



# REFLECTION & REFRACTION

SEMINAR 6

Computer Graphics 2

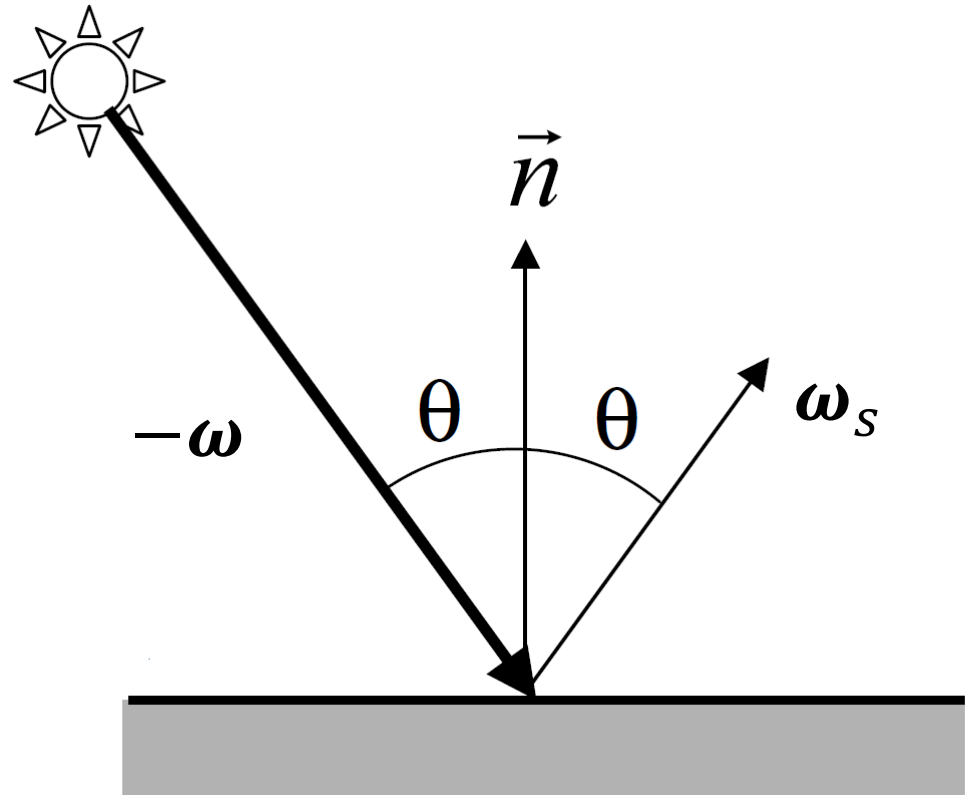
# Reflection

2

Depends upon:

- Light polarization
- Light direction
- Surface normal

$$\omega_s = 2(\omega \cdot n)n - \omega$$



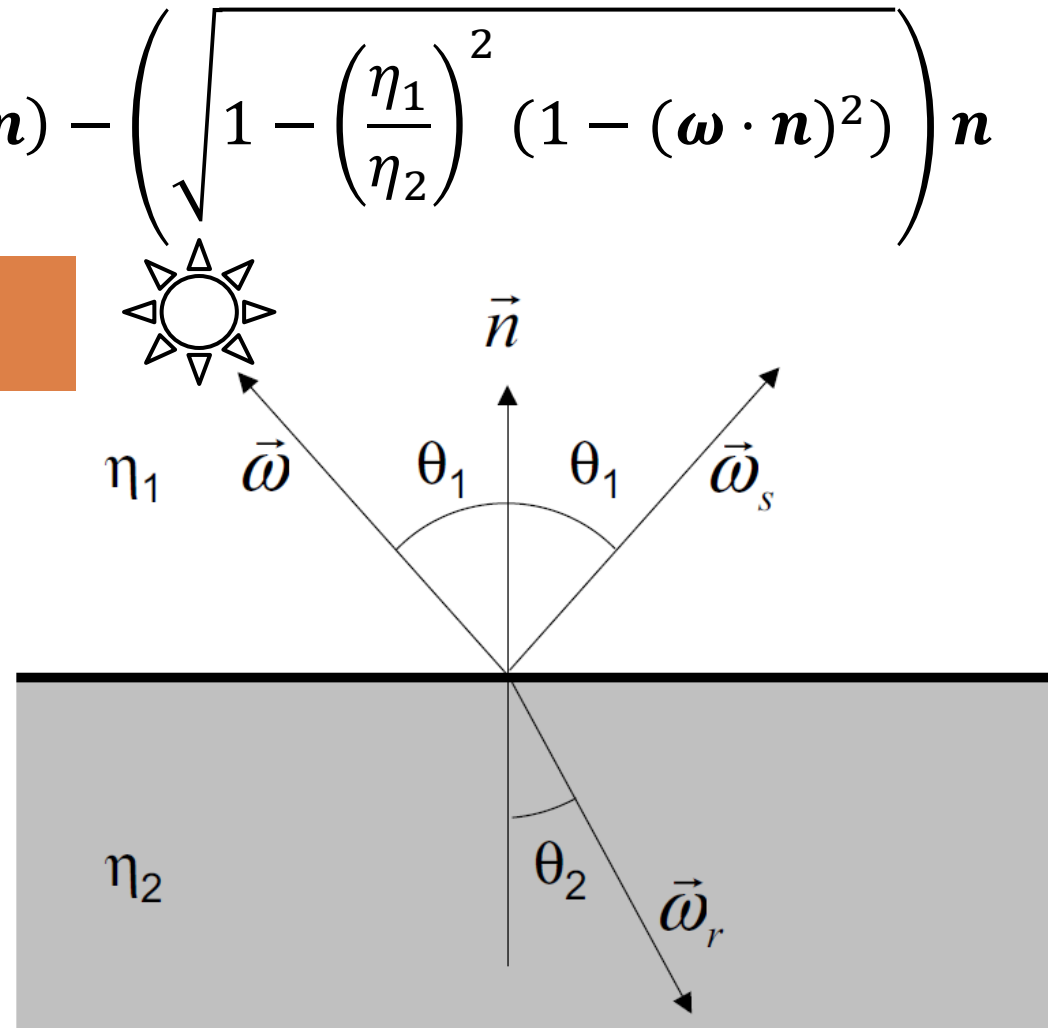
# Refraction

3

$$\omega_r = -\frac{\eta_1}{\eta_2} (\omega - (\omega \cdot \mathbf{n})\mathbf{n}) - \left( \sqrt{1 - \left(\frac{\eta_1}{\eta_2}\right)^2 (1 - (\omega \cdot \mathbf{n})^2)} \right) \mathbf{n}$$

Depends upon:

- Light polarization
- Light direction
- Surface index of refraction



# Snell's Law

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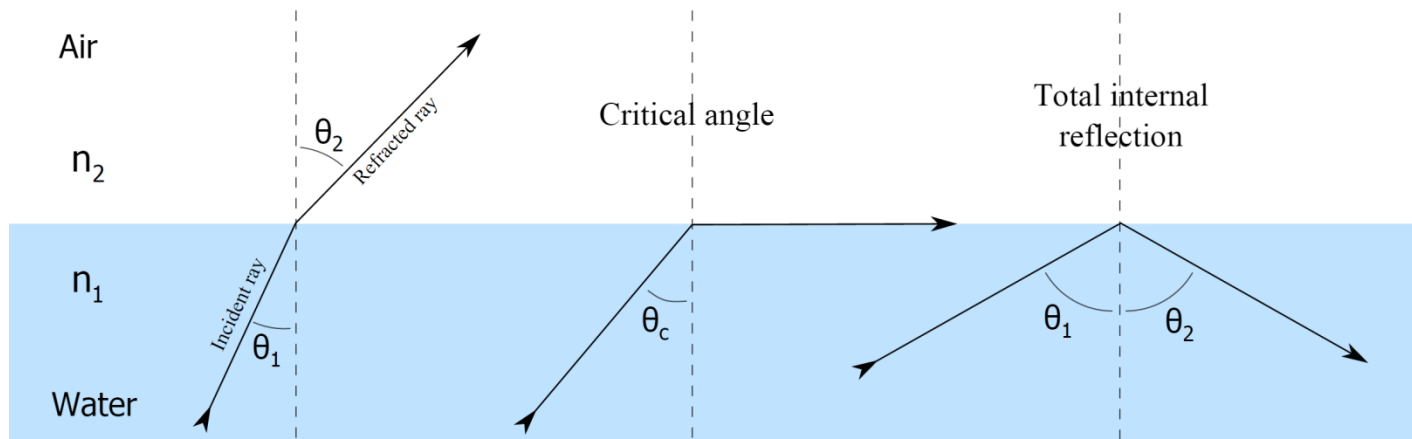
- Describes relationship between angle of incidence and angle of refraction with respect to index of refraction of two surfaces

$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{\eta_2}{\eta_1}$$

# Total Internal Reflection

5

- Light strikes surface with angle larger than a certain critical angle
- Wave cannot pass and is reflected instead of refracted
- Only occurs when going from a medium with higher refractive index to a medium with lower refracting index



# Fresnel Equations

6

- Describe light's behavior when moving between media with different refractive indices
  - Part of the light is reflected
  - Part of the light is refracted

} Adds to 1 due to energy conservation
- Complex formulas not suitable for real time rendering
- Usually approximated using Schlick's approximation

# Schlick's Approximation

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- Approximates Fresnel factor
- Formula calculates specular reflection coefficient

$$F(\theta) = F_0 + (1 - F_0)(1 - \cos \theta)^5$$

Where:  $\theta$  is the angle between view direction and half vector

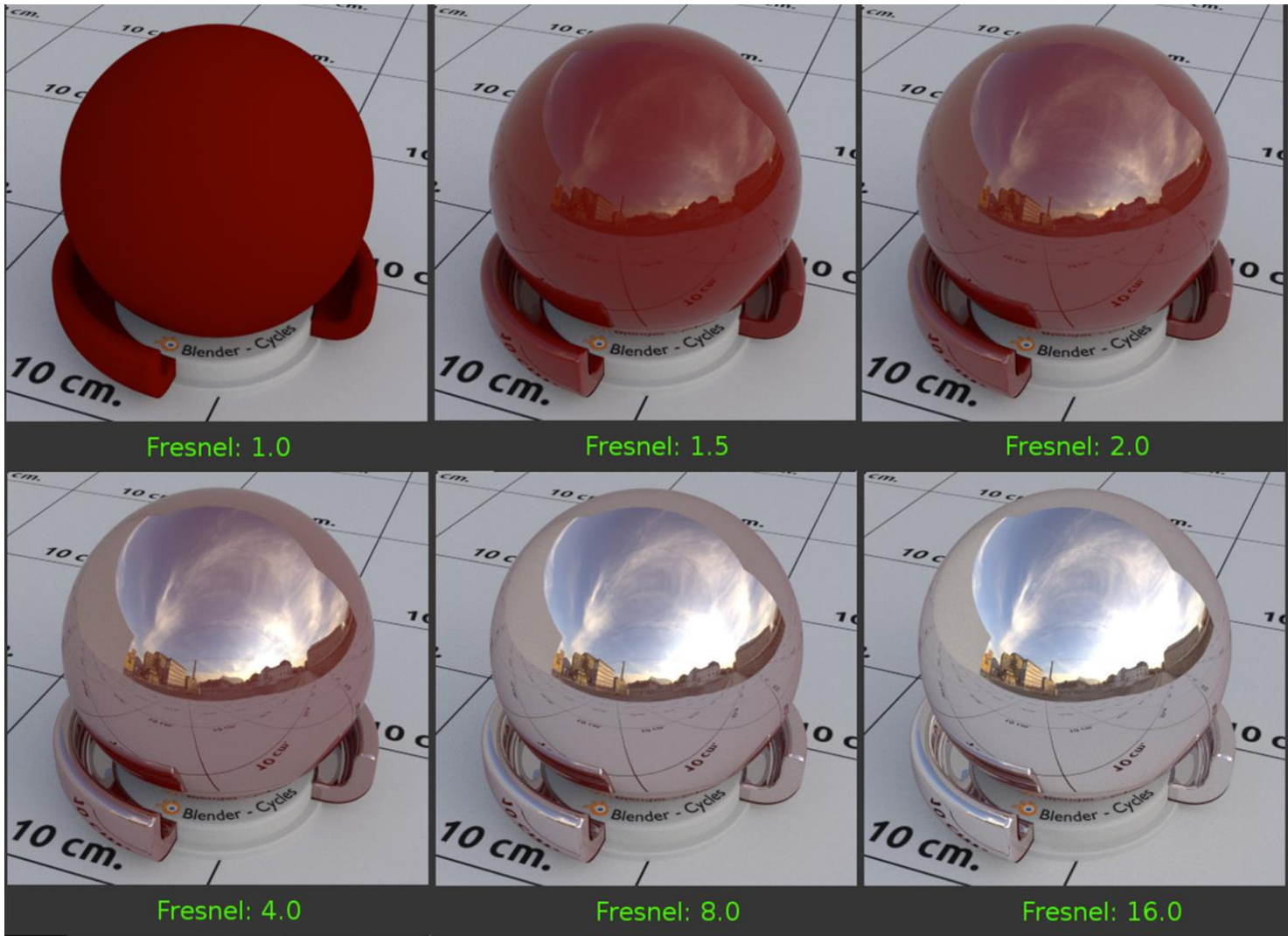
$$F_0 = \left( \frac{\eta_1 - \eta_2}{\eta_1 + \eta_2} \right)^2$$

Then: *ReflectiveFactor* =  $F(\theta)$

*RefractiveFactor* =  $1 - F(\theta)$

# Schlick's Approximation - $F_0$ change

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Questions?