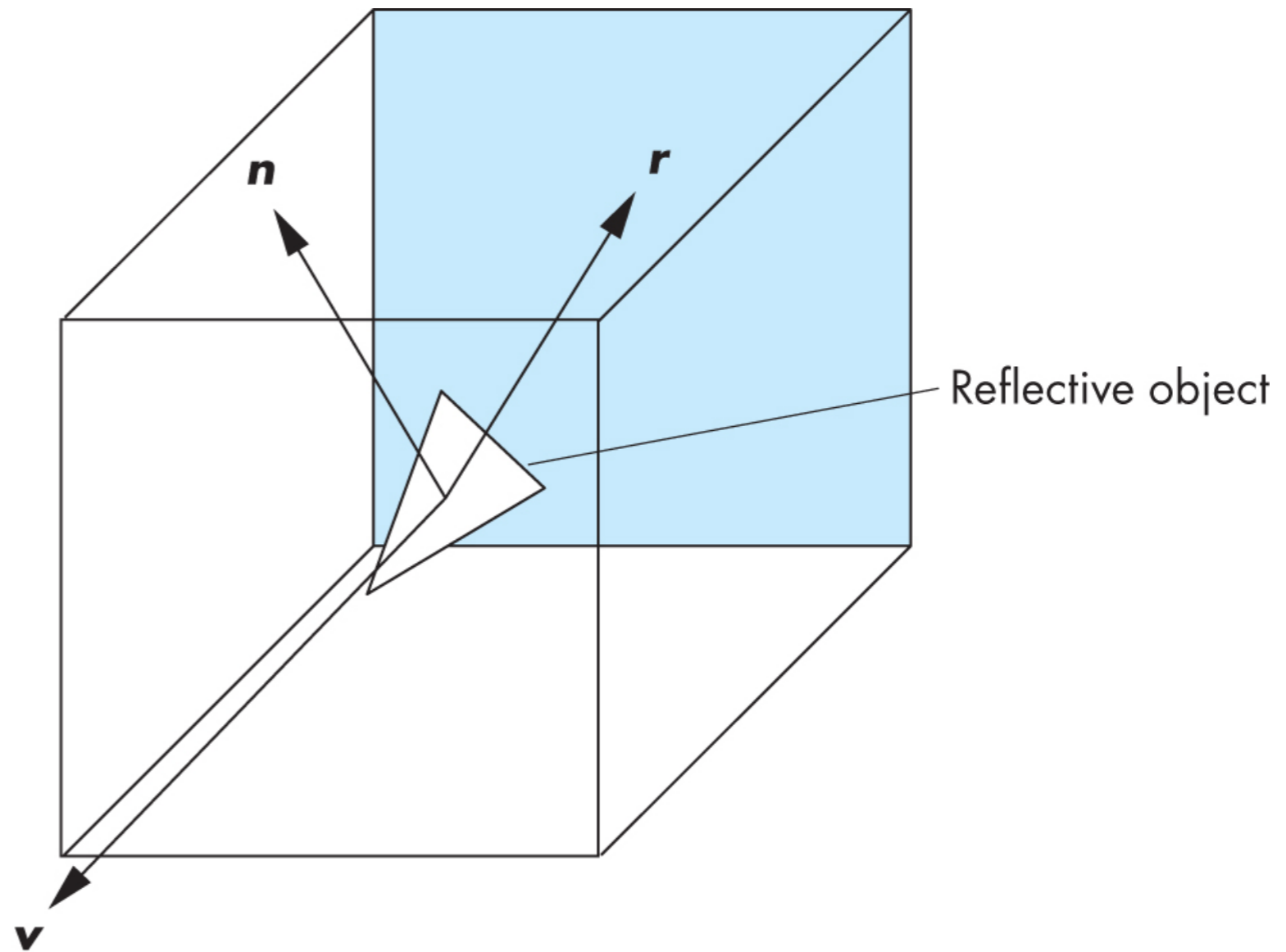
Different environment maps
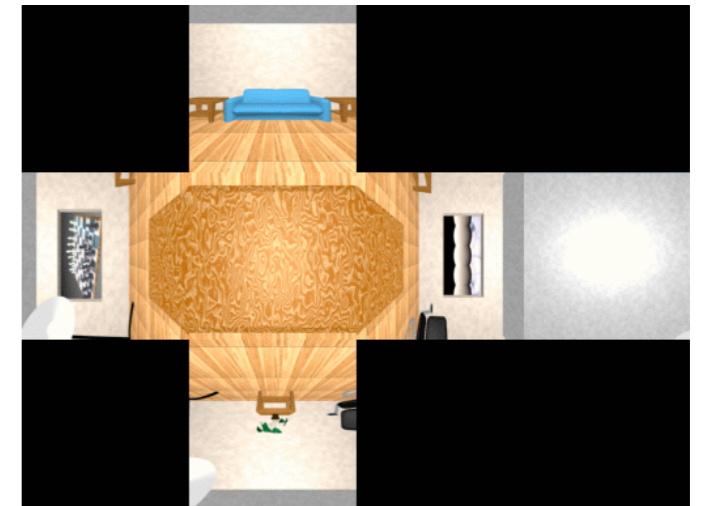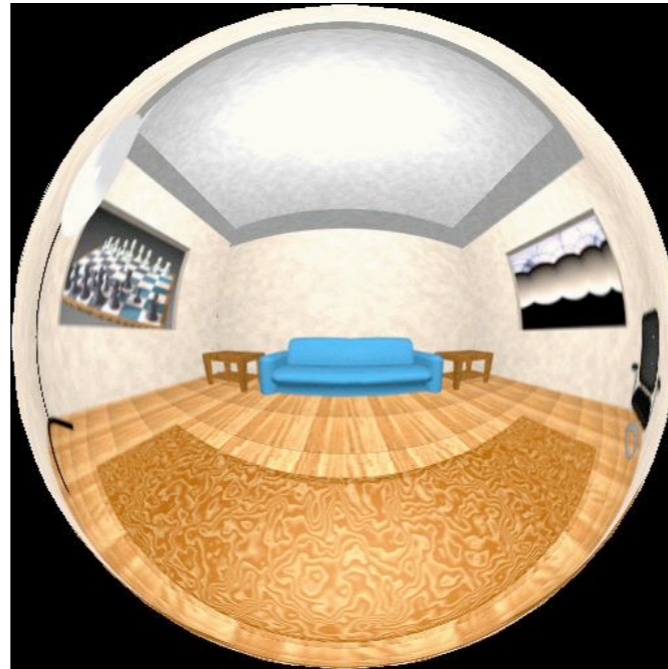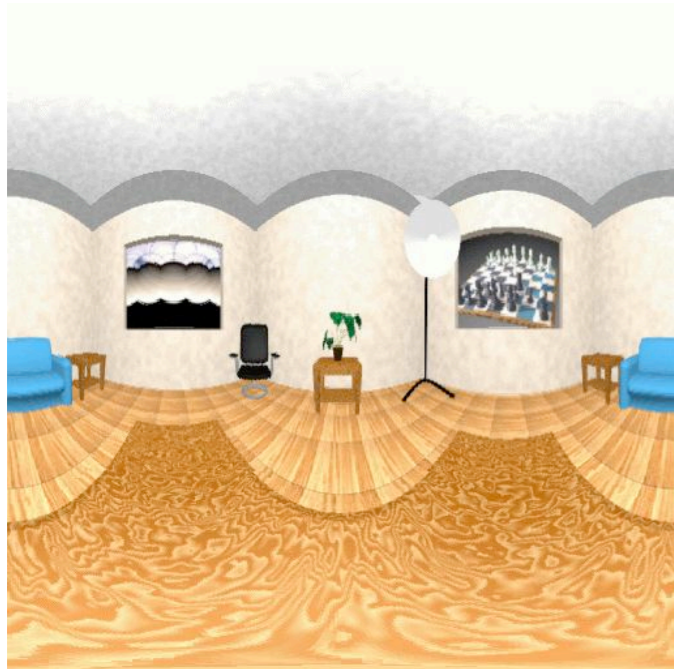
www.reindelsoftware.com

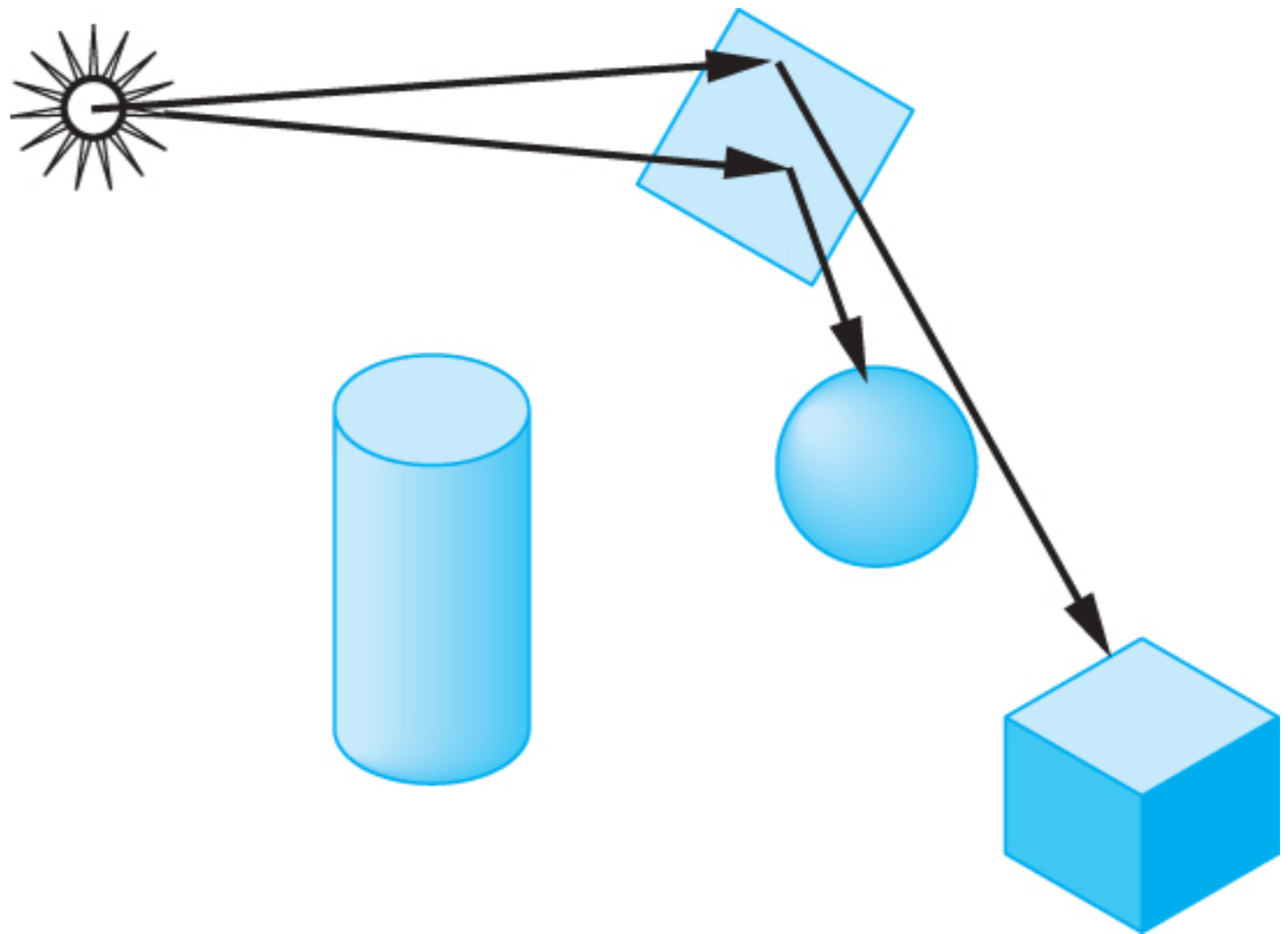Blinn/Newell
latitude mapping

OpenGL spherical
mapping

Cube mapping

Environment Mapping

Create the effect of a mirror with two-pass rendering

1. First pass: render the scene from the perspective of the mirror

2. Second pass: render from original pov; use the first image as a texture for the mirror
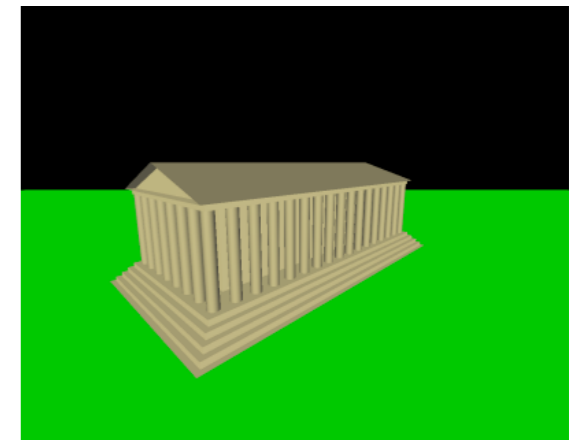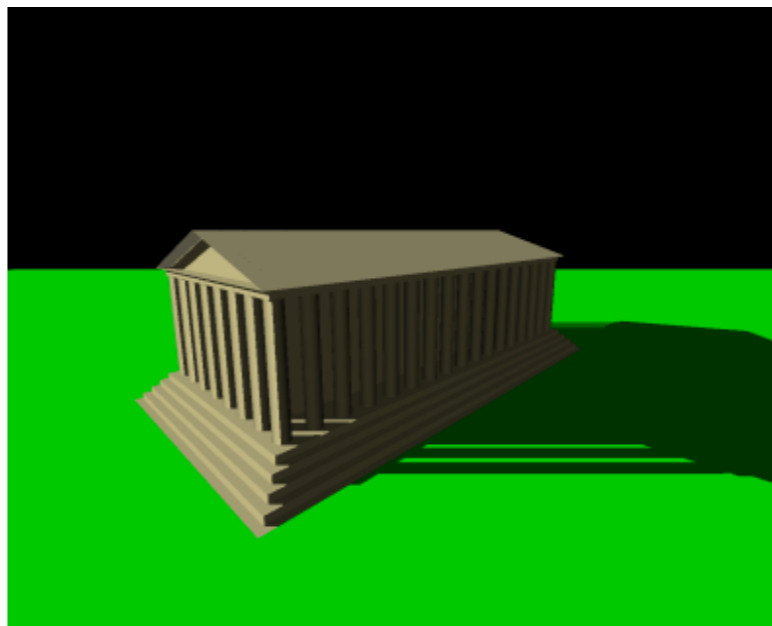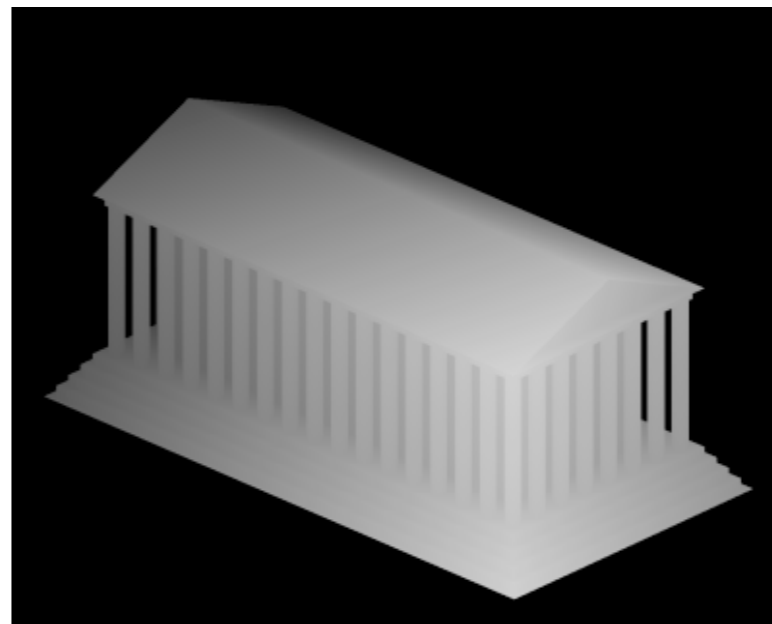
Shadow Mapping

first pass from light's perspective

1. render scene from pov of light and store z-buffer in a texture

2. when rendering scene from desired pov, also render from light pov and test pixel against stored texture

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Bump Mapping
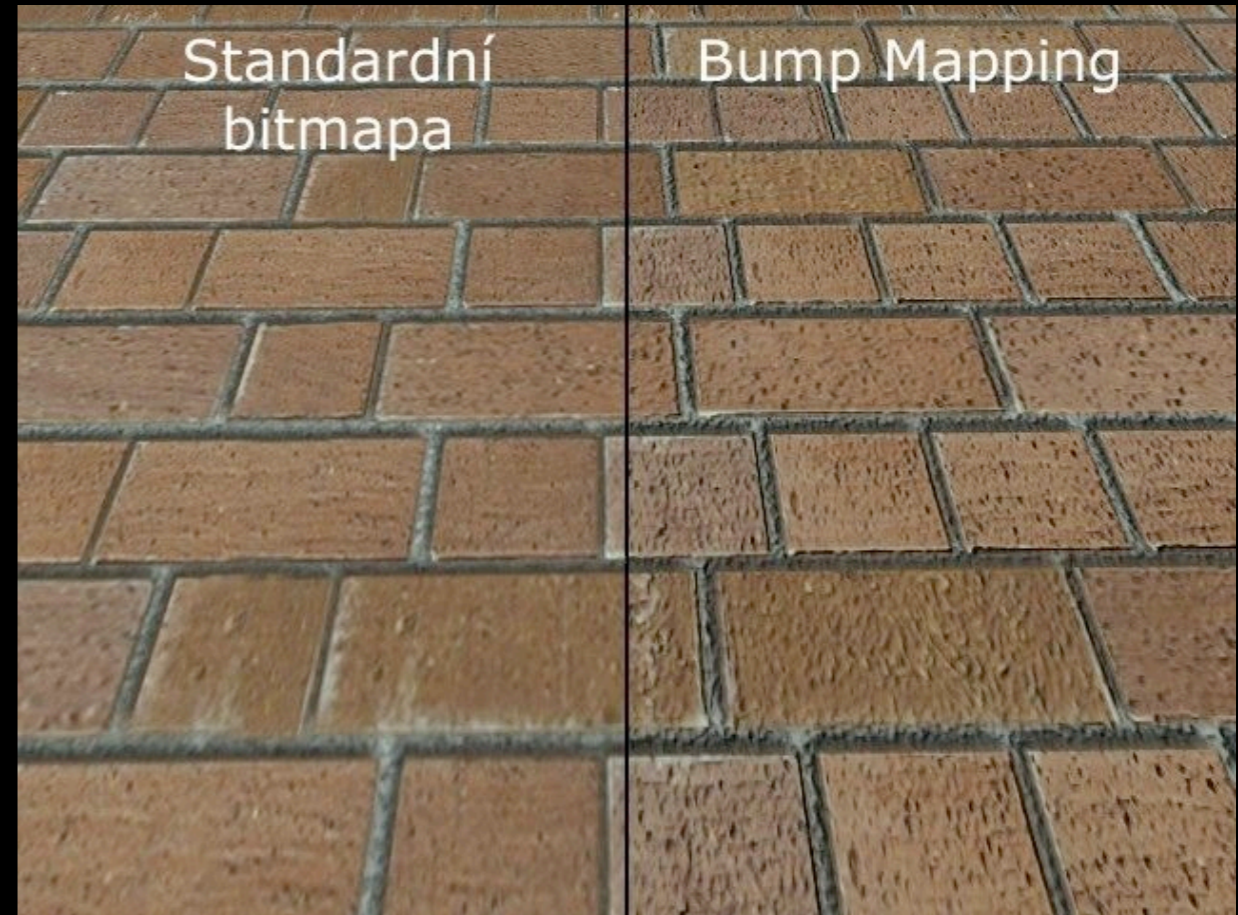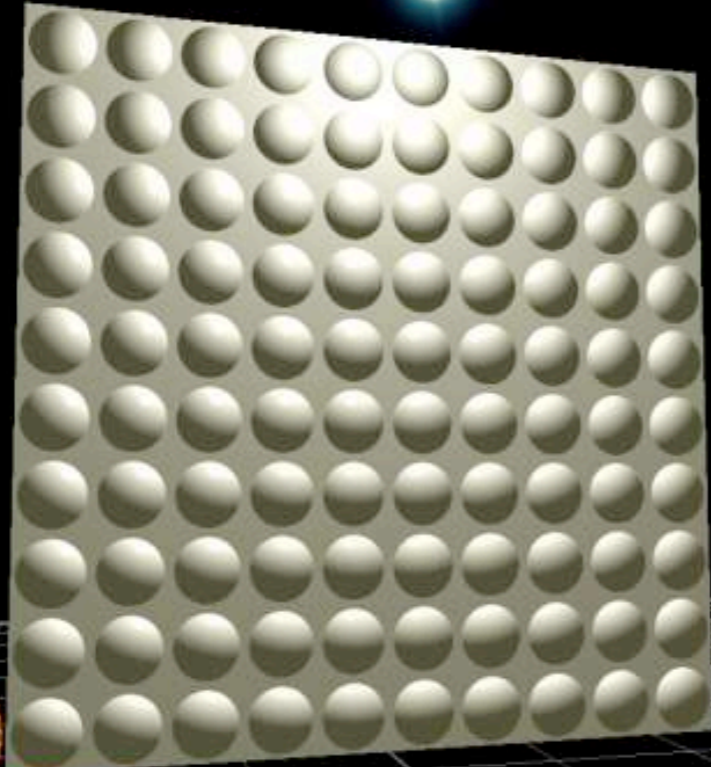

perturb
normal
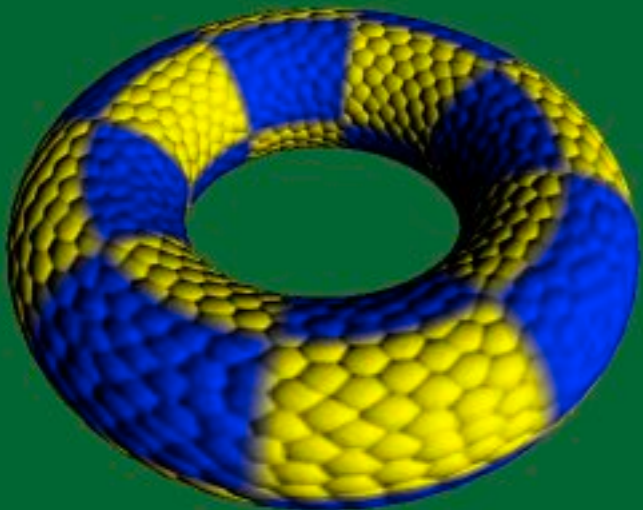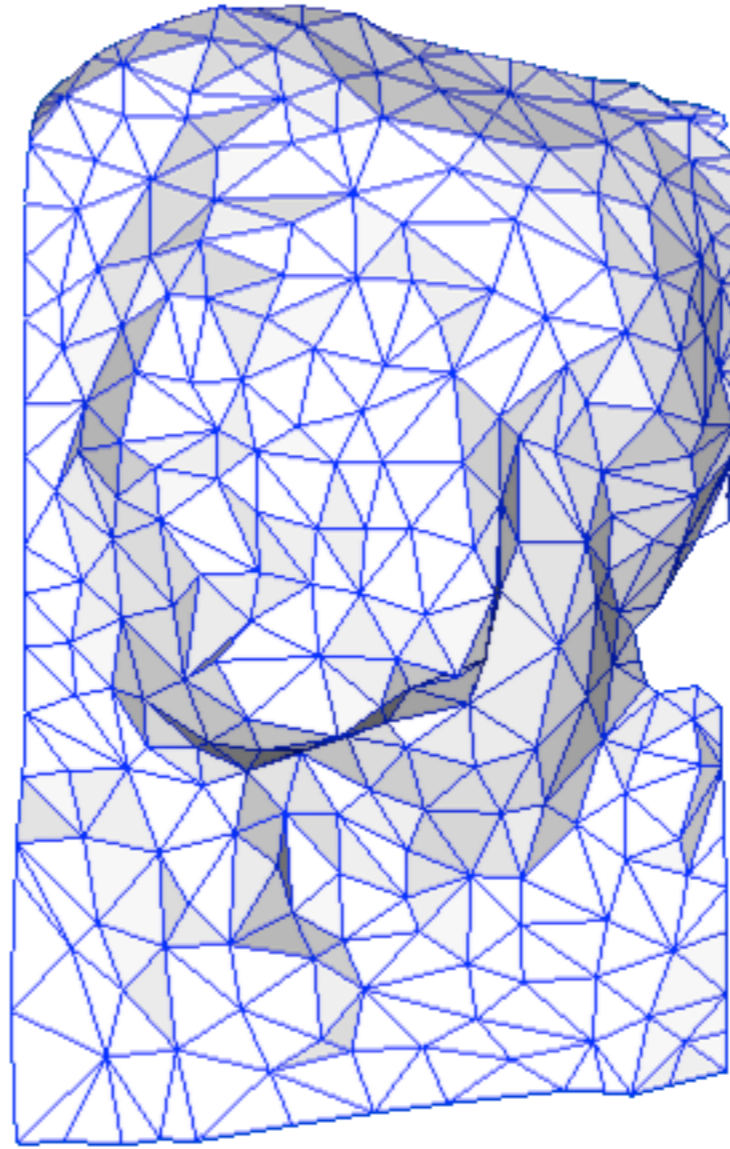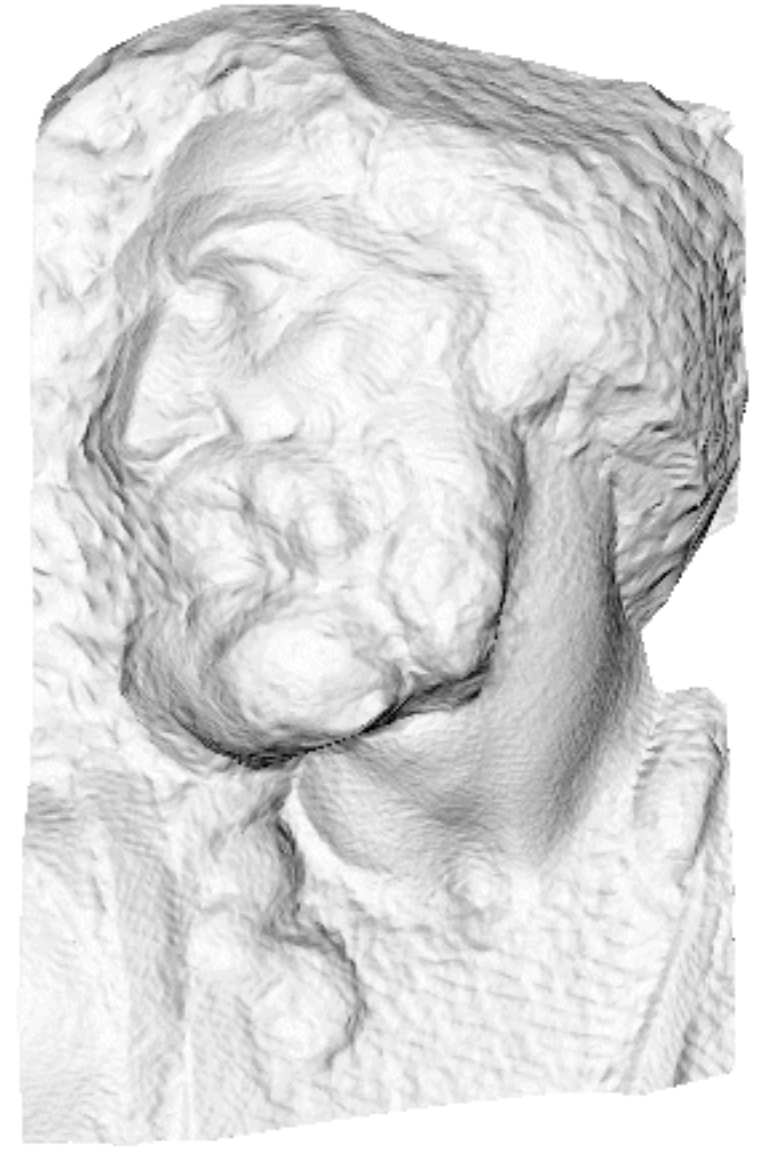vectors

doesn't
affect
silhouette
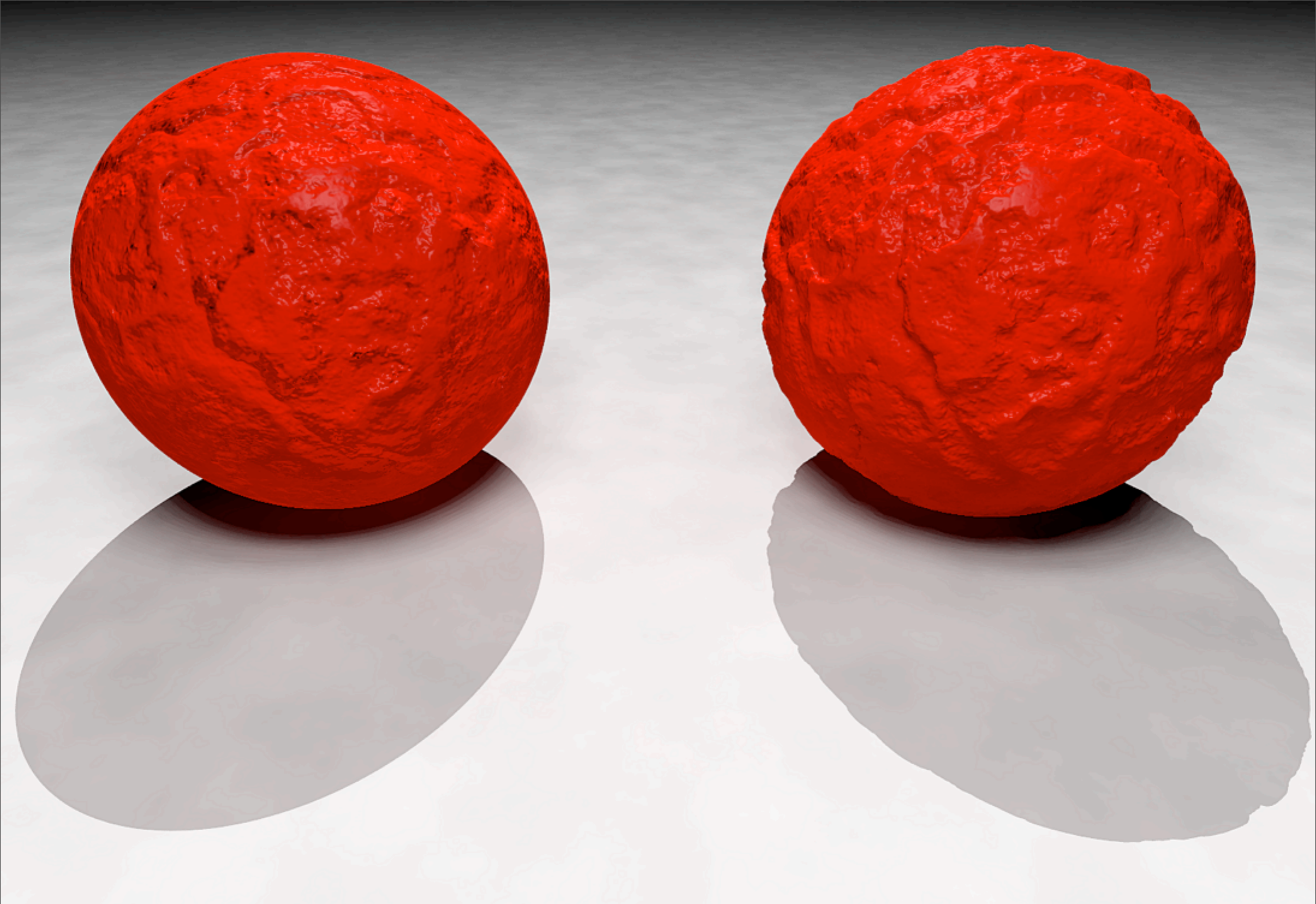
Normal Mapping

original mesh
4M triangles

simplified mesh
500 triangles

simplified mesh
and normal mapping
500 triangles