CS130 : Computer Graphics
Ray Tracing (cont.)

Tamar Shinar
Computer Science & Engineering
UC Riverside
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.
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

[Shirley and Marschner]
Soft Shadows

\[ r = c + \xi_1 a + \xi_2 b. \]
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]
Fuzzy Reflections

randomly perturb ideal specular reflection rays
Motion Blur

objects move while camera aperture is open
Motion Blur

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