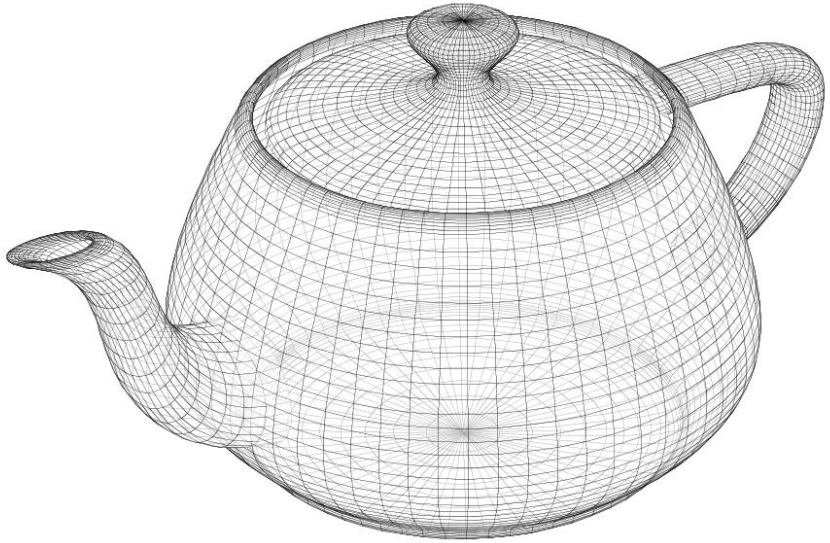
Shadows



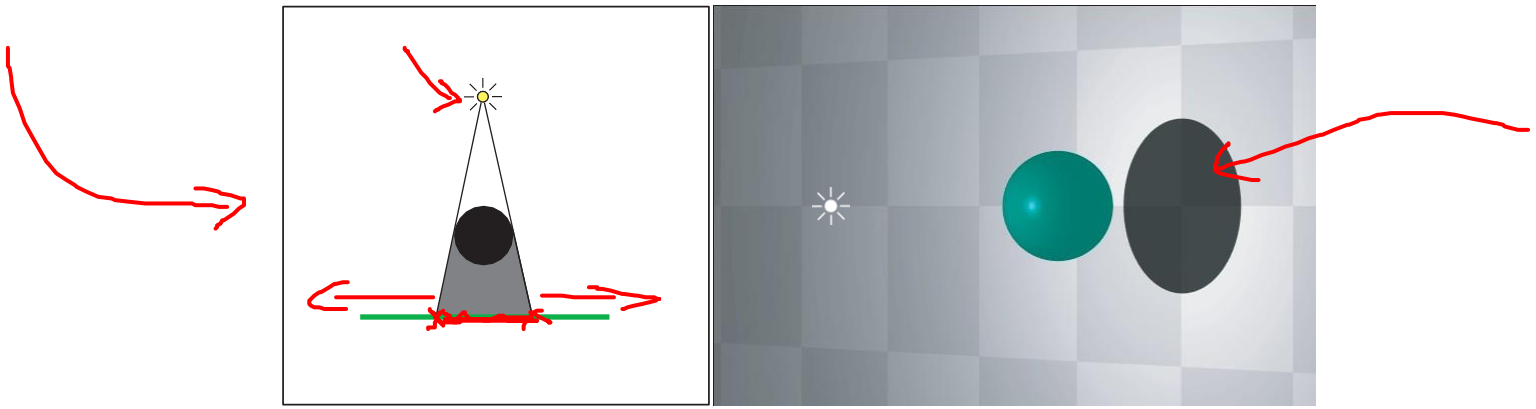
Production Computer Graphics

Professor Eric Shaffer

ILLINOIS

Shadows

- Easy to implement, can be computationally expensive
- Lights
  - Point light has a position, emits light isotropically
  - Directional lights have direction but no position
- For idealized lights (point and directional) shadows are hard-edged

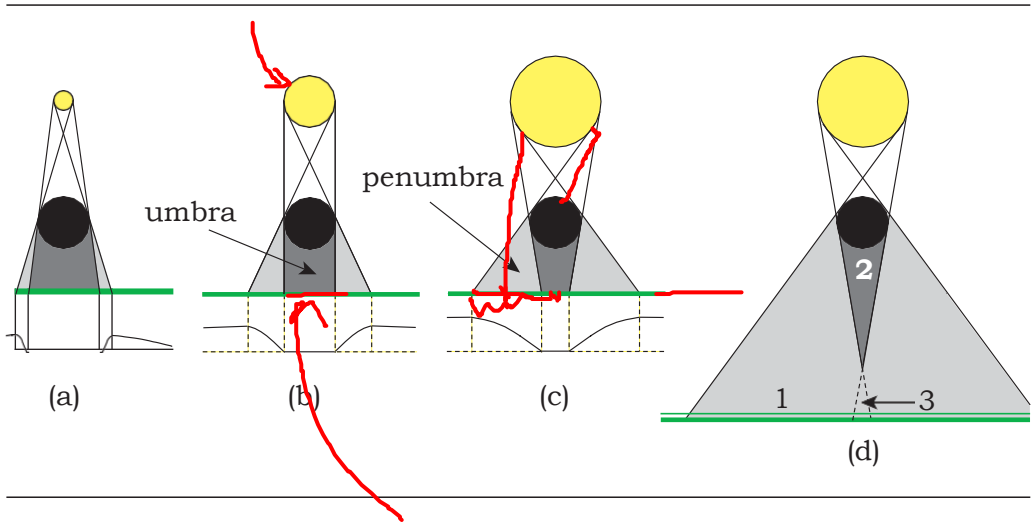


Real Lights…Soft Shadows

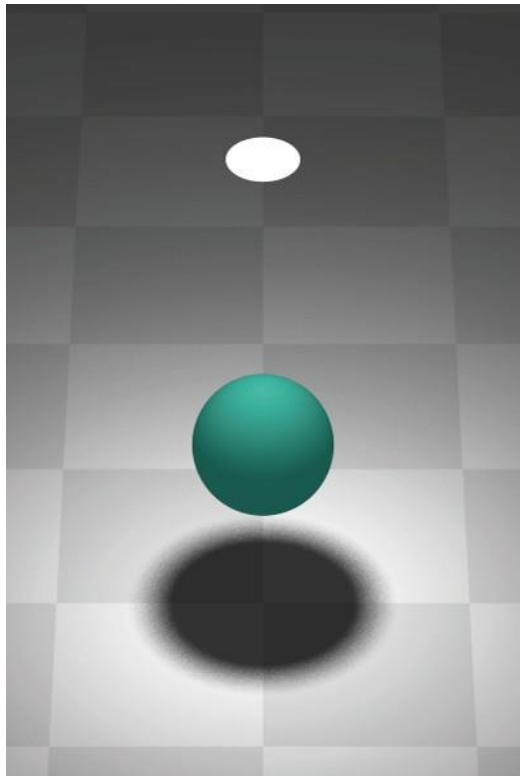
Real lights have a finite area

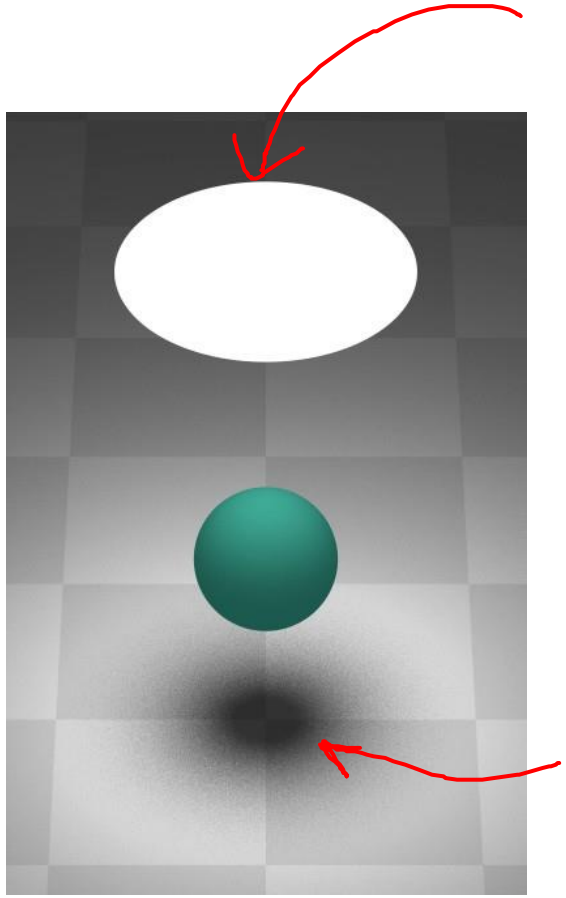
Umbra is the shadow where no light is visible

Penumbra is partial light

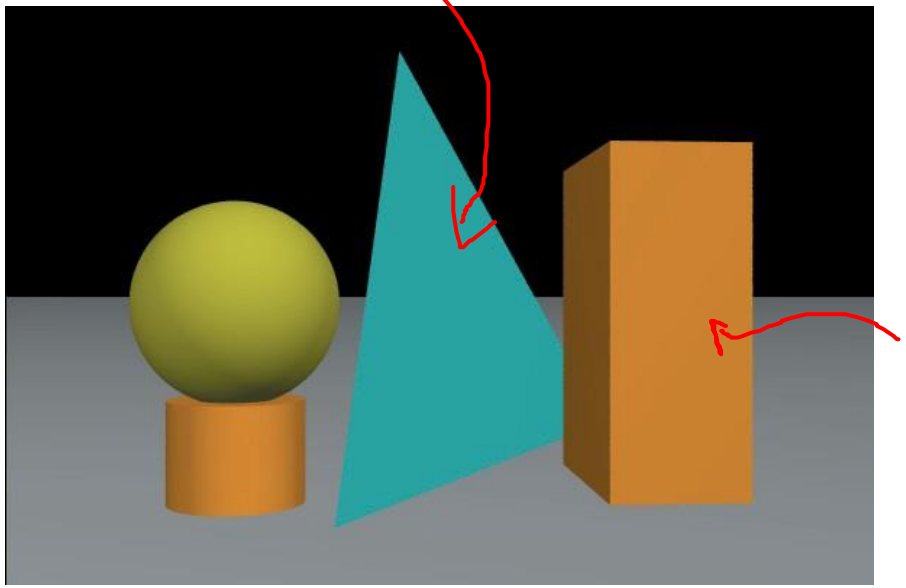


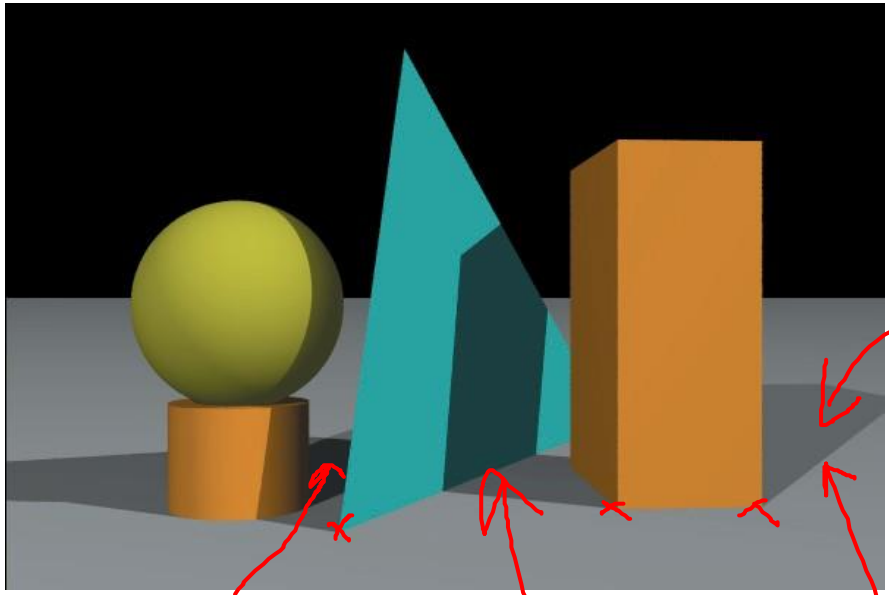
Real Lights...Soft Shadows





Shadows Provide a Lot of Information



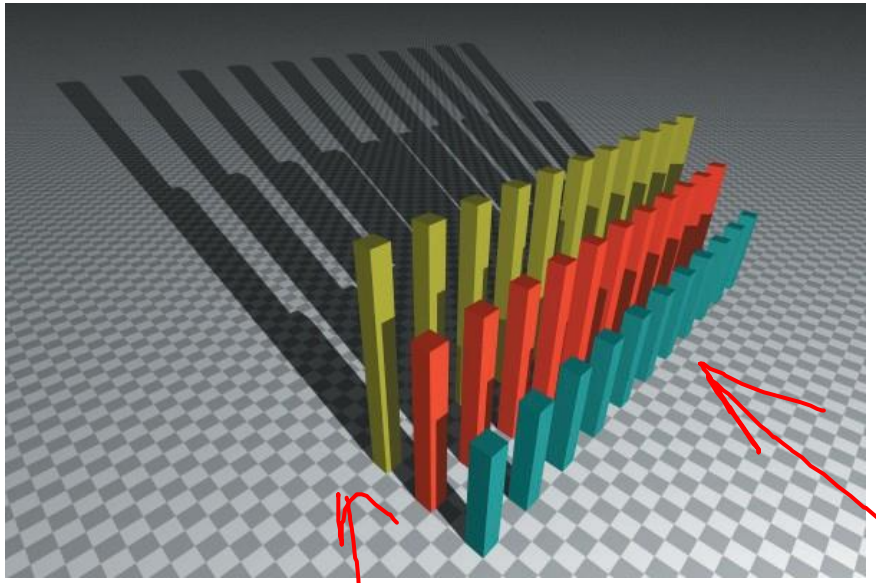


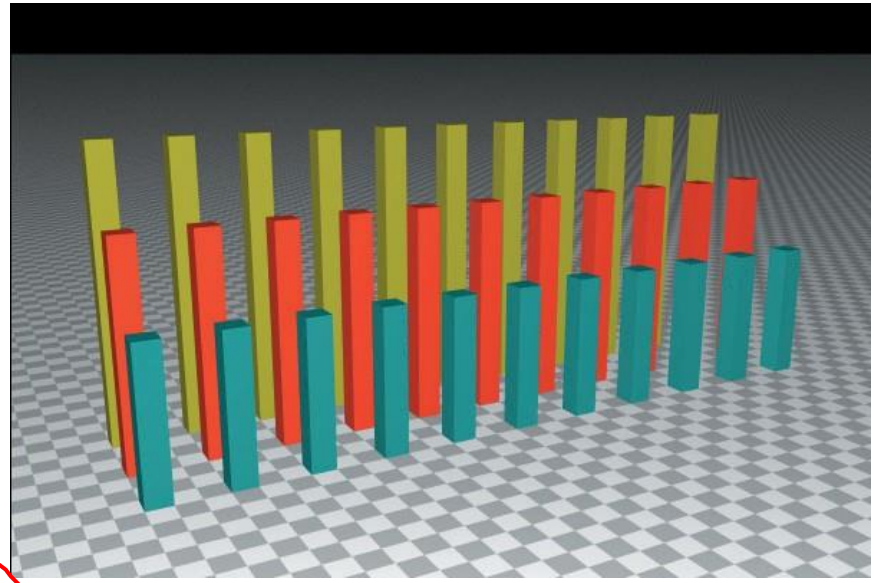
How far are the objects above the plane?

What is their distance from the cameras and relative sizes?

How many lights are there?

Shadows

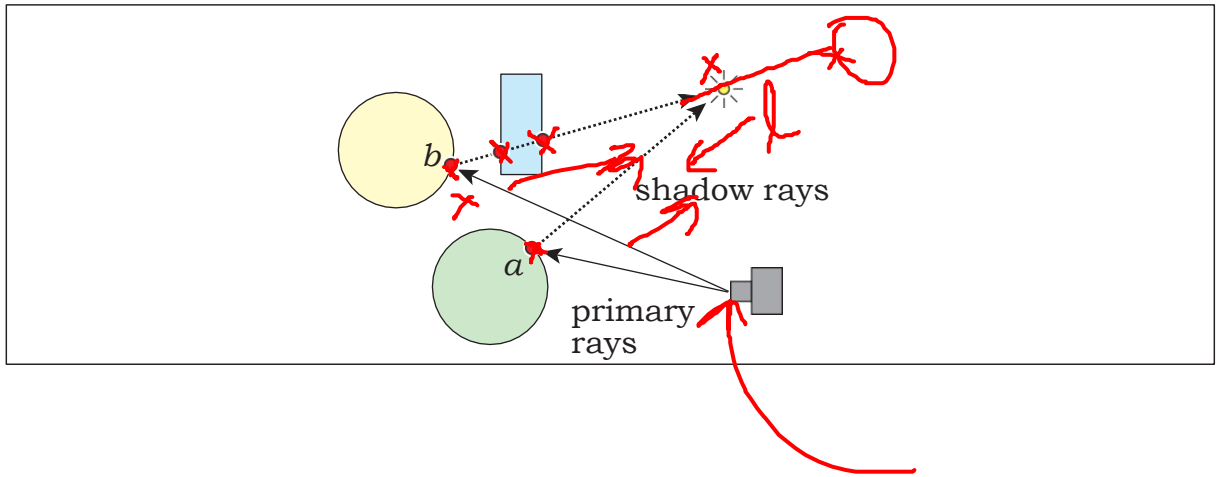




What are the relative positions of the light and eyepoint?

Implementation

- Determine visibility of light by ray-casting
  - Shadow ray origin is a object-primary ray hit point
  - Direction is the light direction
    - For point lights, use light position – hit point



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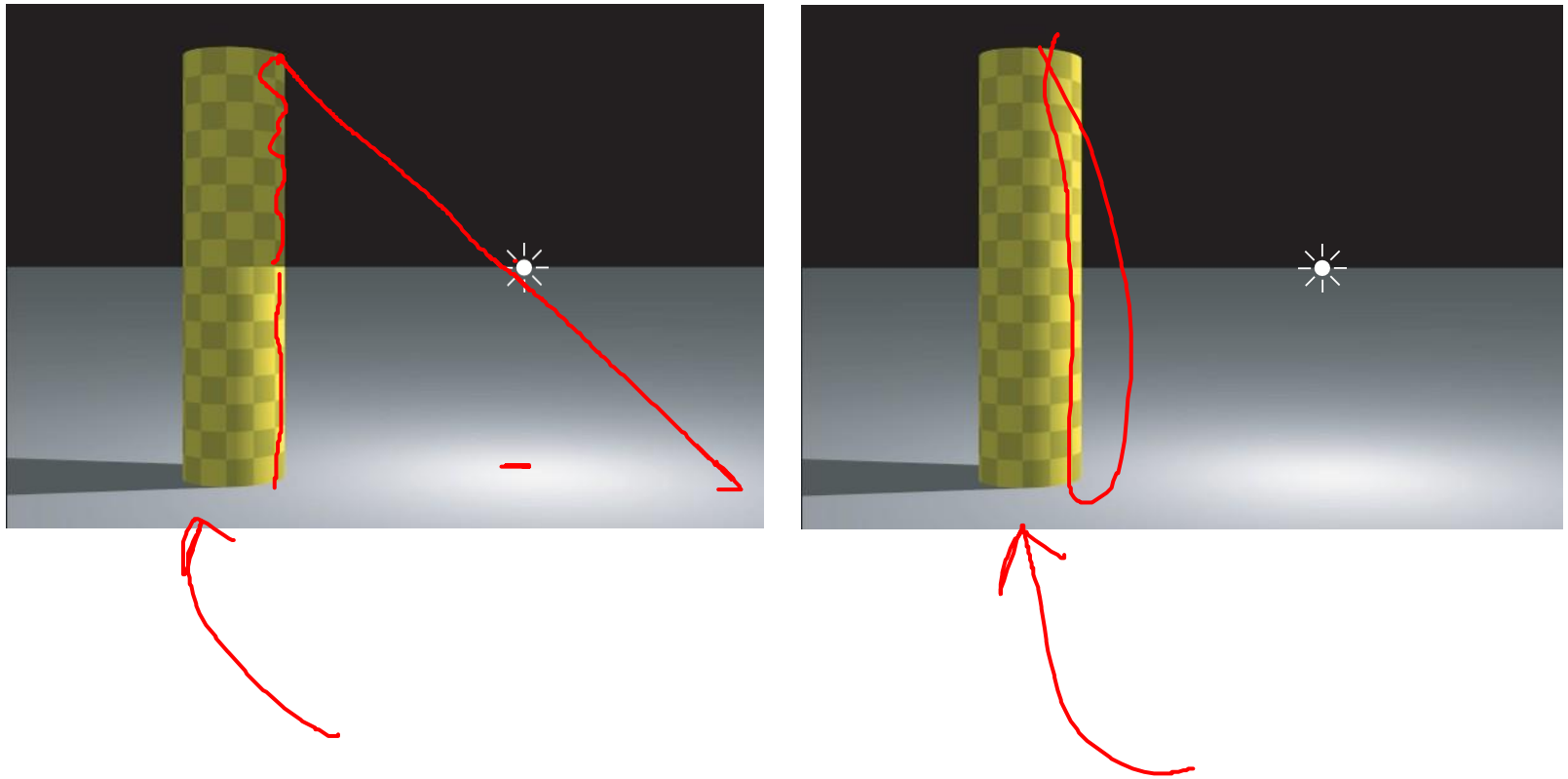
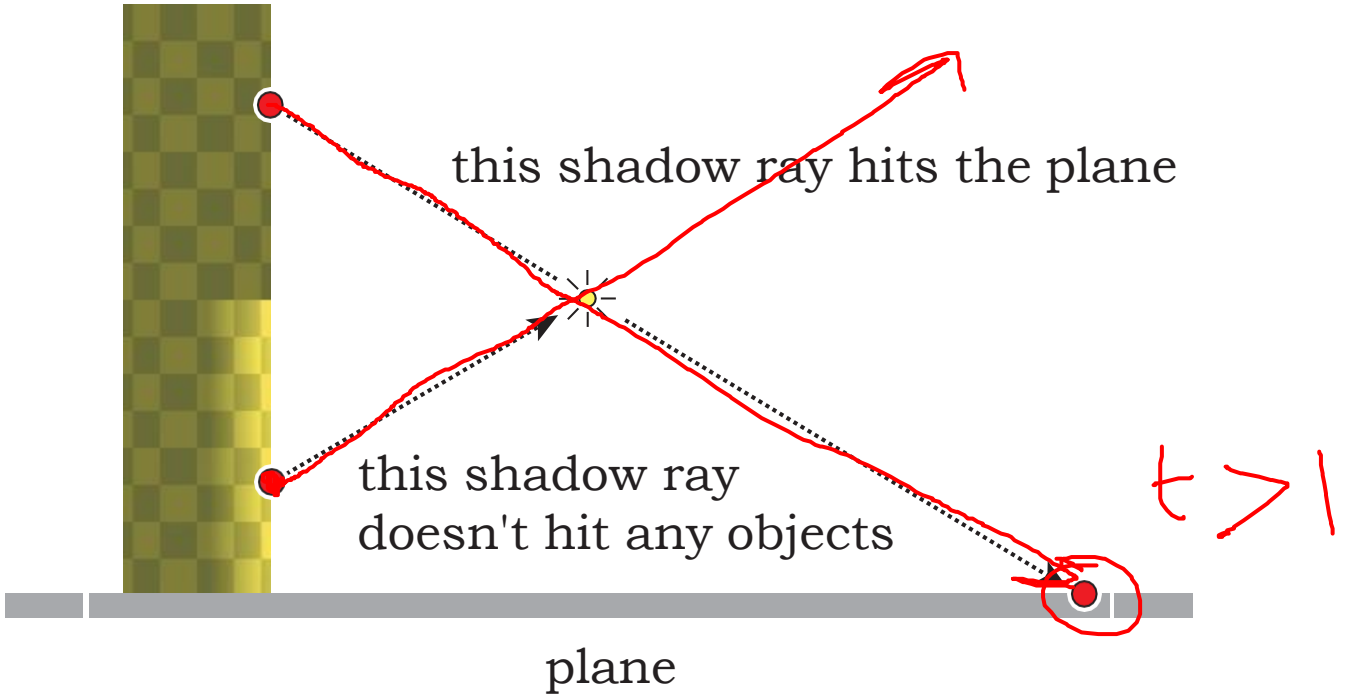
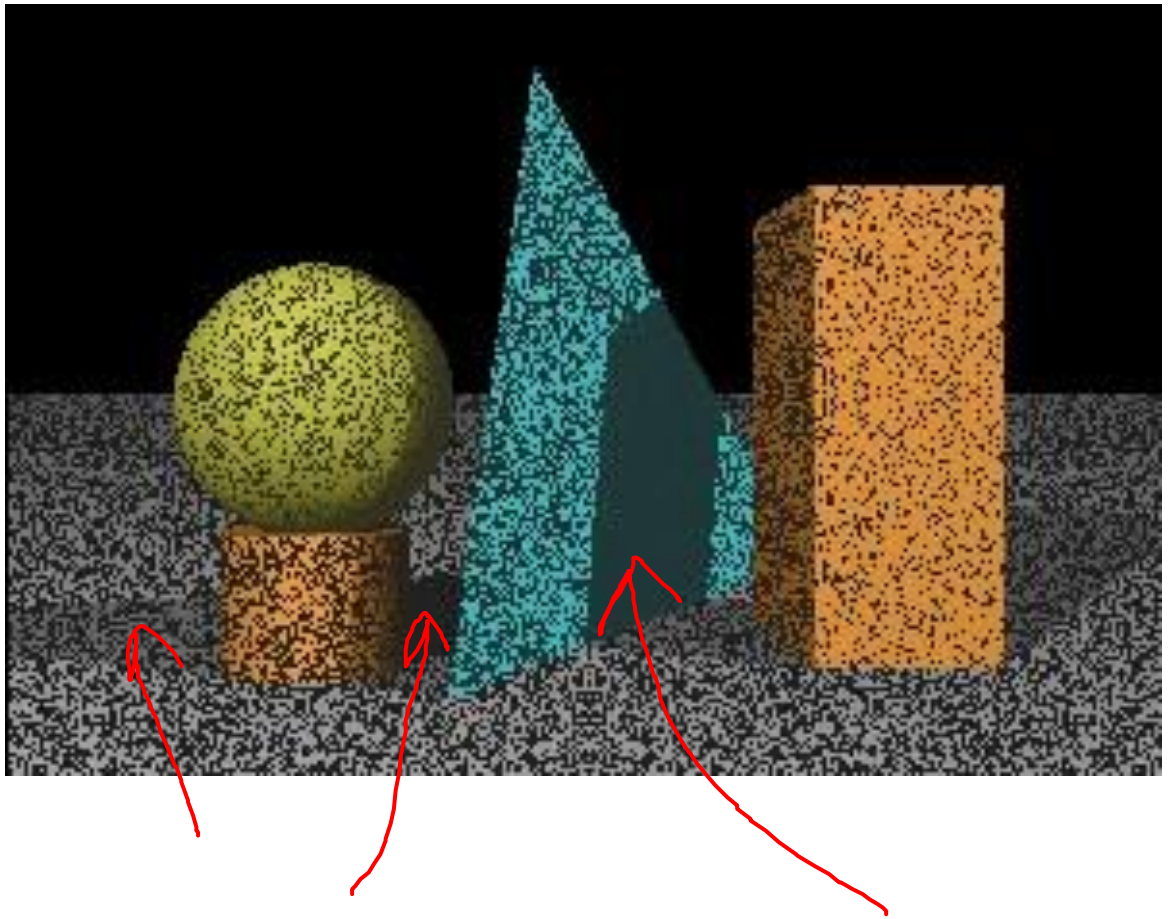
What Went Wrong?



What Went Wrong?



What Went Wrong?



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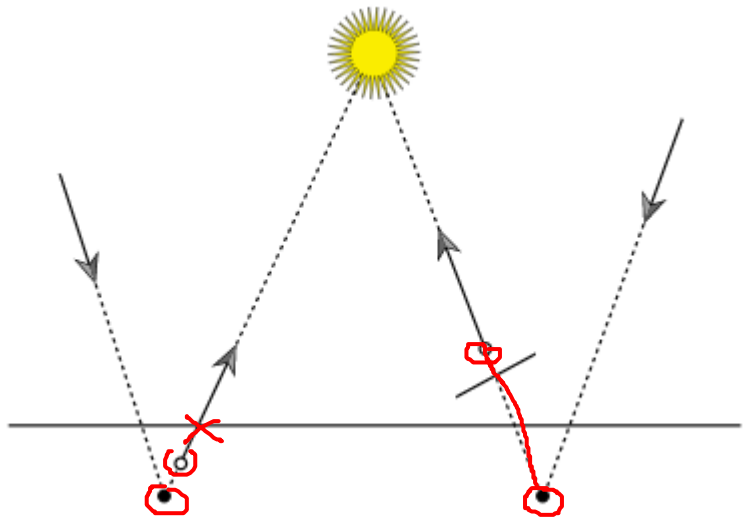
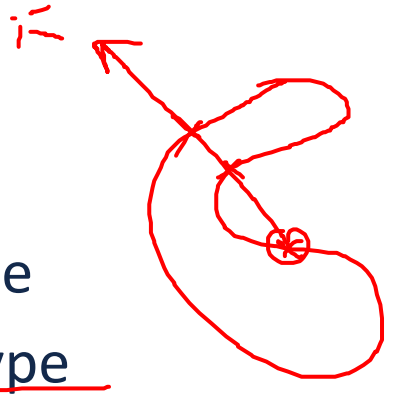
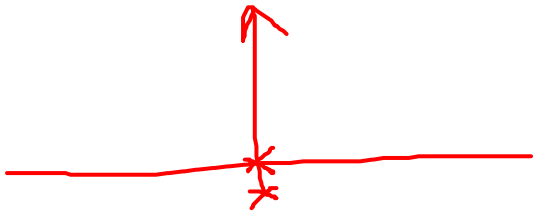
Rays from Objects

- Need to add an ε value to ray origin
  - Move it slightly in direction of ray…
  - Otherwise, numerical issues can result in hitting the object surface
  - To be more robust, define a constant for each geometric object type
    - …dependent on surface area







$\varepsilon = .00001$

Shadows Can Be Expensive