How does the eye see?

Plato (B.C. 428-347)

- **the eye is a lantern**
- **seeing is a meeting of inner and outer light**

Alhazen (A.D. 965-1039)

- **the eye is a darkened chamber awaiting light**
- **first described the *camera obscura***

DaVinci (1452-1519)

- **the eye <u>is</u> a camera obscura**

Kepler (1571-1630)

- **analyzed the optics of the eye**

Descartes (1596-1650)

- **verified Kepler by looking through an ox's eye**

Modern views of light

Geometrical optics

- **Newton** — **corpuscles emitted from shining objects**

Wave optics

- **Descartes** — **motion in a *plenum***
- **Euler** — **vibrations in *ether***
- **Faraday** — **vibrations in a field**
- **Maxwell** — **an electromagnetic disturbance**

Quantum physics

- **Planck** — **black-body radiation**
- **Einstein** — **light quanta (*photons*)**

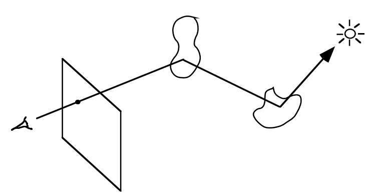
Premises of ray tracing

1. Light rays travel in straight lines
2. Light rays do not interfere with each other if they cross
3. Light rays travel from the light sources to the eye, but the physics is invariant under path reversal (*reciprocity*)

Where does a ray begin?

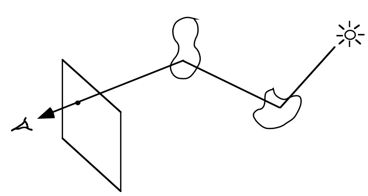
At the eye

- eye ray tracing



At the light

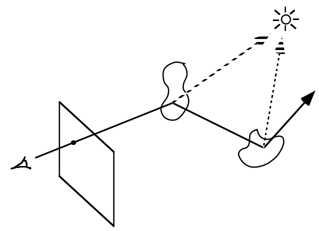
- light ray tracing
- a.k.a. photon tracing



Hybrid solutions

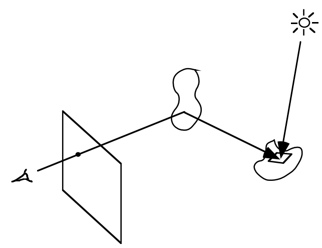
Whitted (1980)

- **eye ray tracing**
  +
  rays to light



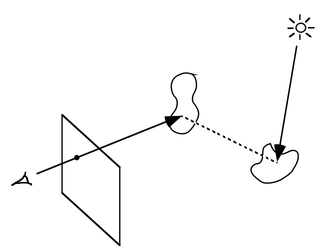
Heckbert (1990)

- **eye ray tracing**
  +
  light ray tracing
  +
  storage on surface



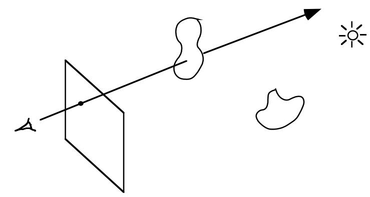
Veach (1995)

- **eye ray tracing**
  +
  light ray tracing
  +
  connecting lines



Casting versus tracing

1st path = ray casting



recursive = ray tracing