CS130 : Computer Graphics
Lecture 10: Texture Mapping (cont.)

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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
\[ u = \frac{1}{2} u_1 + \frac{1}{2} u_2 \]
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.

\[ u = \frac{1}{2} u_1 + \frac{1}{2} u_2 \]

Correct vs. distorted.
Perspective correct interpolation

Using screen space weights looks wrong for textures

[Heckbert and Morton, 1990]

http://en.wikipedia.org/wiki/Texture_mapping#Perspective_correctness
Do we need to transform back to object space?

\[ u = \frac{1}{2} u_1 + \frac{1}{2} u_2 \]

\[ \mathbf{v}_{sc} = M_{vp} M_{pers} M_{cam} \mathbf{v} \]
Do we need to transform back to object space?

NO!

\[ u = \frac{1}{2} u_1 + \frac{1}{2} u_2 \]
Environment mapping
Environment Mapping

Use a texture for the distant environment to simulate the effect of ray tracing more cheaply.
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 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
Different environment maps

Blinn/Newell latitude mapping

OpenGL spherical mapping

Cube mapping

www.reindelsoftware.com
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
Bump Mapping

perturb normal vectors
doesn’t affect silhouette
Bump Map Compression Demo
Camera Control:
- mouse to rotate
- WASD keys to move.
Normal Mapping

- Original mesh: 4M triangles
- Simplified mesh: 500 triangles
- Simplified mesh and normal mapping: 500 triangles