CS130 : Computer Graphics

Lecture 15: Texture Mapping

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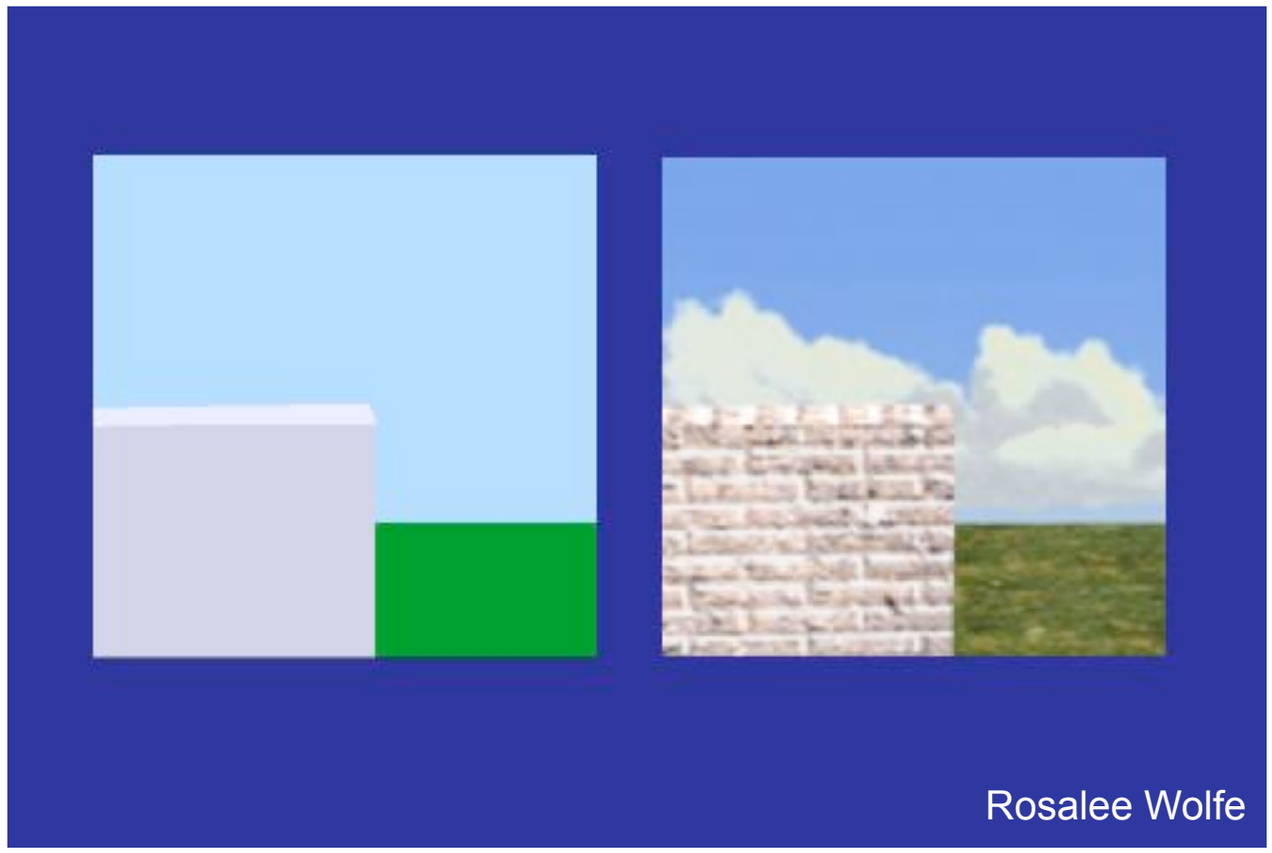
There are limits to geometric modeling

http://www.beinteriordecorator.com

National Geographic

Although modern GPUs can render millions of triangles/ sec, that's not enough sometimes...

Use texture mapping to increase realism through detail

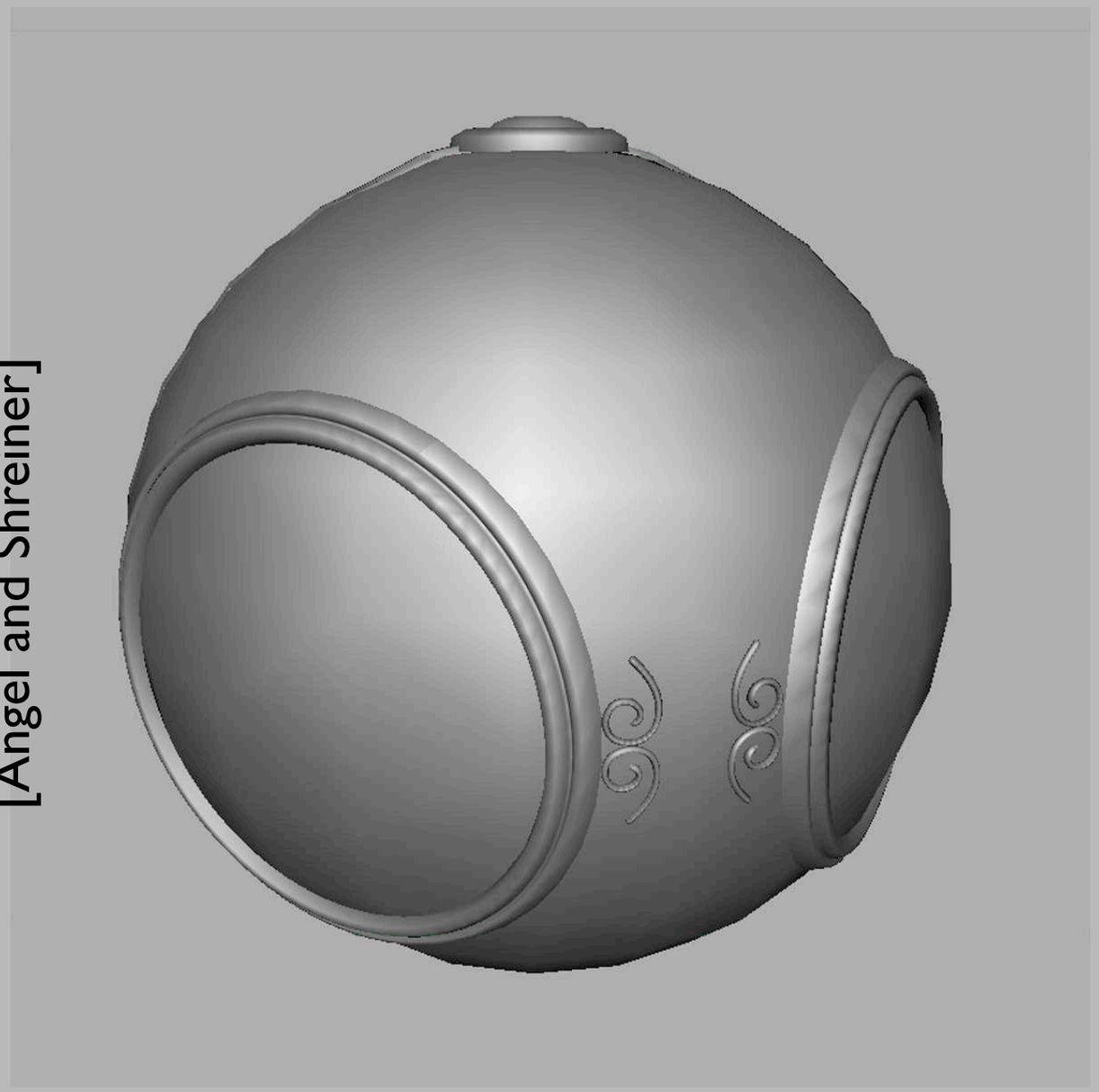


This image is just 8 polygons!

Add visual complexity.

http://www.siggraph.org/education/materials/HyperGraph/mapping/r_wolfe/r_wolfe_mapping_1.htm

[Angel and Shreiner]

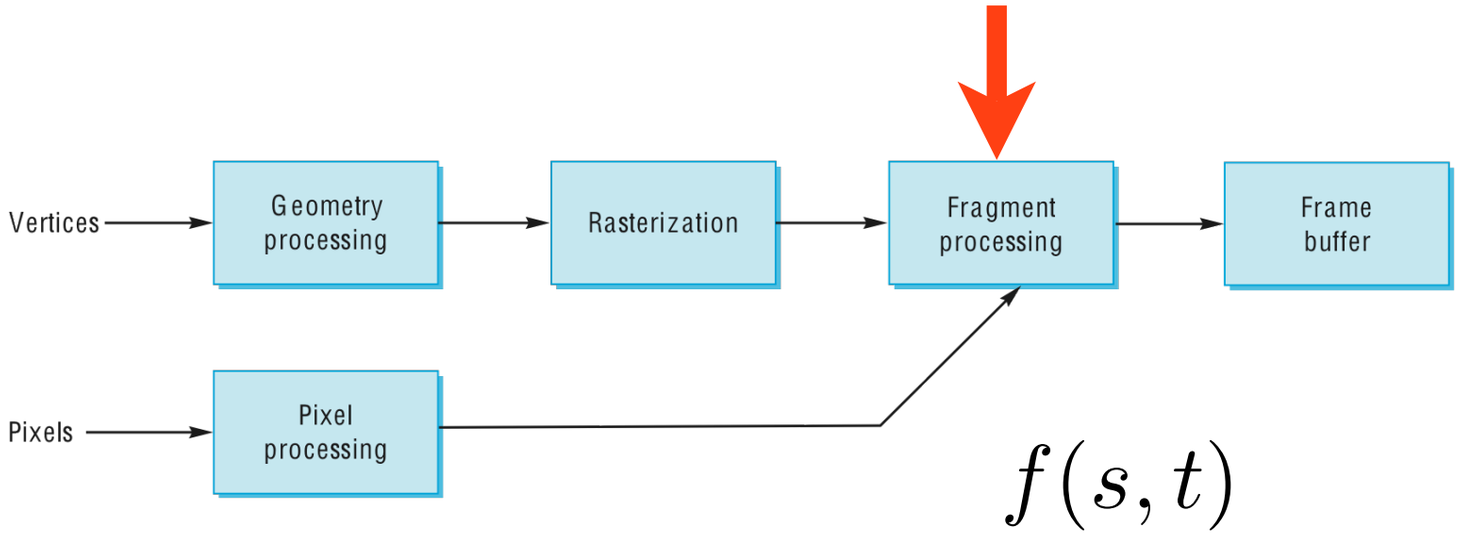


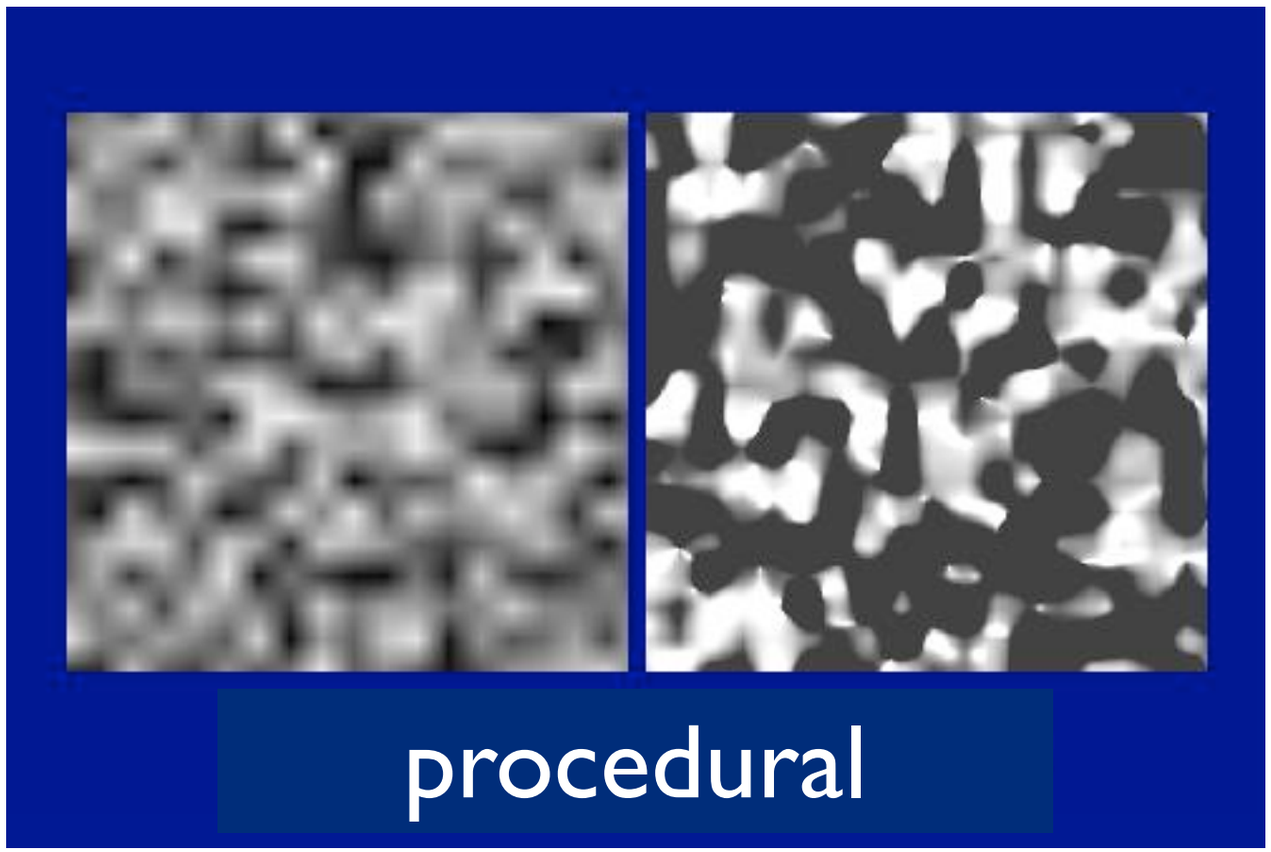
No texture

With texture

Pixar - Toy Story

Store 2D images in buffers and lookup pixel reflectances





photo

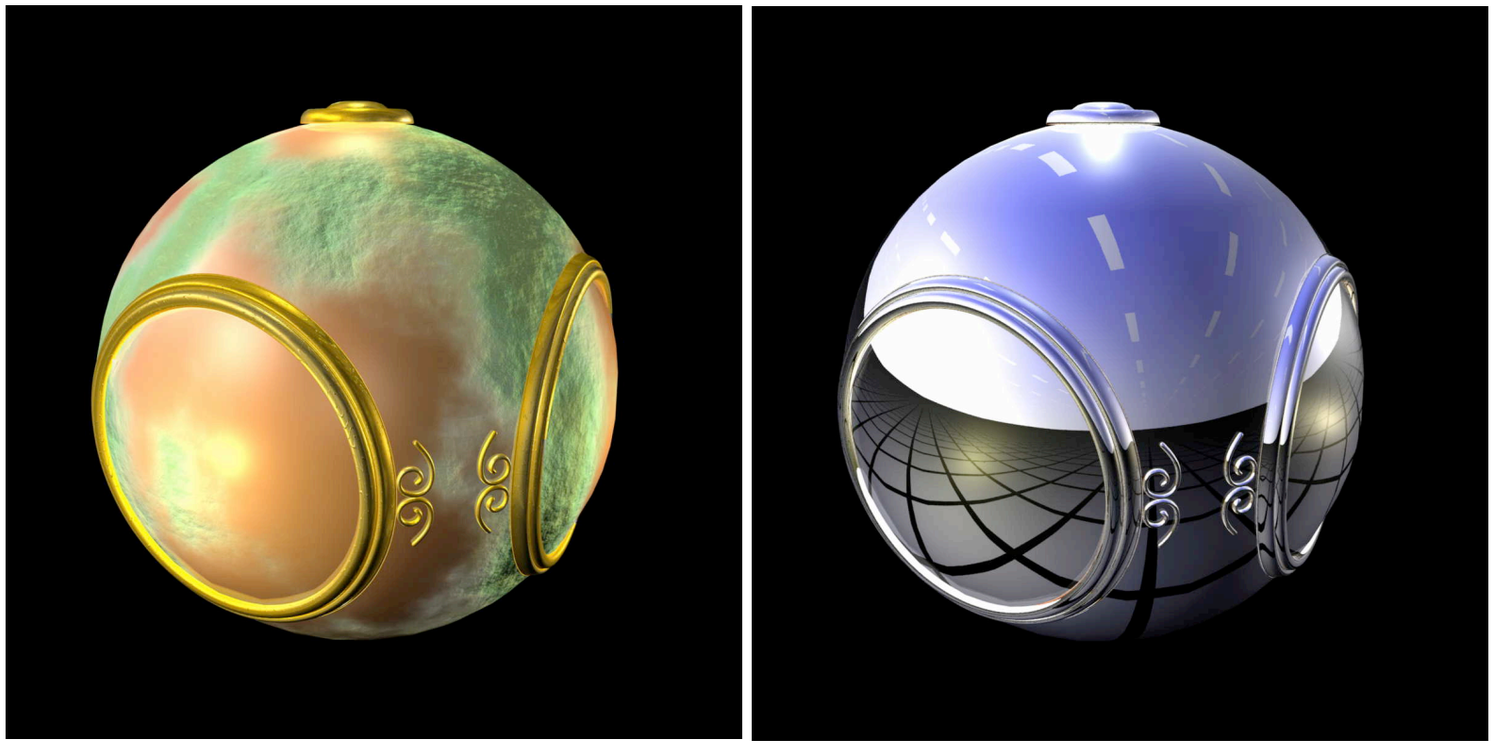
Textures can be anything that you can lookup values in -- photo, procedurally generated, or even a function that computes a value on the fly

3D solid textures

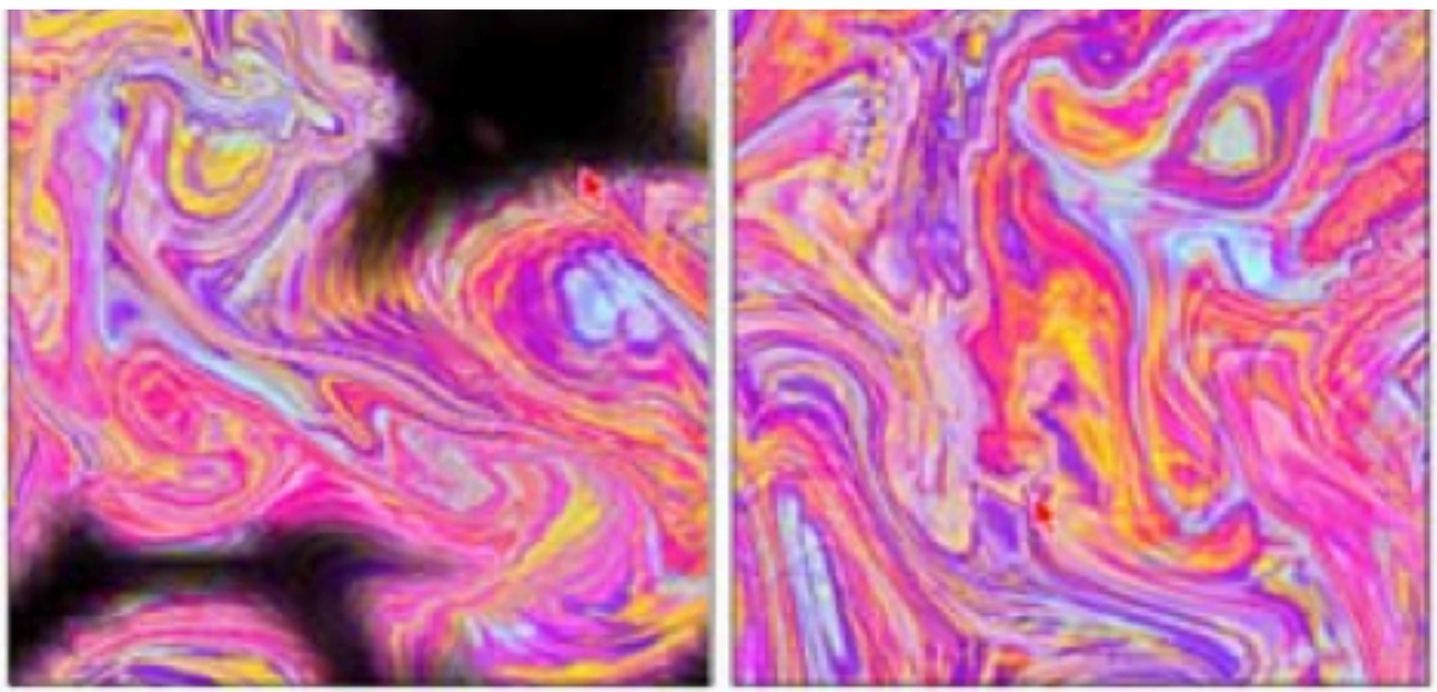
[Dong et al., 2008]

Other uses of textures...

Light maps
Shadow maps
Environment maps
Bump maps
Opacity maps
Animation

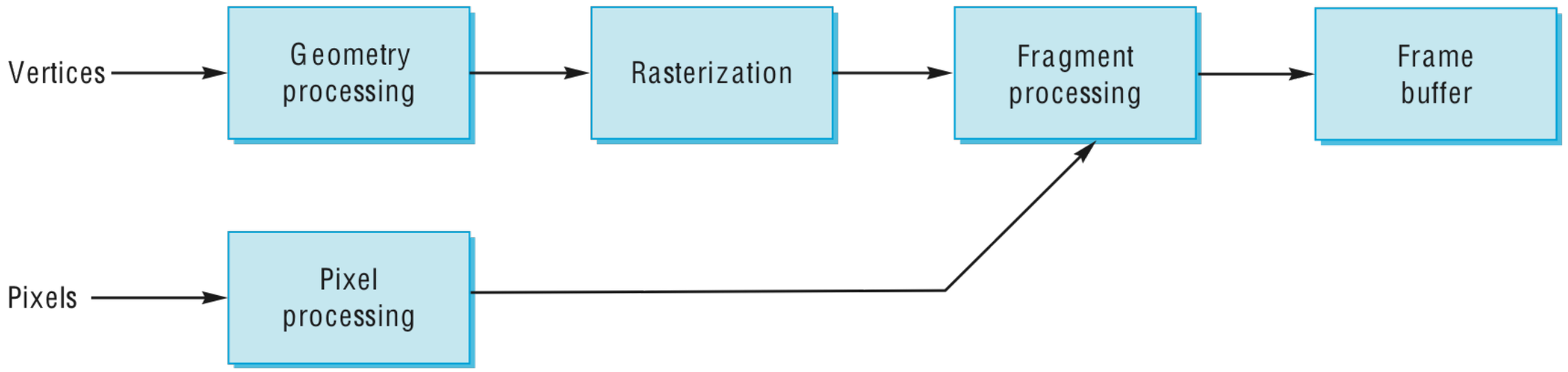


[Angel and Shreiner]



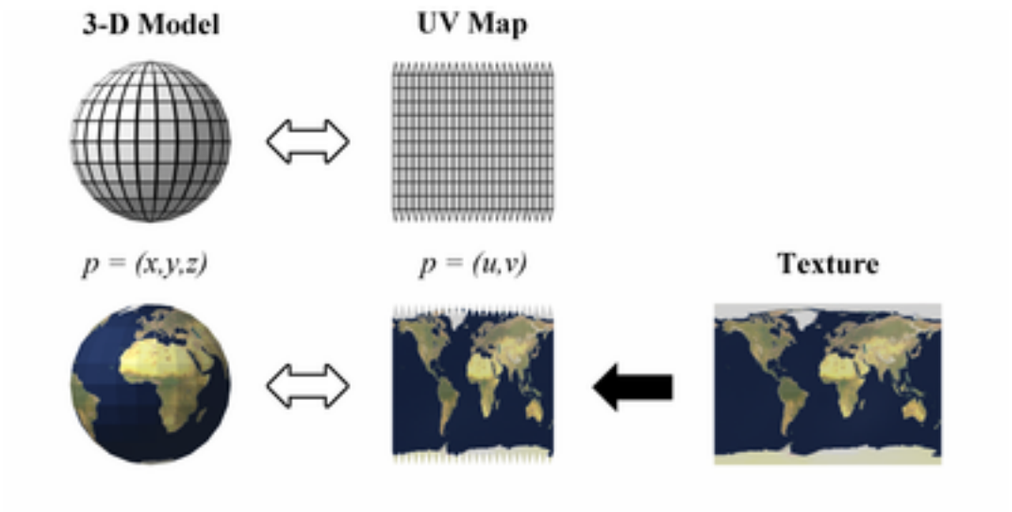
[Stam 99]

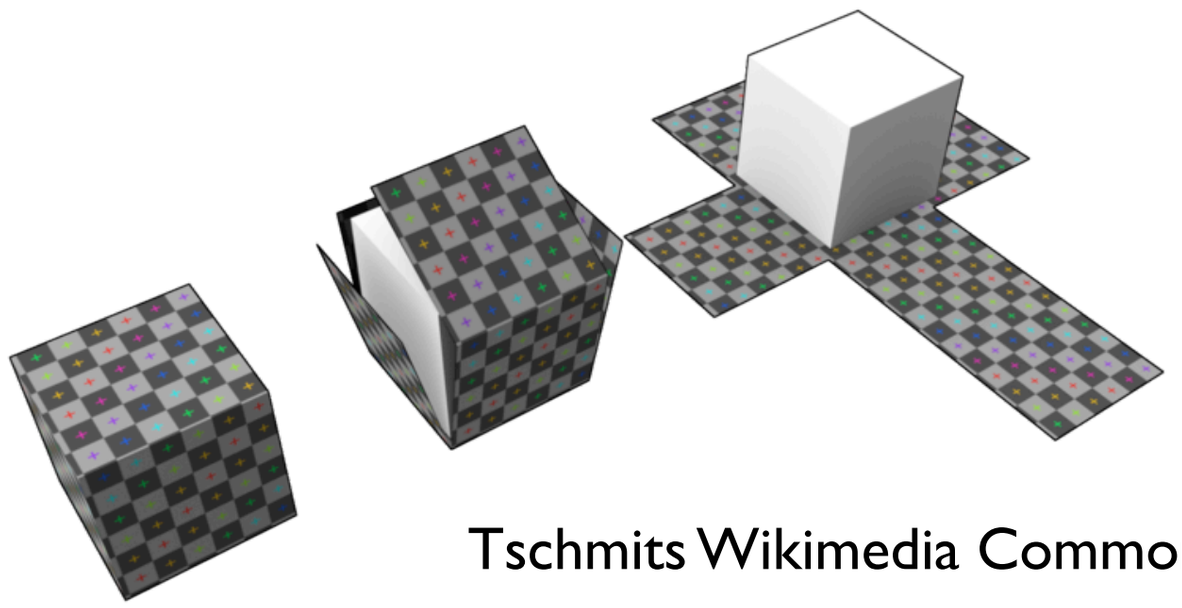
Texture mapping in the OpenGL pipeline



- Geometry and pixels have separate paths through pipeline
- meet in **fragment processing** - where textures are applied
- texture mapping applied at end of pipeline - efficient since relatively few polygons get past clipper

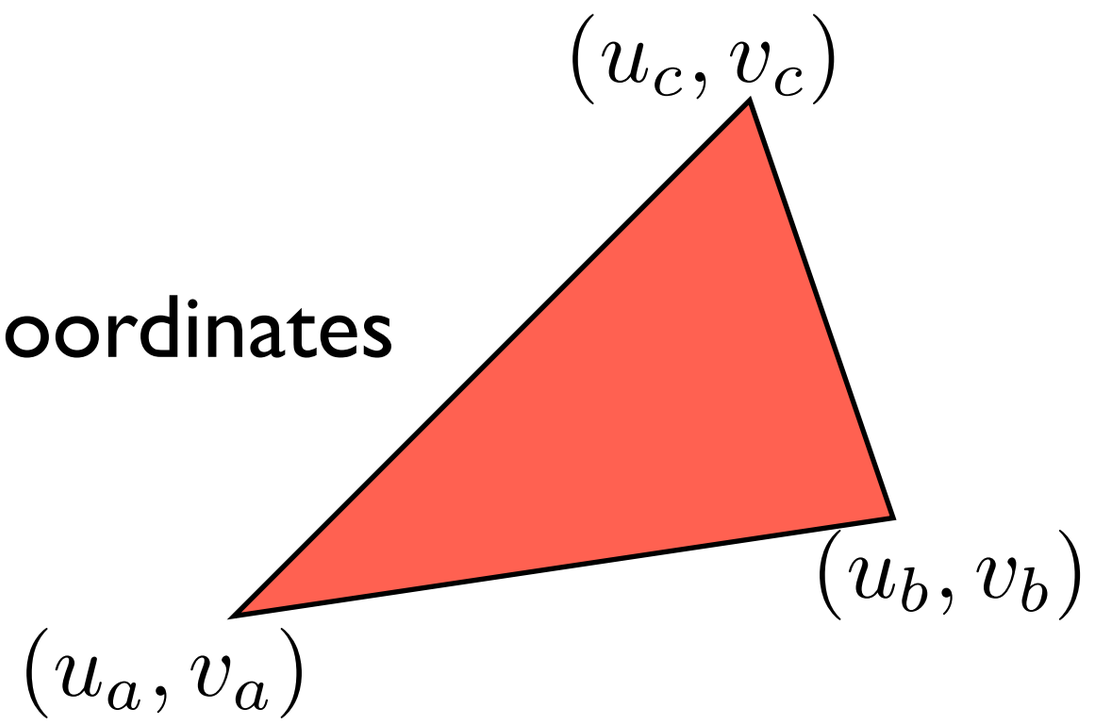
uv Mapping



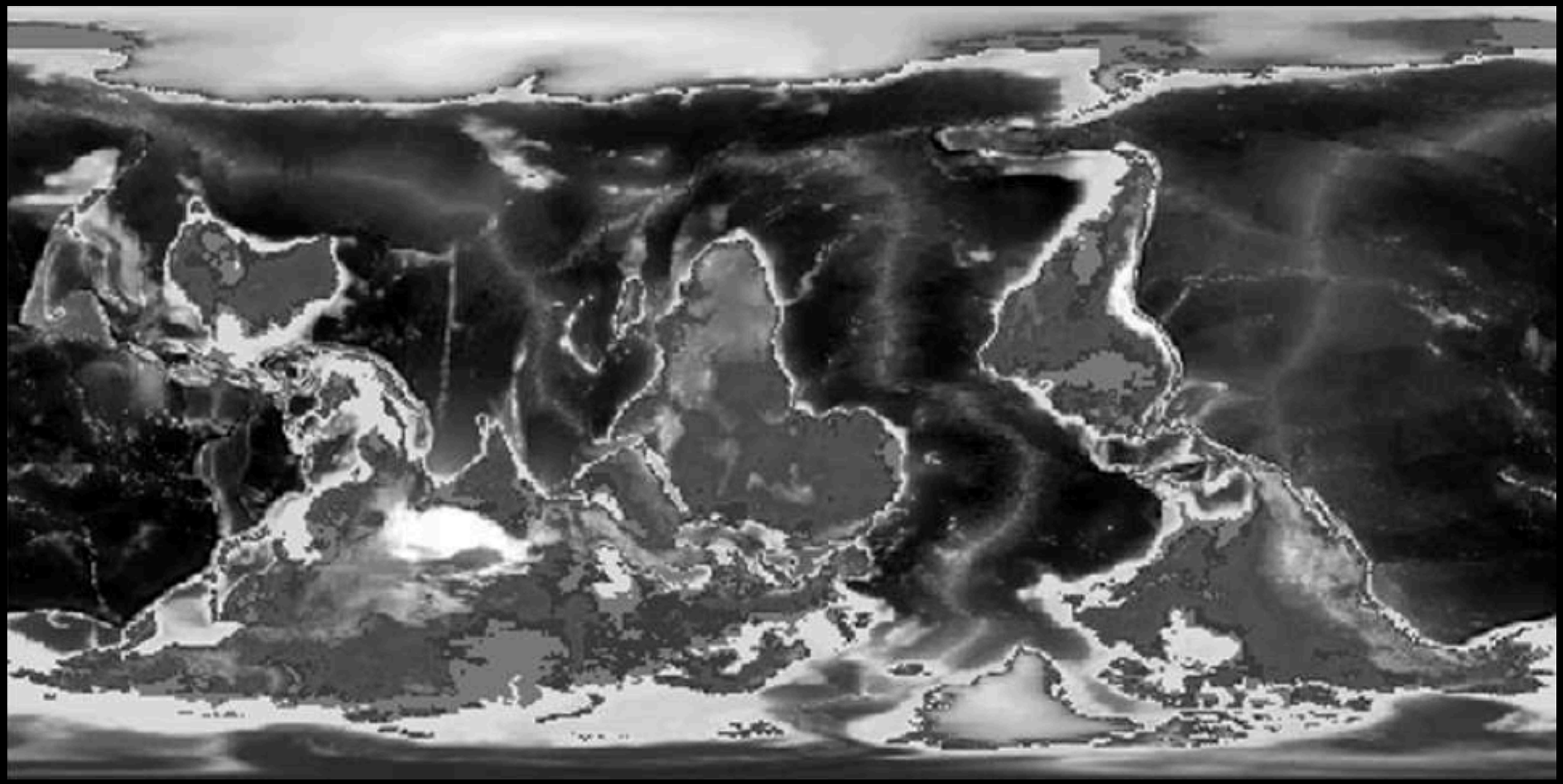


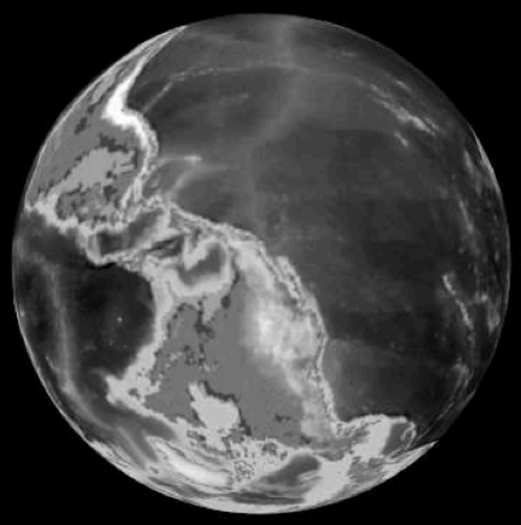
Tschmits Wikimedia Commons

- Texture is parameterized by (u,v)
- Assign polygon vertices texture coordinates
- Interpolate within polygon

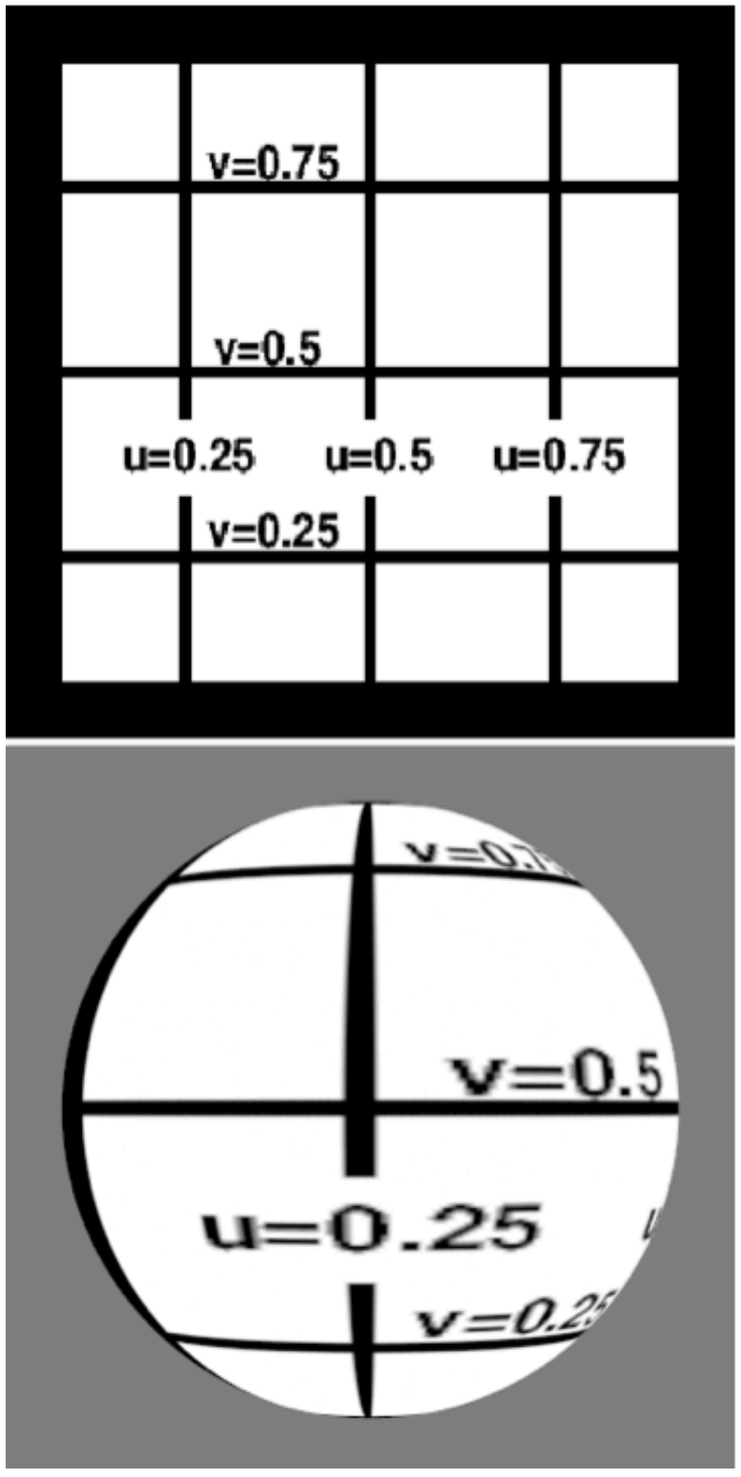


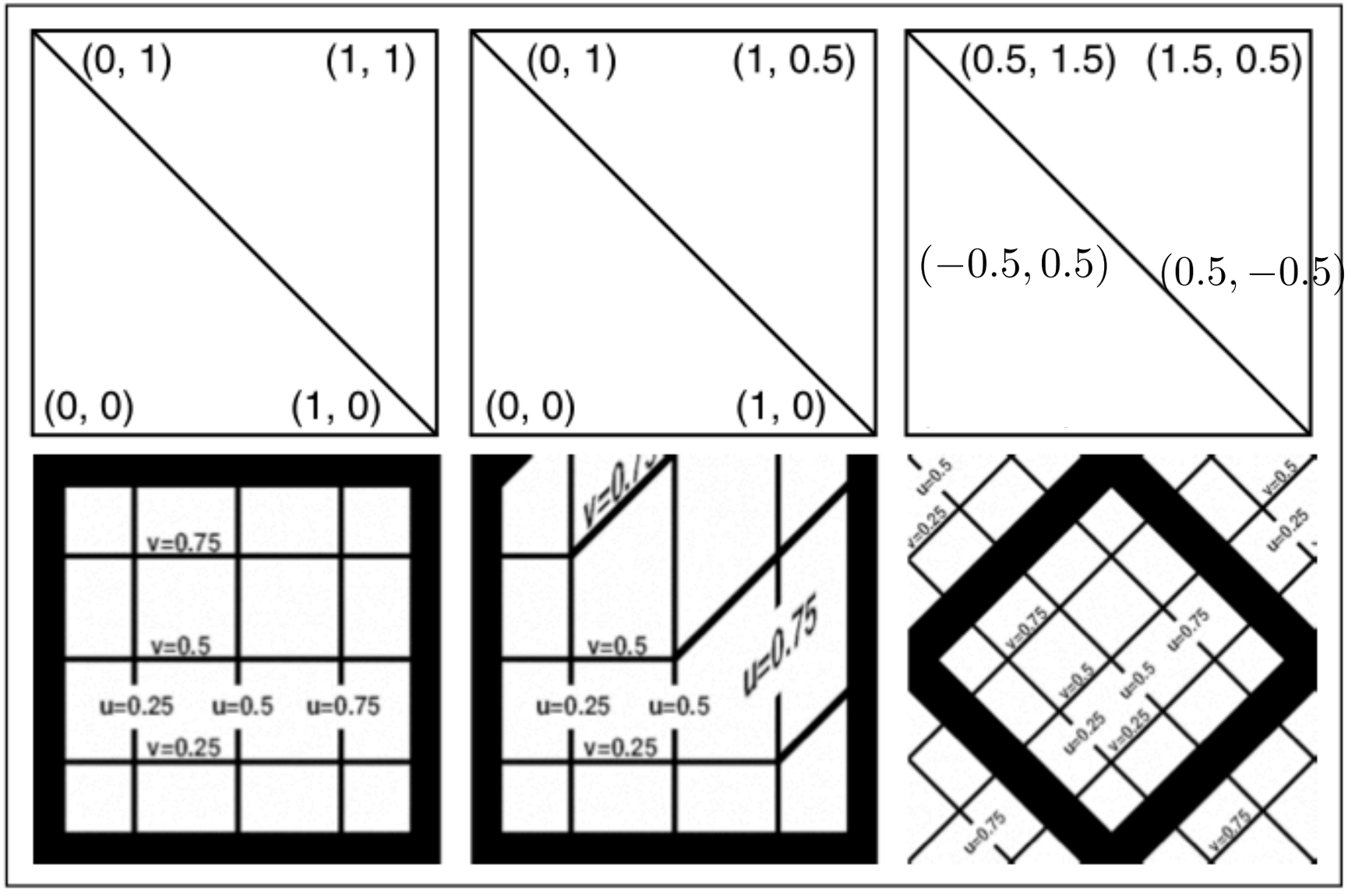
Texture coordinates are per-vertex data – a position in the (u,v) space
can interpolate tex coordinates with barycentric coordinates





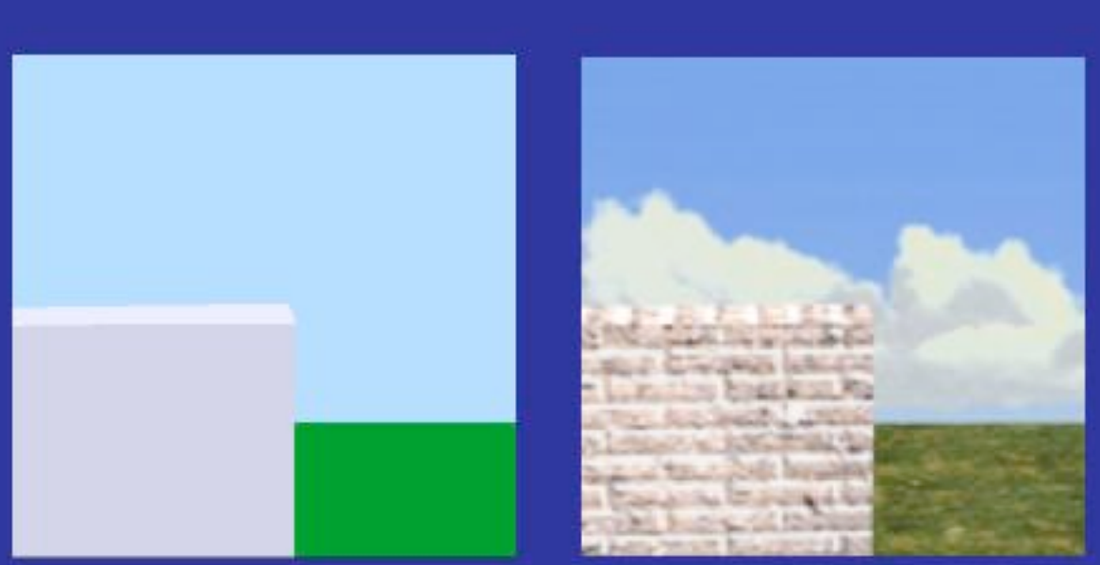
Texture Calibration

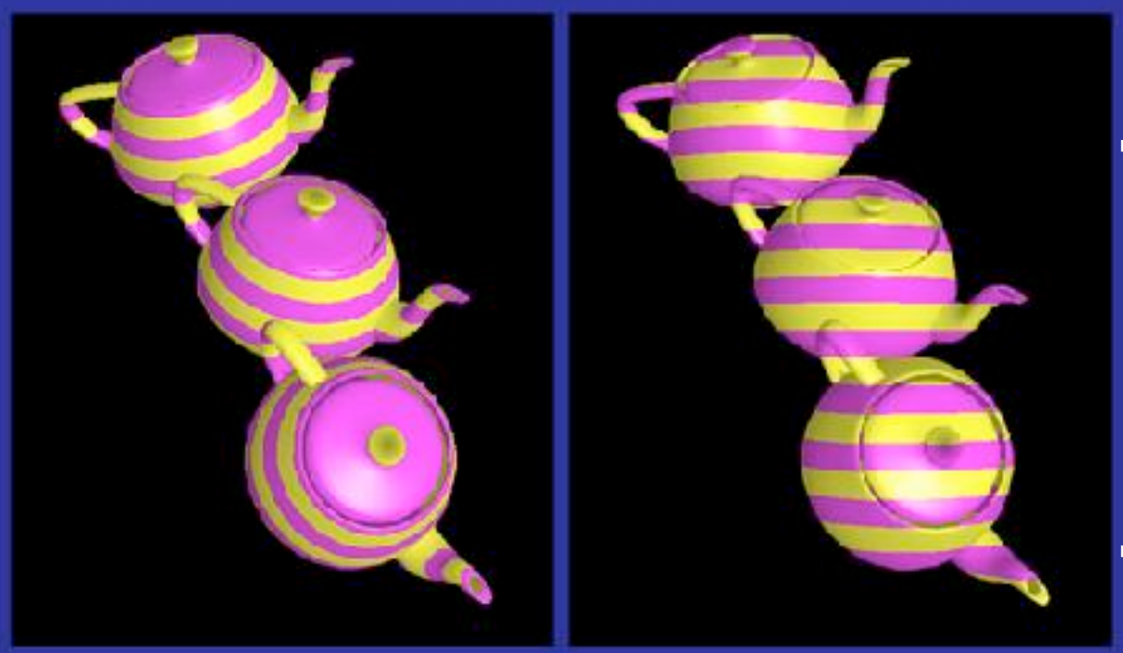




The major issues in texture mapping...

- What should the actual mapping be?





[Rosalee Wolfe]

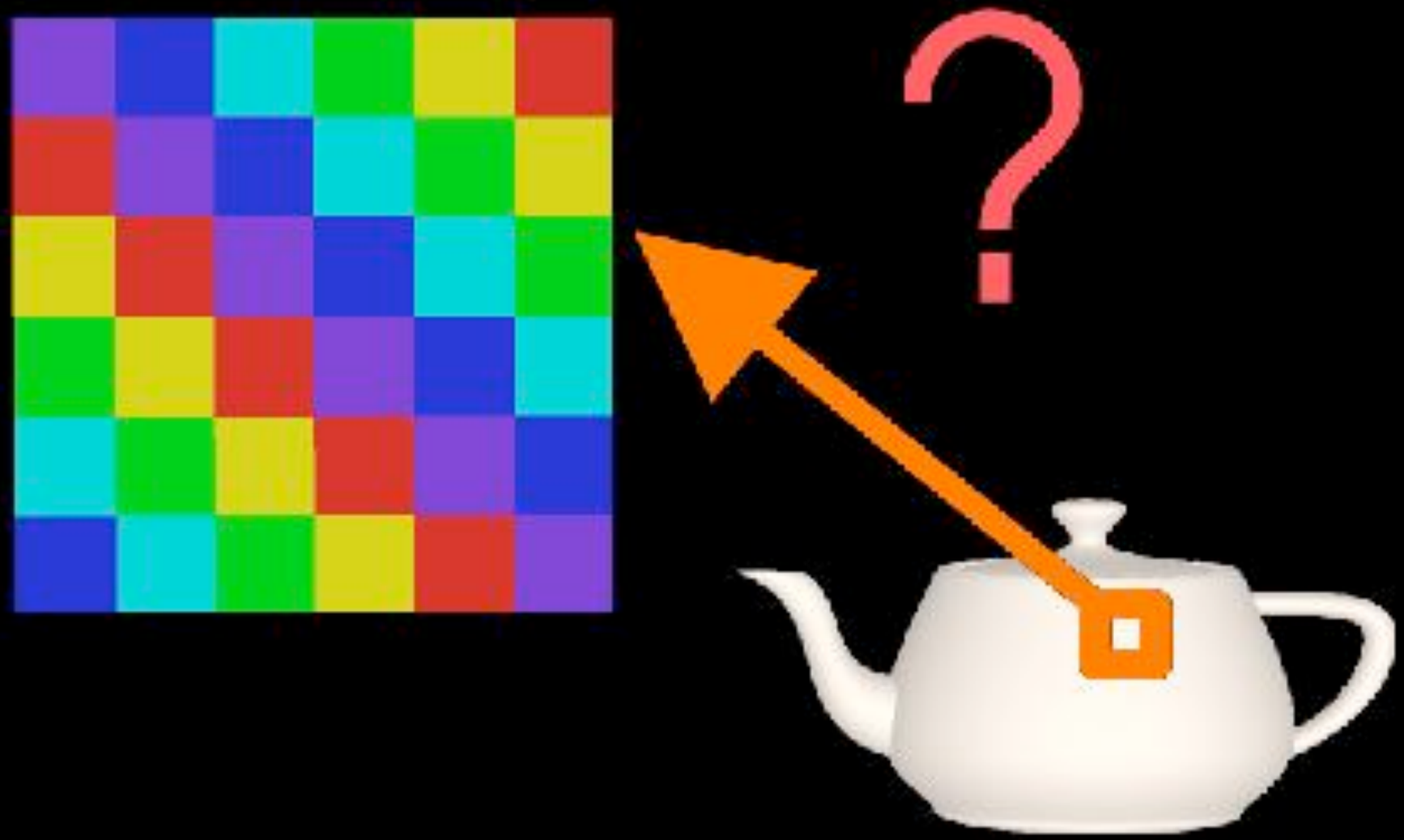
easy: rectangular surface

harder: parametric surface

Teapot: Which image looks better? The image on the left uses **object coordinates** in the texture mapping – this makes more sense. The image on the **right** uses **world coordinates** – texture ends up changing relative to the object

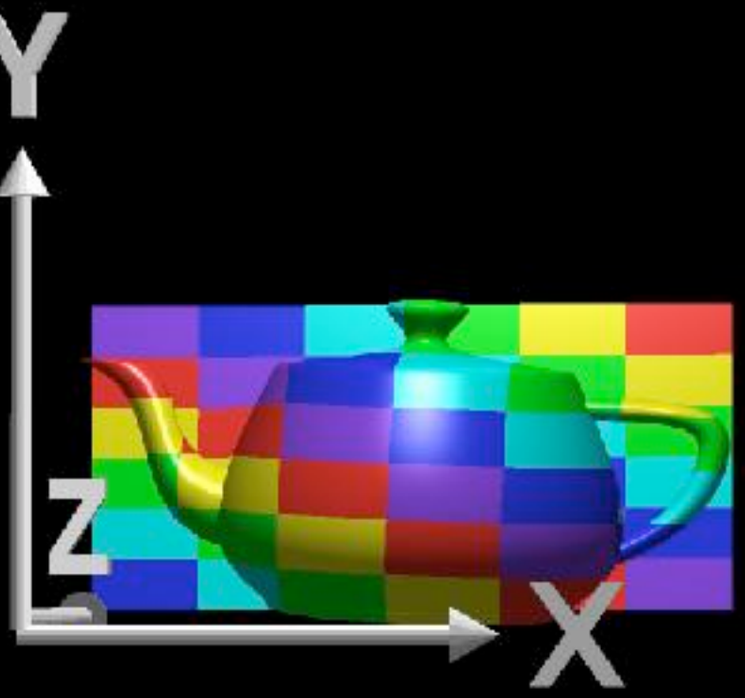
want a nice map that doesn't look distorted

Given a point on the object **(x,y,z)**, what point **(u,v)** in the texture we use?

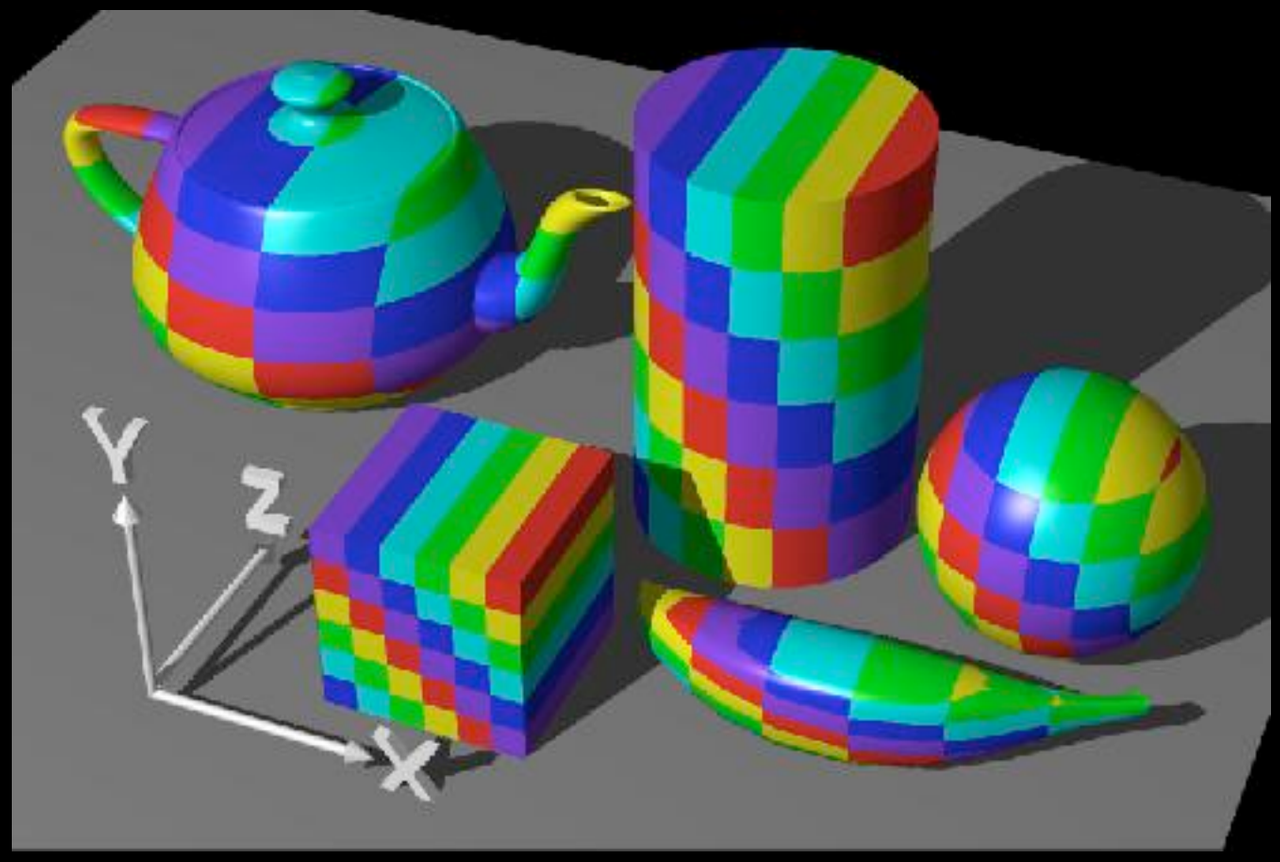


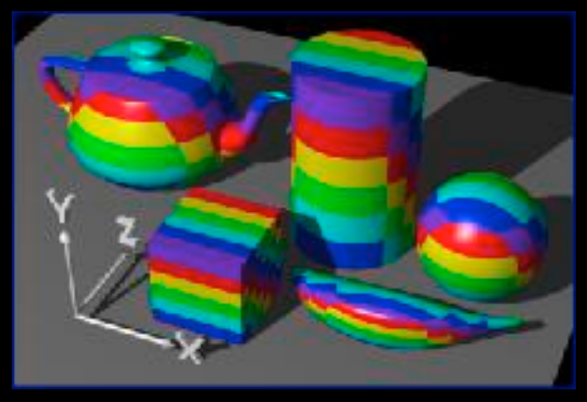
[Rosalee Wolfe]

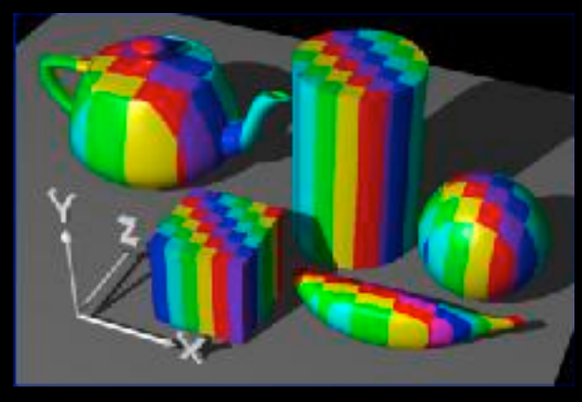
Example: planar mapping



[Rosalee Wolfe]

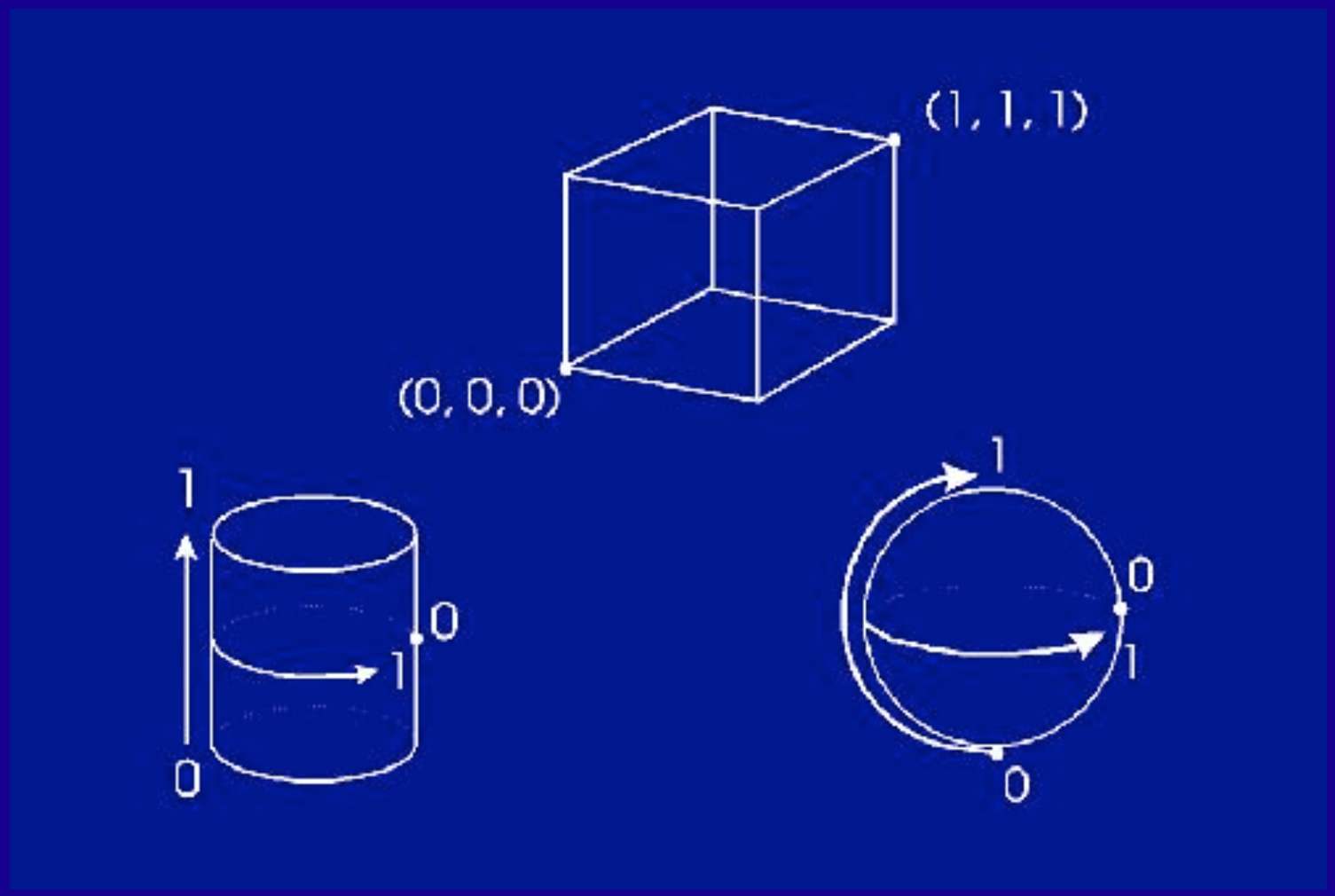






Intermediate surfaces

First map the texture to a simpler, intermediate surface



[Rosalee Wolfe]