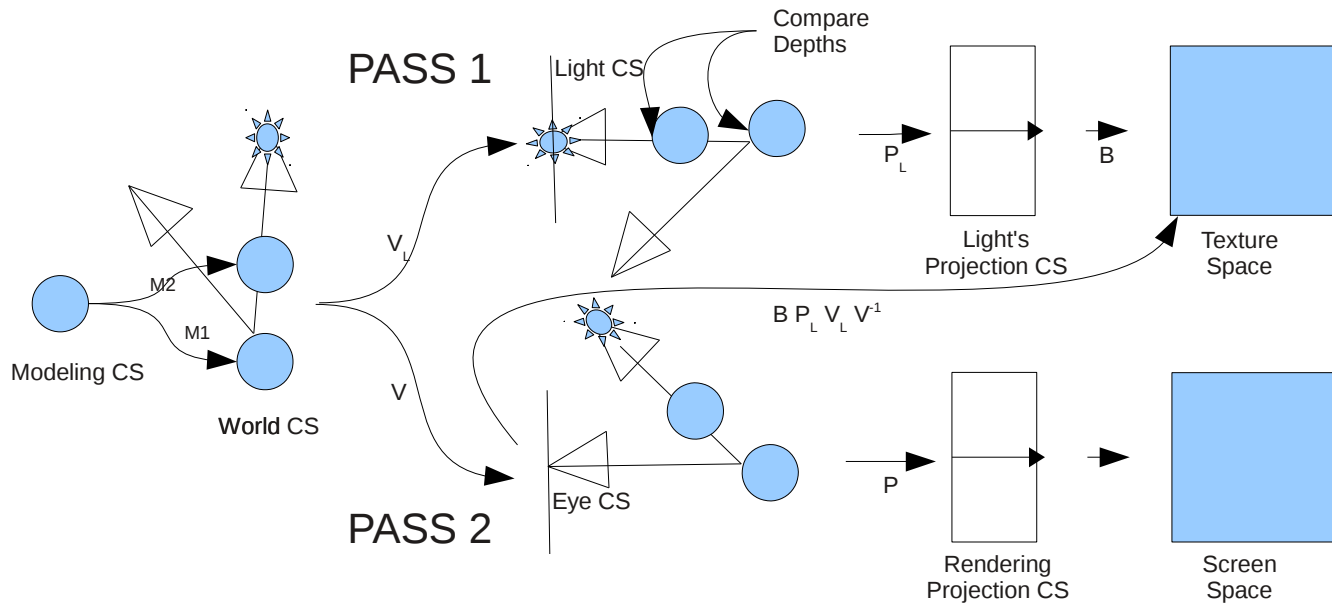


Shadow Maps



Shadow maps

Pass 1: Render from light's POV, to a Frame Buffer Object (FBO)

Viewing: $V_L = \text{gluLookAt}$ from light's POV

Projection: $P_L = \text{glFrustum}$ from light's POV

Vertex processor:

Usual $\text{gl_Position} = \text{ftransform}()$ for the scan conversion

varying **position** = gl_Position ;

Pixel processor:

Write **depth** (that is position.w) to gl_FragColor or $\text{gl_FragData}[0]$

(alternately: write full position and extract its w comp in pass 2)

Pass 2: Render from eye's POV to screen:

Viewing: $V = \text{gluLookAt}$ from eye's POV

Projection: $P = \text{glFrustum}$ from eye's POV

ShadowTr: $B P_L V_L V^{-1}$ (Used to transform position in eye coordinates to shadow-texture coordinates)

Vertex processor:

Usual $\text{ftransform}()$ for the scan conversion

Varying **position** = $\text{gl_ModelViewMatrix} * \text{gl_Vertex}$

Fragment shader:

$\text{shadowCoord} = \text{ShadowTr} * \text{position}$

(For efficiency sake, consider moving this multiplication to the vertex shader.)

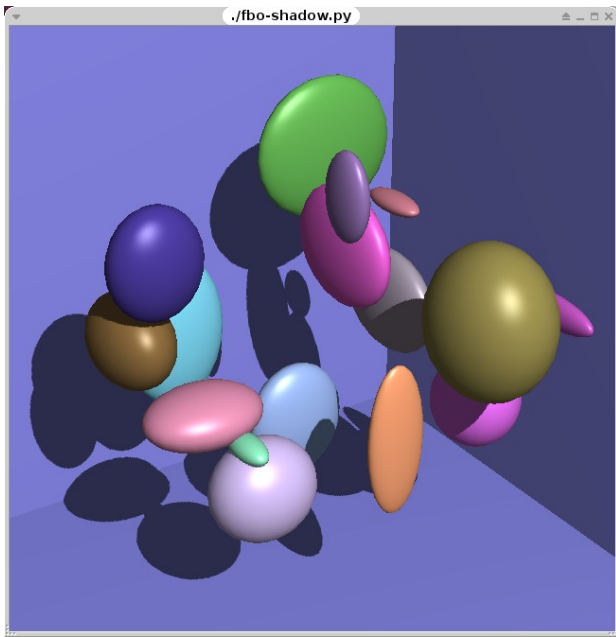
Light-depth = w coordinate from indexing shadow-texture at $\text{shadowCoord.xy}/\text{shadowCoord.w}$

Pixel-depth = shadowCoord.w

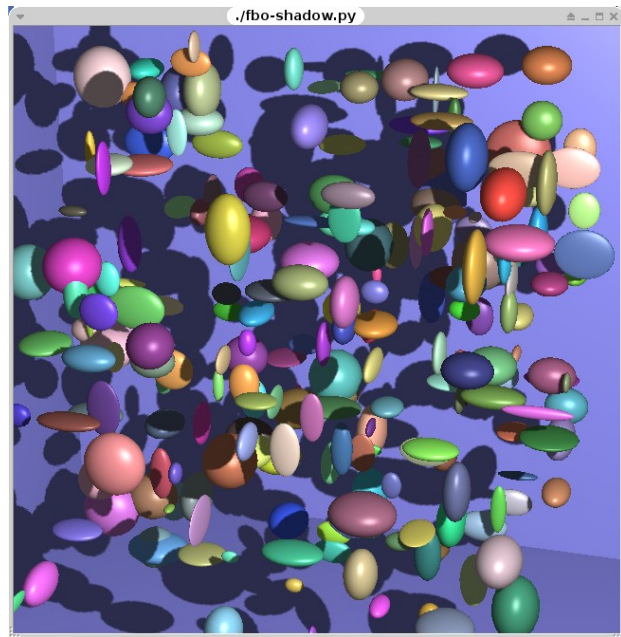
Pixel is in shadow if: $\text{Pixel-depth} > \text{Light-depth}$

Color pixel accordingly: ambient only (if in shadow),
ambient+diffuse+specular (if not in shadow).

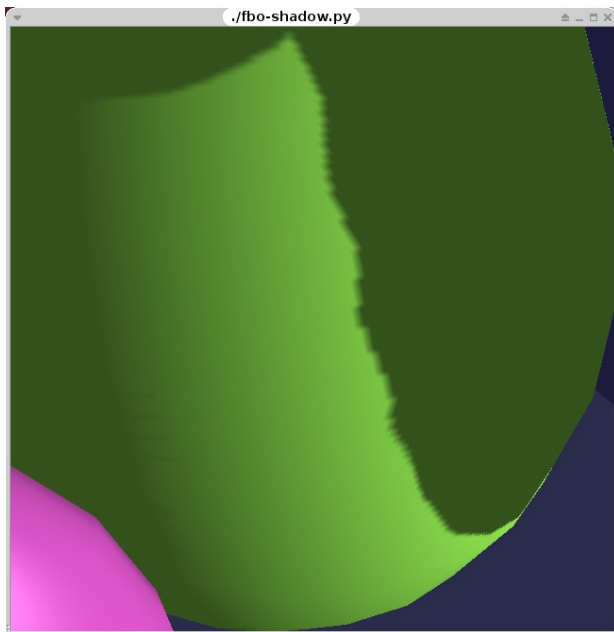
Examples



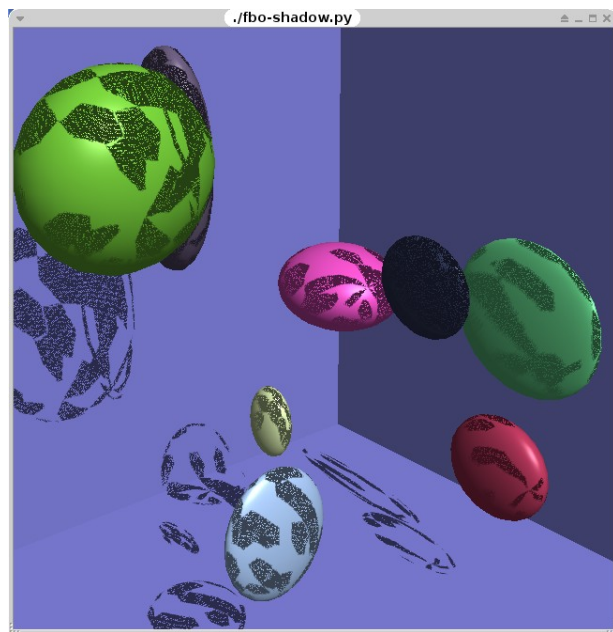
Example



Many shadows cast on many objects



Closeup showing pixelation of shadow map



Error due to depth precision problems

Problems and solutions

- Depth precision problems:
 - The shadow test compare two float for equality. This must be done carefully to allow for round-off errors.
- Depth fighting occurs at the front surface of any object
 - Front face culling, so shadow starts at back of surface
 - Fighting at back of surface is OK since
unlit due to geometry == unlit due to shadow