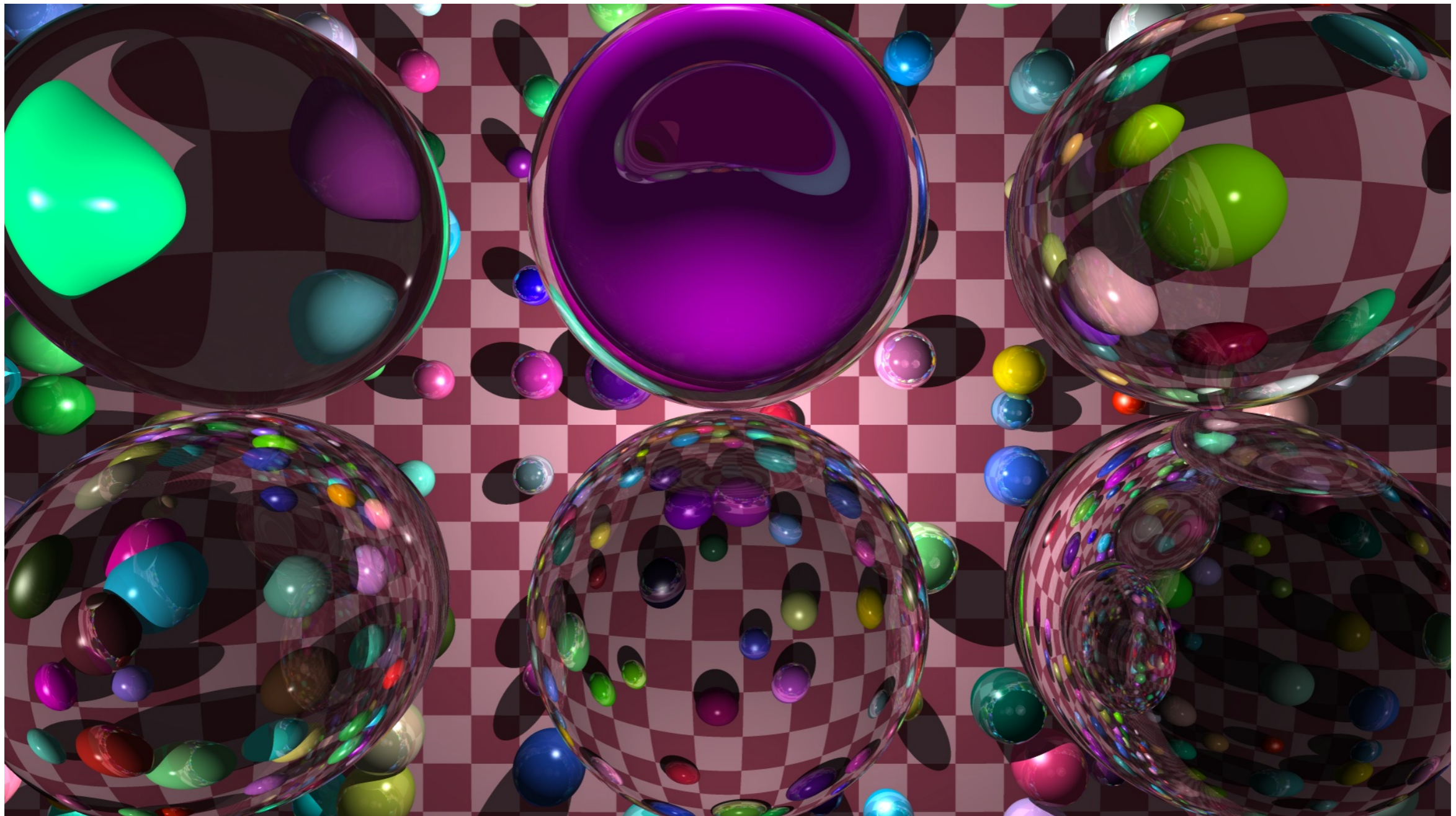


ray tracer extensions

- refraction
- more complex geometry
 - instancing
 - CSG
- distribution ray tracing (Cook et al., 1984)
 - antialiasing
 - soft shadows
 - depth of field
 - fuzzy reflections
 - motion blur

Transparency and Refraction



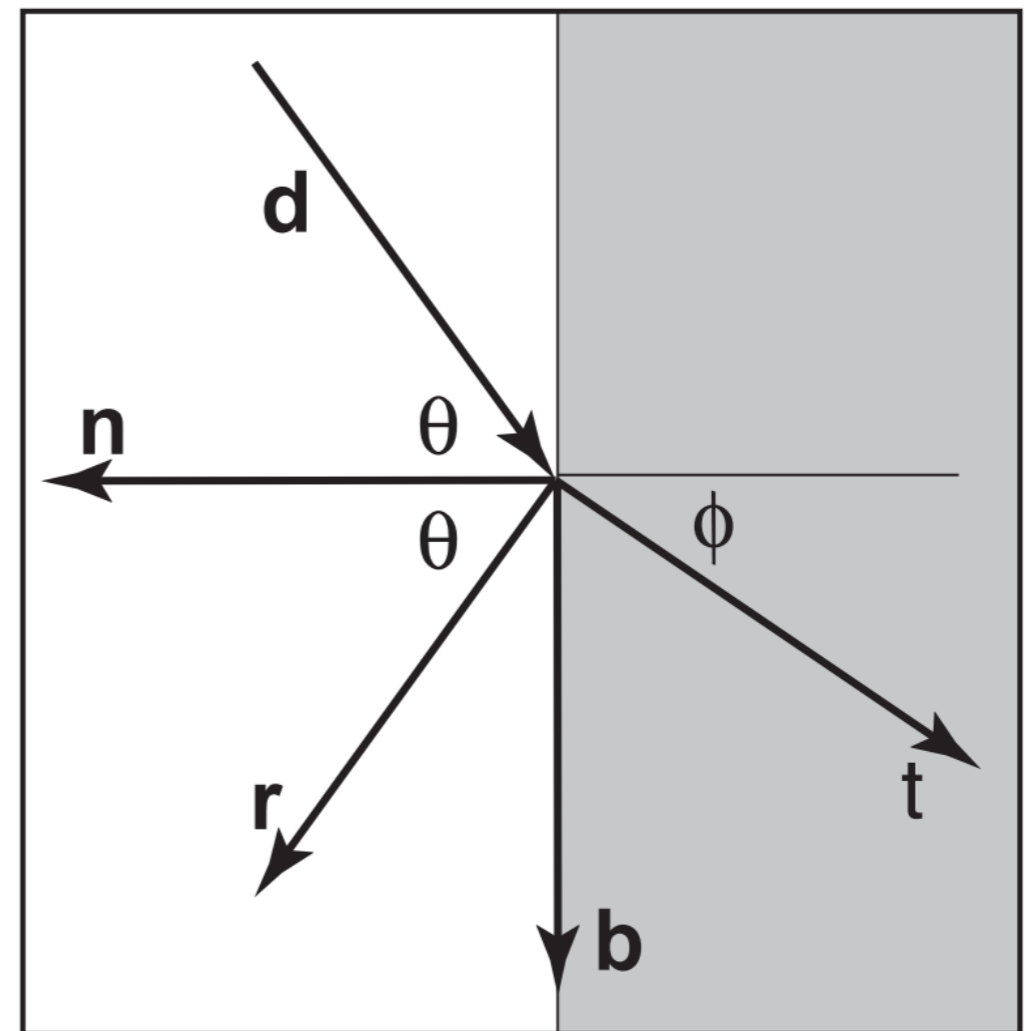
[marczych/github]

Transparency and Refraction

Snell's Law

$$n_1 \sin\theta = n_2 \sin\phi$$

Example values of n :
air: 1.00;
water: 1.33–1.34;
window glass: 1.51;
optical glass: 1.49–1.92;
diamond: 2.42.



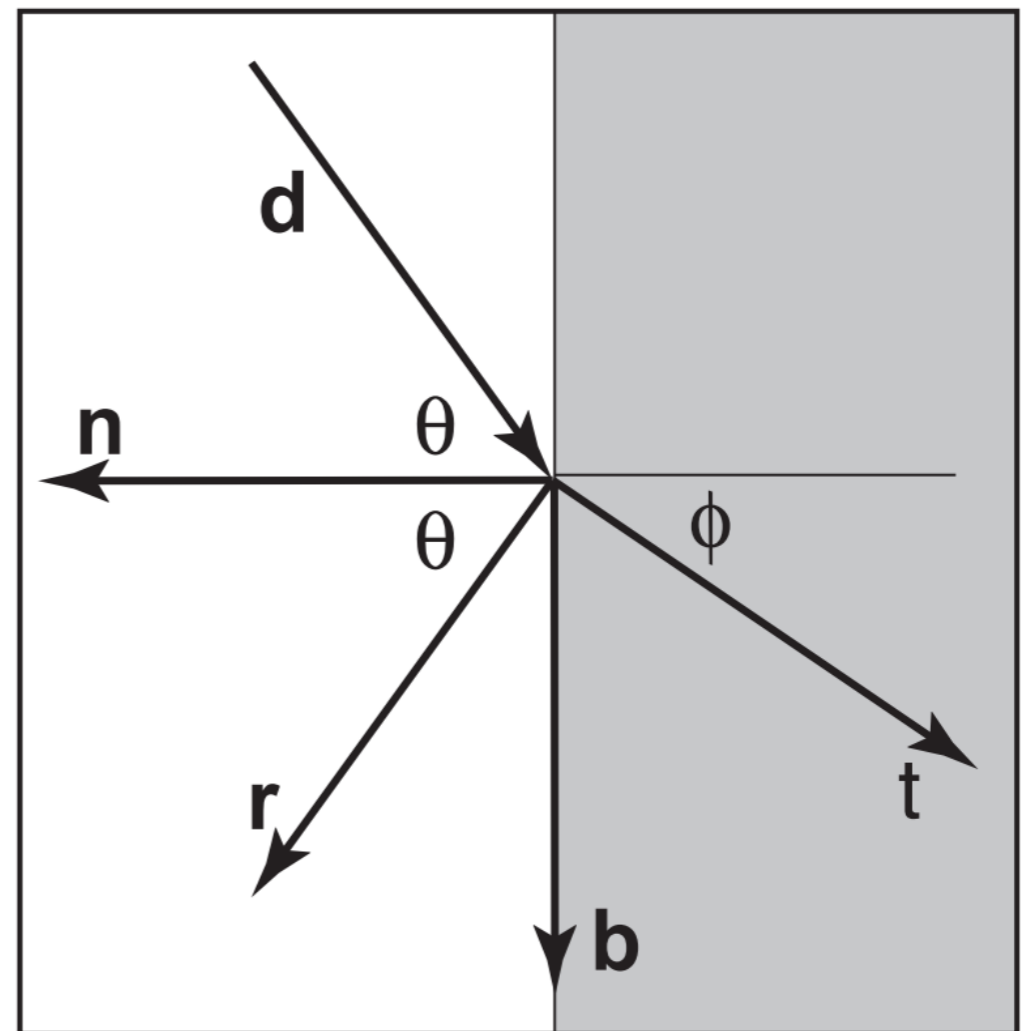
<whiteboard>

Transparency and Refraction

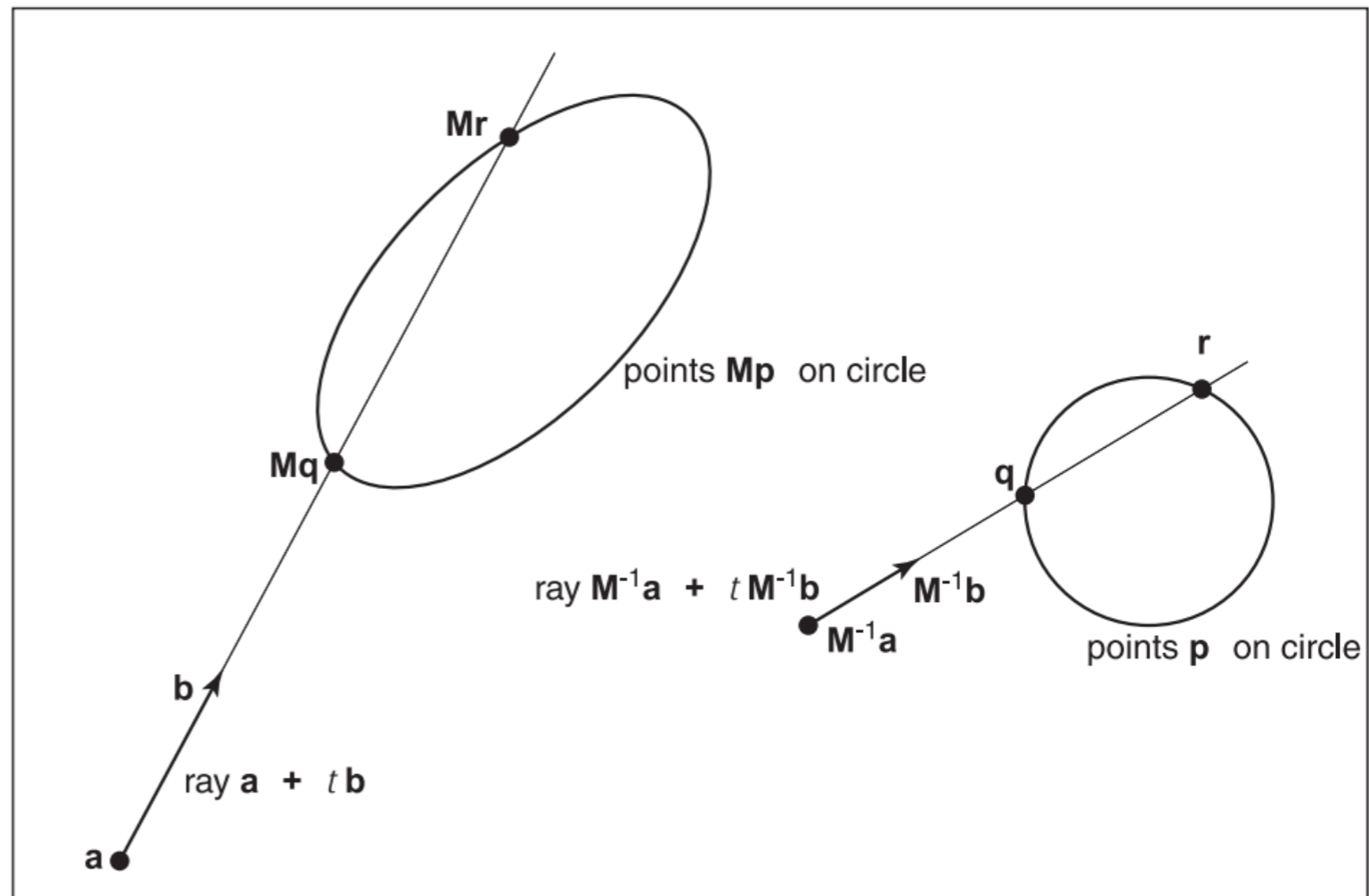
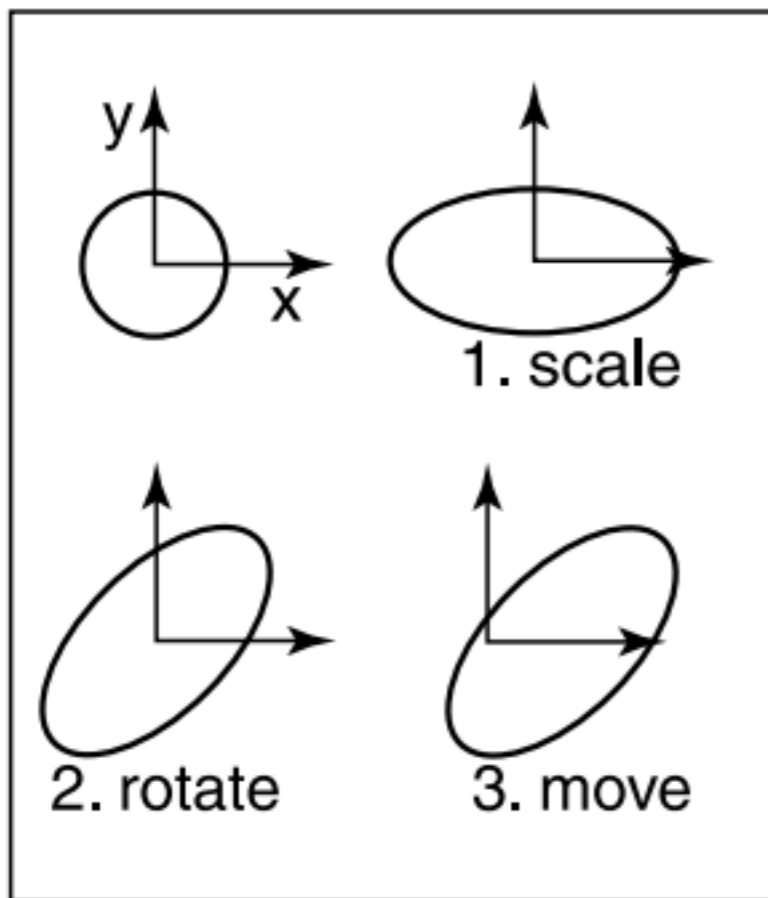
Snell's Law

Additional effects

- varying reflectivity
Fresnel equations
- attenuation of light intensity
Beer's Law



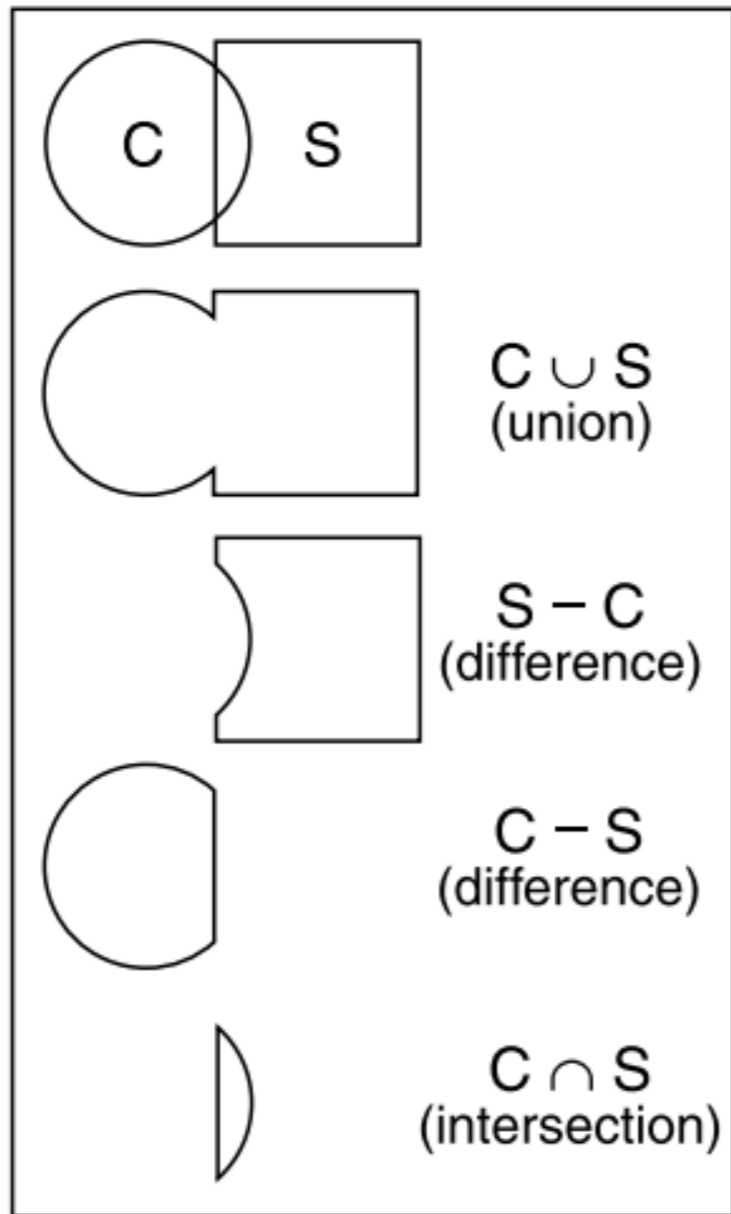
Object Instancing



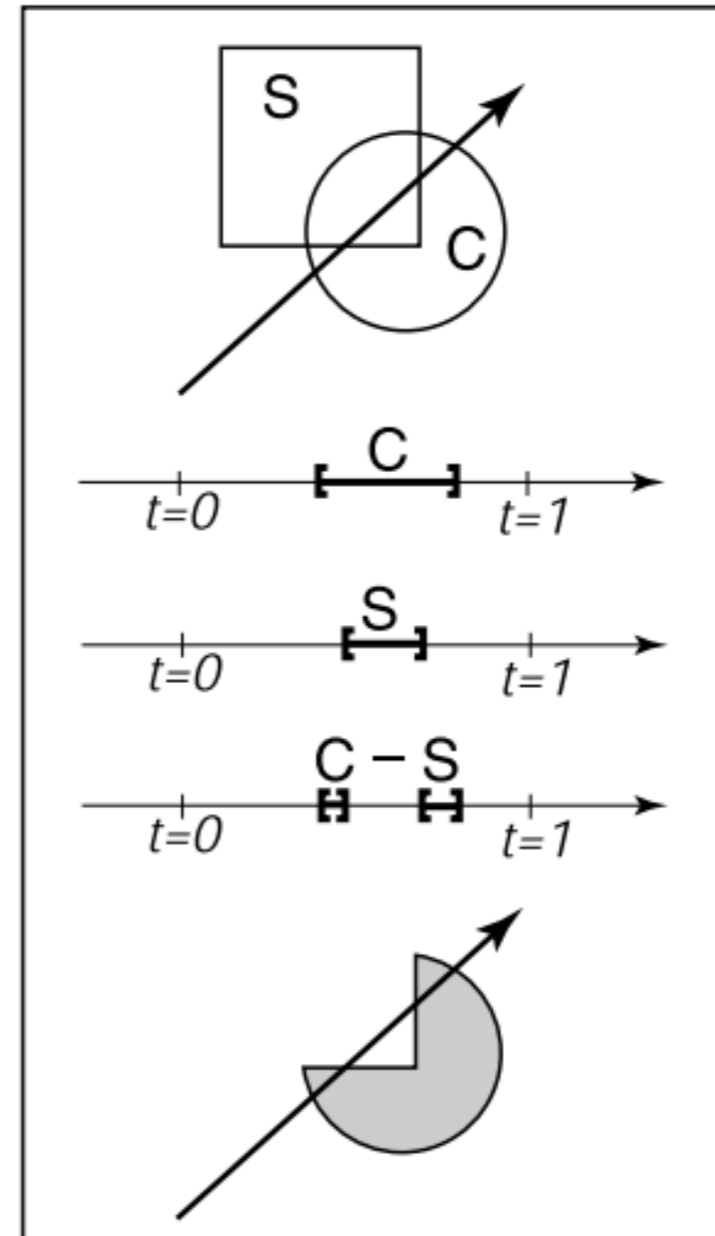
instance of circle with 3 transformations applied

ray intersection problem in the two spaces are simple transforms of each other

Constructive Solid Geometry (CSG)



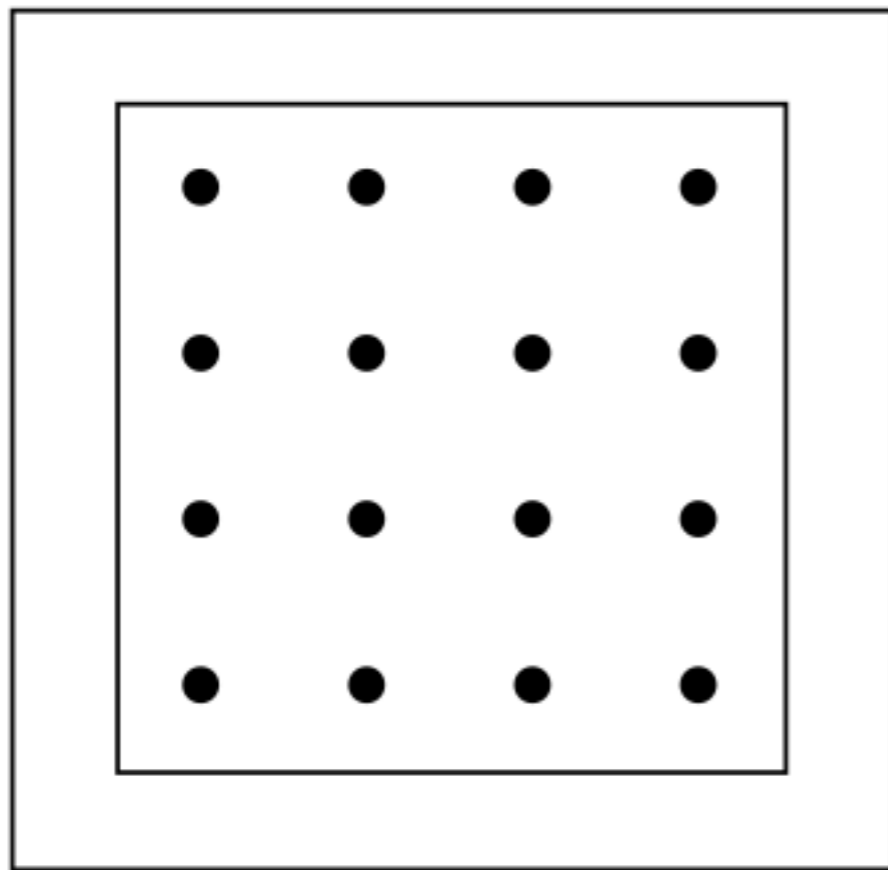
use set operations to
combine solid shapes



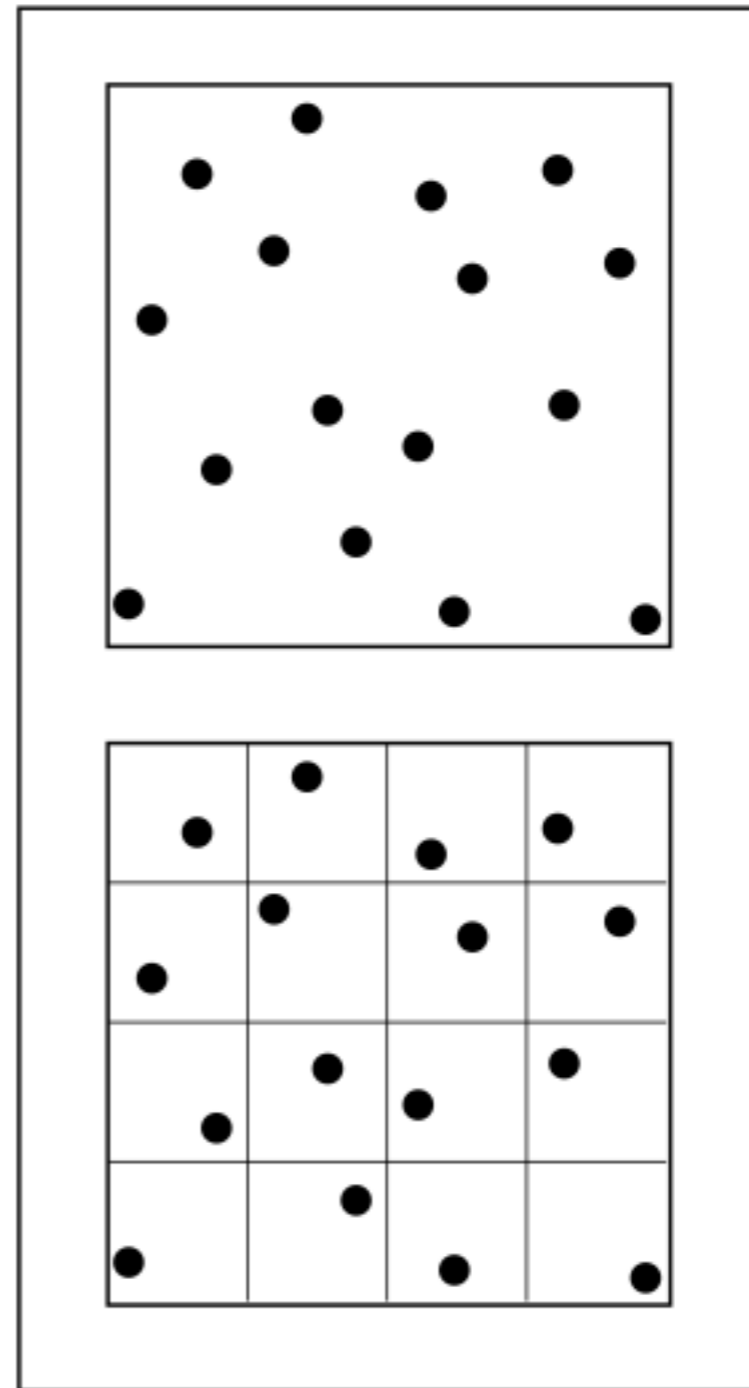
intersection with
composite object

Distribution Ray Tracing

Anti-aliasing

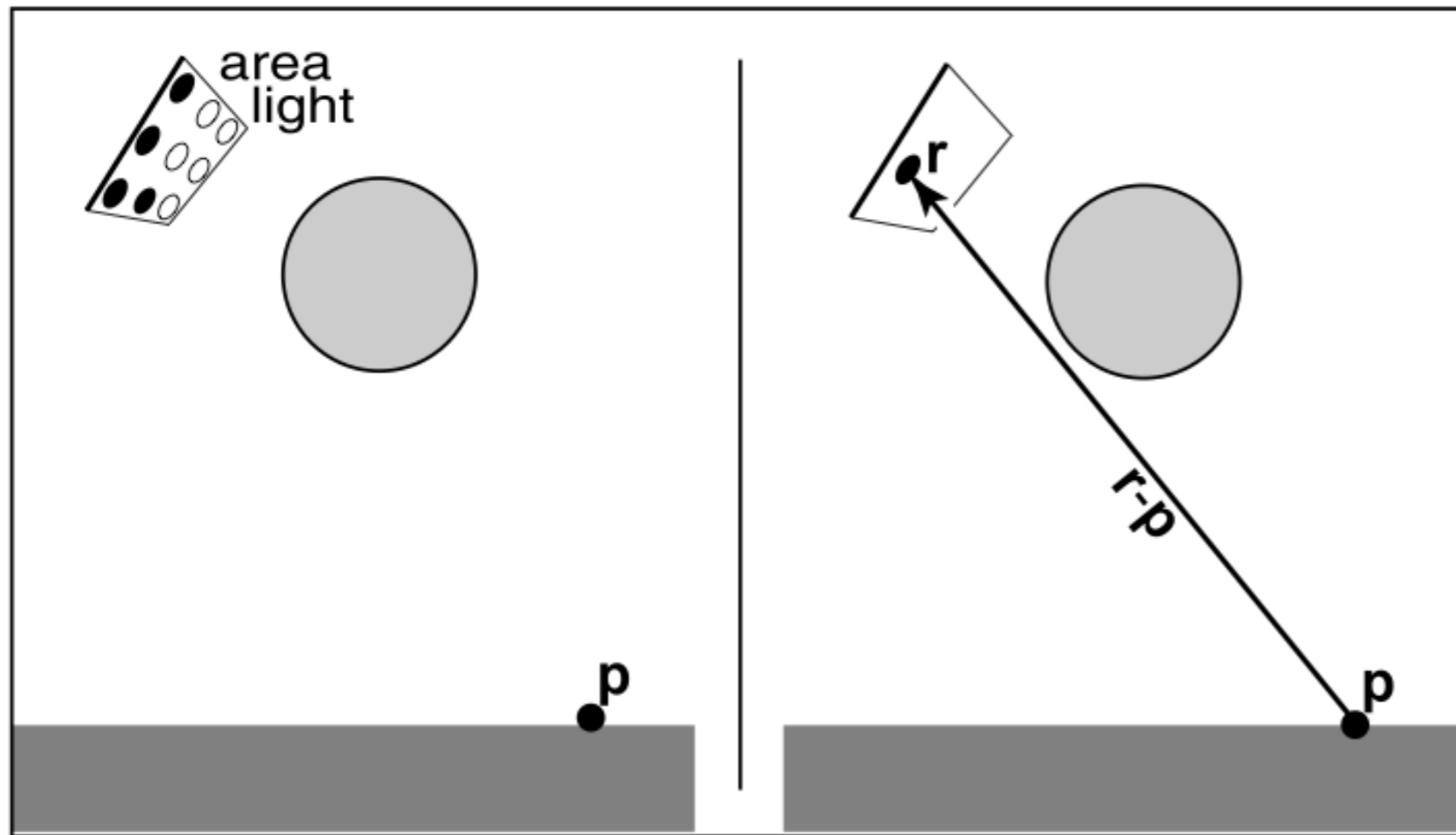


16 regular samples /
pixel

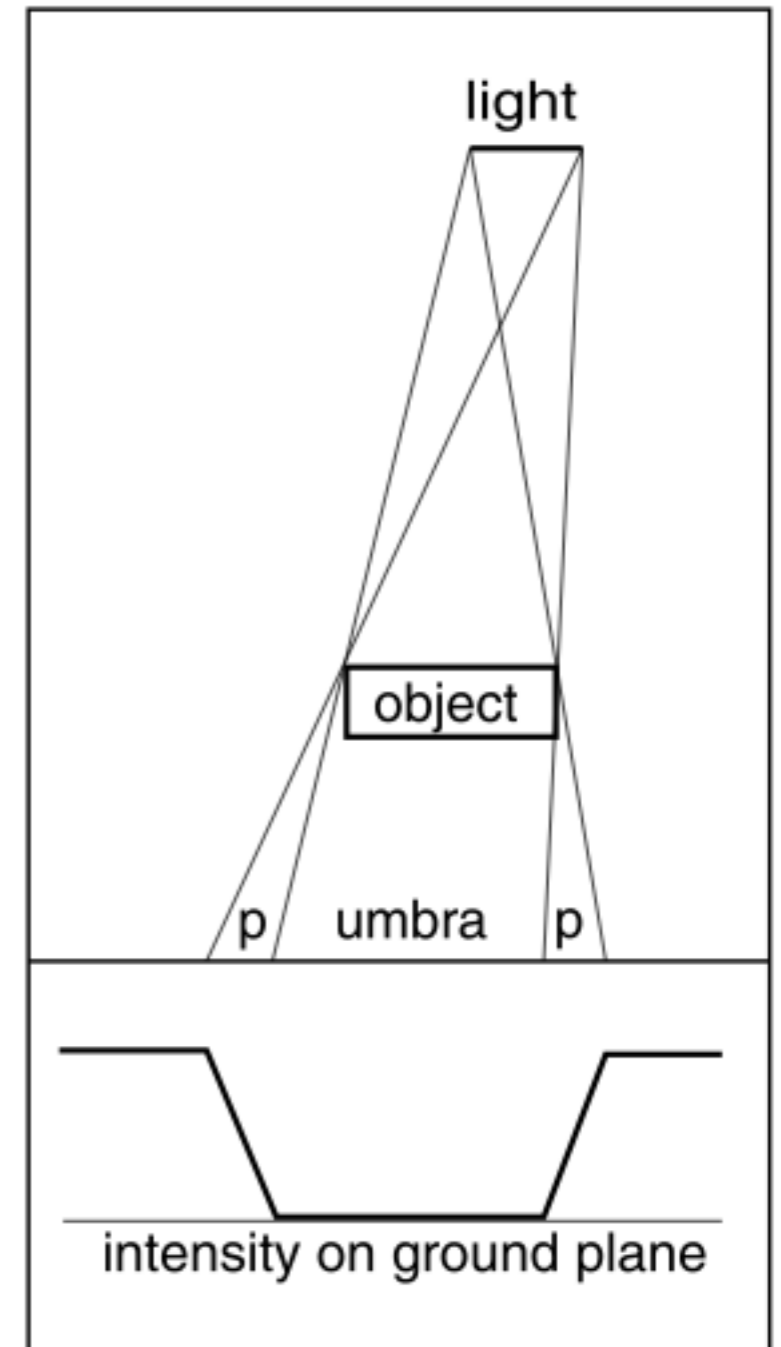


jittered samples

Soft Shadows

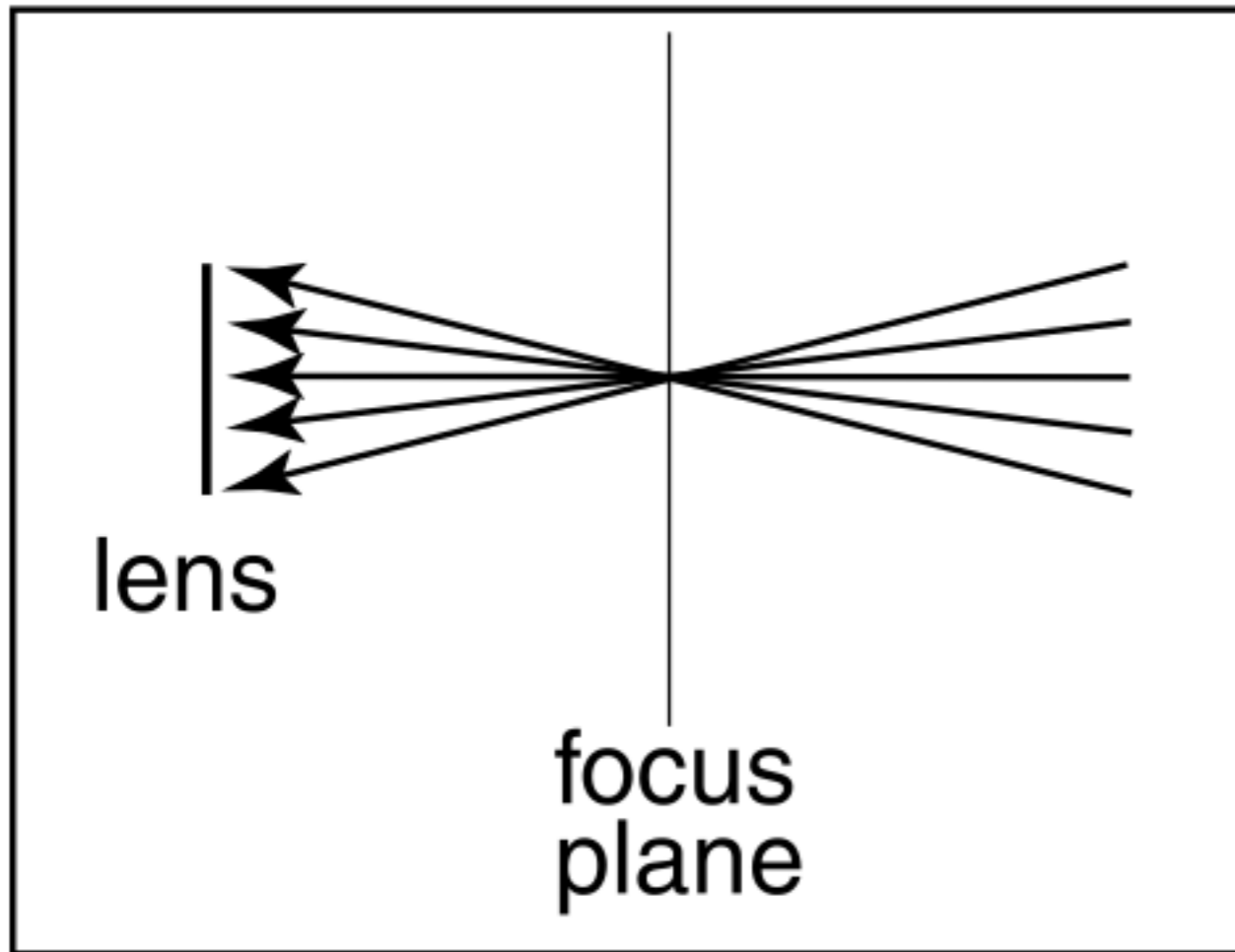


$$\mathbf{r} = \mathbf{c} + \xi_1 \mathbf{a} + \xi_2 \mathbf{b},$$

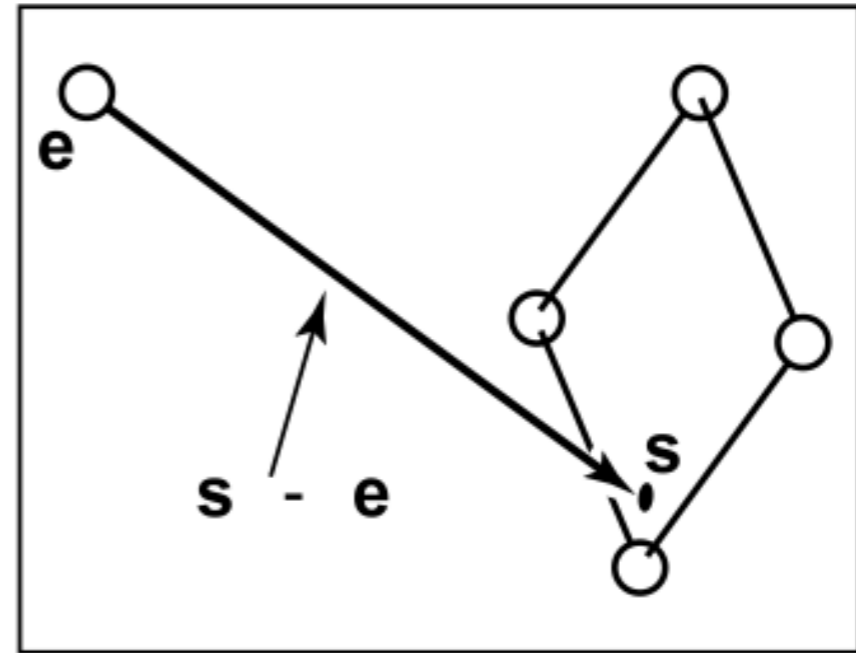


[Shirley and Marschner]

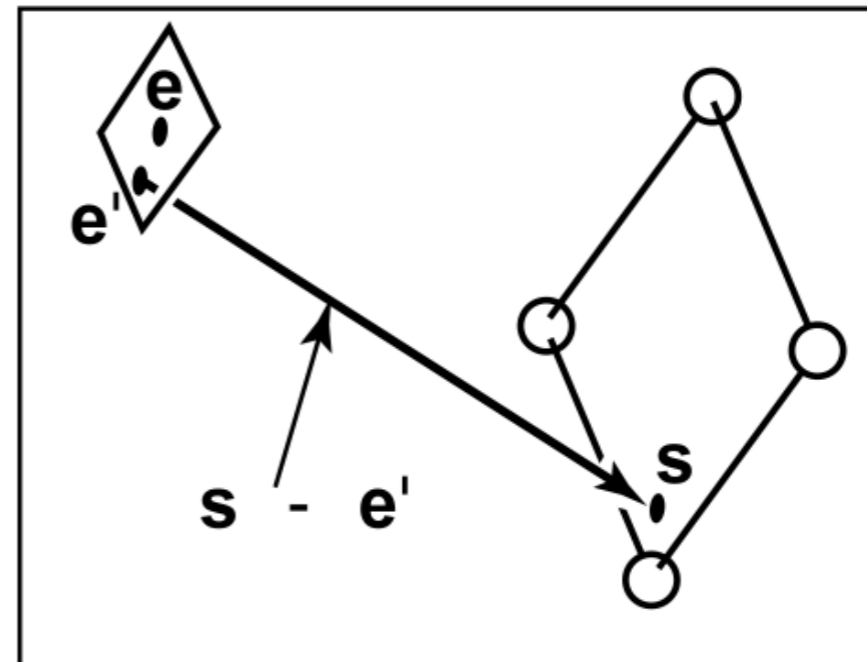
Soft Focus (depth of field)



lens (eye location) averages over a cone of directions



without depth of field



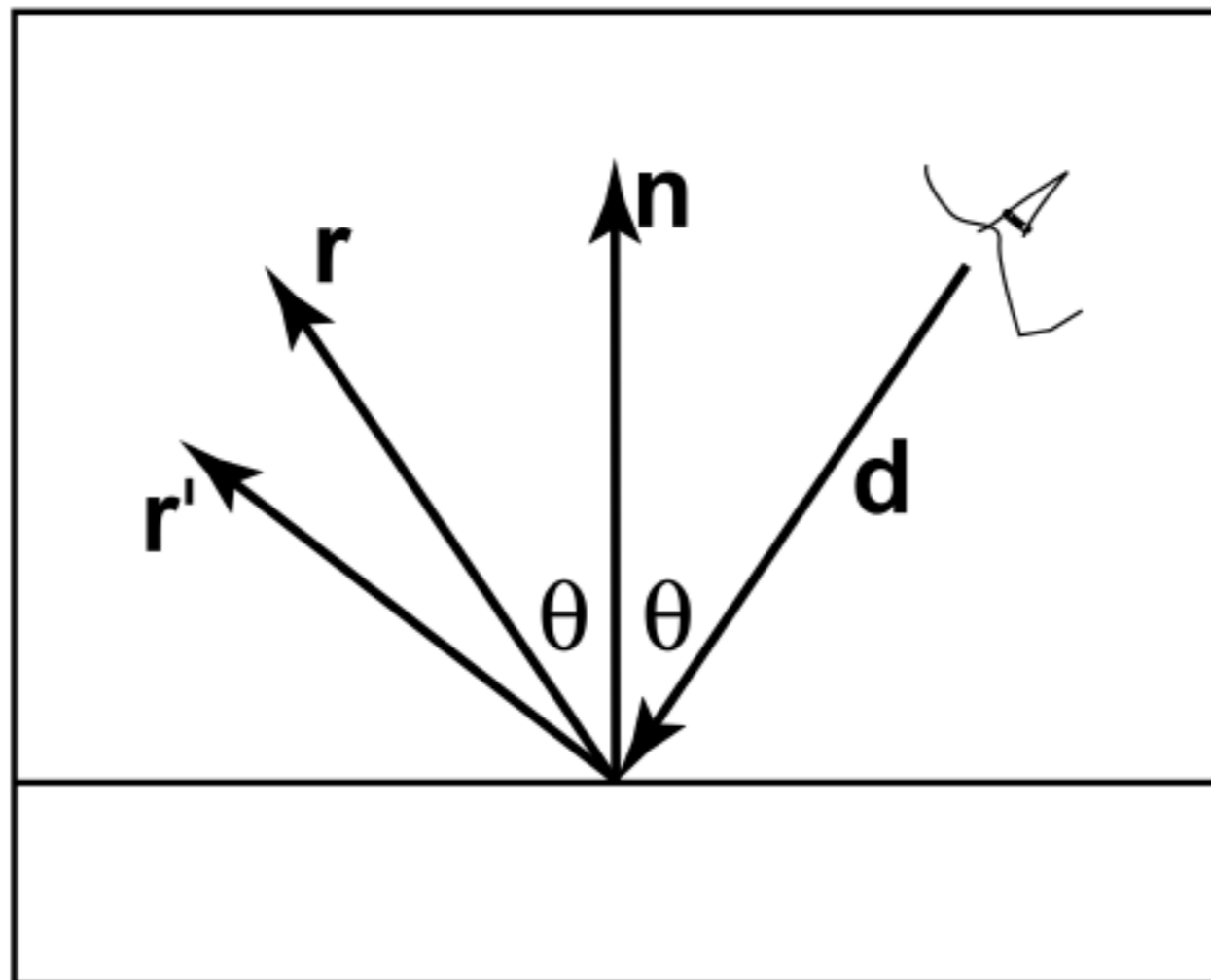
with depth of field



[Shirley and Marschner]

image using 25 samples per pixel

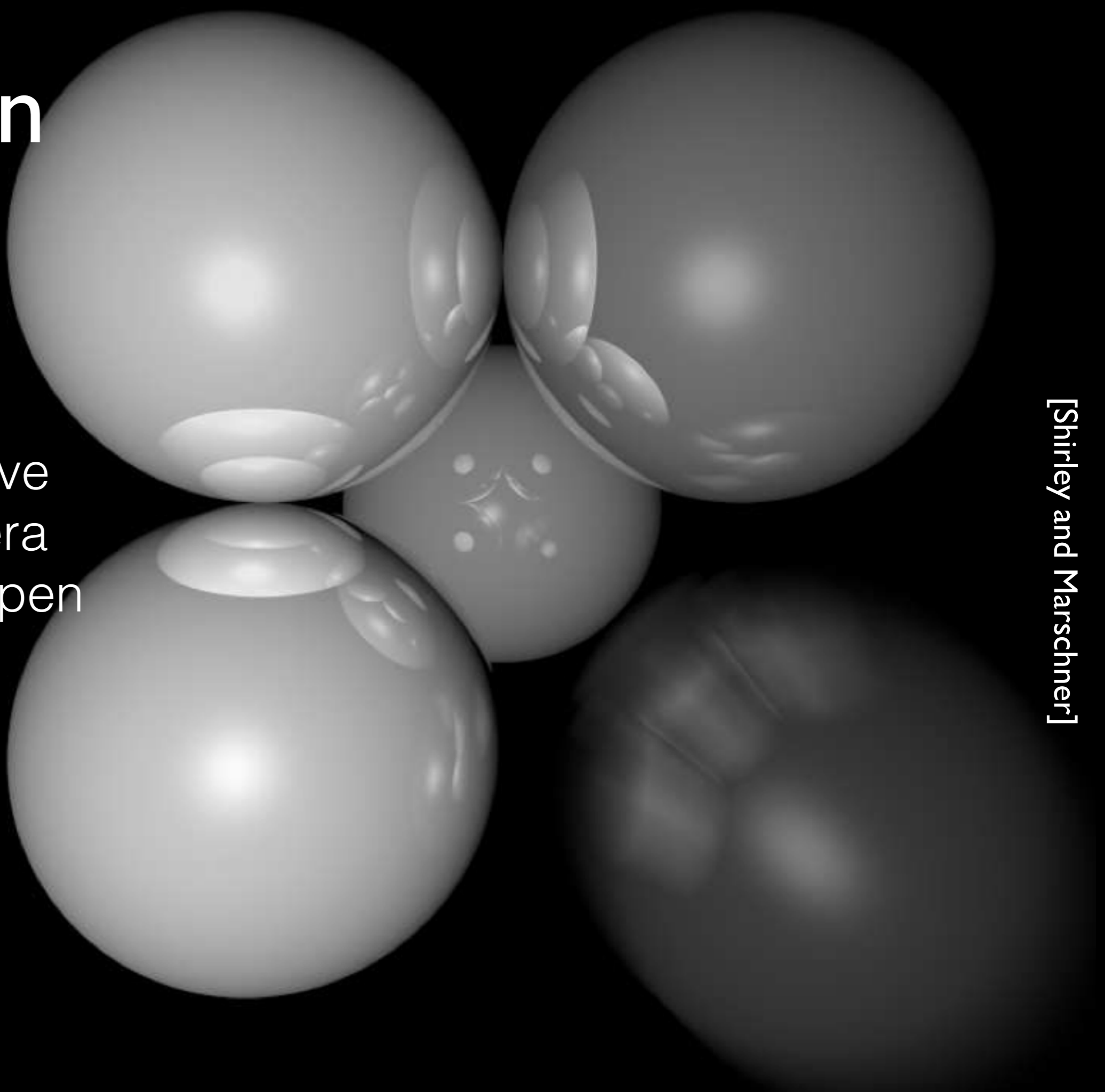
Fuzzy Reflections



randomly perturb ideal
specular reflection rays

Motion Blur

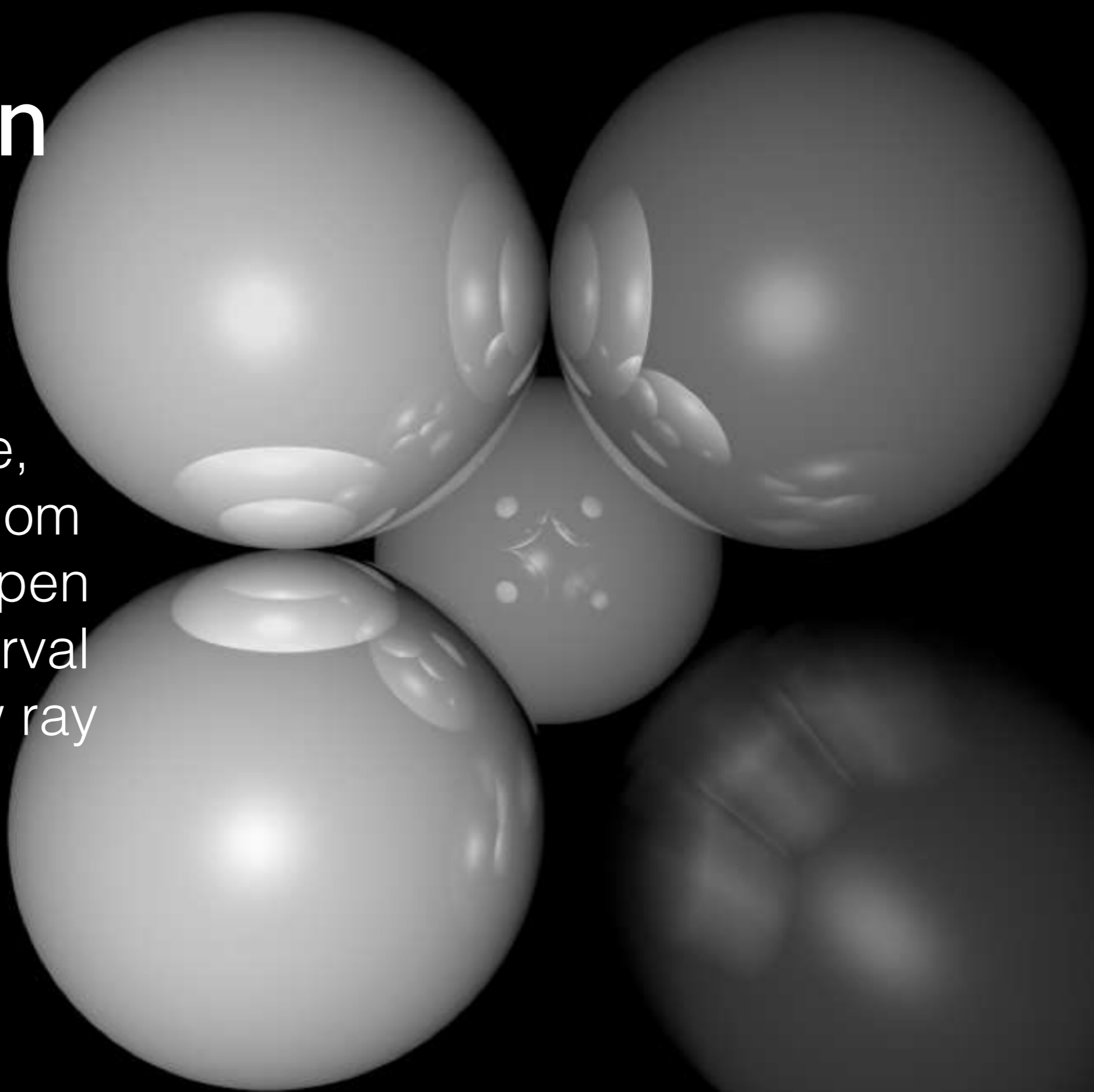
objects move
while camera
aperture is open



[Shirley and Marschner]

Motion Blur

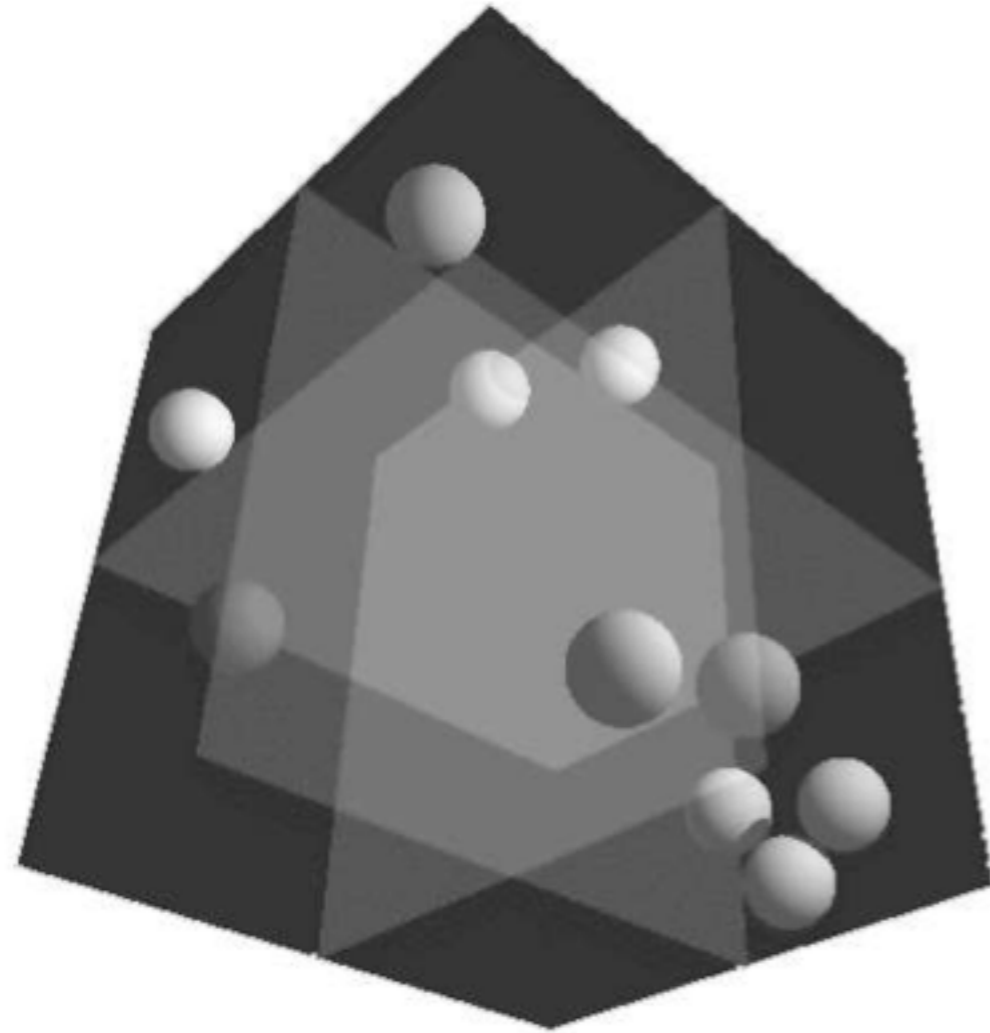
to simulate,
choose random
time within open
aperture interval
for each view ray



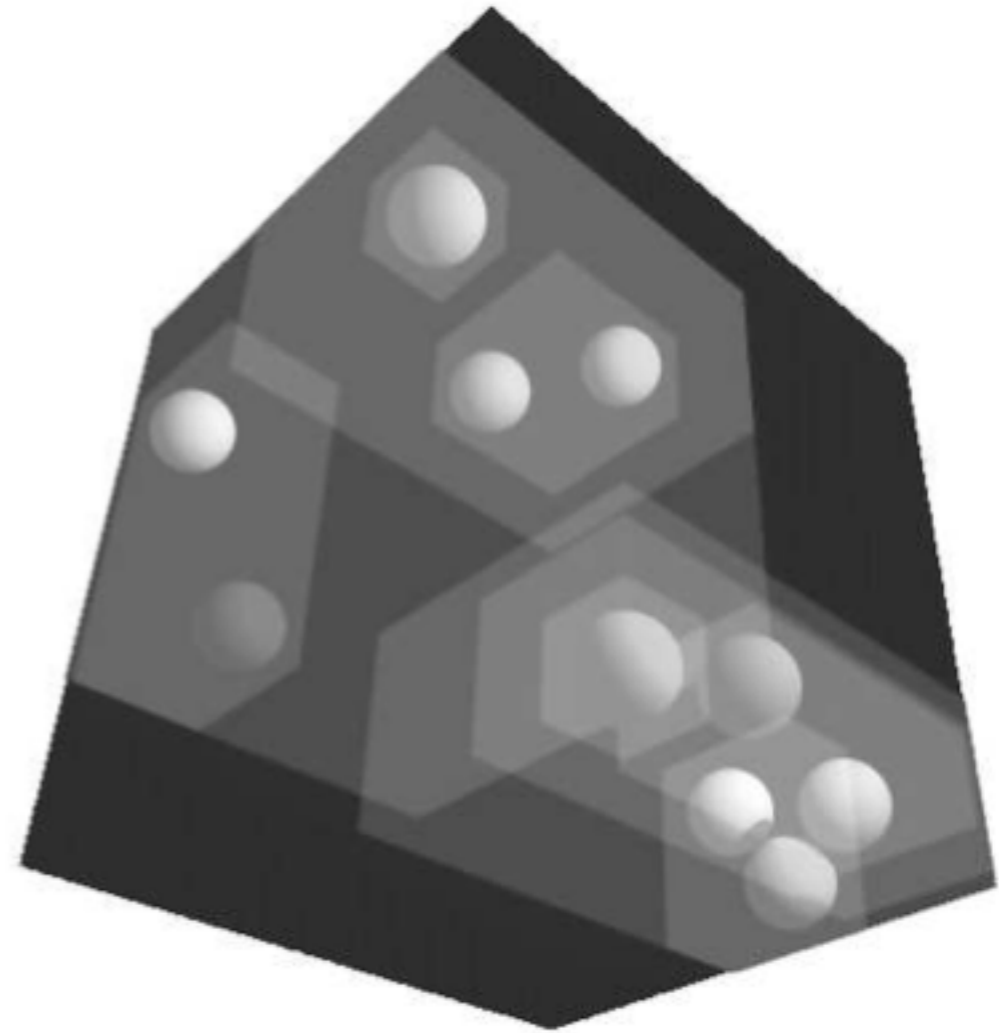
[Shirley and Marschner]

Acceleration Structures

Acceleration Structures



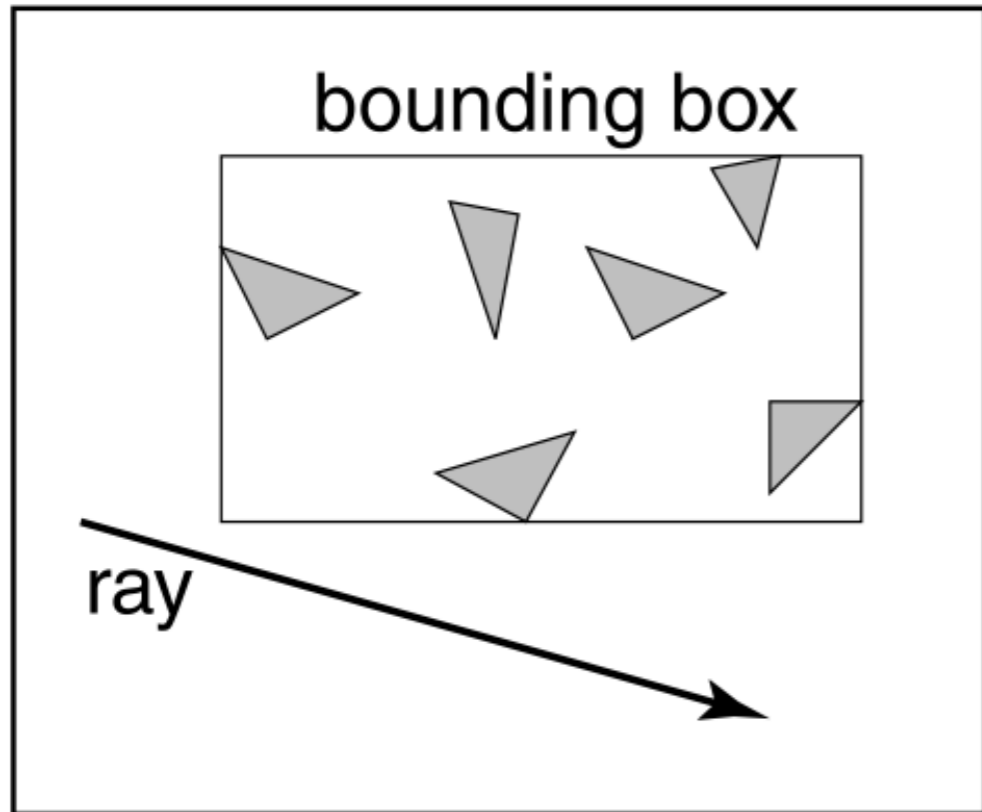
uniform partitioning
of space



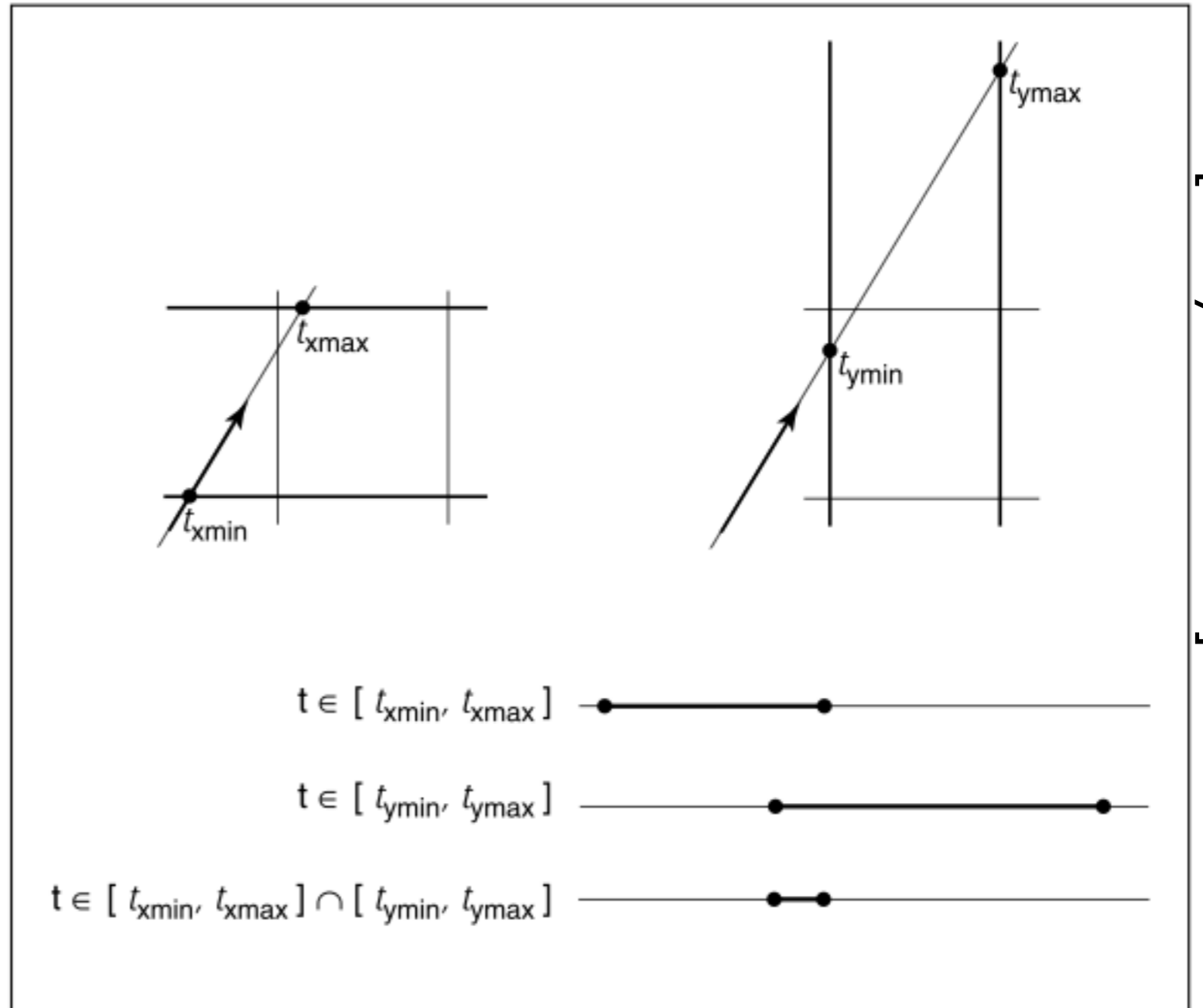
adaptive bounding
box hierarchy

Bounding boxes

key operation in many acceleration schemes



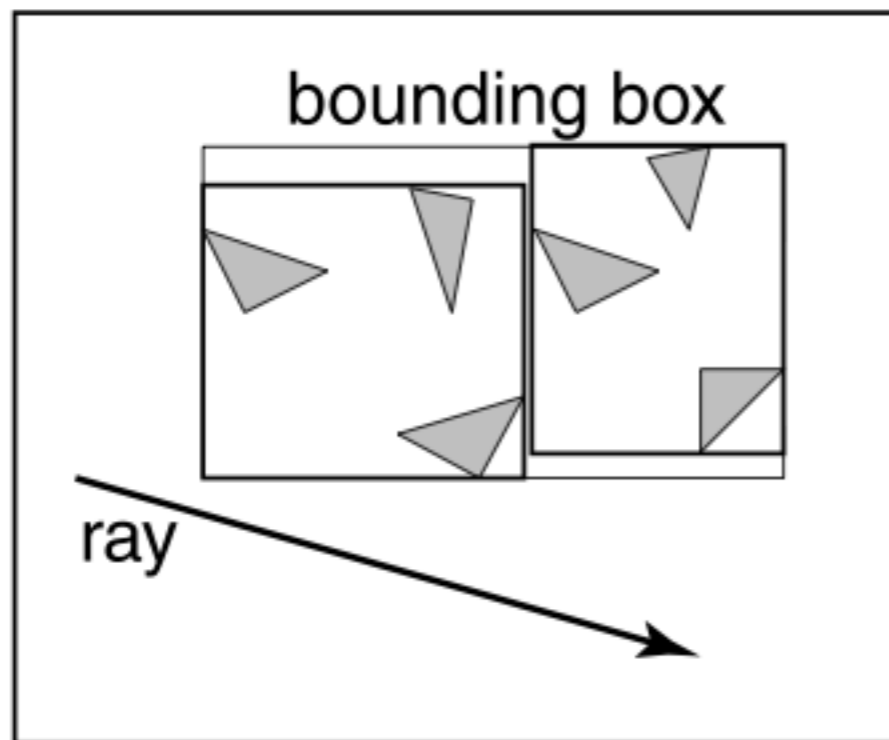
check whether the ray hits the box



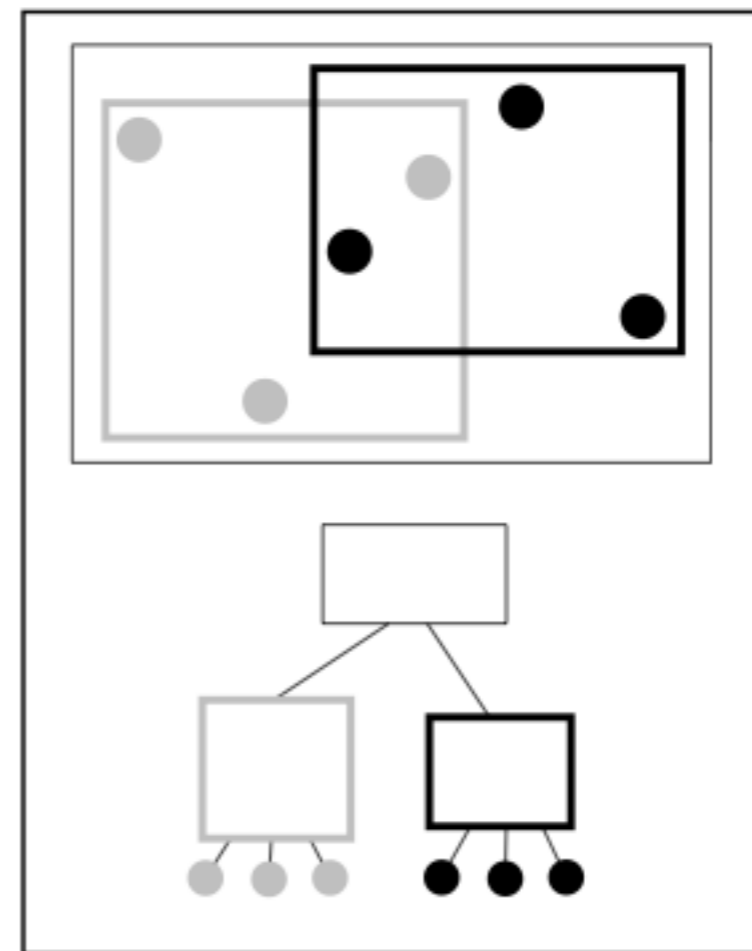
[Shirley and Marschner]

determining if ray hits box

Bounding Volume Hierarchy

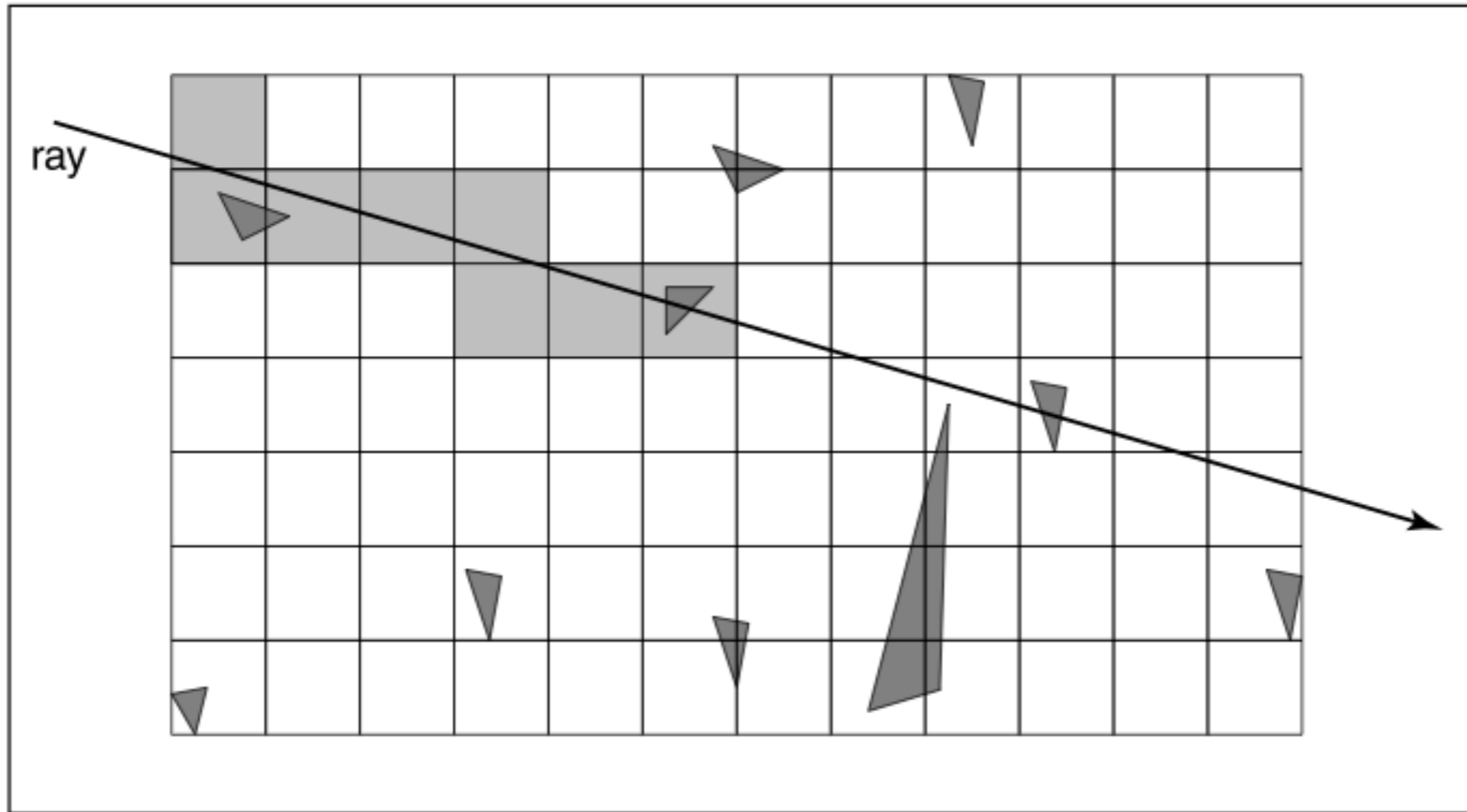


bounding boxes can be nested



[Shirley and Marschner]

Uniform Spatial Partitioning



track a ray forward through cells until an object is hit