Textures for Data Storage: Shadows

CSCI 4239/5239
Advanced Computer Graphics
Spring 2013

Shadows in Computer Graphics

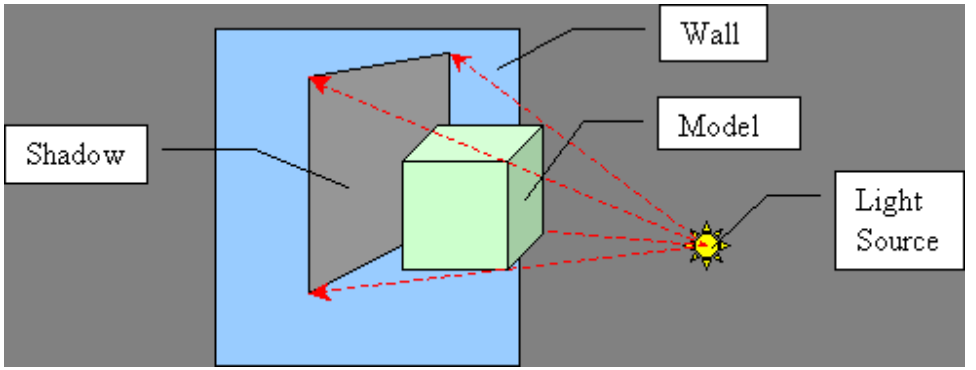
- Shadows are important to realism
  - Depth cues
  - Relative positions of objects
- Doesn't “just happen” when lighting is turned on
  - Nor is there a glEnable(GL_SHADOWS)
- Scene must be rendered 2-4 times
- Shader implementation can be efficient
  - Draw once every time the light or scene changes
  - Draw once for every eye position

Shadow Examples

- Planar Shadows (CSCI 5229 ex32)
  - Shadows on the floor only
- Shadow Volumes (CSCI 5229 ex33)
  - True shadow, very hard
- Shadow Maps (CSCI 5229 ex34)
  - True shadows, depth in textures
- Shader Shadow Map (ex18)
  - Fast implementation via shader

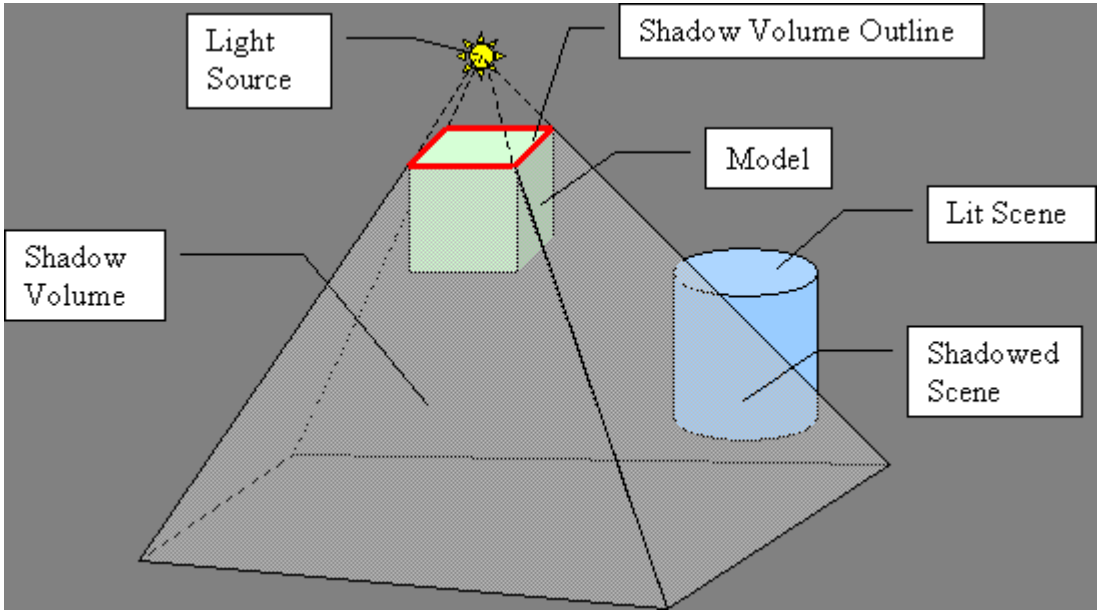
Planar Shadows

- Projects object on surface
- Simplest shadows
- Fast but very limited
- The problem:
  - Surface defined by point *E* and normal *N*
  - L is the light
  - *P* is on the object
  - Find *P*' the projection of *P* on the surface
- Only works on a large plane (e.g. floor)



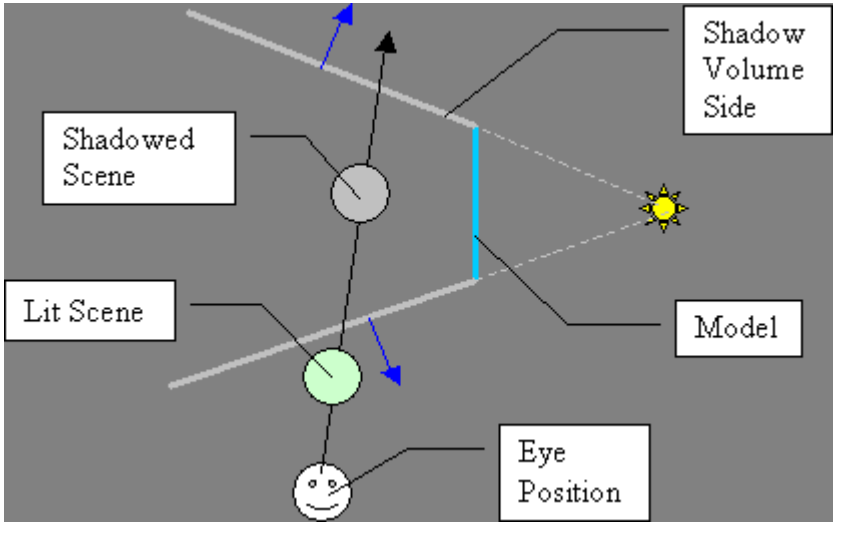
Shadow Volumes

- The volume corresponding to the shadow cast by a facet of each object
  - Potentially multiple shadow volumes per object
  - Shadow of the object is the combination of all shadow volumes for the object



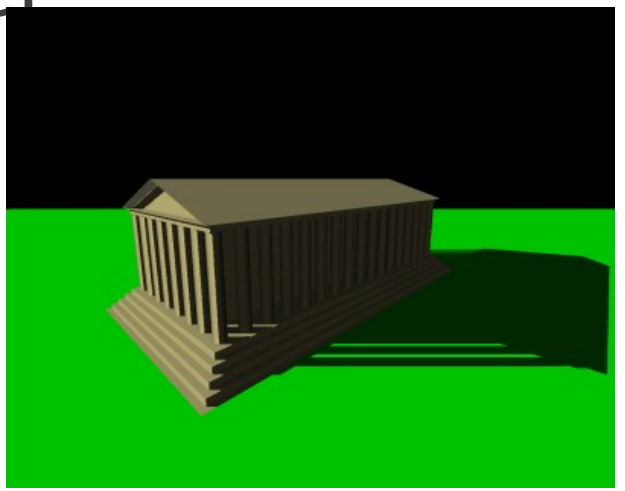
Shadow Volume Algorithm

- Count transitions in and out of shadow volumes
  - Increment of in, decrement for out
  - Similar to polygon winding rule for in/out
- Lit areas has value of zero (initial value)
- Requires a complete code rewrite to use shadow volumes to render polygons
- Needs stencil buffer



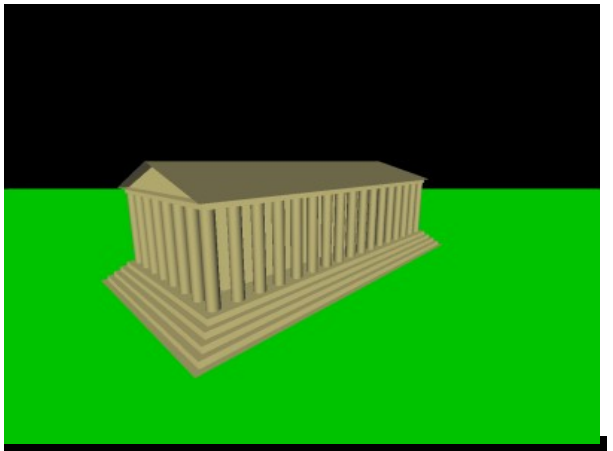
Shadow Mapping

- Project with light as viewpoint
- Depth buffer from light
- Light/shadow determined just like visibility
  - Objects in light foremost in depth buffer
  - Objects in shadow depth obscured
- Requires second depth buffer
  - Store depth to texture
  - Compare R to texture
- In OpenGL extensions
- Used in *Toy Story* etc.

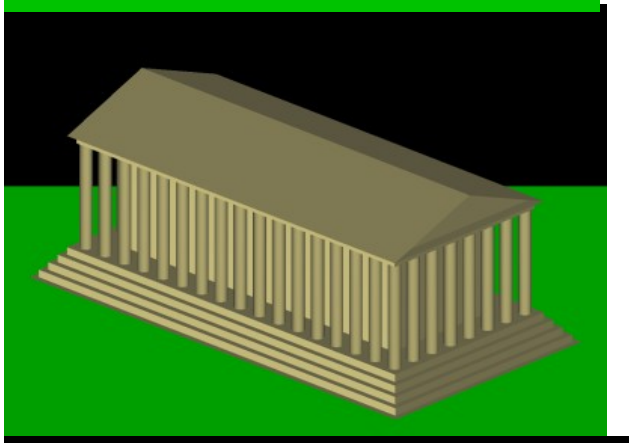


Shadow Map Example

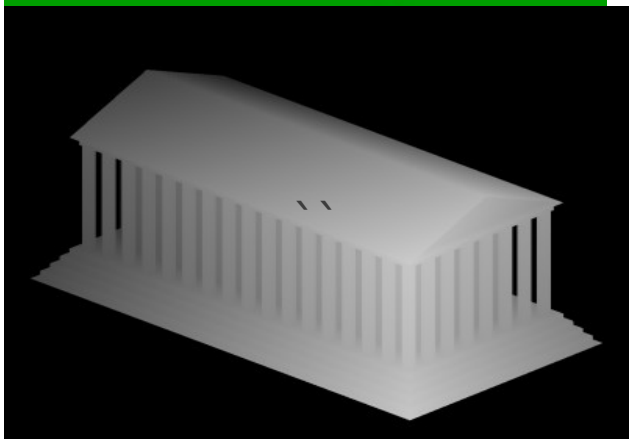
No Shadows



Light View



Light View Depth



Shadow Map Shader

- Draw shadow map
  - Bind framebuffer to depth texture
  - Draw scene with eye at light to generate depths
  - Update if light or scene changes
- Draw scene
  - Generate texture coordinates with light PoV
  - Compare depth (R) with depth texture
    - R=depth means lit – light as normal
    - R>depth means shadowed – ambient light only
- Fast, Simple, Realistic