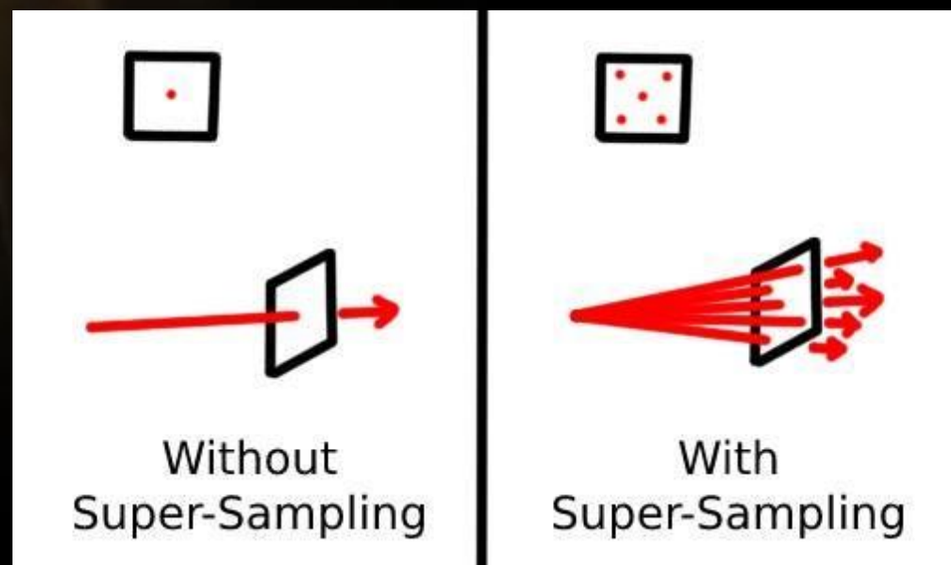
Super-sampling

In this part of the mini-project
Each team will choose an algorithm,
design it and implement it
in their own ray tracer



Distributed Ray Tracing

Ray traced scenes often look "fake" due to:

- Jagged edges
- Hard shadows
- Everything is in focus
- Surfaces are perfectly shiny
- Glass is perfectly clear

Single rays should be **replaced** with a **distribution of rays**

Rob Cook, SIGGRAPH 84

Single ray -> distribution of rays

Multiple eye rays

- Jagged edges -> anti-aliasing
- Everything is in focus -> depth of field

Multiple shadow rays

- Hard shadows -> soft shadows

Multiple reflection rays

- Surfaces are perfectly shiny -> glossy surfaces

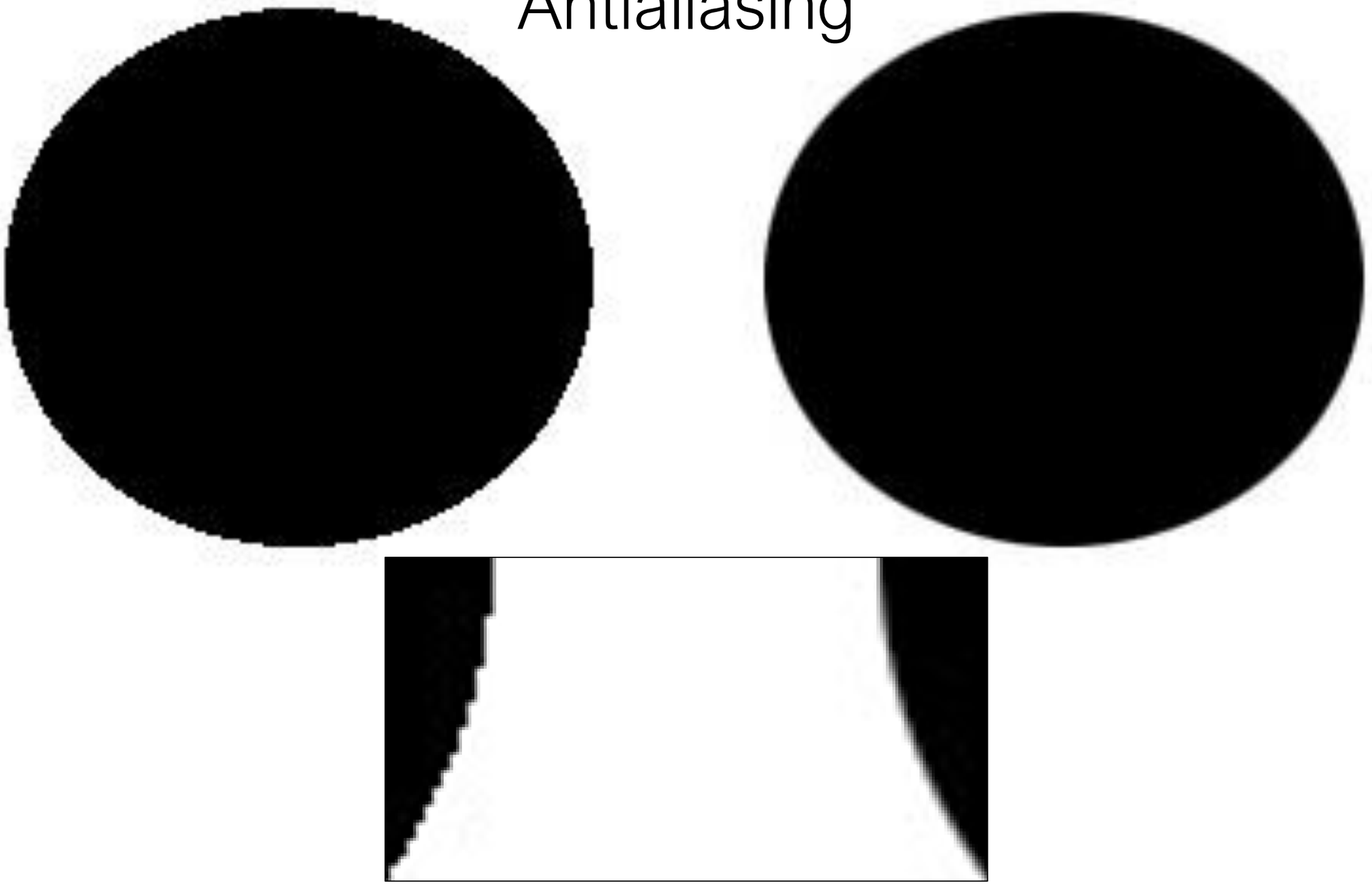
Multiple refraction rays

- Glass is perfectly clear -> diffused glass

All done by a beam of rays (Super-sampling)

Improving Ray Tracing

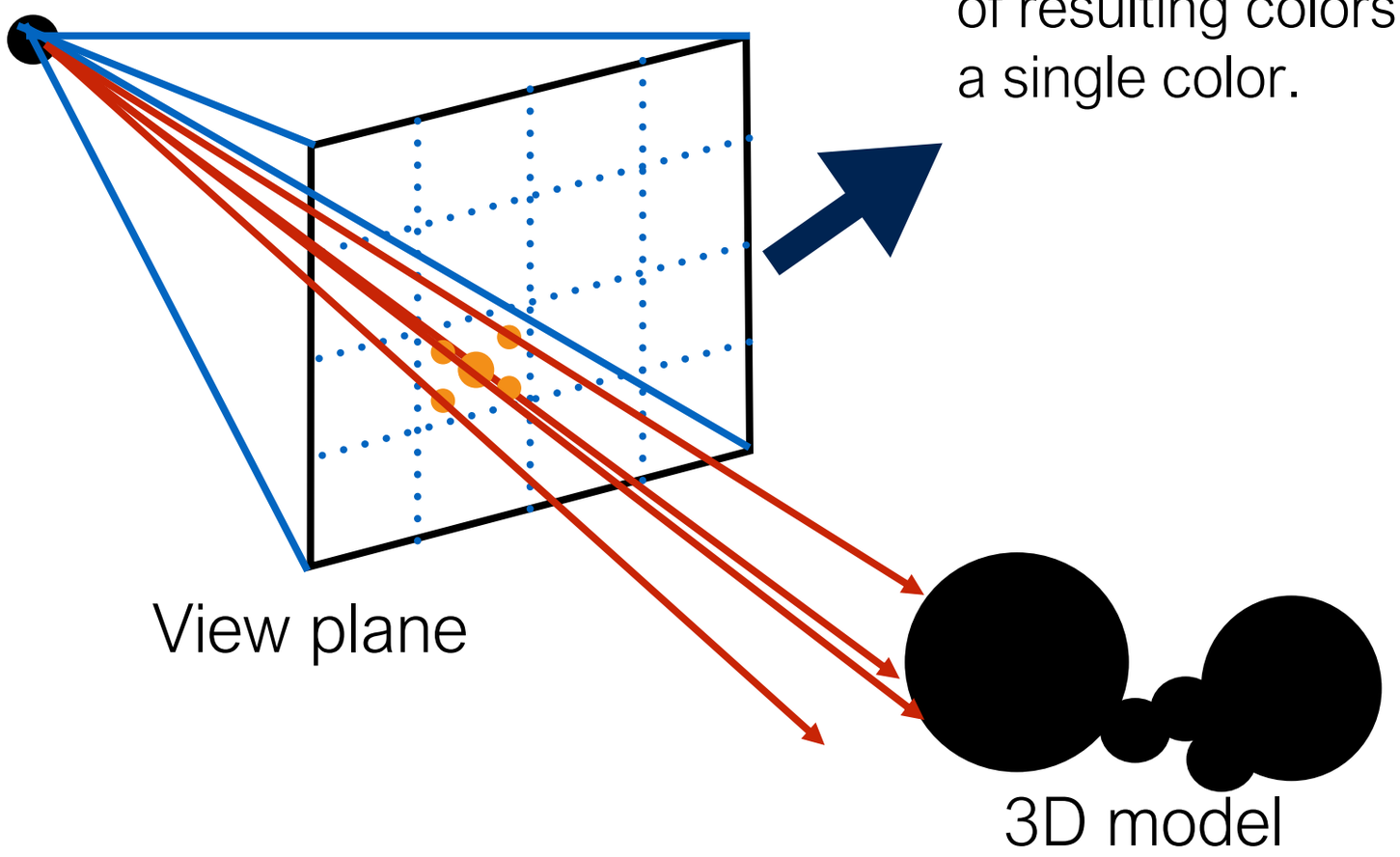
Antialiasing



Improving Ray Tracing

Antialiasing

Camera

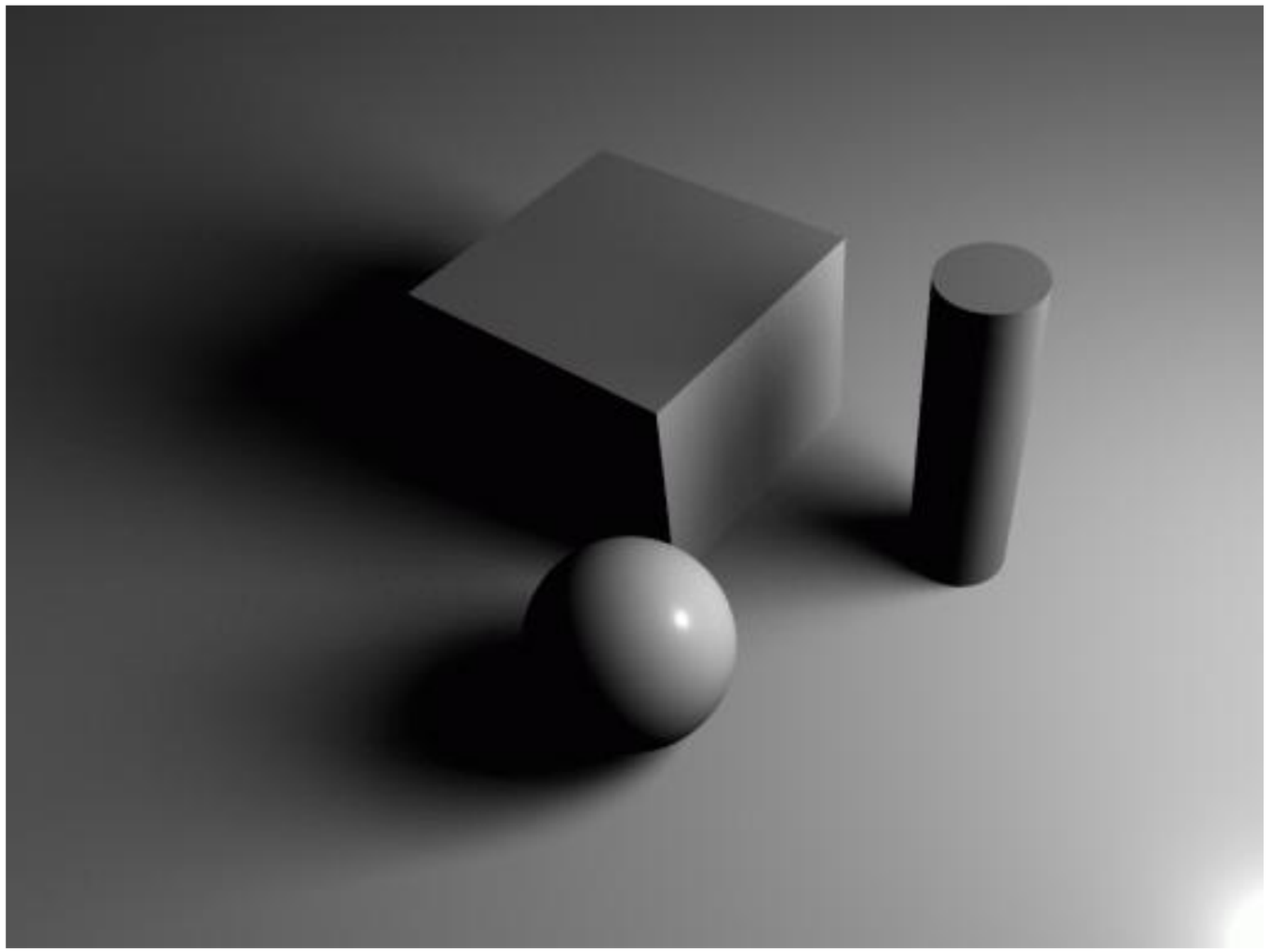


Compute the **average** of resulting colors into a single color.

Cast **multiple rays** from eye through different parts of same pixel

Improving Ray Tracing

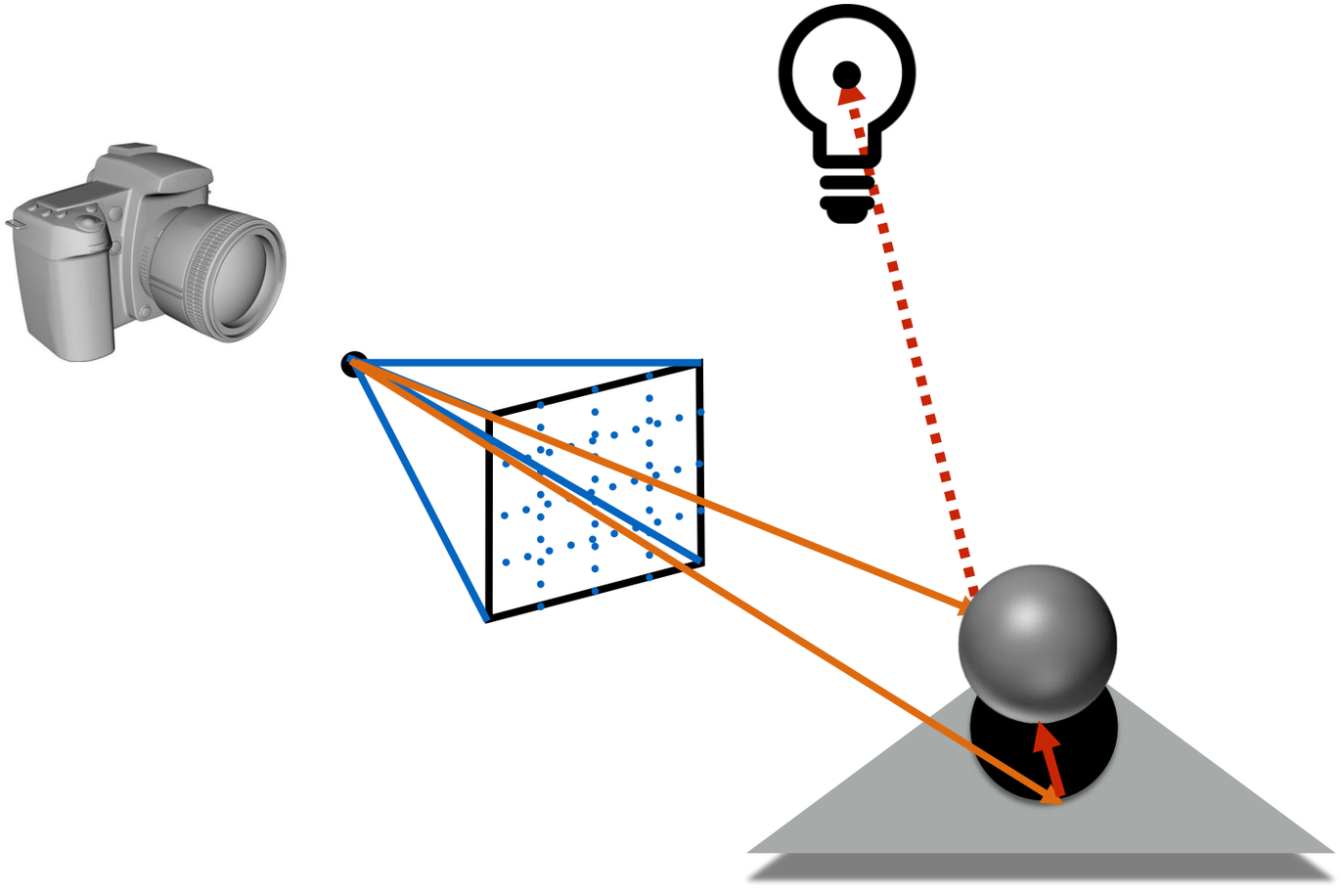
Soft shadows



Improving Ray Tracing

Soft shadows

Point/Spot light sources are **unrealistic**

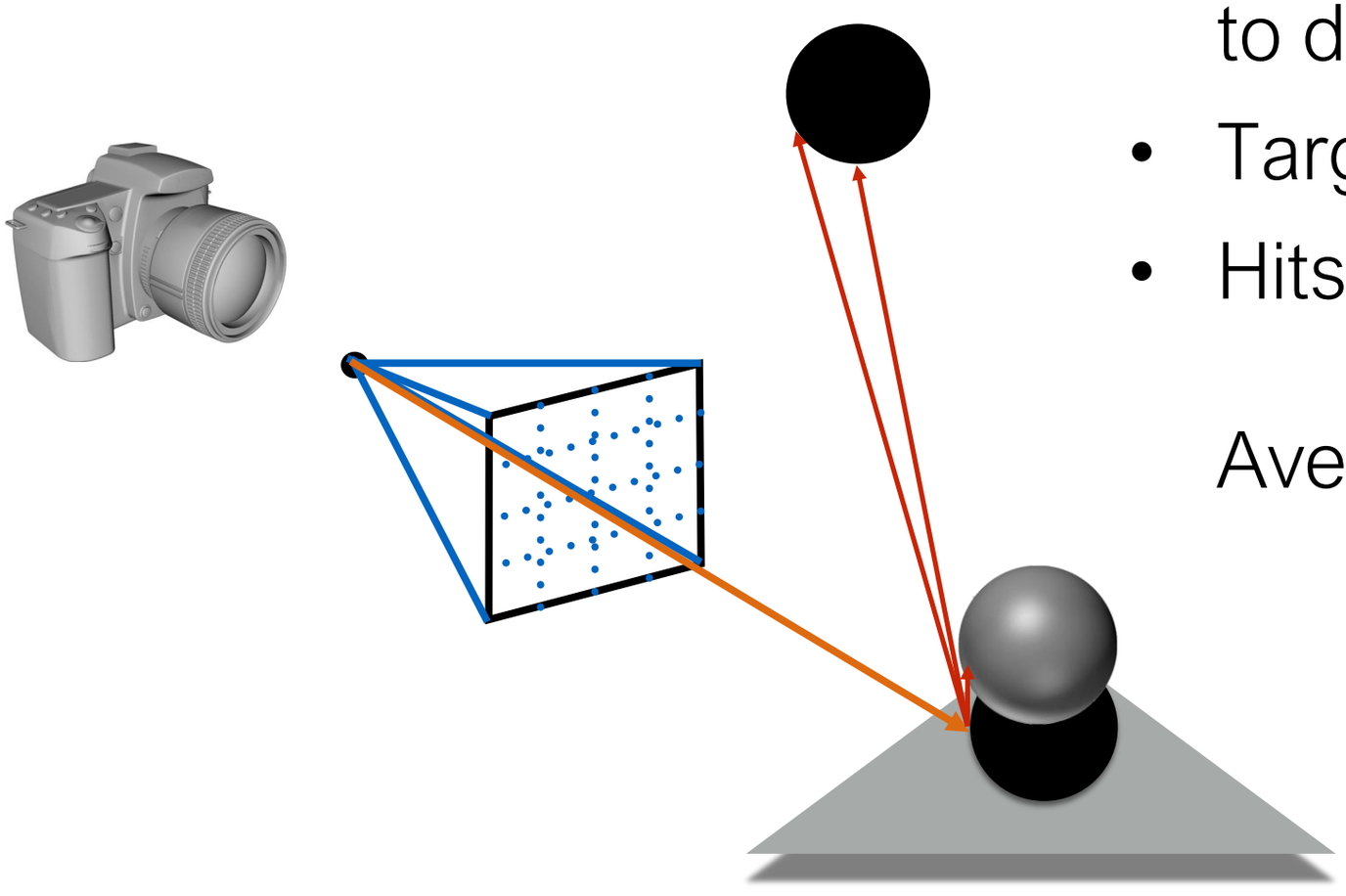


Improving Ray Tracing

Soft shadows

Use **area** light source

Cast multiple shadow rays – super-sampling



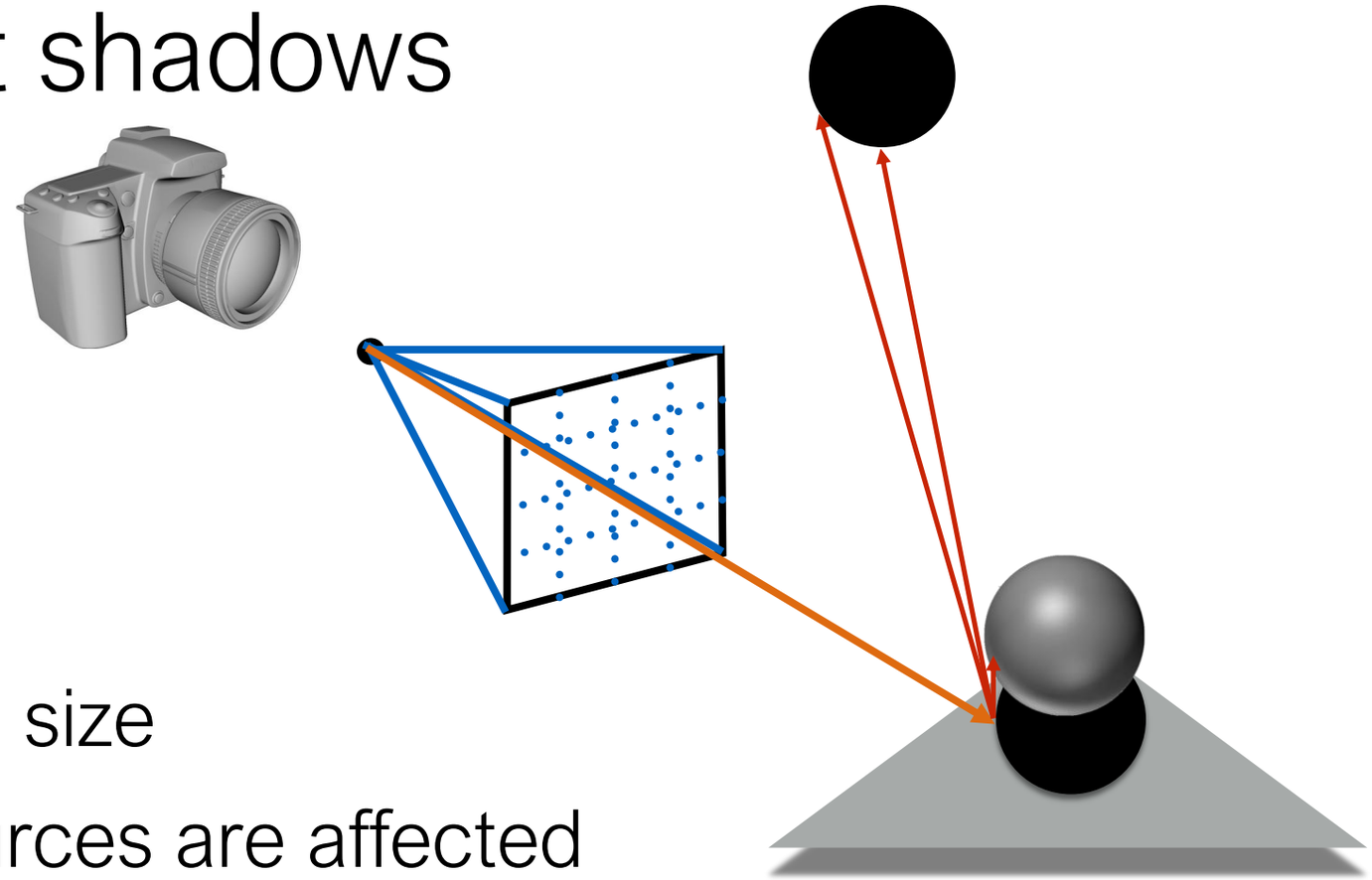
- Give a size to the Point light source (e.g. radius)
- Cast shadow rays from surface to different locations on light
- Target area should be plane (2D)
- Hits/rays = % illuminated

OR

Average k_{tr} from all shadow rays

Improving Ray Tracing

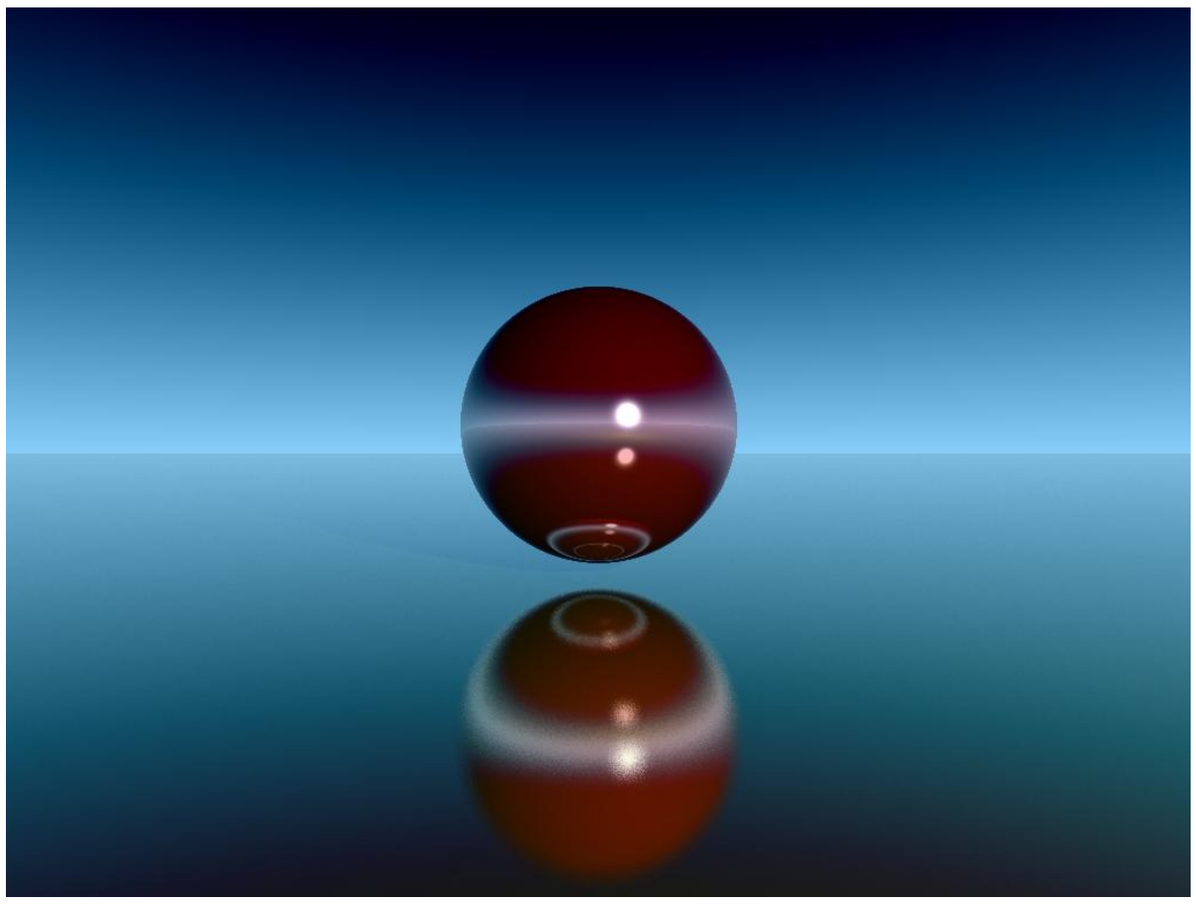
Soft shadows



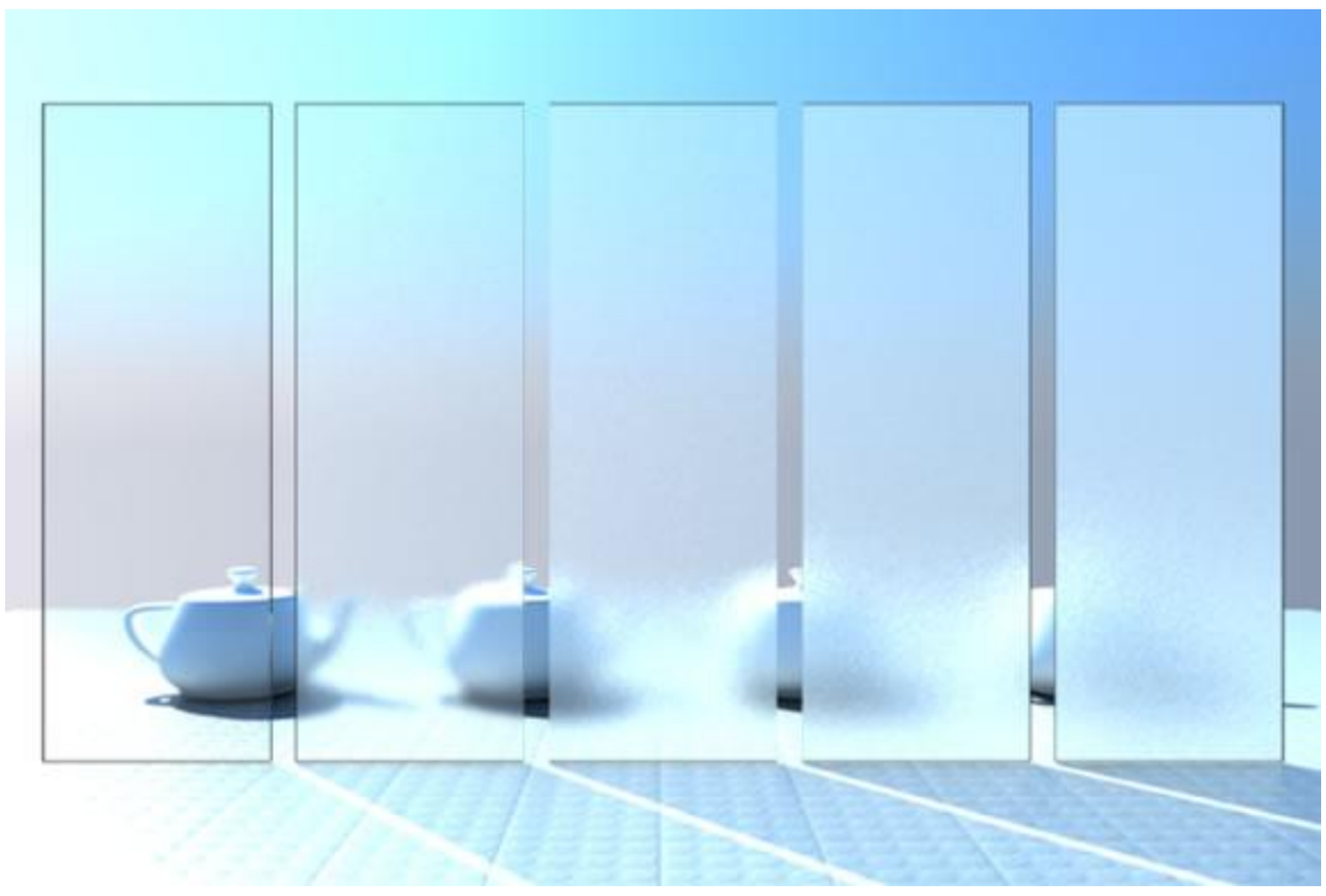
- Each light source has its own size
- **Just** Point and Spot light sources are affected
- When the target area must be orthogonal to each shadow ray and when it does not have to?
- Look at sunset when most of the Sun is under the horizon – there are still shadows (soft)
  that is, specific rays must be tested for going to other side of surface (do not rely on testing the central ray only)

Improving Ray Tracing

Glossy surfaces

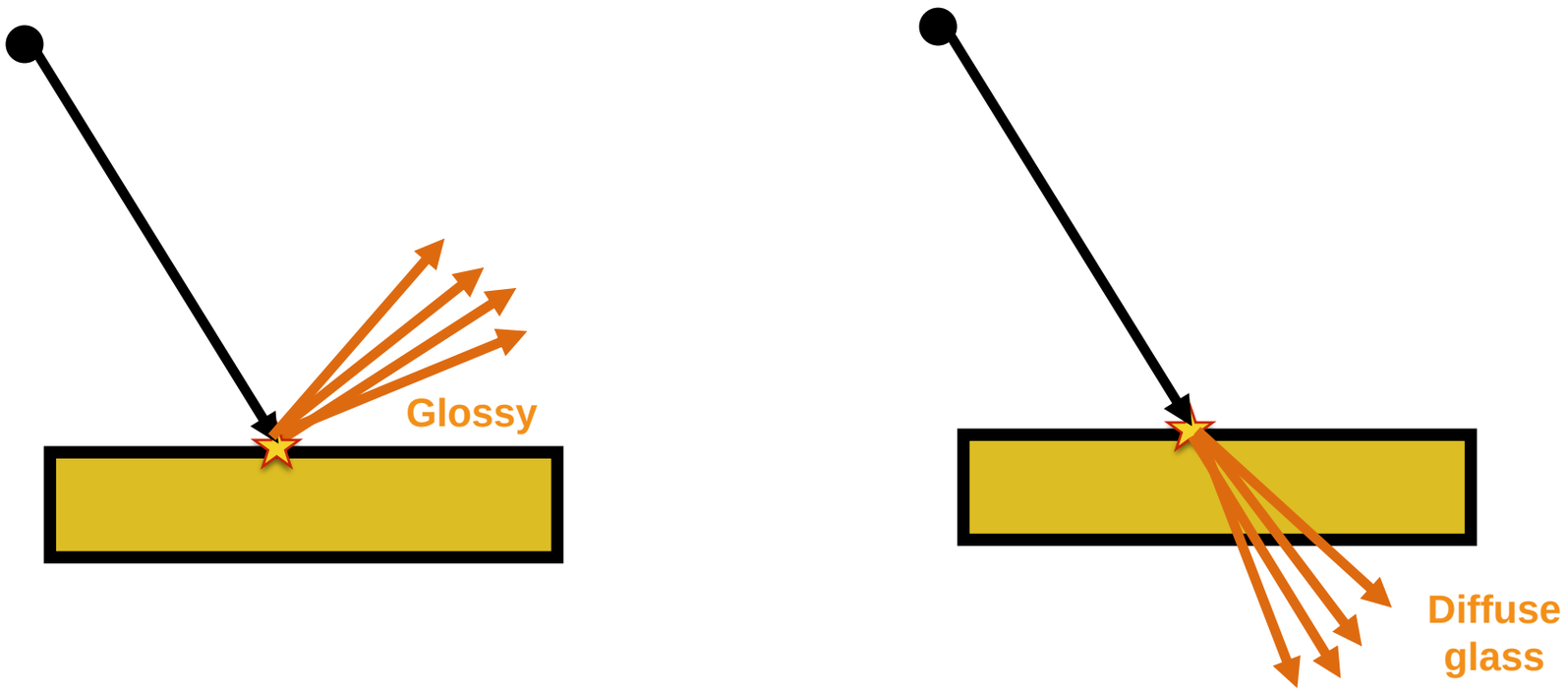


Diffuse (Blurry) Glass



Improving Ray Tracing

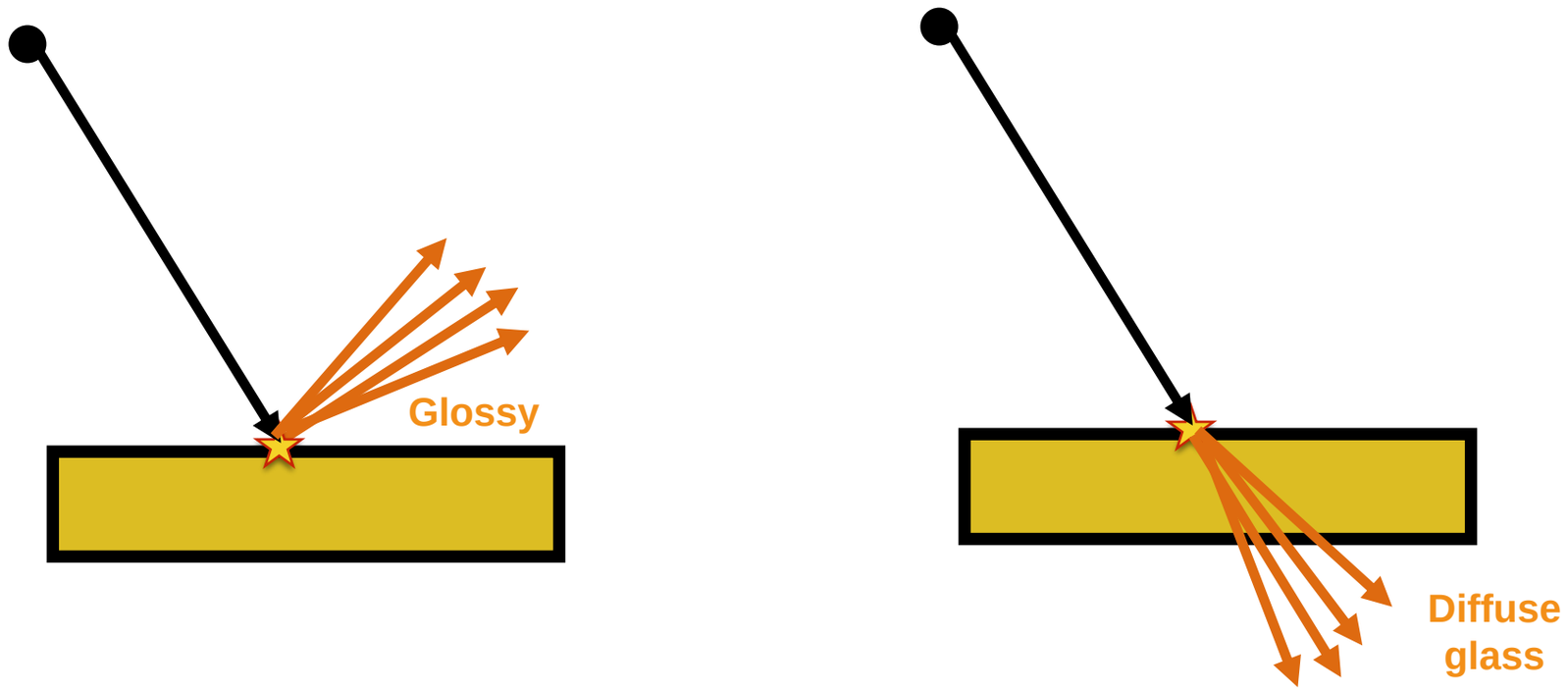
Glossy surfaces / Blurry Glass



Surface microfacets perturb reflection ray directions.
Nearby objects reflect more clearly because distribution still narrow
Farther objects reflect blurrier because distribution has spread.
Similar effect happens with both refraction and transparency rays.

Improving Ray Tracing

Glossy surfaces / Blurry Glass



- Target area distance – uniform (1? 100?)
- Target area size – depends on material (and on distance)
- If a part of the beam goes to other side of surface – it’s not included (what is the best way to ensure that? Filter? Elliptic target area?)

IN THE NEXT LESSON

Super-sampling (cont.)

Acceleration