CS130 : Computer Graphics

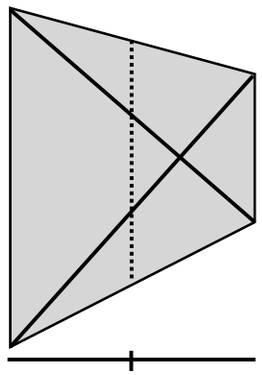
Lecture 10: Texture Mapping (cont.)

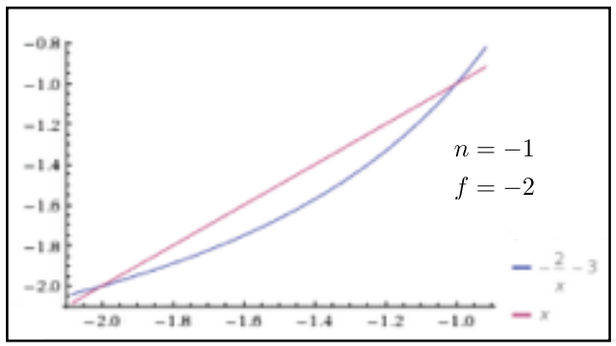
Tamar Shinar
Computer Science & Engineering
UC Riverside

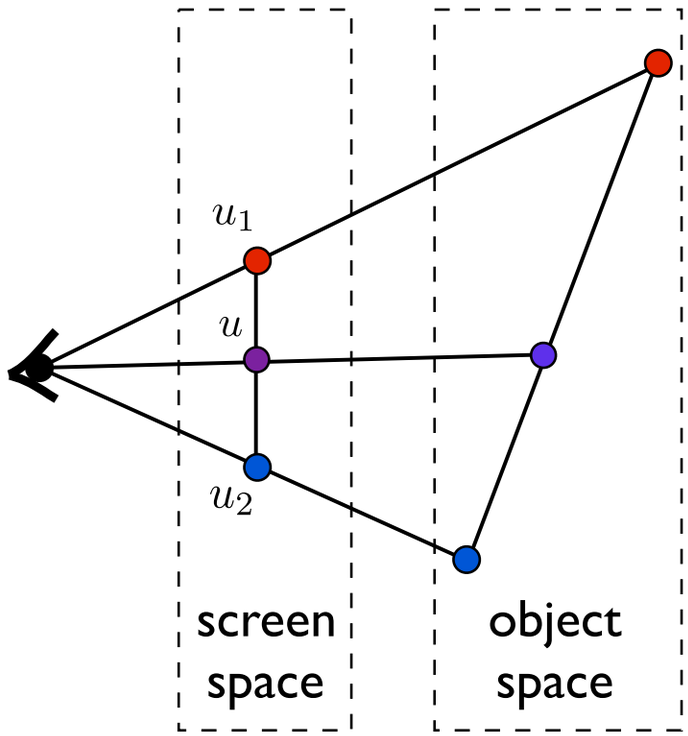
Perspective correct interpolation

Perspective correct interpolation

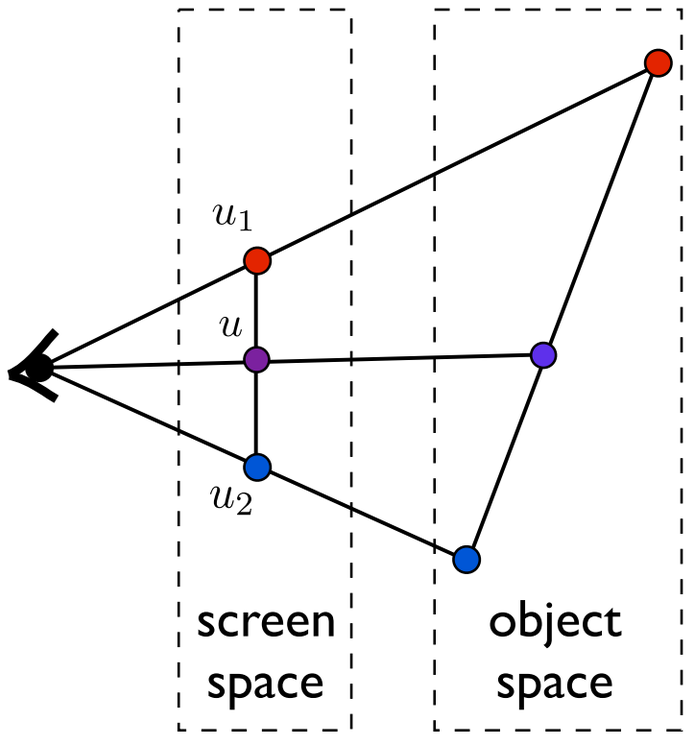
- In assignment 1, we found barycentric coordinates in 2D screen space
  - but not the correct object space barycentric coords
  - these coordinates were okay for z-buffer test





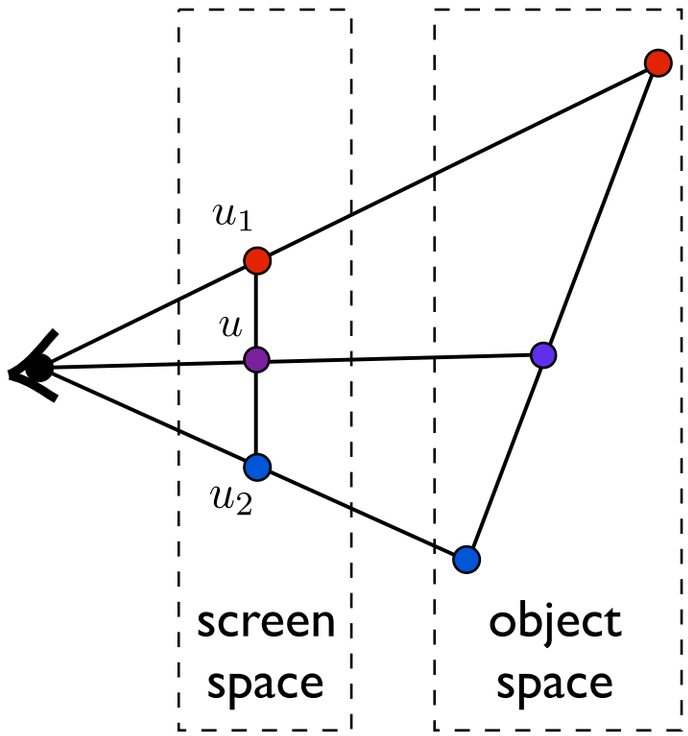


$$u = \frac{1}{2}u_1 + \frac{1}{2}u_2$$



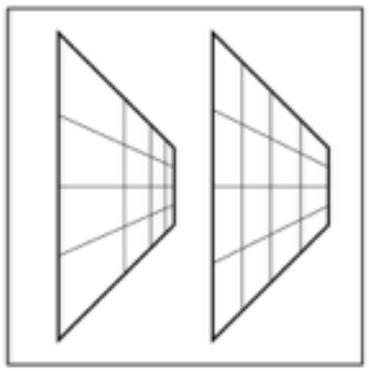
$$u = \frac{1}{2}u_1 + \frac{1}{2}u_2$$

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.



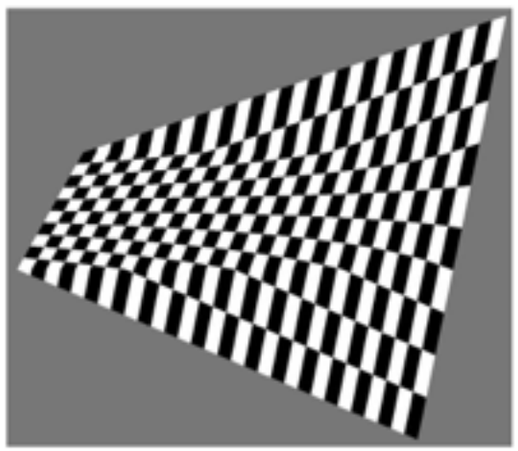
Interpolation with screen space weights is incorrect

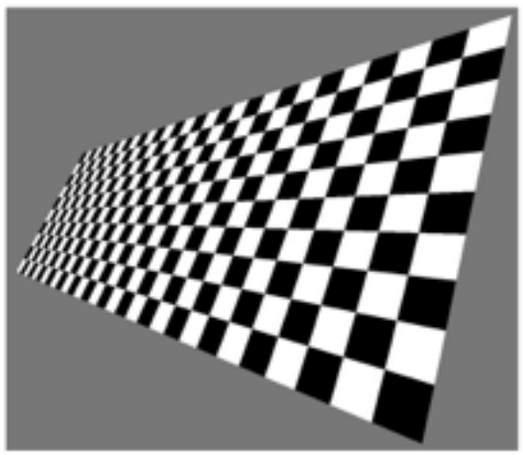
$$u = \frac{1}{2}u_1 + \frac{1}{2}u_2$$



Perspective correct interpolation

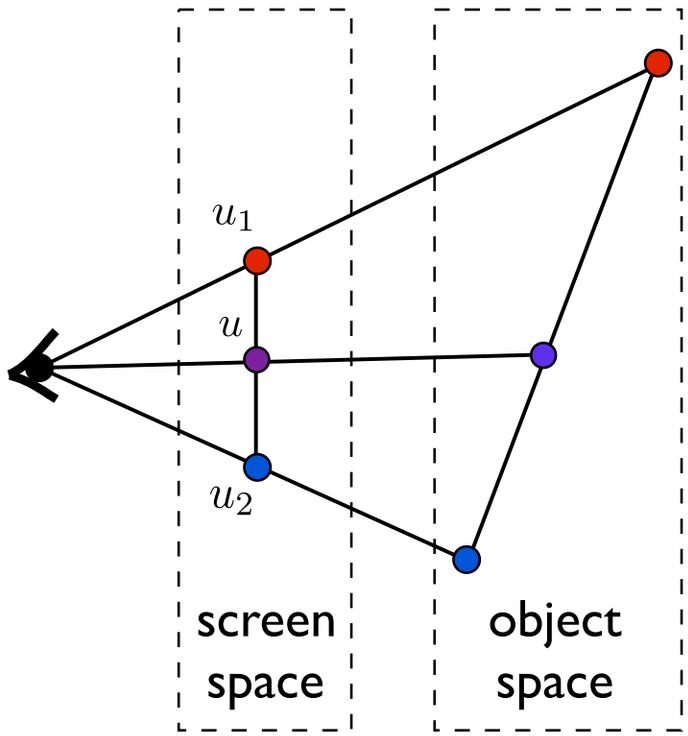
Using screen space weights looks wrong for textures





[Heckbert and Morton, 1990]

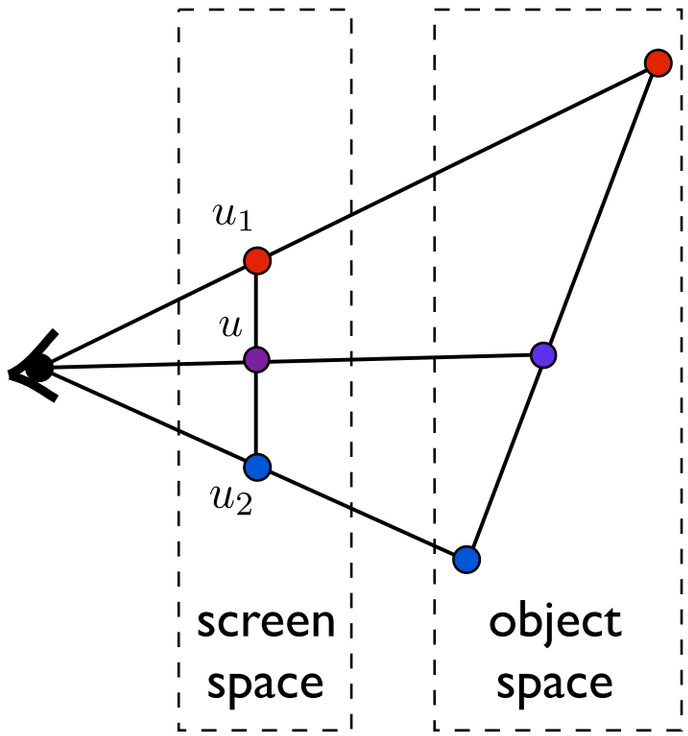
http://en.wikipedia.org/wiki/Texture_mapping#Perspective_correctness



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

Do we need to transform back to object space?

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



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

Do we need to transform back to object space?

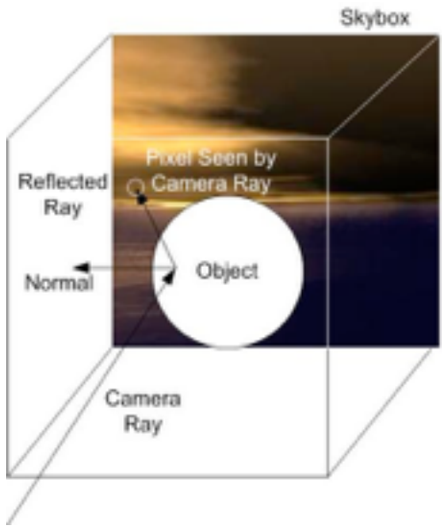
NO!

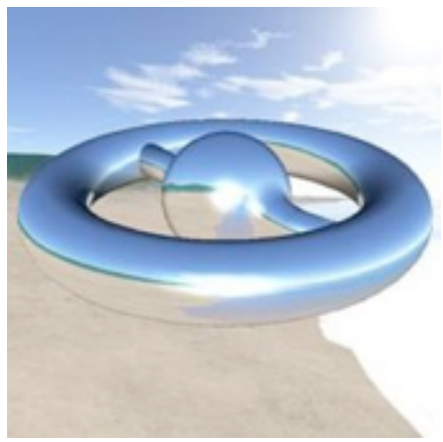
<whiteboard>

Environment mapping

Environment Mapping

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

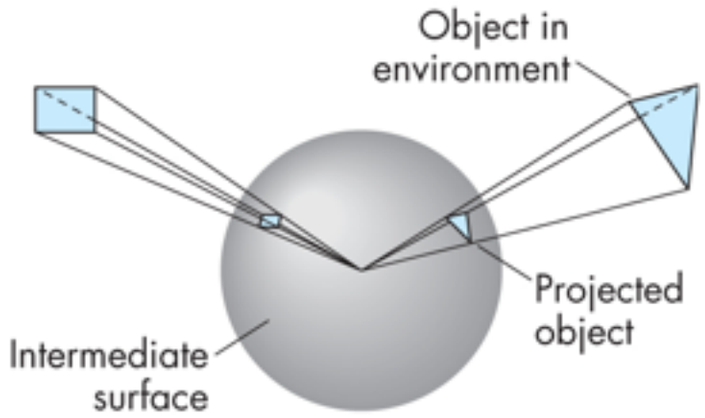




Wikimedia Commons

Sphere Mapping

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

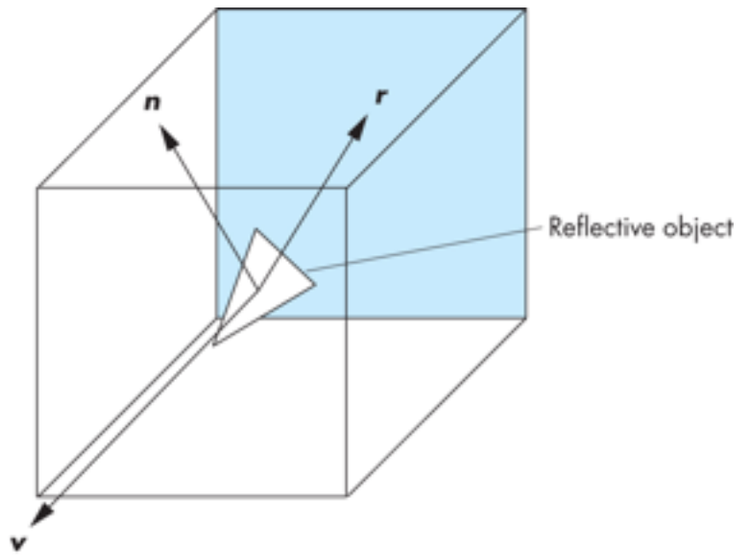


How is environment mapping different from ray tracing?

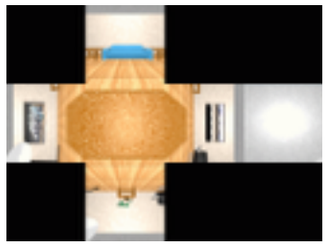
- typically only the direction of the reflection vector is used to look up the texture value- this doesn't reproduce the true intersection of the reflected ray and the object it hits
- Note: realism of environment map degrades as model is displaced from where the textures were generated

Cube Mapping

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



Different environment maps



www.reindelsoftware.com

Blinn/Newell latitude mapping

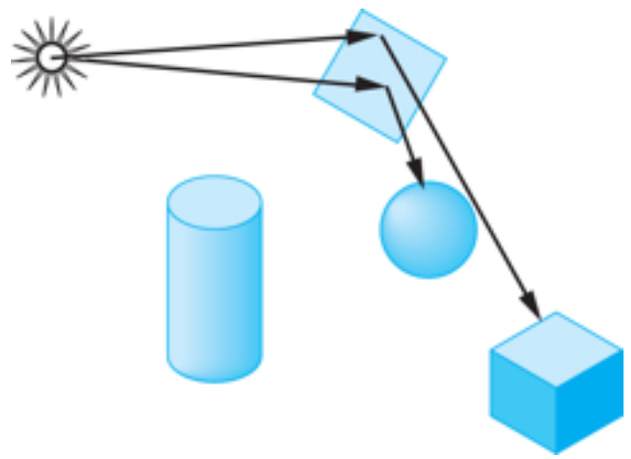
OpenGL spherical mapping

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

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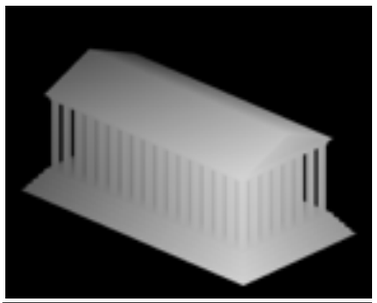
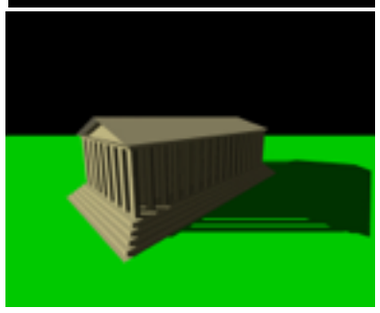
1. render scene from pov of light and store z-buffer in a texture



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

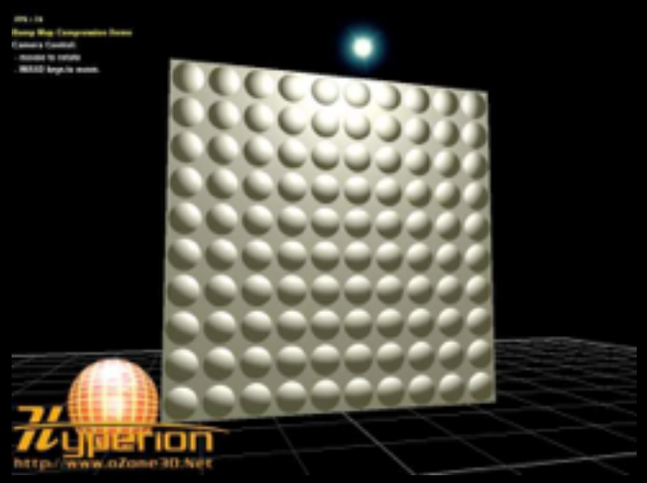


Bump Mapping

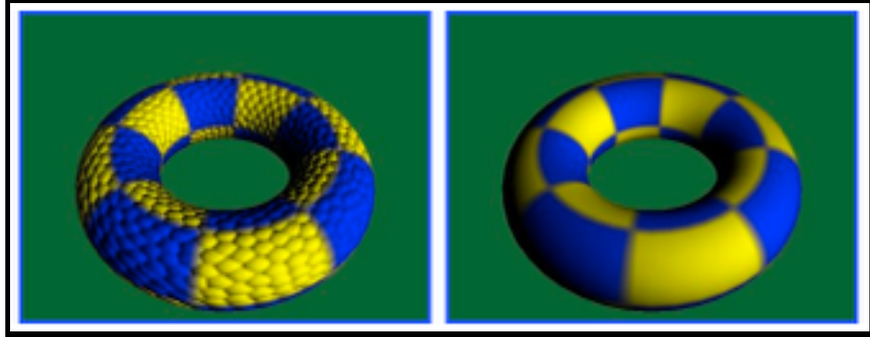
perturb
normal
vectors

doesn't
affect
silhouette

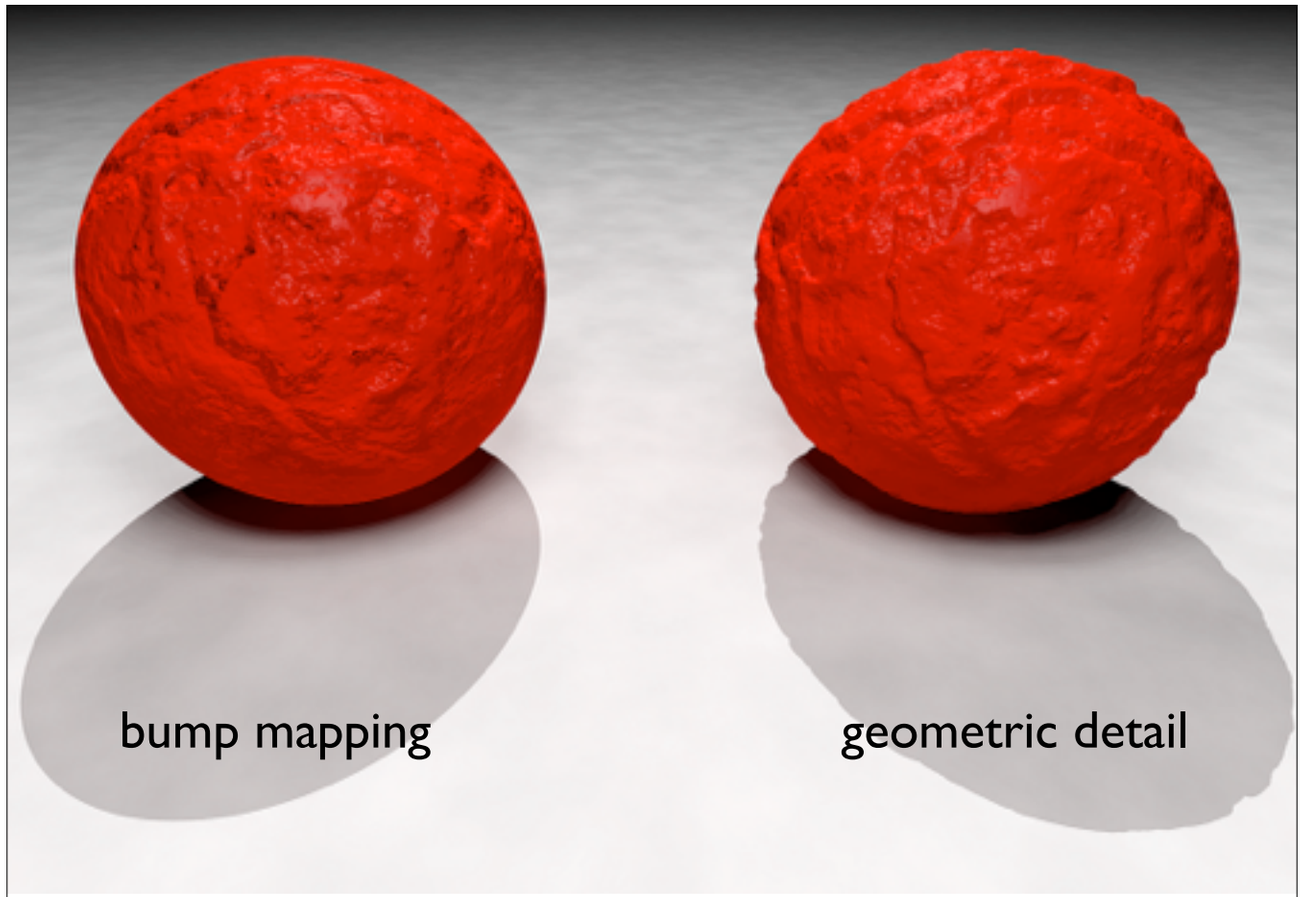
[DirectXTutorial.com]



http://www.lg.clanhost.cz



http://www.paulsprojects.net/tutorials/simplebump/simplebump.html



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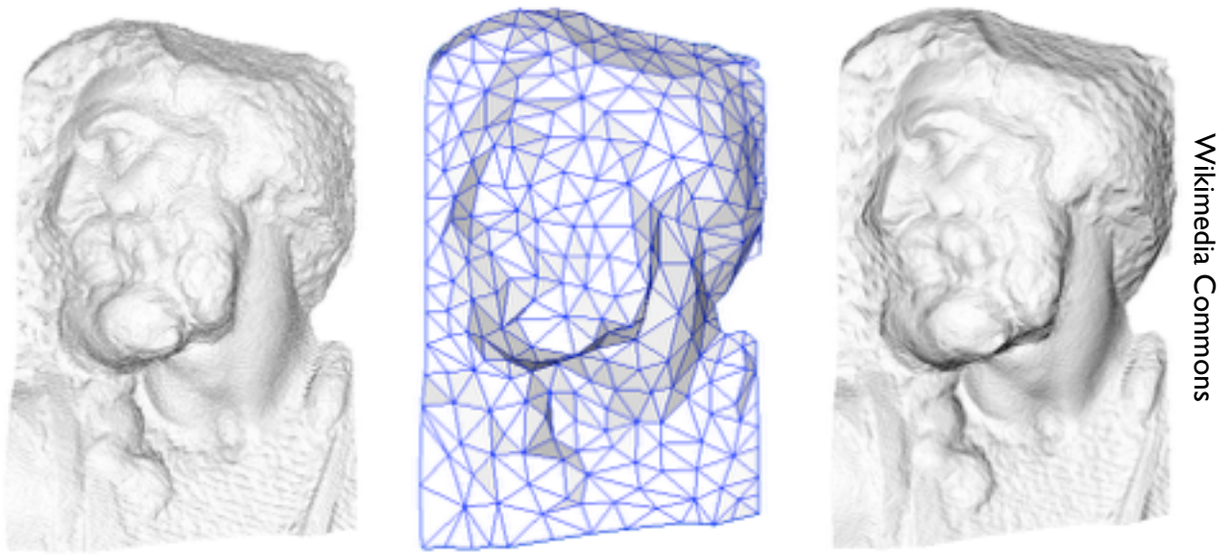
Normal Mapping



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