Lab #4 – Path tracing (part 3)

Informática Gráfica

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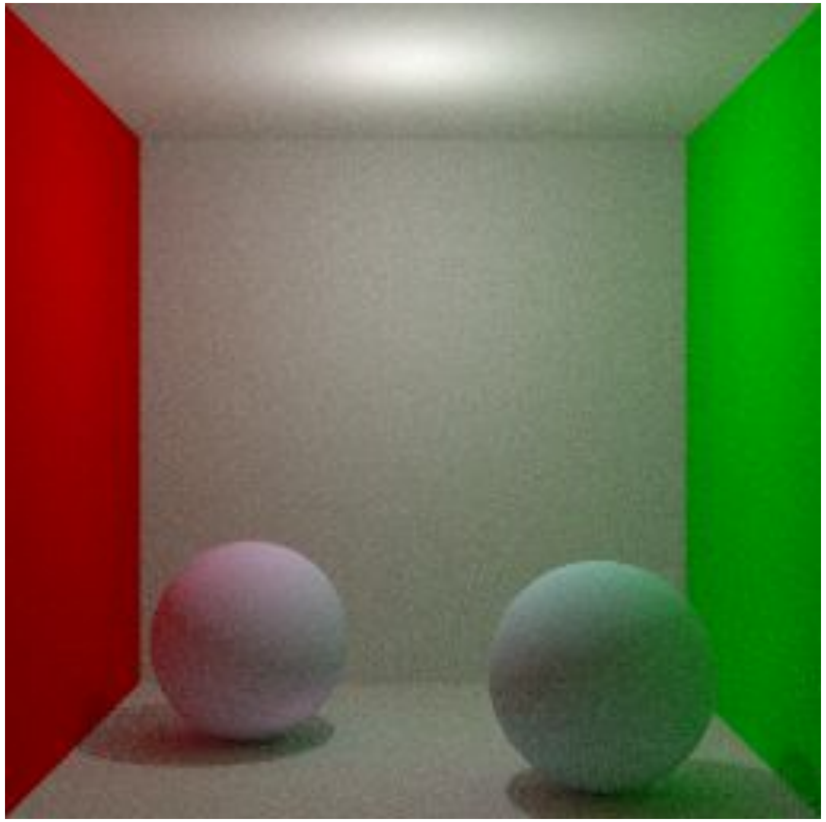
Pablo Luesia - J. Daniel Subías – Óscar Pueyo

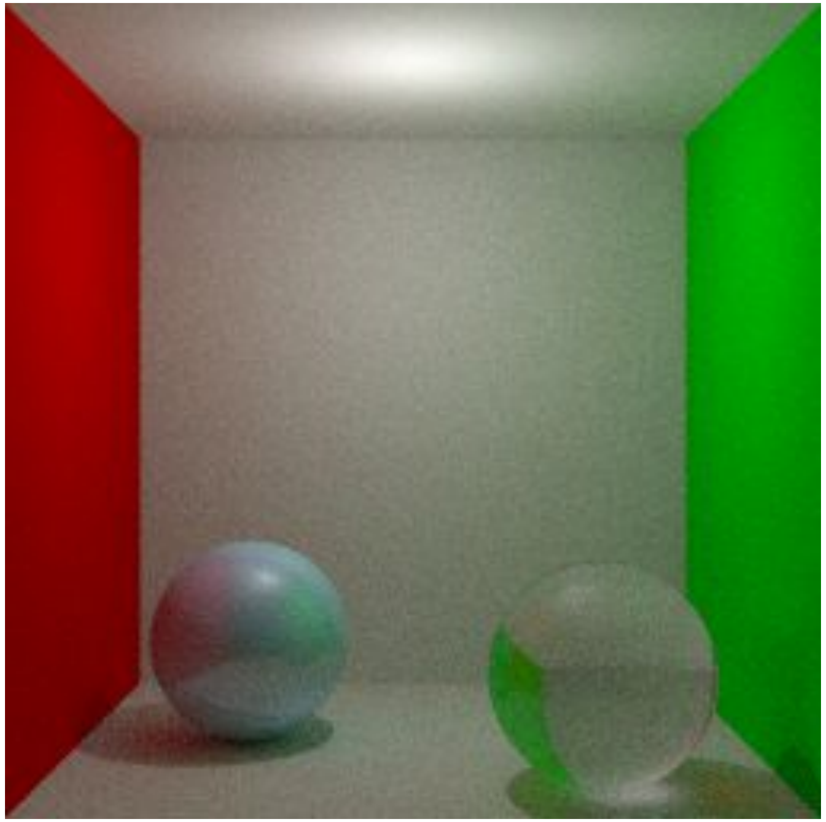
Graphics and Imaging Lab

Before we begin…

- Today: add **more materials** to the path tracing algorithm



Previous session (diffuse)

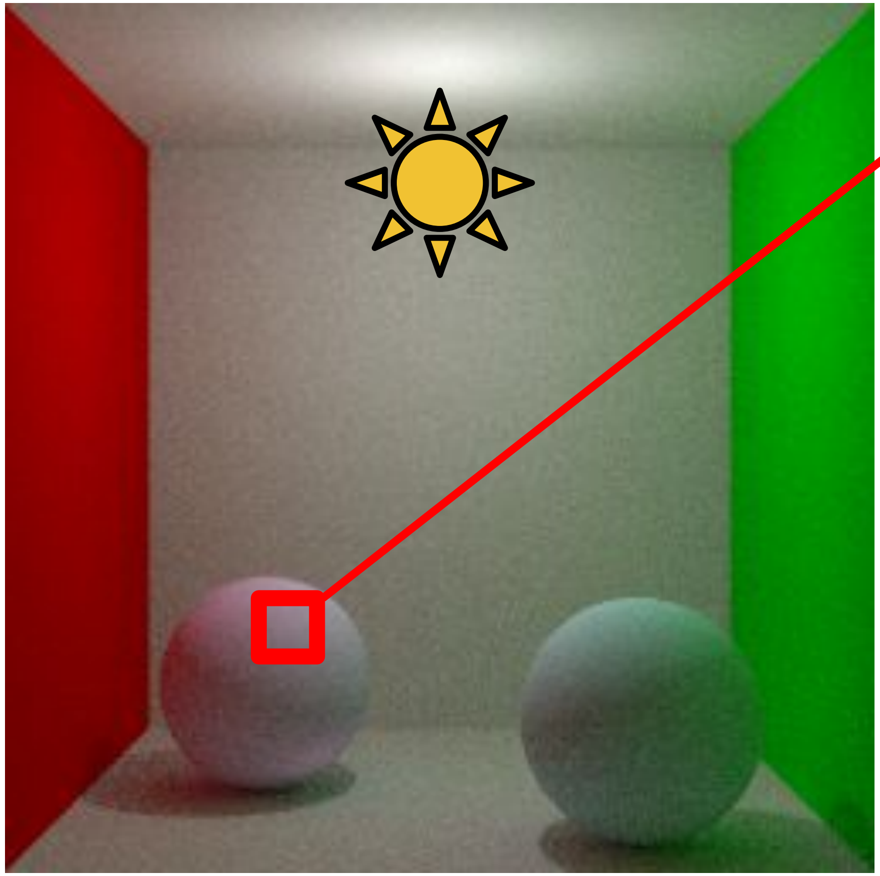


\+ Perfect specular and refraction

Before we begin…

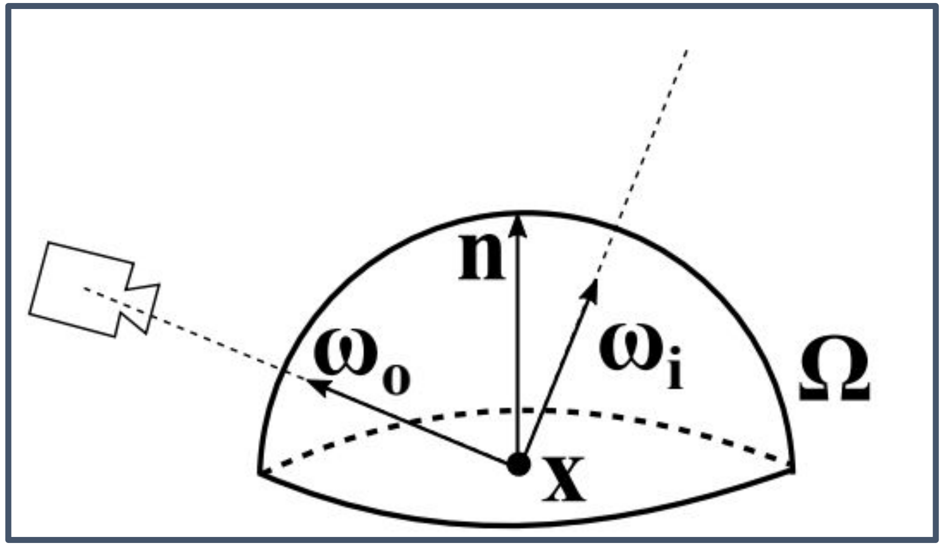
- Lab 4 (path tracing) **is the first submitted work**
  - Recommended deadline: November 13th
  - Moodle: January 11th
  - You will use most of today's code for Lab 5 (photon mapping) too
- Remember: Final work is 80% of the final grade

Recap: Which color do we fill each pixel with?

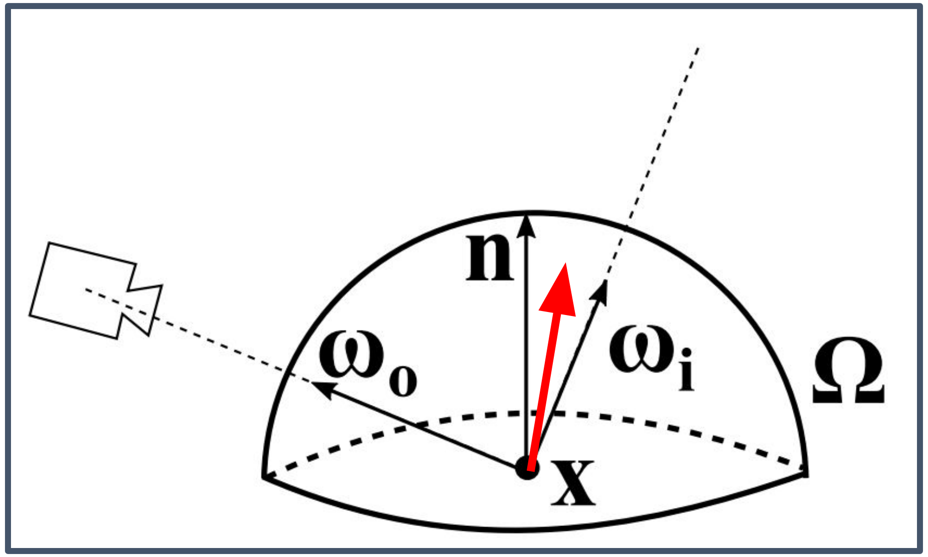


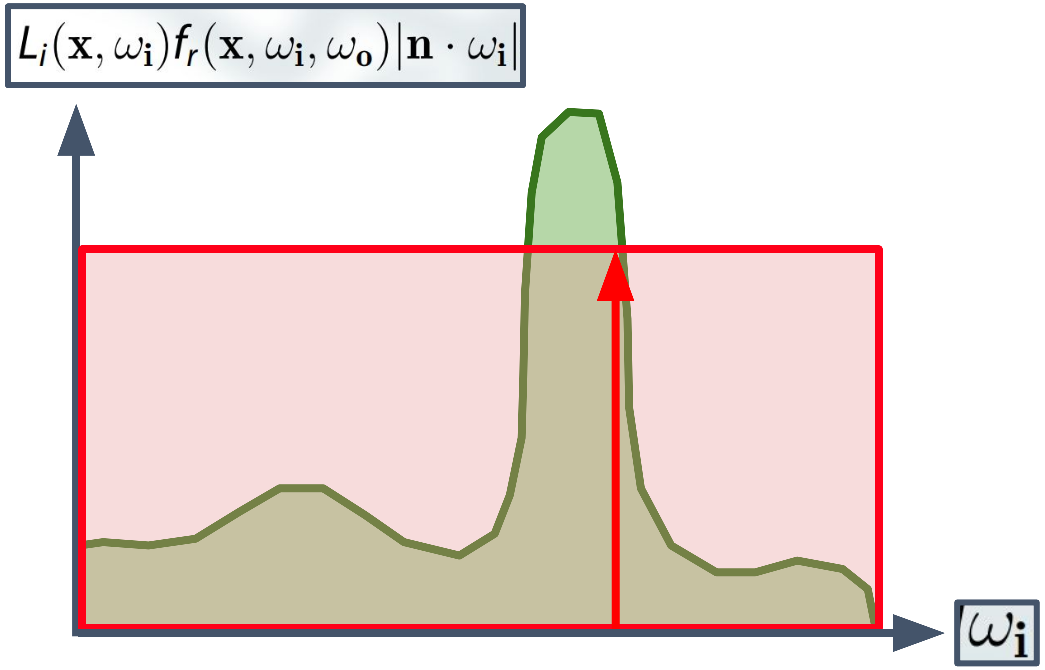
$$L_o(\mathbf{x}, \omega_o) = \cancel{L_e(\mathbf{x}, \omega_o)} + \boxed{\int_\Omega L_i(\mathbf{x}, \omega_i) f_r(\mathbf{x}, \omega_i, \omega_o) |\mathbf{n} \cdot \omega_i| d\omega_i}$$

The full integral



Recap: Approximating one integral



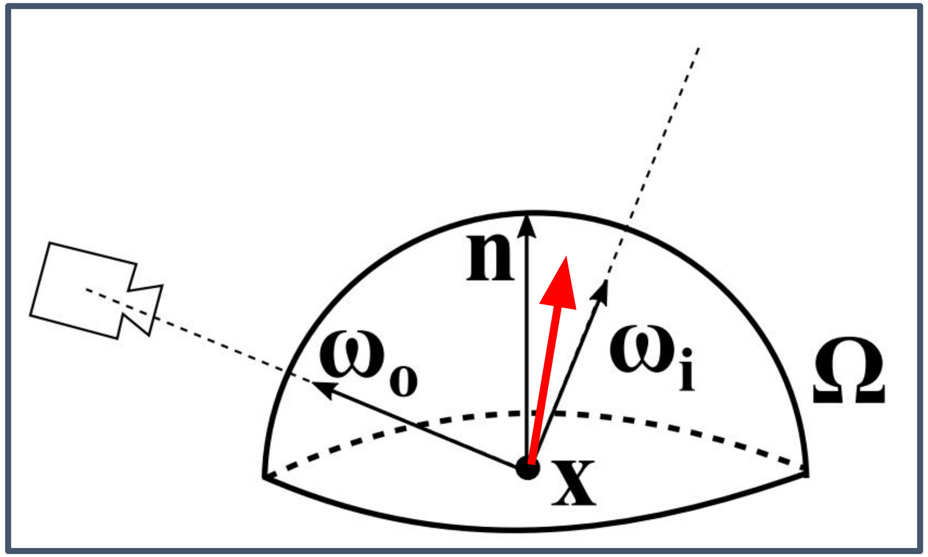


- There are infinite values for ω_i
- Idea 3: **Monte Carlo estimator**, use the mean of **N = 1** random sample

 ≈ for a randomly chosen direction

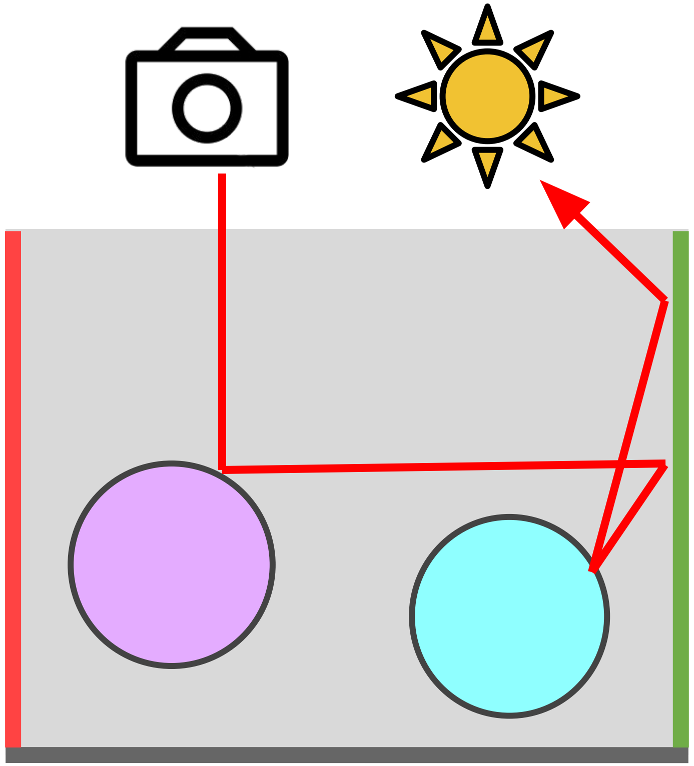
Recap: Approximating one integral in practice

- Monte Carlo estimation for the path integral



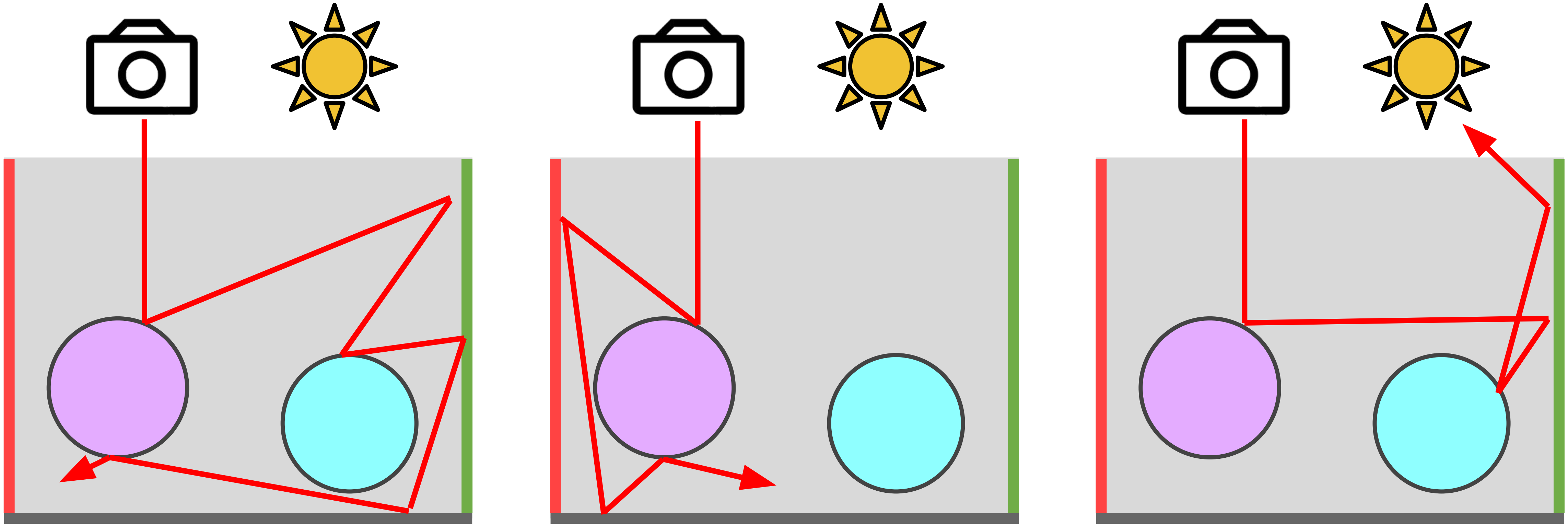
One random ω_i on each bounce

One random path



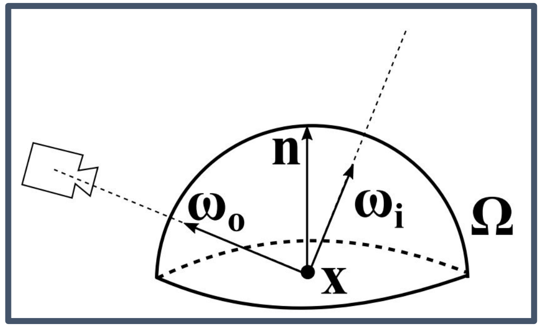
Recap: Approximating one integral in practice

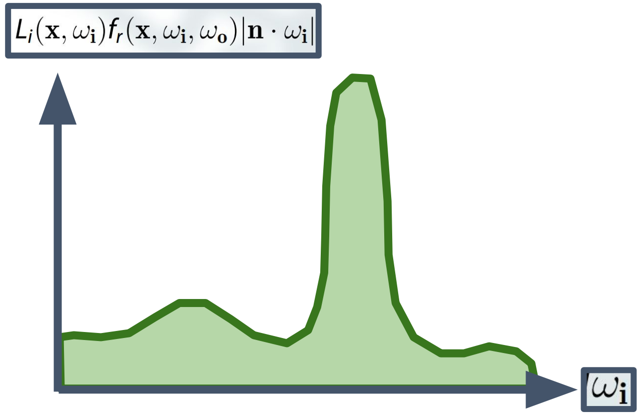
- Monte Carlo estimation for the path integral
  - Sum of multiple random paths
  - More paths ⟶ better approximation of the integral (better result)



Recap: Sampling directions in Ω

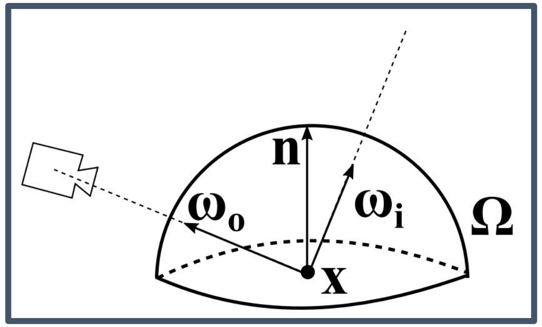
- How to generate a value for ω_{i}?
- Use the sampling method (probability distribution of ω_{i}) that benefits you

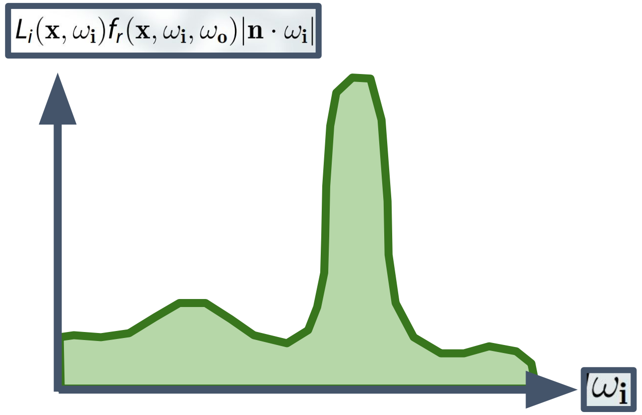




Recap: Sampling directions in Ω

- How to generate a value for $\boxed{\omega_{\mathbf{i}}}$?
- Use the sampling method (probability distribution of $\boxed{\omega_{\mathbf{i}}}$) that benefits you





Uniform solid angle sampling

$$p(\theta_i) = \sin \theta_i$$

$$p(\phi_i) = \frac{1}{2\pi}$$

Uniform cosine sampling

$$p(\theta_i) = 2 \sin \theta_i \cos \theta_i$$

$$p(\phi_i) = \frac{1}{2\pi}$$

Recap: Sampling directions in Ω

- How to generate a value for $\boxed{\omega_{\mathbf{i}}}$?
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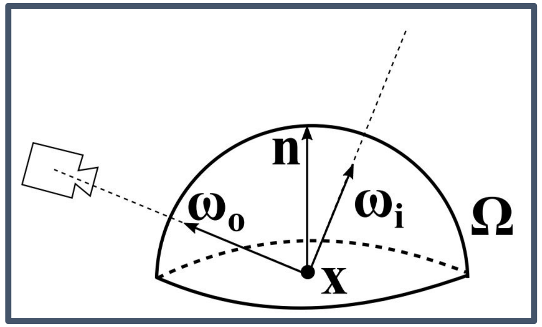

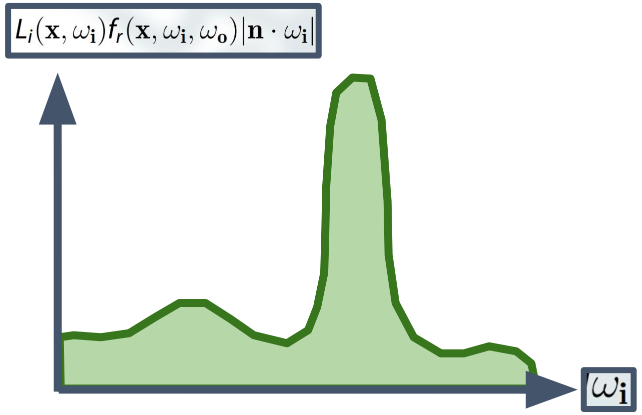

Uniform solid angle sampling

$$p(\theta_i) = \sin\theta_i \qquad c^{-1}(\xi_{\theta_i}) = \arccos \xi_{\theta_i}$$

$$p(\phi_i) = \frac{1}{2\pi} \qquad c^{-1}(\xi_{\phi_i}) = 2\pi\xi_{\phi_i}$$

Uniform cosine sampling

$$p(\theta_i) = 2\sin\theta_i \cos\theta_i \qquad c^{-1}(\xi_{\theta_i}) = \arccos\sqrt{1 - \xi_{\theta_i}}$$

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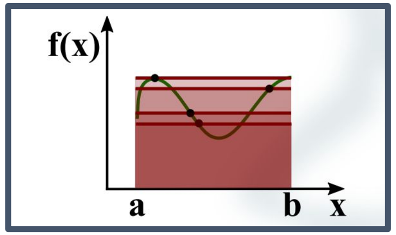
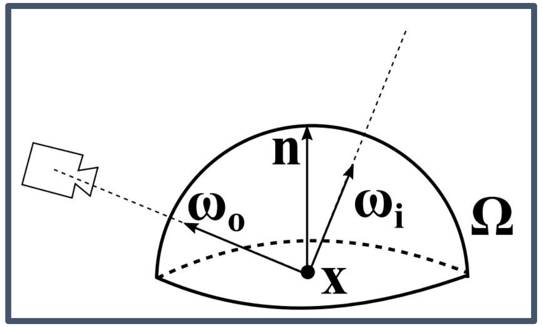
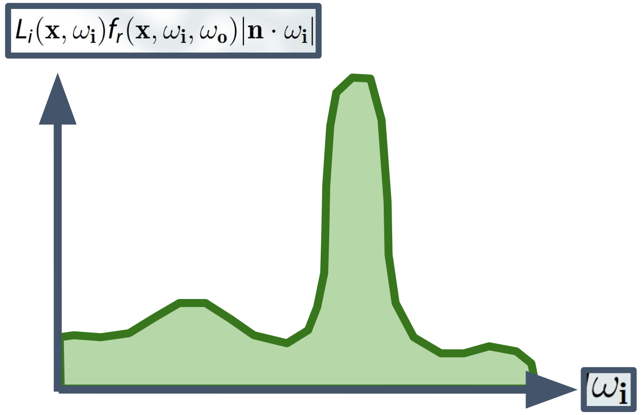
Recap: Sampling directions in Ω



$$\int_a^b f(x)dx \approx \frac{1}{N}\sum_{i=1}^{N}\frac{f(x_i)}{p(x_i)}$$





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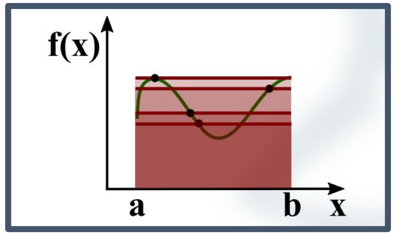
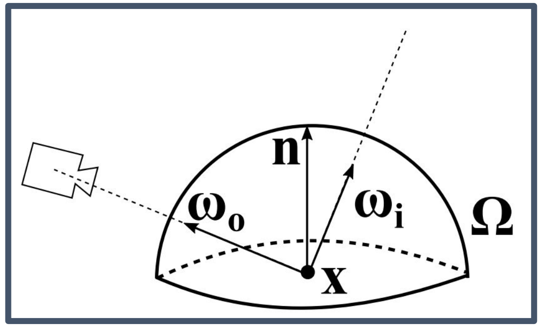
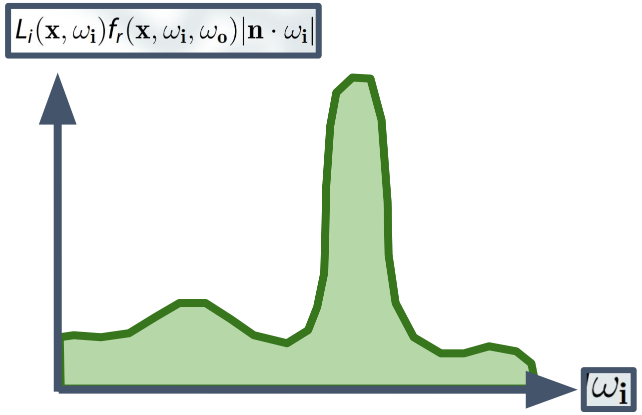
Recap: Sampling directions in Ω



Remember to simplify

$$\int_a^b f(x)dx \approx \frac{1}{N}\sum_{i=1}^{N}\frac{f(x_i)}{p(x_i)}$$





Uniform solid angle sampling

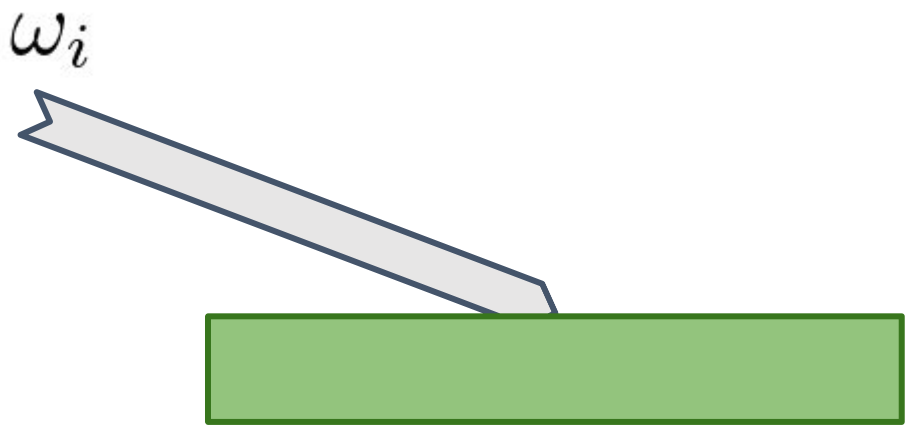
$$L_o(\mathbf{x}, \omega_o) \approx \sum_{i=1}^{N} \frac{2\pi L_i(\mathbf{x}, \omega_i) f_r(\mathbf{x}, \omega_i, \omega_o) \cos\theta_i \cancel{\sin\theta_i}}{\cancel{\sin\theta_i}}$$

Uniform cosine sampling

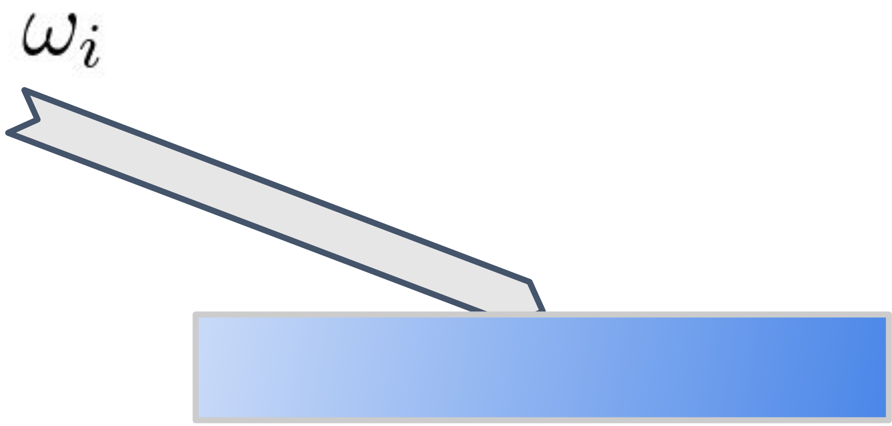
$$L_o(\mathbf{x}, \omega_o) \approx \sum_{i=1}^{N} \frac{\cancel{2}\pi L_i(\mathbf{x}, \omega_i) f_r(\mathbf{x}, \omega_i, \omega_o) \cancel{\cos\theta_i \sin\theta_i}}{\cancel{2 \sin\theta_i \cos\theta_i}}$$

Diffuse and specular BRDFs

Diffuse material



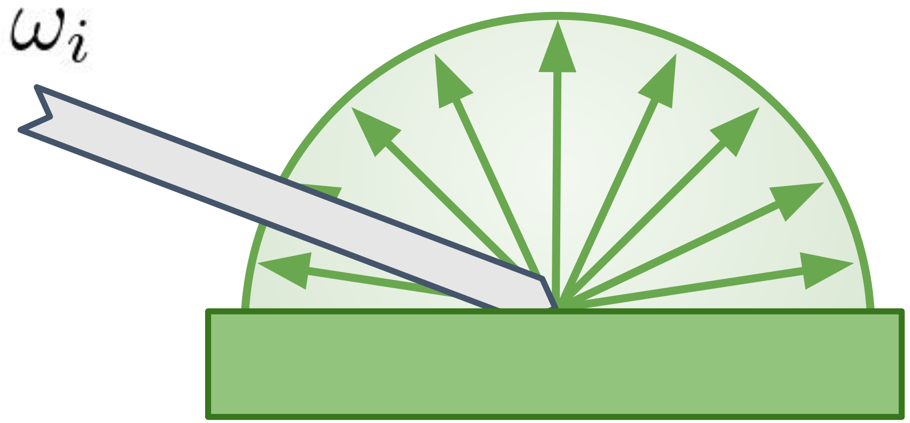
Perfect specular material



Diffuse and specular BRDFs

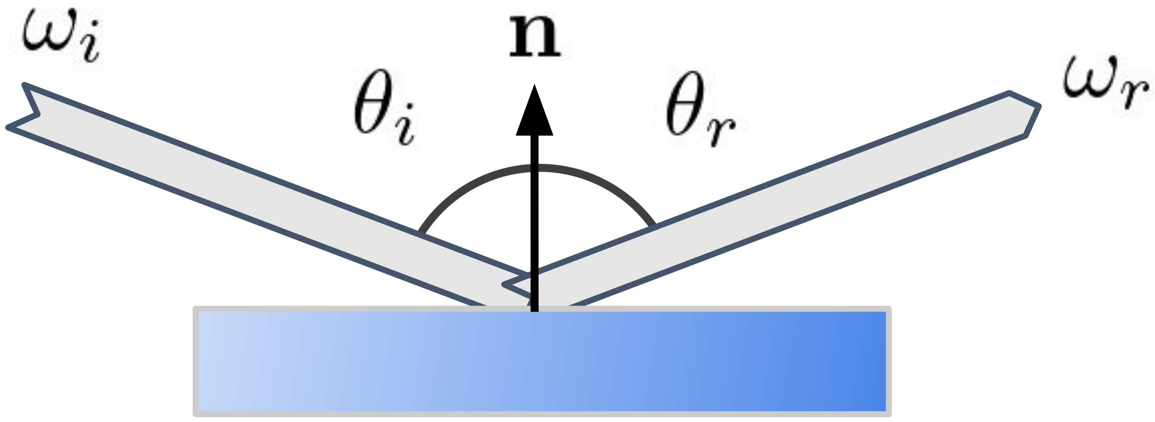
Diffuse material

Light is reflected in all directions equally



Perfect specular material

All light is (perfectly) reflected towards one direction ω_r



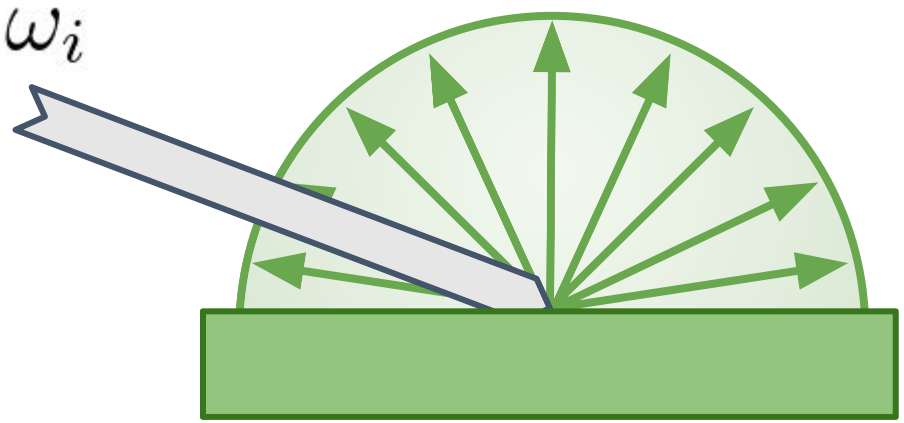
$$\theta_i = \theta_r$$

Diffuse and specular BRDFs

Graphics and Imaging Lab

Diffuse material

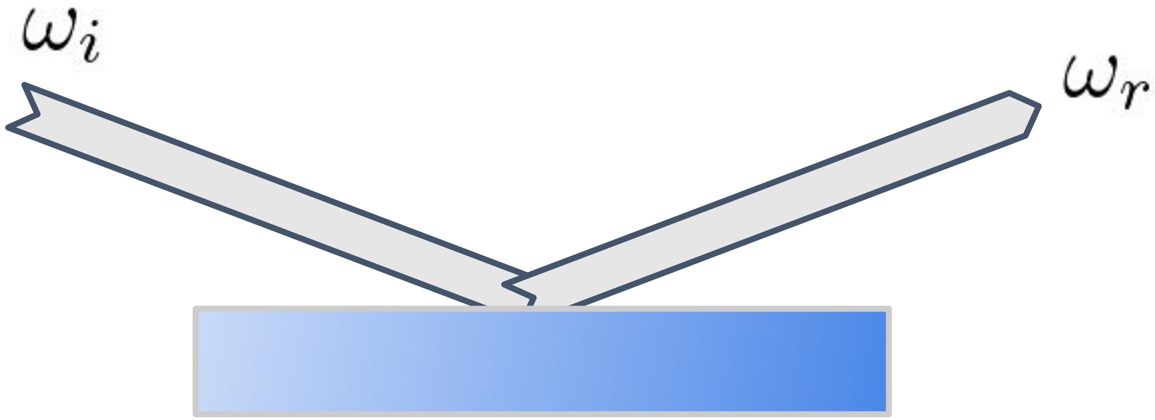
Light is reflected in all directions equally



$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \frac{k_d}{\pi}$$

Perfect specular material

All light is (perfectly) reflected towards one direction ω_r



$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \frac{\delta_{\omega_\mathrm{r}}(\omega_\mathbf{i})}{(\omega_\mathbf{i} \cdot \mathbf{n})}$$

Diffuse and specular BRDFs

Diffuse material

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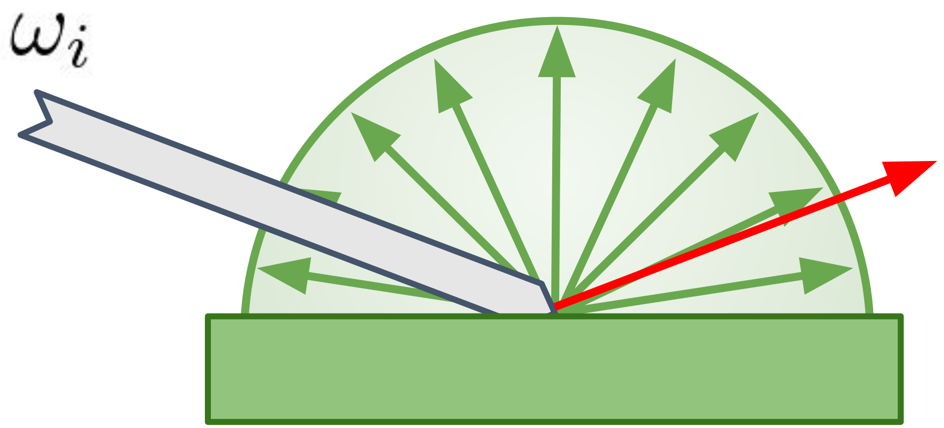

$$f_r(\mathbf{x}, \omega_i, \omega_o)|\mathbf{n} \cdot \omega_i| = \frac{k_d}{\pi}|\mathbf{n} \cdot \omega_i|$$

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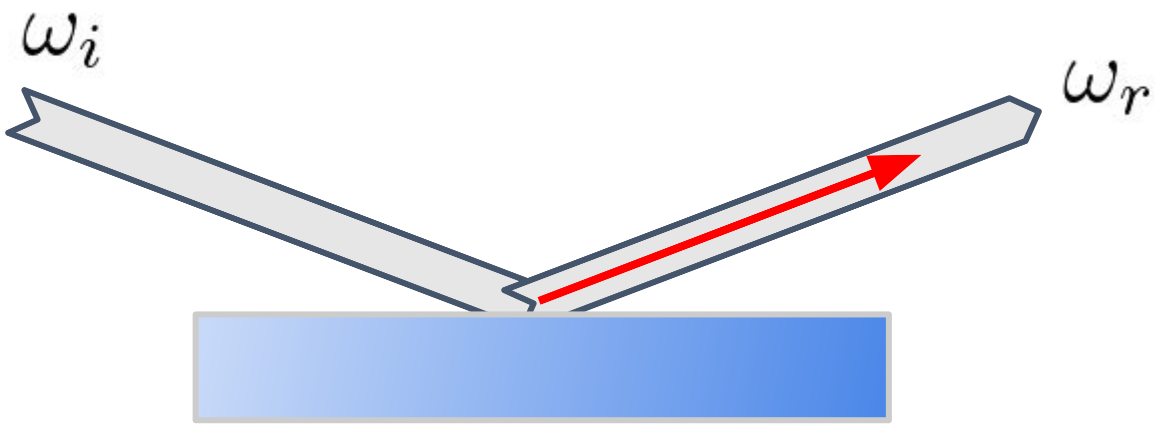
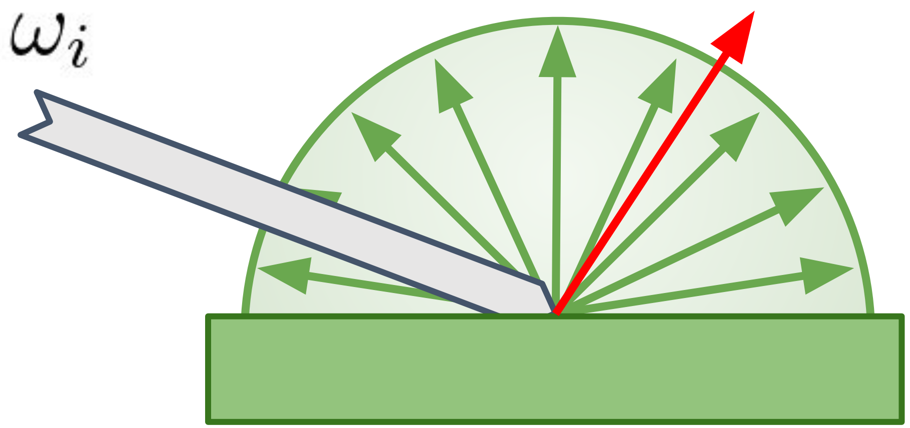


$$f_r(\mathbf{x}, \omega_i, \omega_o)|\mathbf{n} \cdot \omega_i| = 1$$

Diffuse and specular BRDFs

Diffuse material

Light is reflected in all directions equally



$$f_r(\mathbf{x}, \omega_i, \omega_o)|\mathbf{n} \cdot \omega_i| = \frac{k_d}{\pi}|\mathbf{n} \cdot \omega_i|$$

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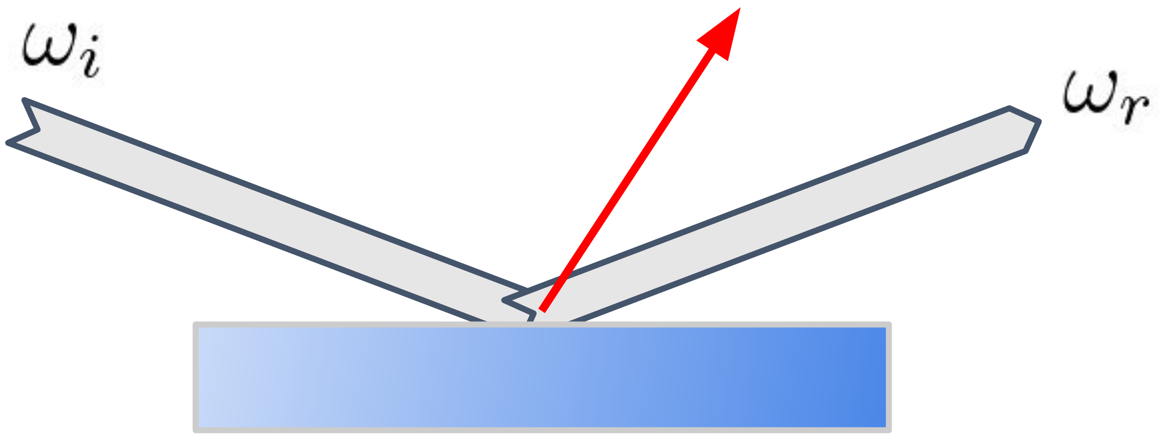
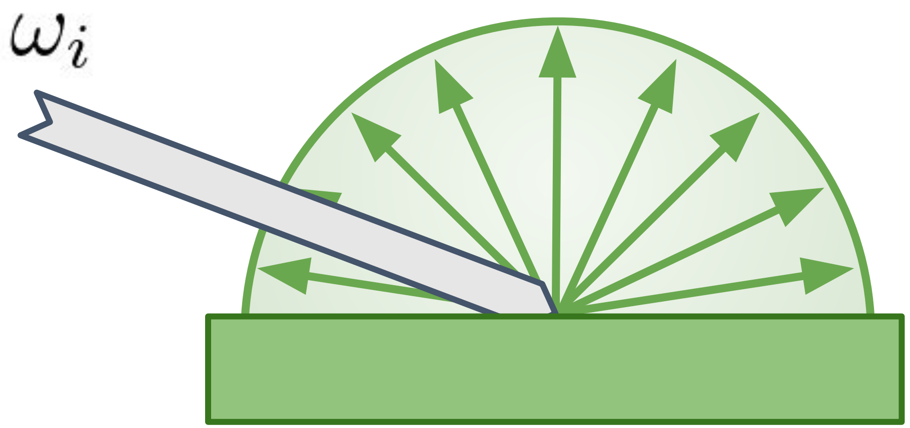


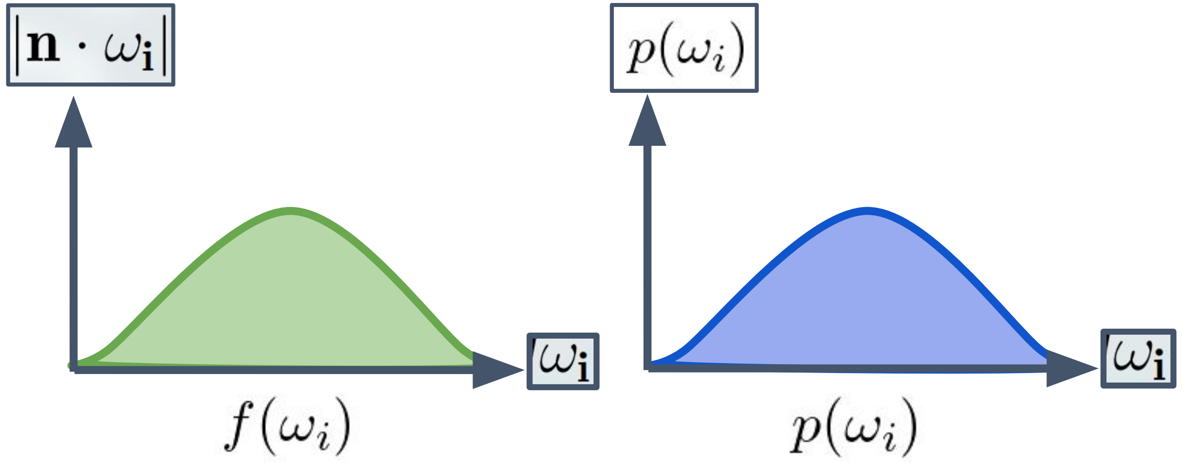
$$f_r(\mathbf{x}, \omega_i, \omega_o)|\mathbf{n} \cdot \omega_i| = 0$$

Diffuse and specular BRDFs

Graphics and Imaging Lab

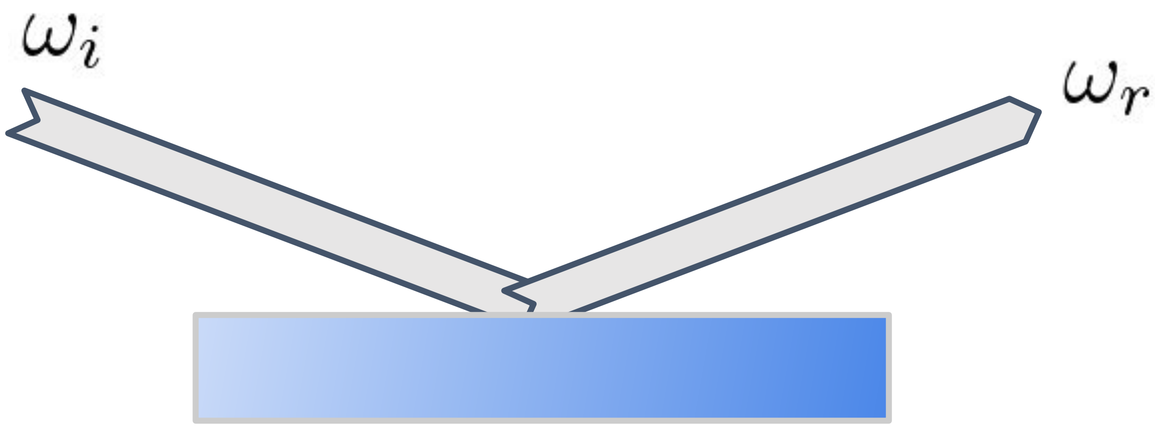
Diffuse material





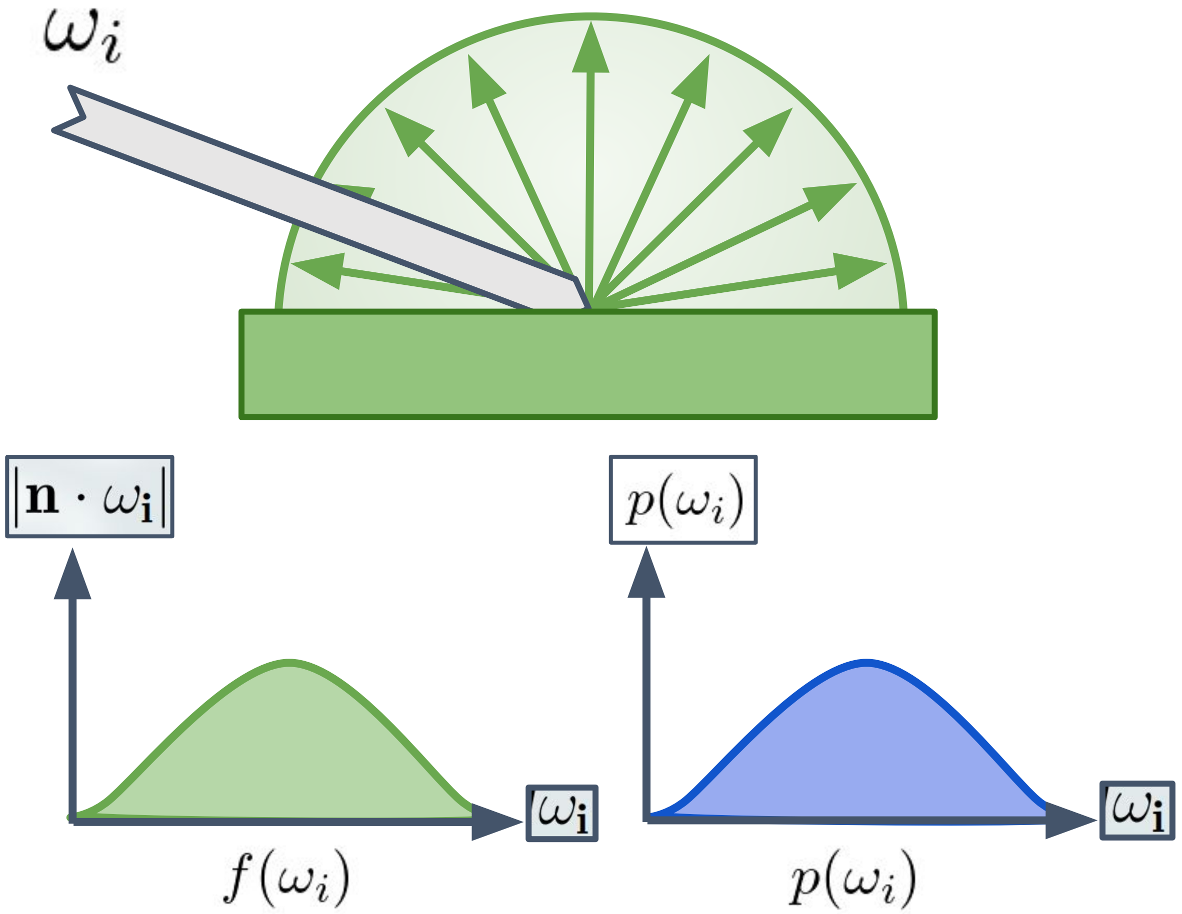
Uniform cosine sampling is good

Perfect specular material



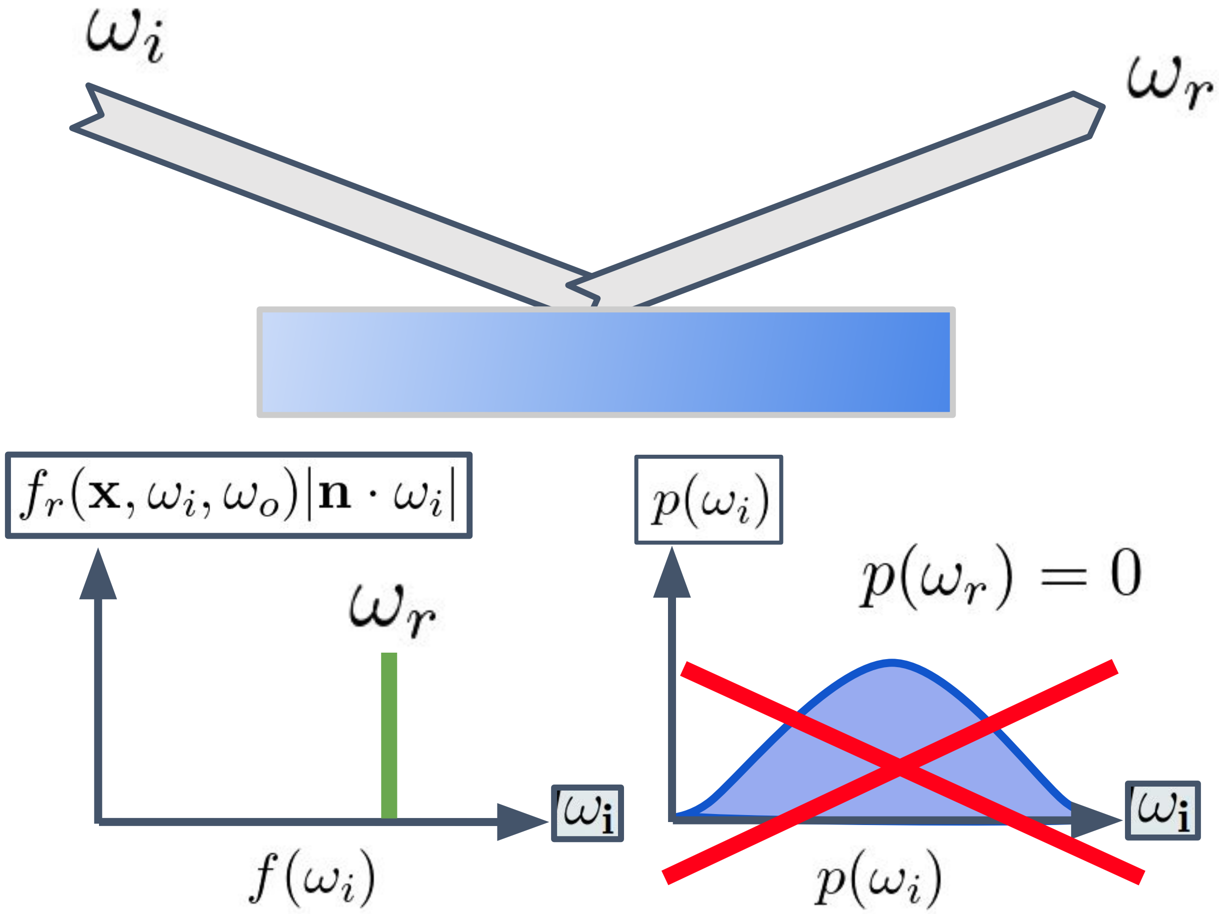
Diffuse and specular BRDFs

Diffuse material



Uniform cosine sampling is good

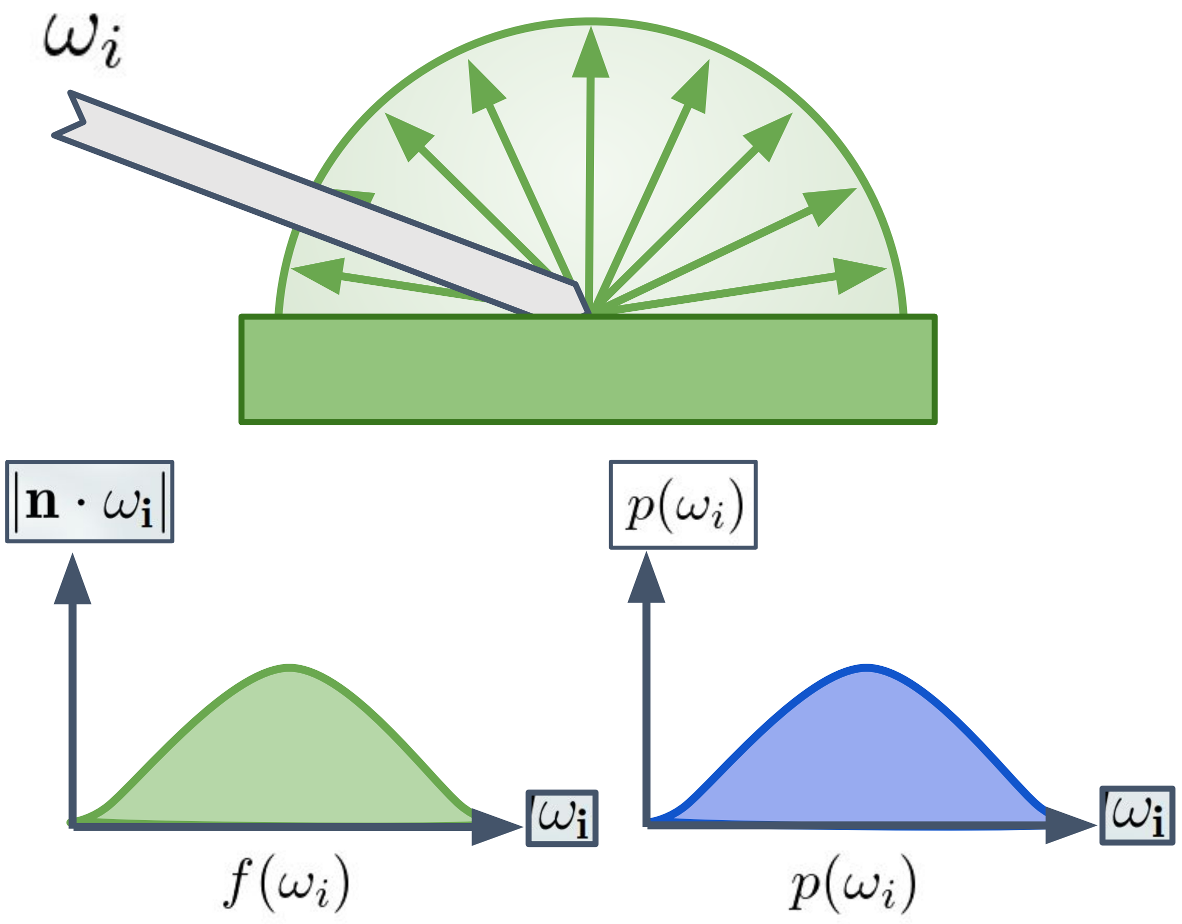
Perfect specular material



Uniform cosine sampling is wrong

Diffuse and specular BRDFs

Diffuse material



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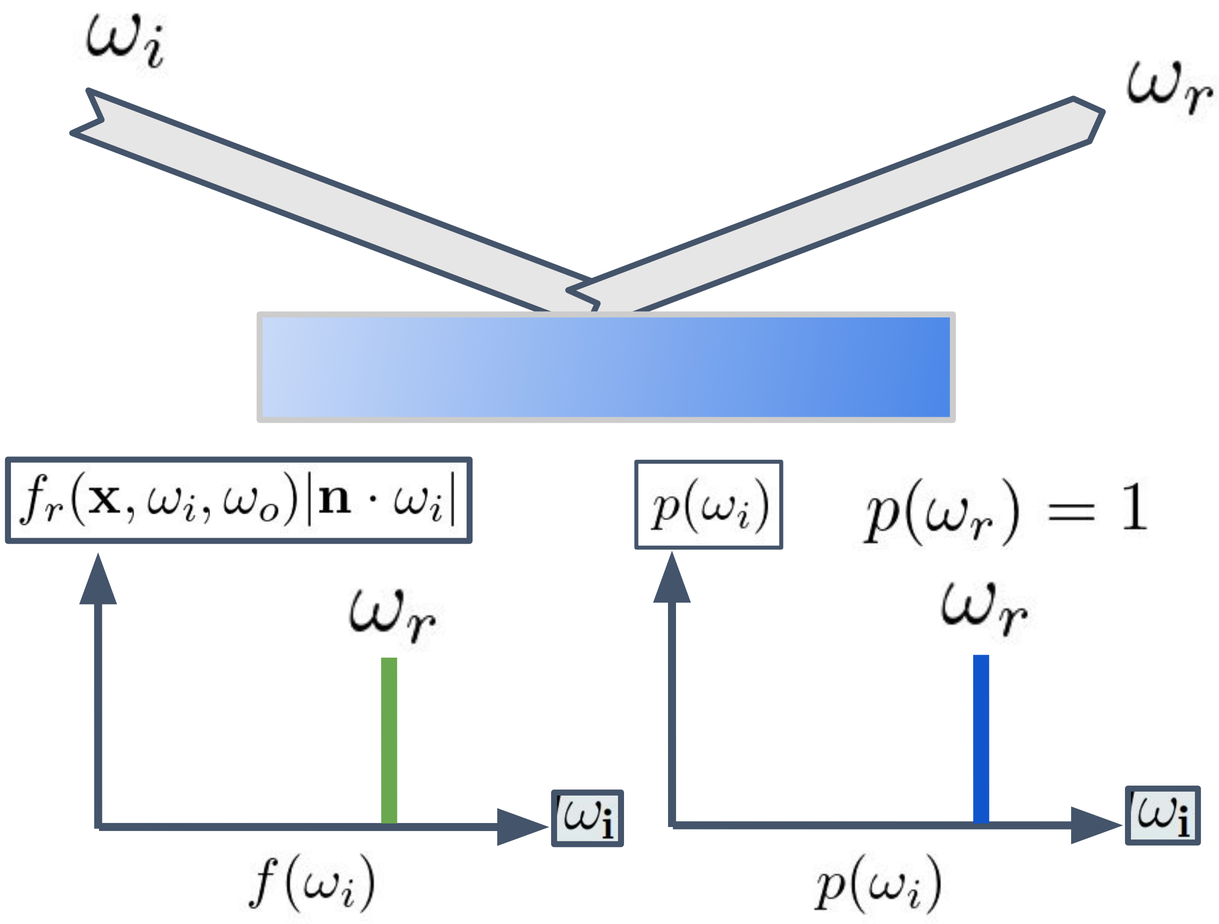
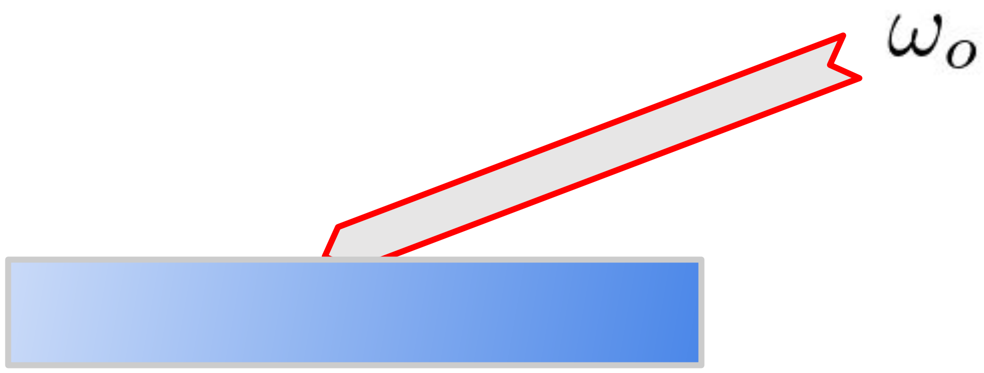
Perfect specular material



Deterministic sampling (not Monte Carlo)

Perfect specular (delta BRDF) sampling

- **Remember:** paths go from the camera to the light source



$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{(\omega_\mathbf{i} \cdot \mathbf{n})}$$

Always sample the perfect specular direction ω_r

Perfect specular (delta BRDF) sampling

Graphics and Imaging Lab

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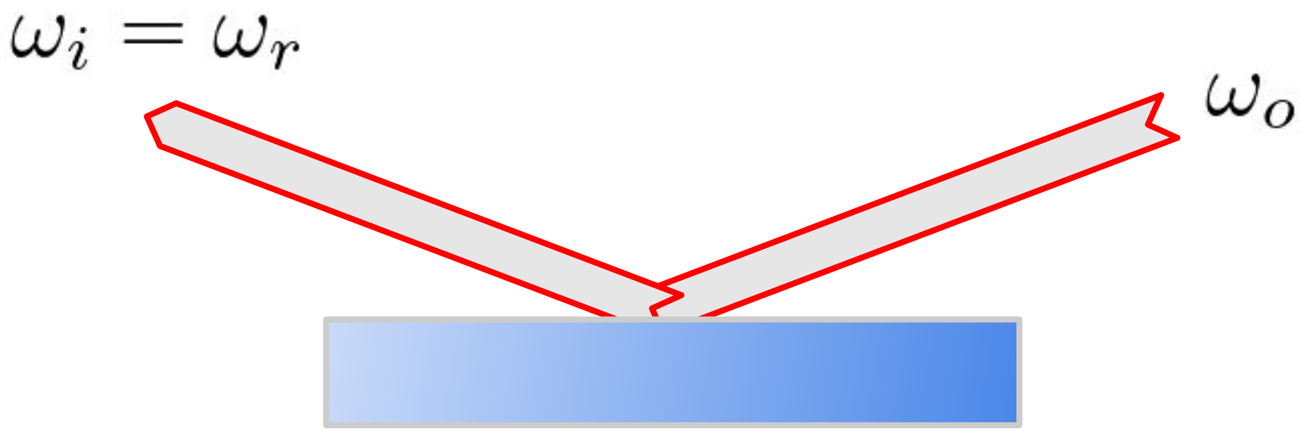

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$$\omega_i = \omega_r = \omega_o - 2\mathbf{n}(\omega_o \cdot \mathbf{n})$$

Perfect specular (delta BRDF) sampling

Graphics and Imaging Lab

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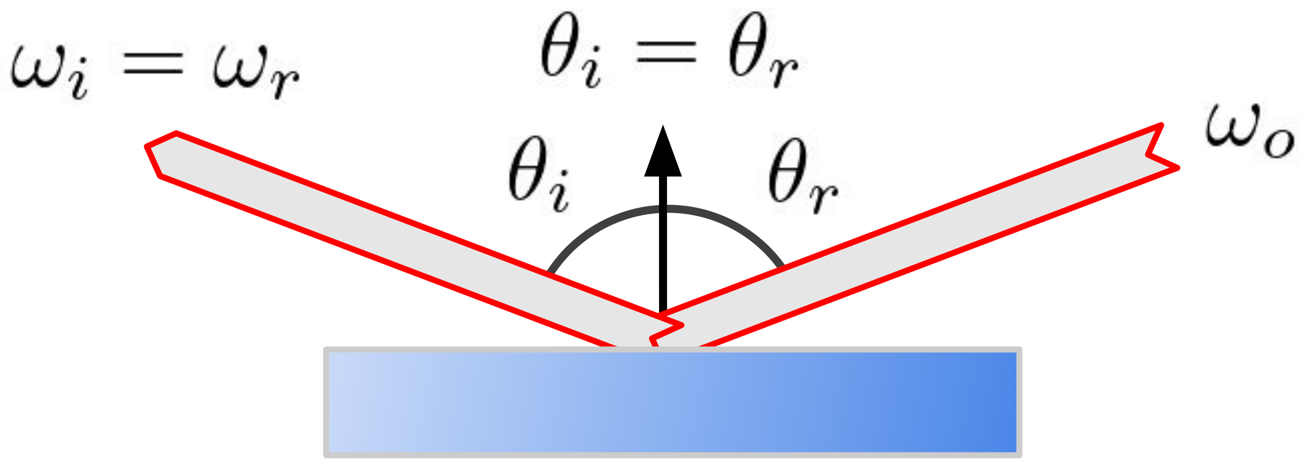


$$\boxed{f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{(\omega_\mathbf{i} \cdot \mathbf{n})}}$$

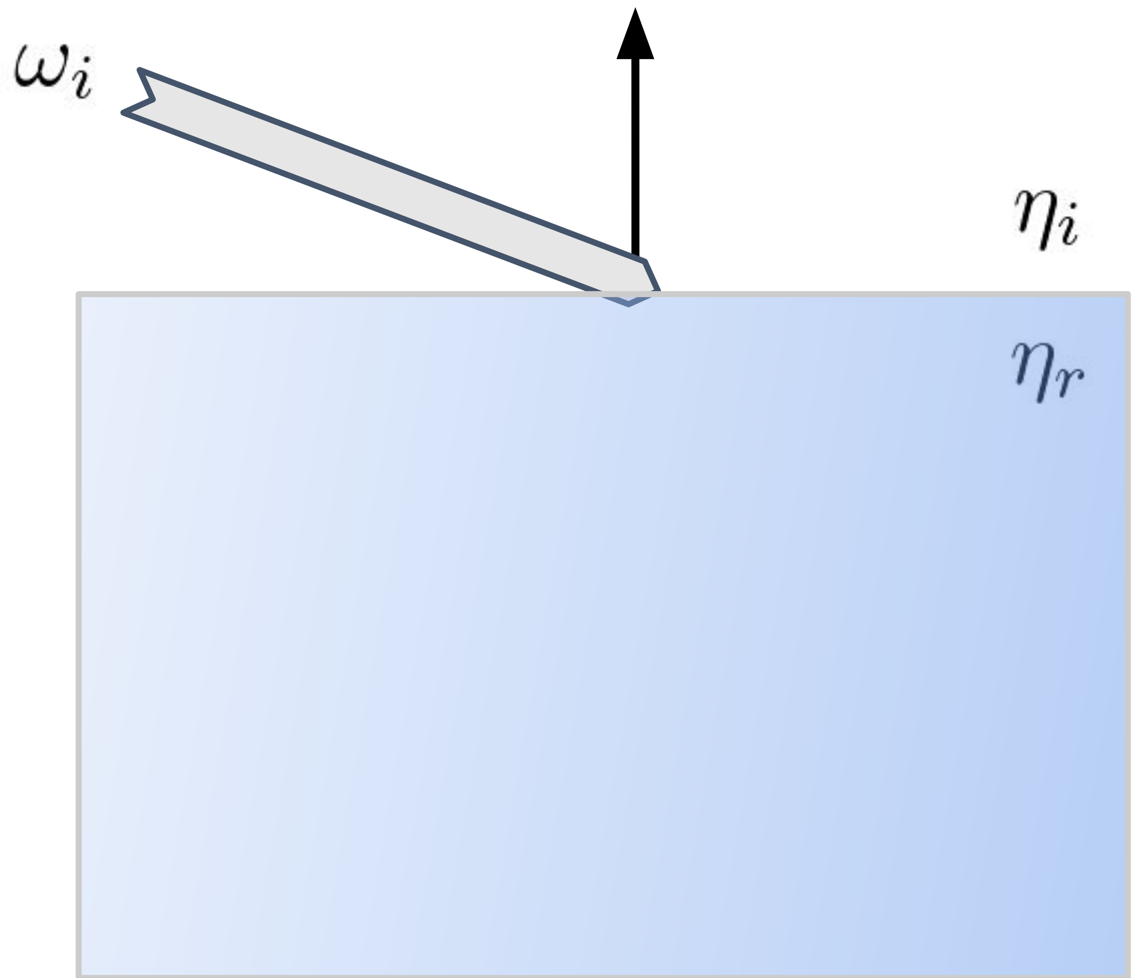
Always sample the perfect specular direction ω_r

$$\boxed{\omega_i = \omega_r = \omega_o - 2\mathbf{n}(\omega_o \cdot \mathbf{n})}$$

$$\boxed{p(\omega_r) = 1}$$

Perfect refraction (delta BTDF) sampling

- The material does not **reflect** light, instead it (perfectly) **refracts** light



$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \frac{\delta_{\omega_t}(\omega_\mathbf{i})}{(\omega_\mathbf{i} \cdot \mathbf{n})}$$

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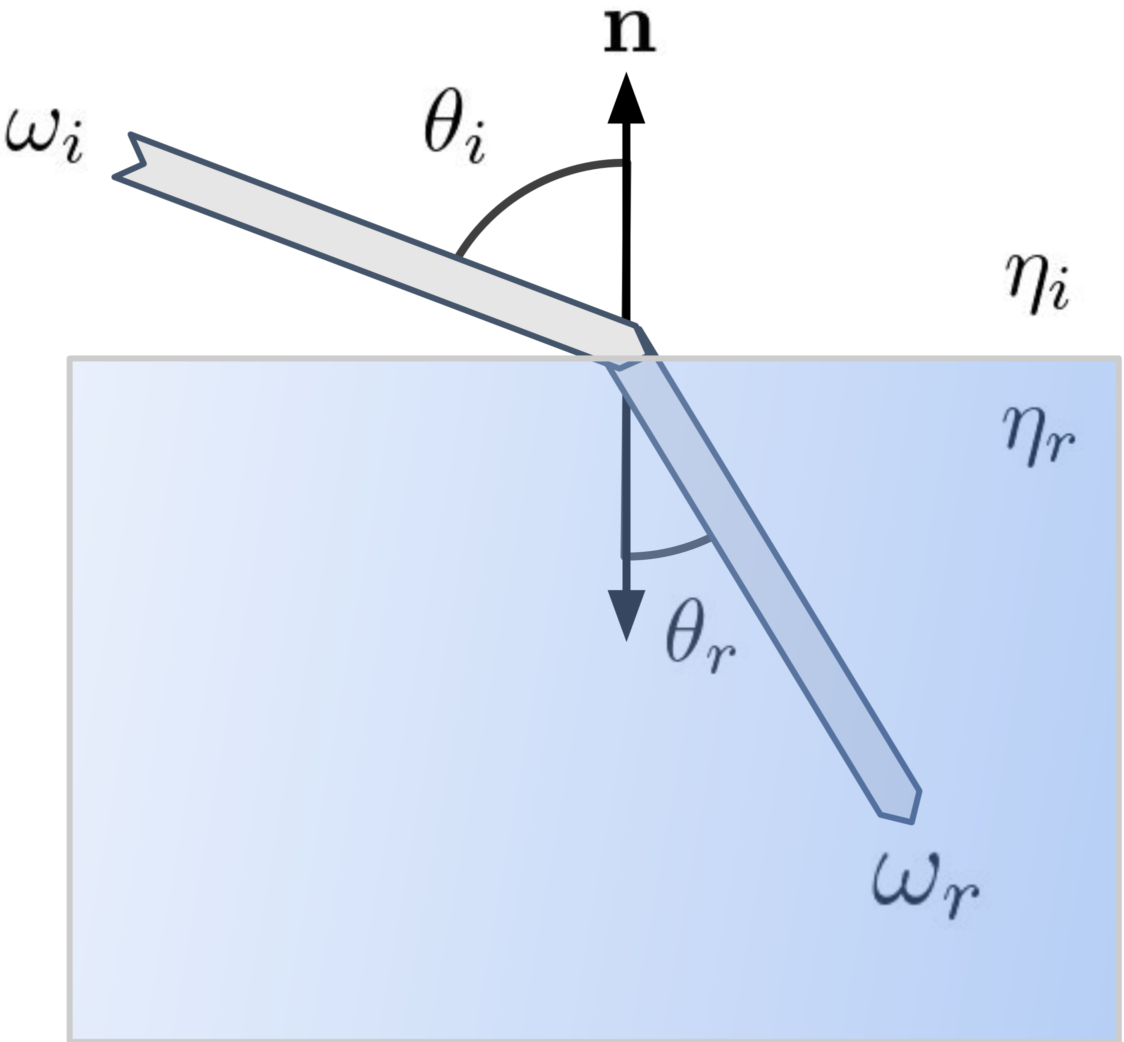

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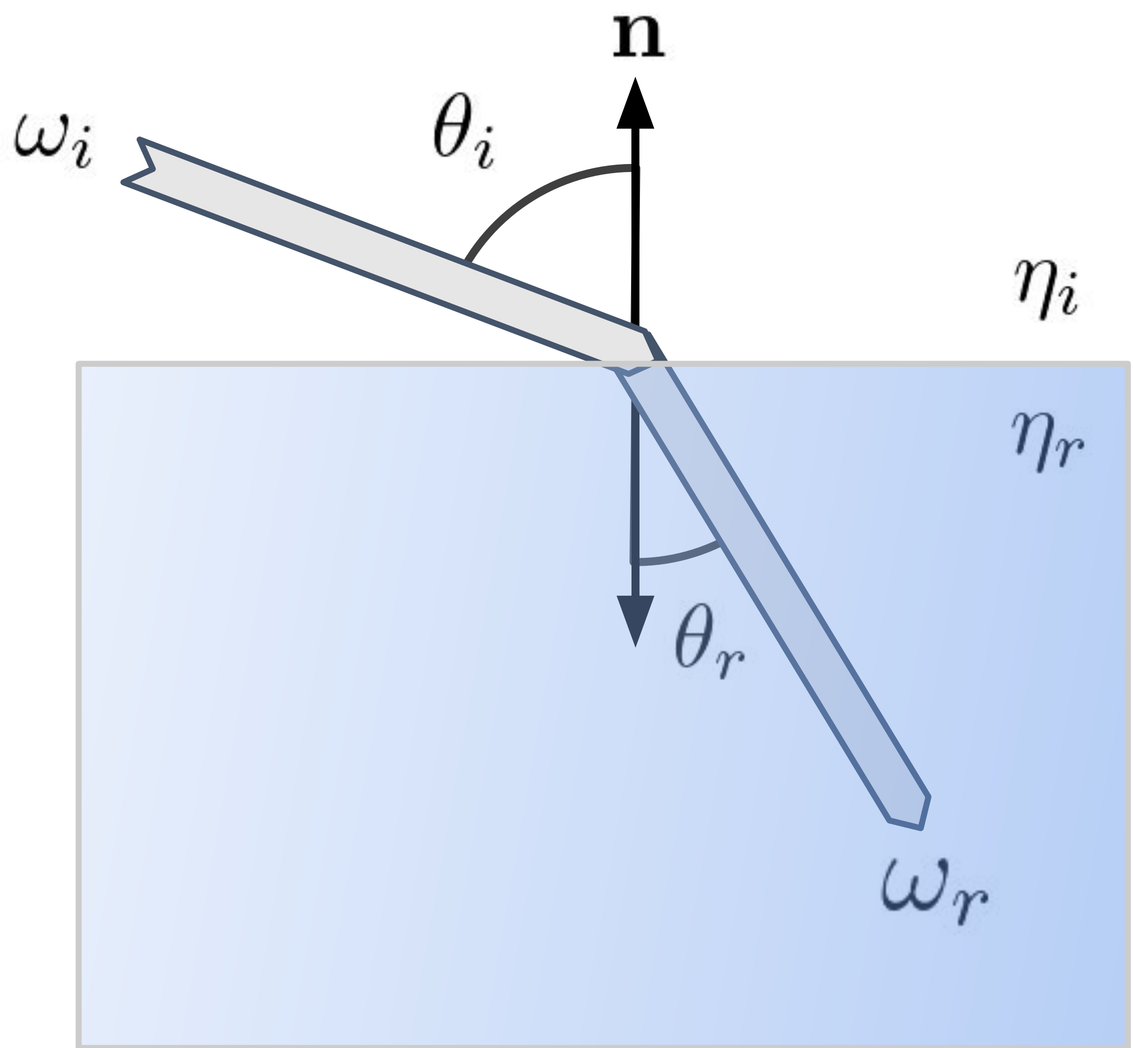

$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \frac{\delta_{\omega_t}(\omega_\mathbf{i})}{(\omega_\mathbf{i} \cdot \mathbf{n})}$$

- **Snell's law:**

ω_r depends on the index of refraction η_i , η_r of the two media

$$\eta_i \sin\theta_i = \eta_r \sin\theta_r$$

Perfect refraction (delta BTDF) sampling

Graphics and Imaging Lab

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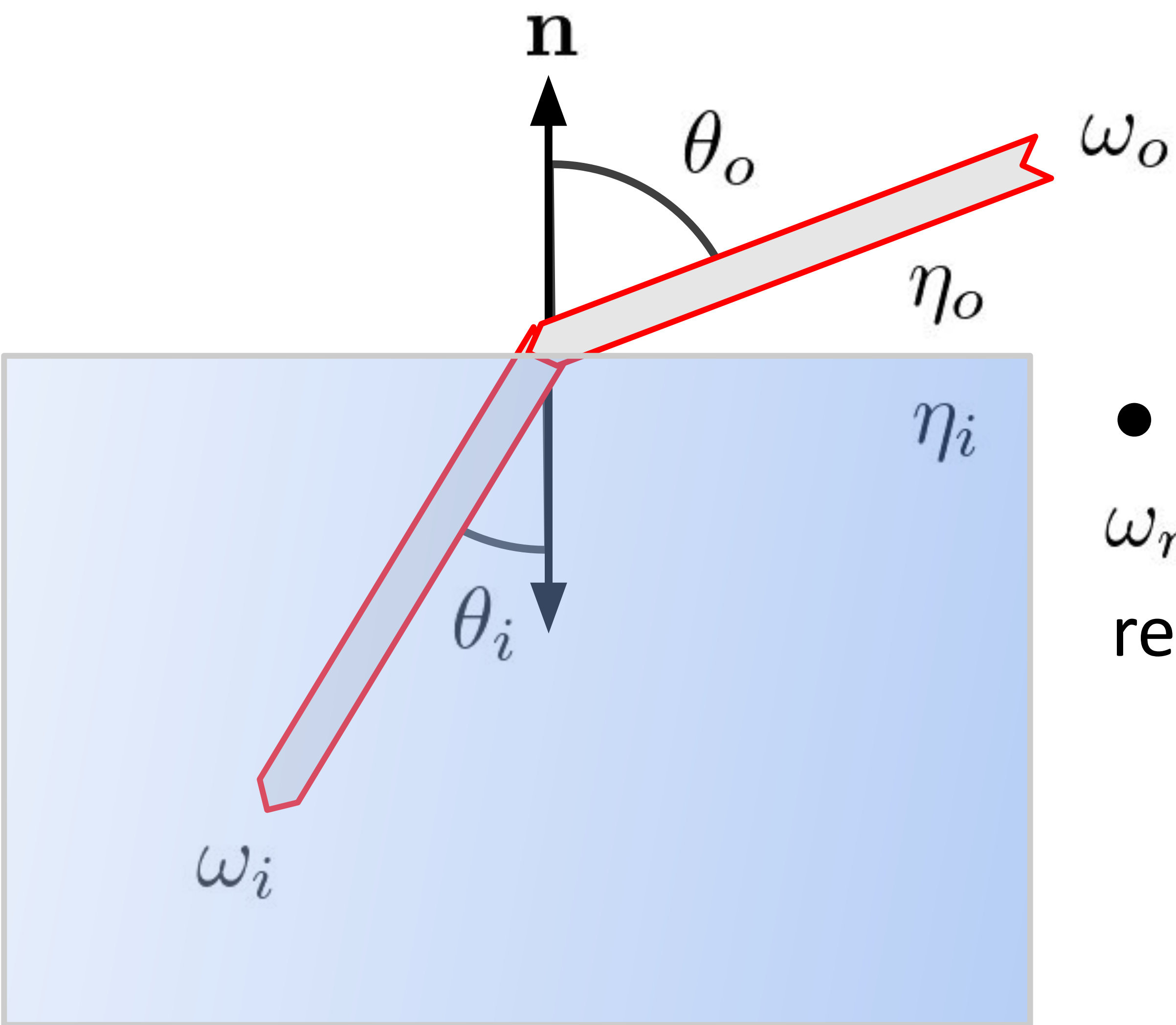


$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \frac{\delta_{\omega_t}(\omega_\mathbf{i})}{(\omega_\mathbf{i} \cdot \mathbf{n})}$$

- **Snell's law:**

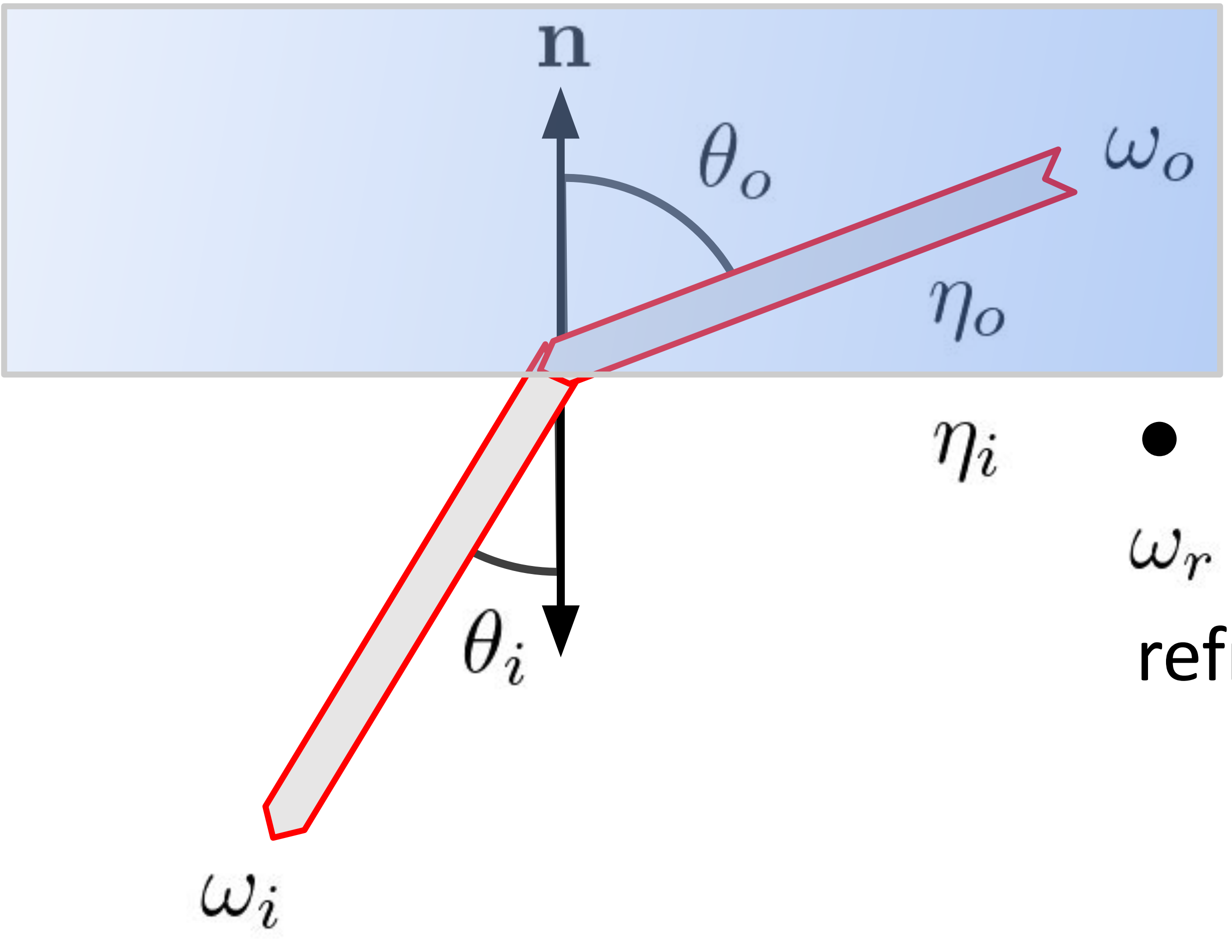
ω_r depends on the index of refraction η_i , η_r of the two media

$$\sin\theta_i = \sin\theta_r = \frac{\eta_o}{\eta_i}\sin\theta_o$$

$$p(\omega_r) = 1$$

Perfect refraction (delta BTDF) sampling

- The material does not **reflect** light, instead it (perfectly) **refracts** light



$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \frac{\delta_{\omega_t}(\omega_\mathbf{i})}{(\omega_\mathbf{i} \cdot \mathbf{n})}$$

- **Snell's law:**

ω_r depends on the index of refraction η_i , η_r of the two media

$$\boxed{\sin\theta_i = \sin\theta_r = \frac{\eta_o}{\eta_i}\sin\theta_o}$$

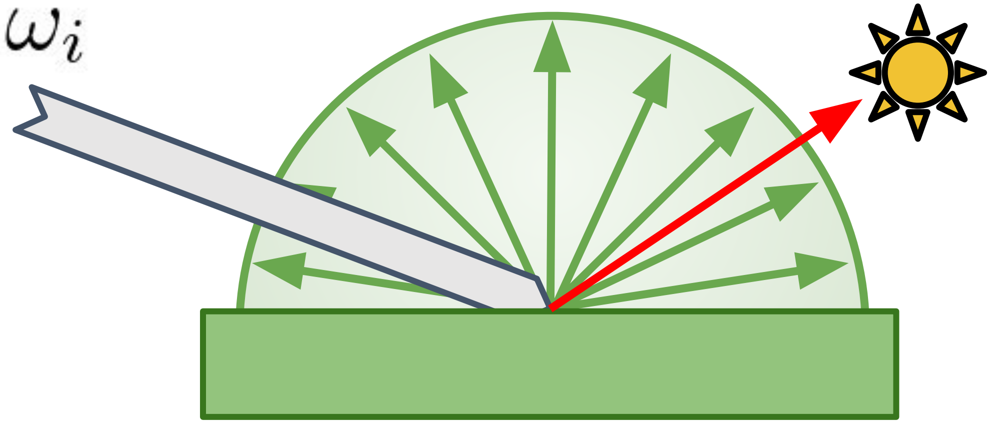
$$\boxed{p(\omega_r) = 1}$$

Next-event estimation and delta BRDF

Graphics and Imaging Lab

Diffuse material

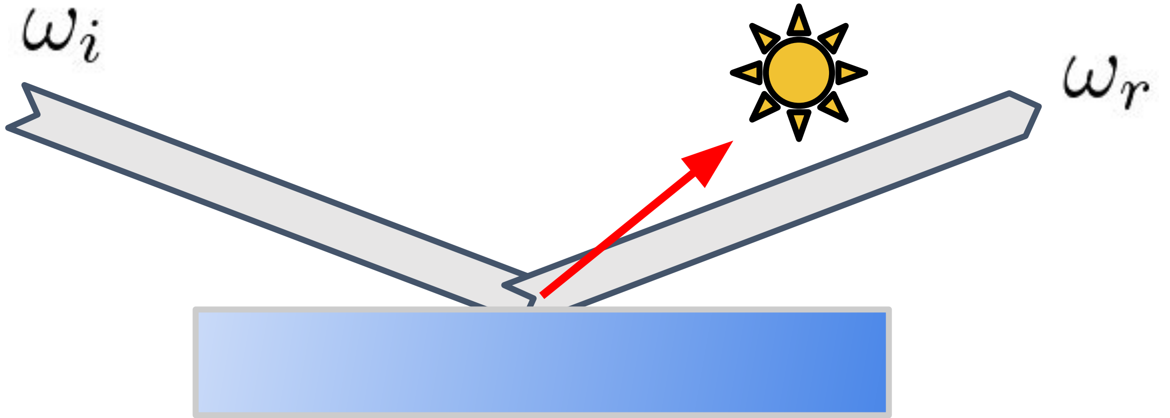
Light is reflected in all directions equally



$$f_r(\mathbf{x}, \omega_i, \omega_o)|\mathbf{n} \cdot \omega_i| = \frac{k_d}{\pi}|\mathbf{n} \cdot \omega_i|$$

Perfect specular material

All light is (perfectly) reflected towards one direction ω_r



$$f_r(\mathbf{x}, \omega_i, \omega_o)|\mathbf{n} \cdot \omega_i| = 0$$

Next-event estimation will always return 0

The full BSDF

Graphics and Imaging Lab

- Combining these three properties:

$$\boxed{f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = k_d \frac{1}{\pi} + k_s \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}} + k_t \frac{\delta_{\omega_\mathbf{t}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}}}$$

- Each geometry primitive/material must have three BSDF coefficients:
  - $\boxed{k_d}$: Lambertian diffuse
  - $\boxed{k_s}$: Perfect specular reflectance (delta BRDF, law of reflection)
  - $\boxed{k_t}$: Perfect refraction (delta BTDF, Snell's law)

The full BSDF

- Combining these three properties:

$$\boxed{f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = k_d \frac{1}{\pi} + k_s \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}} + k_t \frac{\delta_{\omega_\mathbf{t}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}}}$$

- For physical correctness:
  - $k_d + k_s + k_t \leq 1$ on all channels (RGB)
- Recommended, not mandatory:
  - Emissive objects do not reflect/refract, and vice versa
    - Area lights with emission coefficient ($k_e > 0$)

Material coefficients

- Each primitive/material must have four coefficients in total:
  - $\boxed{k_d}$ lambertian diffuse
  - $\boxed{k_s}$ perfect specular
  - $\boxed{k_t}$ perfect refraction
  - $\boxed{k_e}$ emission coefficient

$$\boxed{f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = k_d \frac{1}{\pi} + k_s \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}} + k_t \frac{\delta_{\omega_\mathbf{t}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}}}$$

$$\boxed{L_e(\mathbf{x}, \omega_\mathbf{o})}$$

$$\boxed{L_o(\mathbf{x}, \omega_\mathbf{o}) = L_e(\mathbf{x}, \omega_\mathbf{o}) + \int_\Omega L_i(\mathbf{x}, \omega_\mathbf{i}) f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) |\mathbf{n} \cdot \omega_\mathbf{i}| d\omega_\mathbf{i}}$$

Material coefficients

- Each primitive/material must have four coefficients in total:
  - k_d lambertian diffuse
  - k_s perfect specular
  - k_t perfect refraction
  - k_e emission coefficient

$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = k_d \frac{1}{\pi} + k_s \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}} + k_t \frac{\delta_{\omega_\mathbf{t}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}}$$

$$L_e(\mathbf{x}, \omega_\mathbf{o})$$

$$L_o(\mathbf{x}, \omega_\mathbf{o}) = \boxed{L_e(\mathbf{x}, \omega_\mathbf{o})} + \int_\Omega L_i(\mathbf{x}, \omega_\mathbf{i}) \boxed{f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o})} |\mathbf{n} \cdot \omega_\mathbf{i}| d\omega_\mathbf{i}$$

Combining coefficients

- You can combine coefficients to get different materials

Diffuse

$k_d > 0$

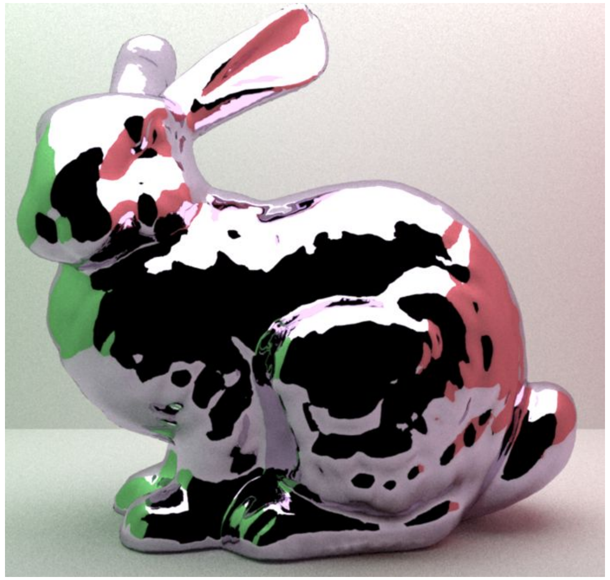
Combining coefficients

- You can combine coefficients to get different materials

Diffuse

$$k_d > 0$$

Specular



$$k_s > 0$$

Combining coefficients

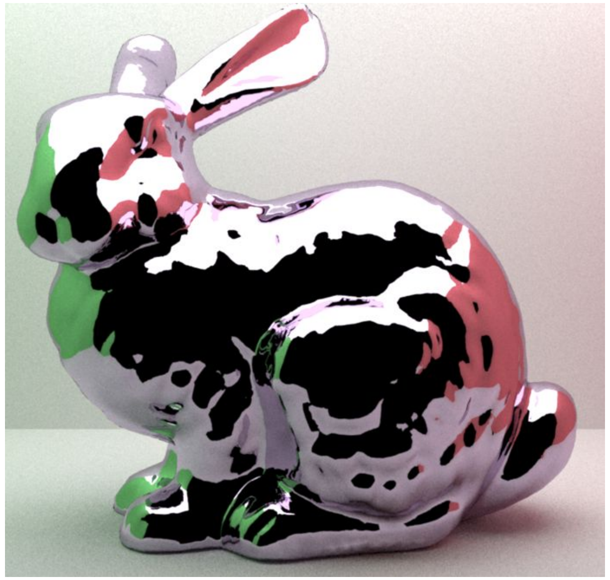
- You can combine coefficients to get different materials

Diffuse

$$k_d > 0$$

+

Specular



$$k_s > 0$$

=

Plastic

$$k_d, k_s > 0$$

Combining coefficients

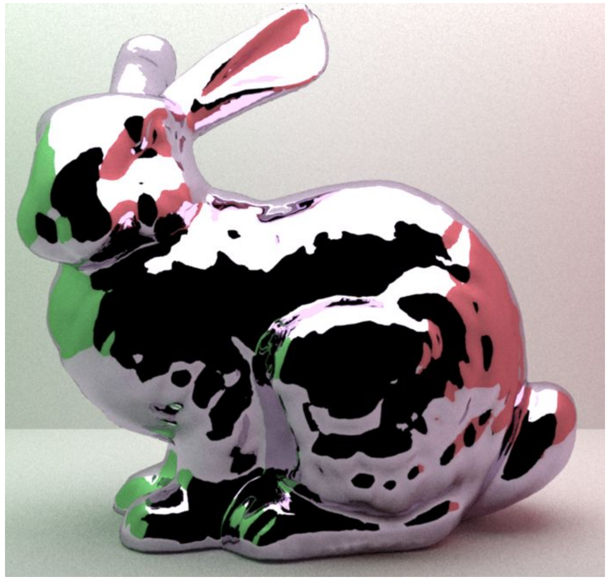
- How do we sample ω_i when there is more than one strategy?

Diffuse

Uniform cosine sampling

+

Specular



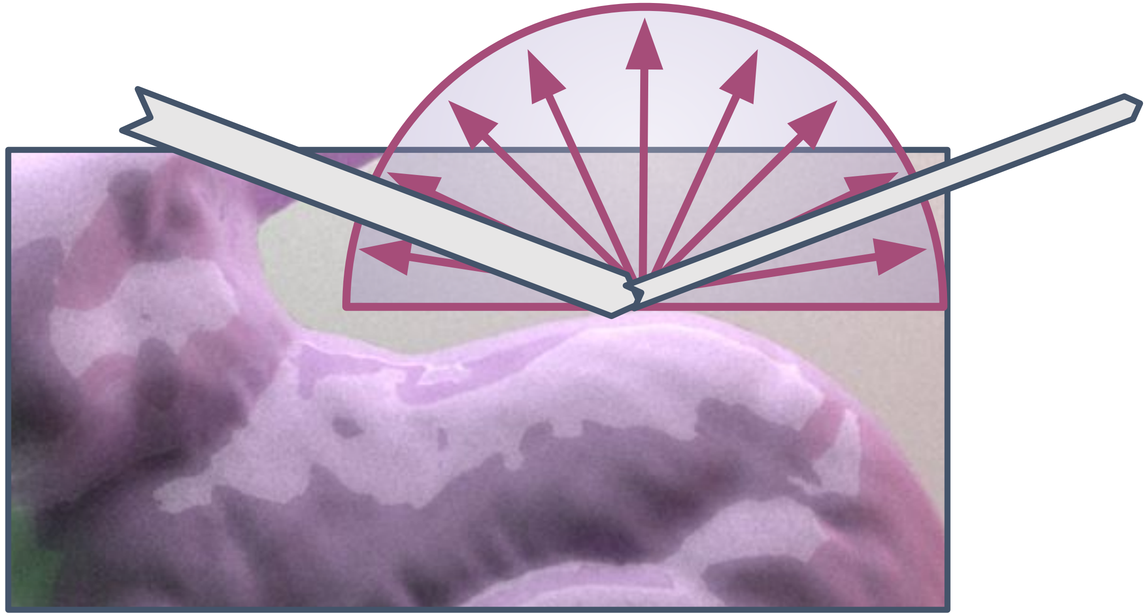
Deterministic (delta BRDF)

=

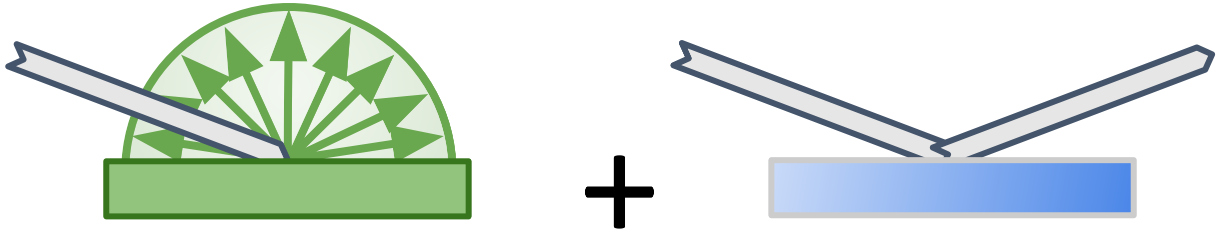
Plastic

???

Russian Roulette: motivation

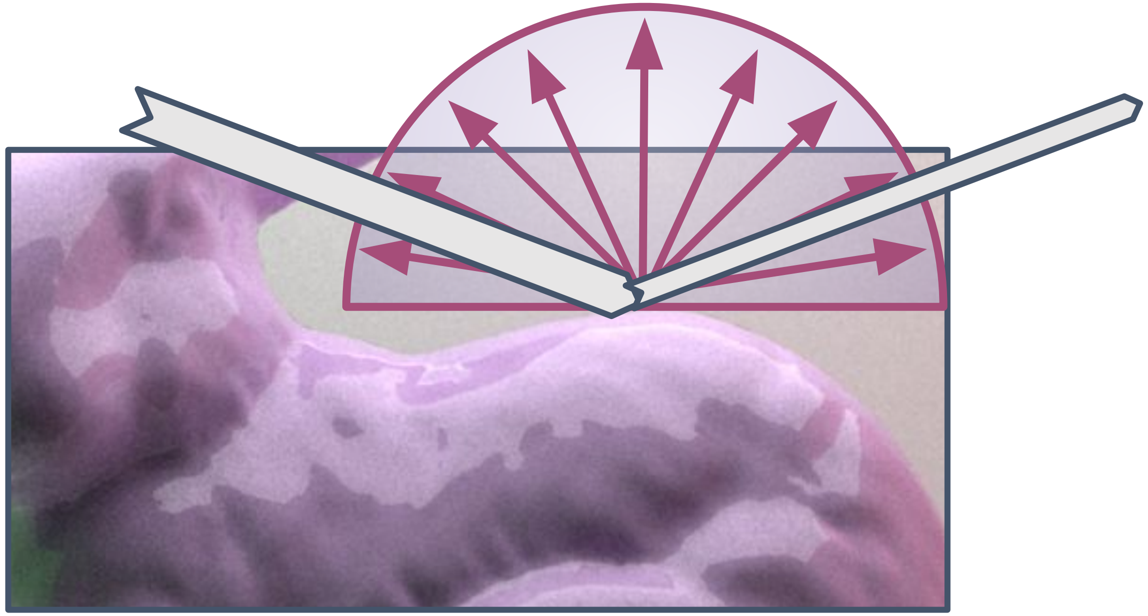


Plastic



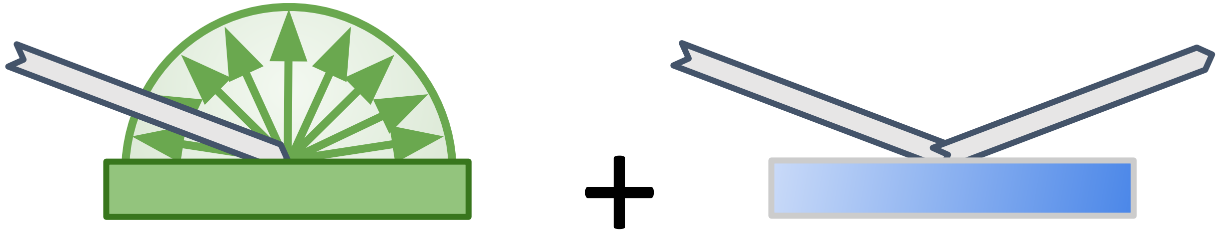
Diffuse + Specular

Russian Roulette: motivation



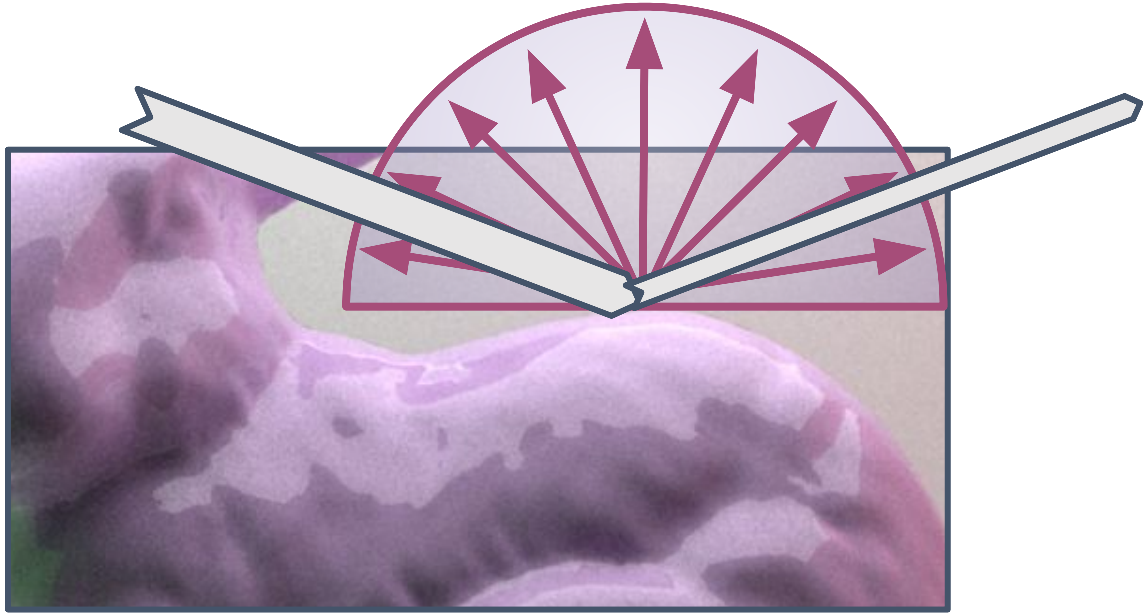
Plastic

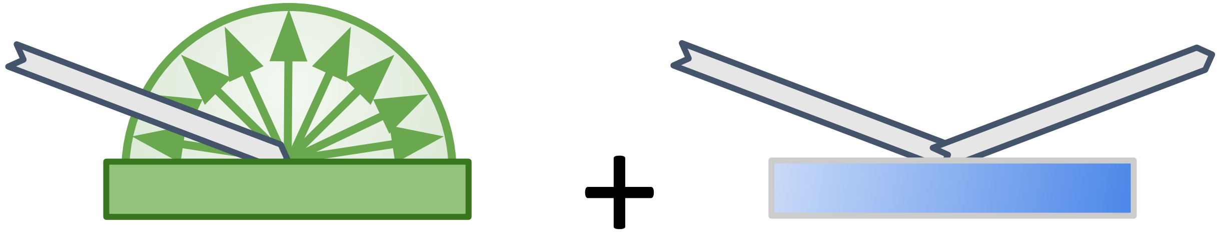
- Only sample diffuse
  - Ignores specular part
- Only sample specular
  - Ignores diffuse part



Diffuse + Specular

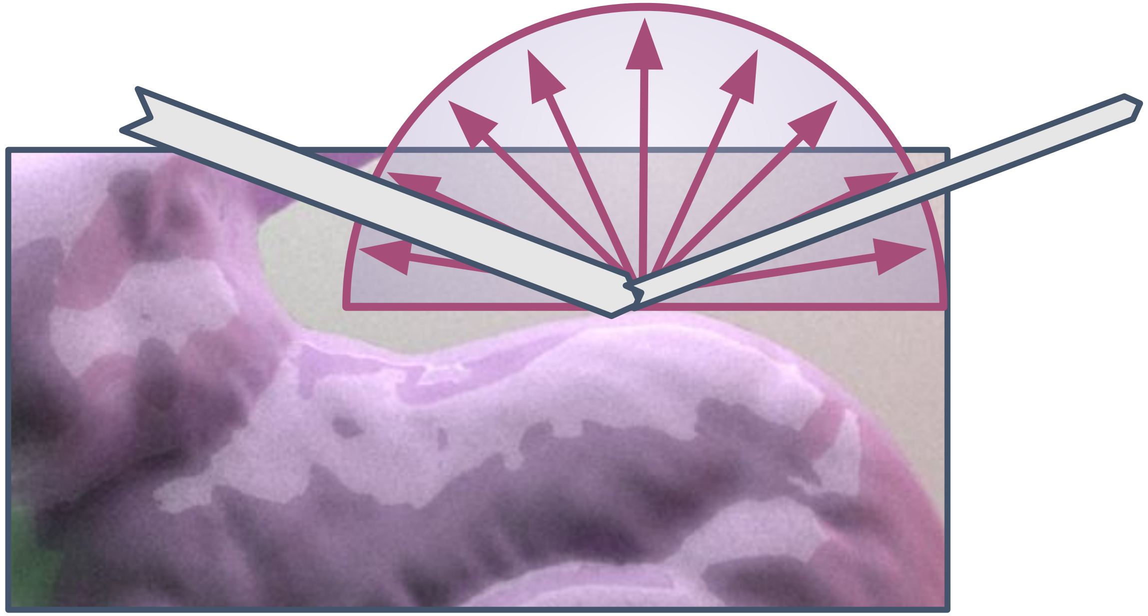
Russian Roulette: motivation



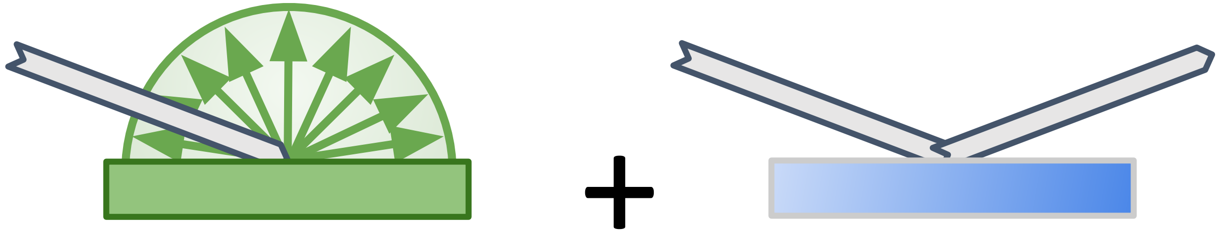


- ~~Only sample diffuse~~
  - Ignores specular part
- ~~Only sample specular~~
  - Ignores diffuse part
- Sample both at the same time with two rays
  - Grows exponentially

Russian Roulette: motivation



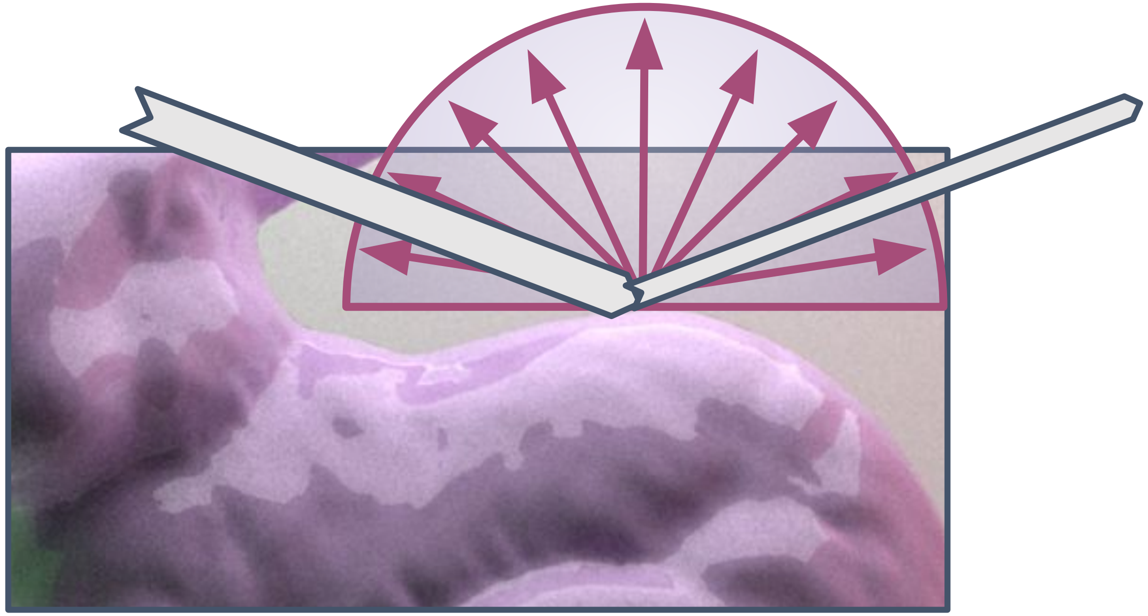
Plastic



Diffuse + Specular

- ~~Only sample diffuse~~
  - Ignores specular part
- ~~Only sample specular~~
  - Ignores diffuse part
- ~~Sample both at the same time with two rays~~
  - Grows exponentially
- **Russian Roulette:** sample one random event (diffuse / specular)

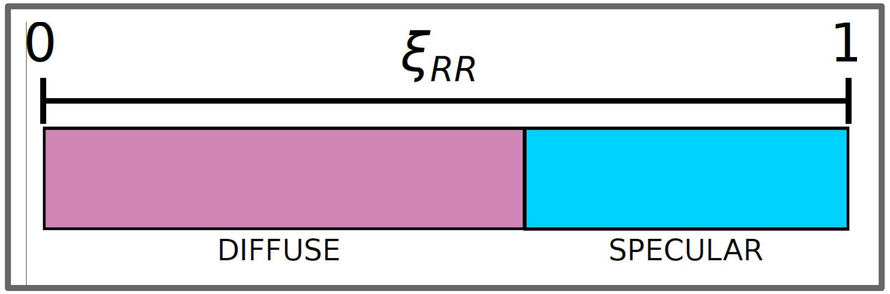
Russian Roulette: explanation



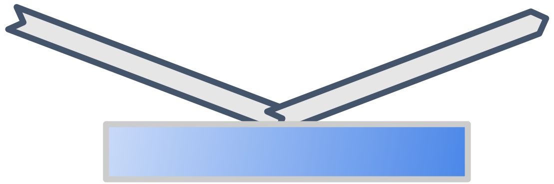
Plastic

- **Russian Roulette:** sample one random event (diffuse / specular)

Random number $\xi_{RR} \in [0, 1]$:

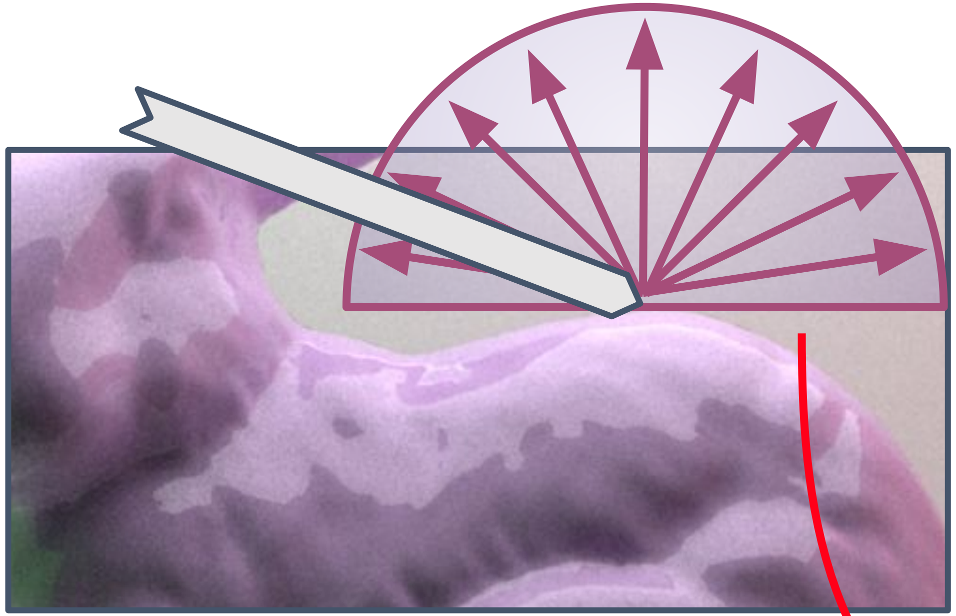


Diffuse



Specular

Russian Roulette: explanation

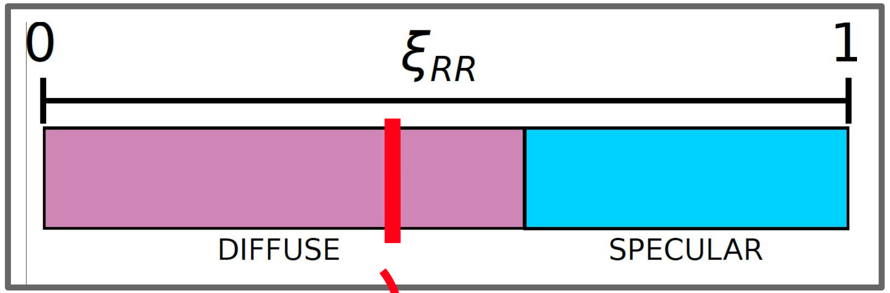


Plastic

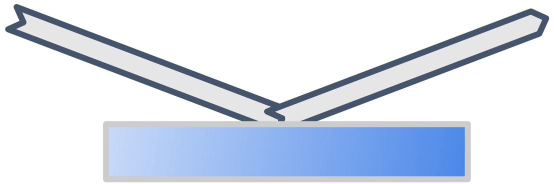
Sample ω_i based on your strategy for **diffuse** BRDFs

- **Russian Roulette:** sample one random event (diffuse / specular)

Random number $\xi_{RR} \in [0, 1]$:

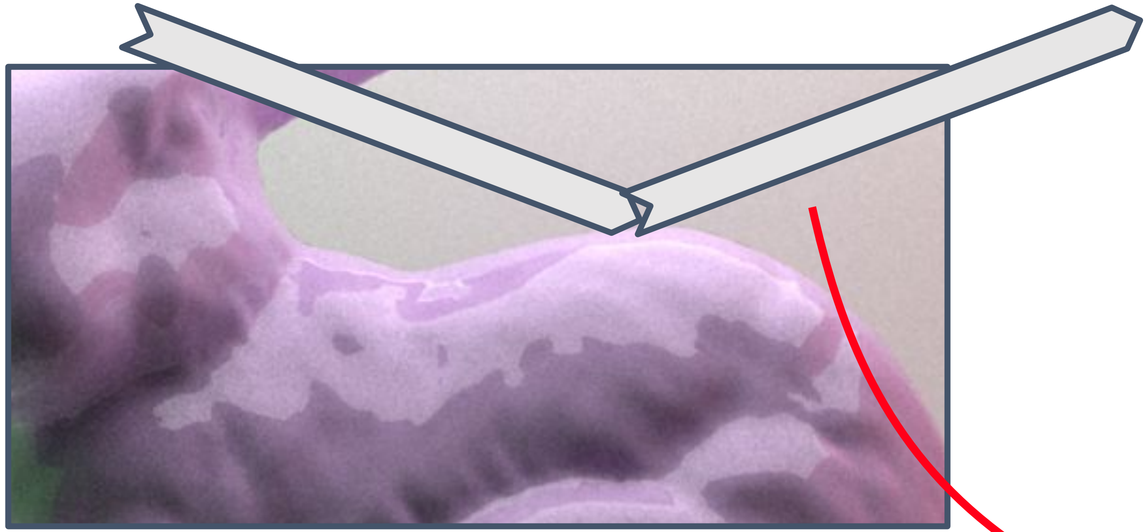


Diffuse



Specular

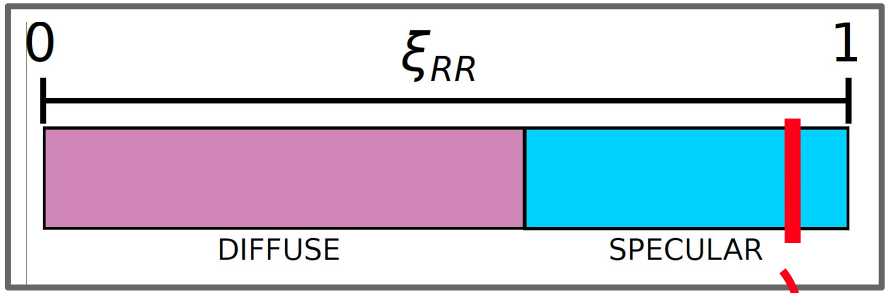
Russian Roulette: explanation



Plastic

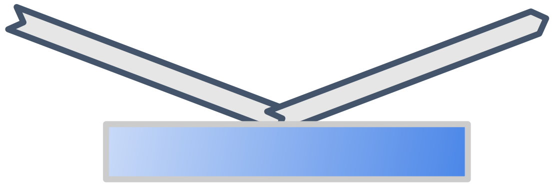
- **Russian Roulette:** sample one random event (diffuse / specular)

Random number $\xi_{RR} \in [0, 1]$:



Sample ω_i based on your strategy for **specular** BRDFs

Diffuse

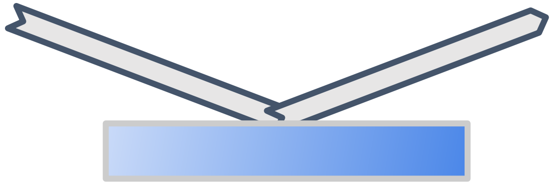


Specular

Russian Roulette: probabilities

Diffuse

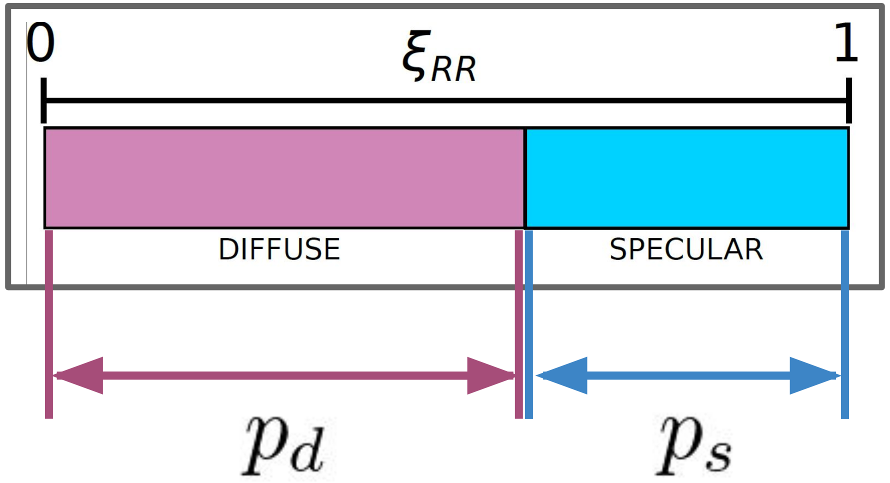
k_d



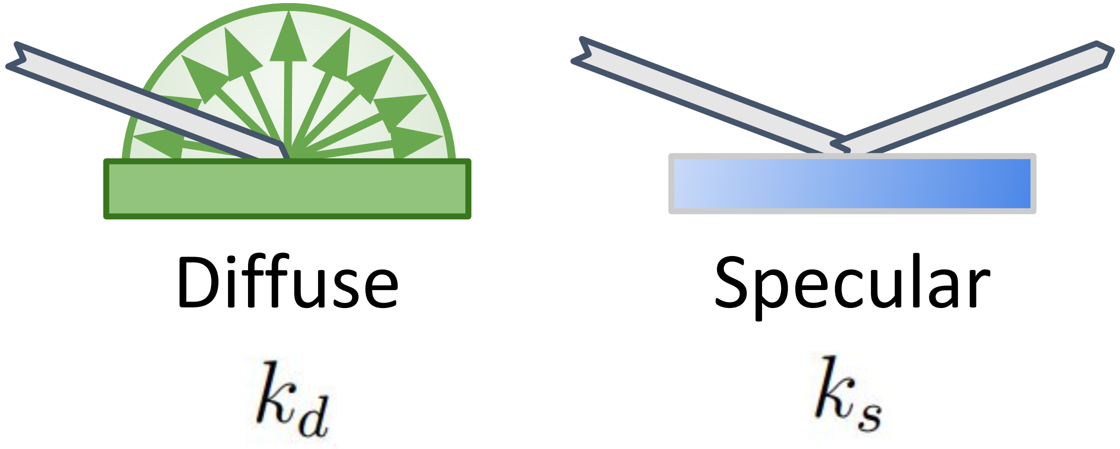
Specular

k_s

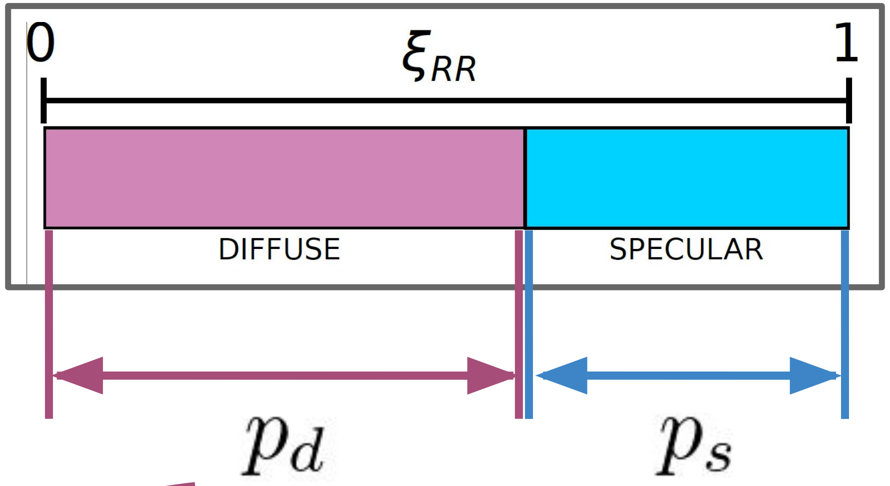
Random number $\xi_{RR} \in [0, 1]$:



Russian Roulette: probabilities



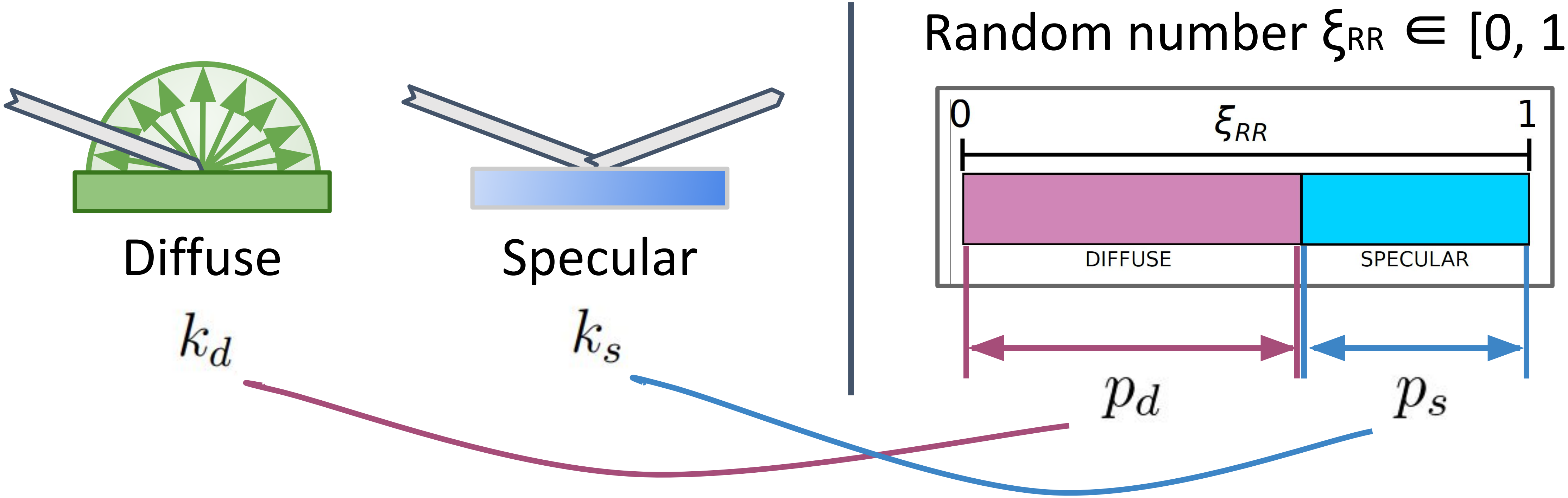
Random number $\xi_{RR} \in [0, 1]$:



- How to obtain probabilities p_d, p_s based on RGB coefficients k_d, k_s?

Russian Roulette: probabilities

Random number $\xi_{RR} \in [0, 1]$:

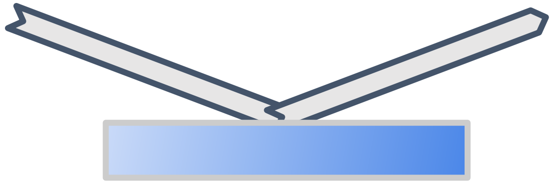


- How to obtain probabilities p_d, p_s based on RGB coefficients k_d, k_s?
  - Example: $p_i = \max k_i$ (maximum of RGB channels)
  - Remember: $k_d + k_s + k_t \leq 1$ on all channels (RGB)

Russian Roulette: probabilities

Diffuse

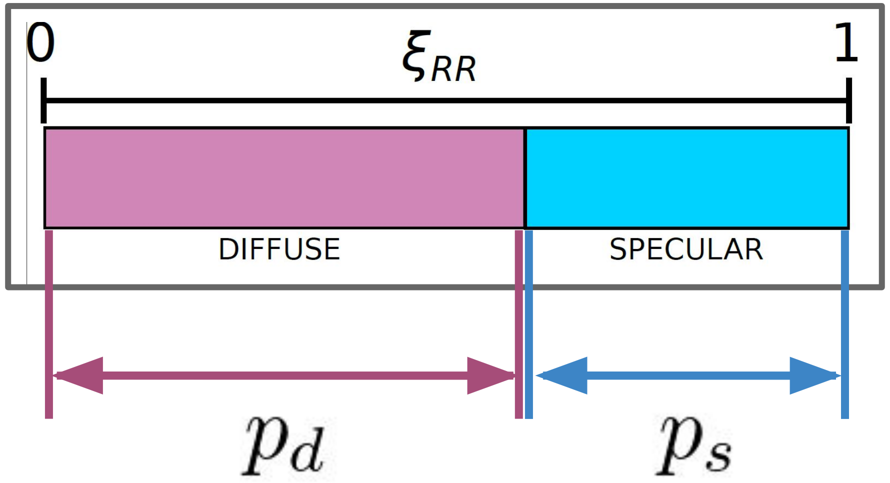
k_d



Specular

k_s

Random number $\xi_{RR} \in [0, 1]$:



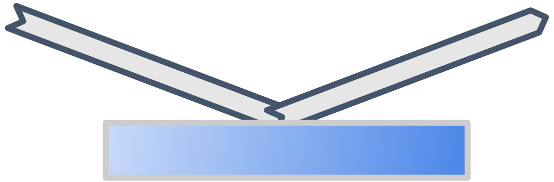
- After evaluating each event, divide by its probability:

$$\boxed{f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = k_d \frac{1}{\pi} + k_s \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}} + k_t \frac{\delta_{\omega_\mathbf{t}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}}}$$

Russian Roulette: probabilities

Diffuse

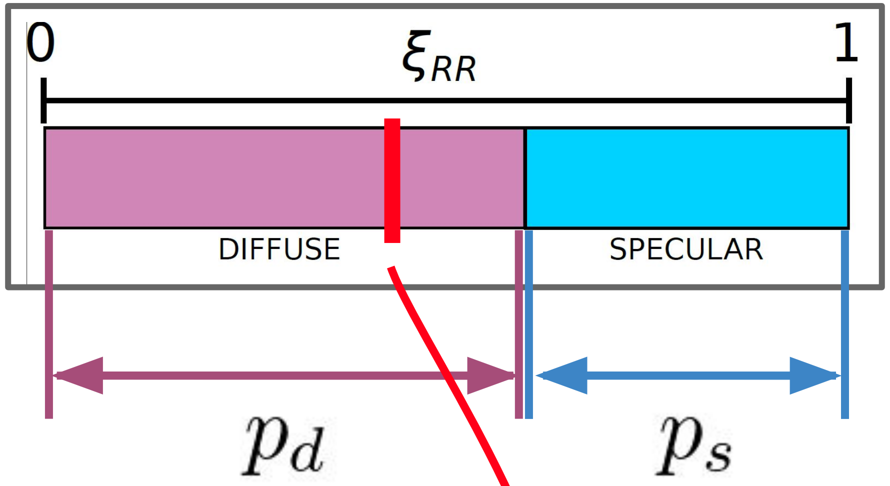
k_d



Specular

k_s

Random number $\xi_{RR} \in [0, 1]$:



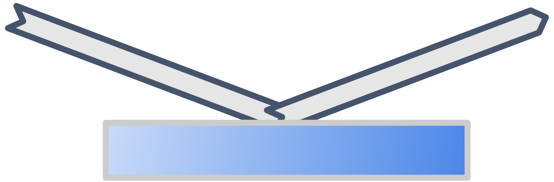
- After evaluating each event, divide by its probability:

$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = k_d \frac{1}{\pi} \boxed{\cdot \frac{1}{p_d}}$$

Russian Roulette: probabilities

Diffuse

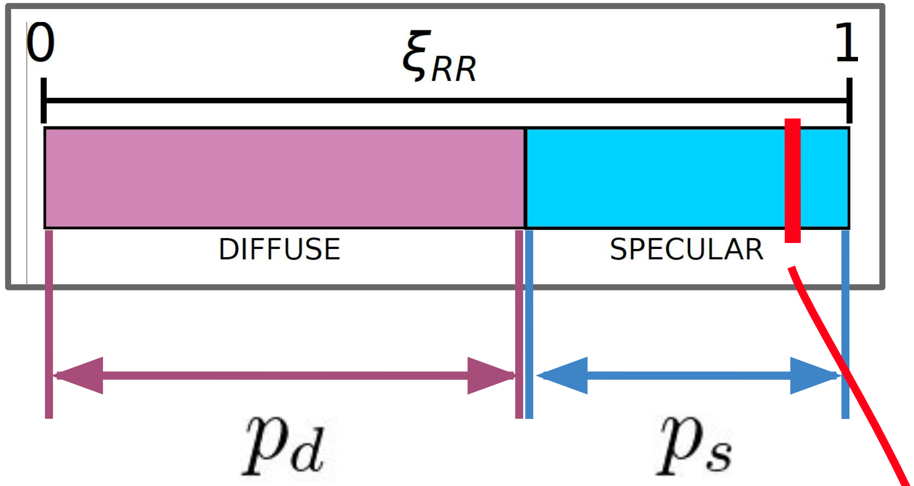
k_d



Specular

k_s

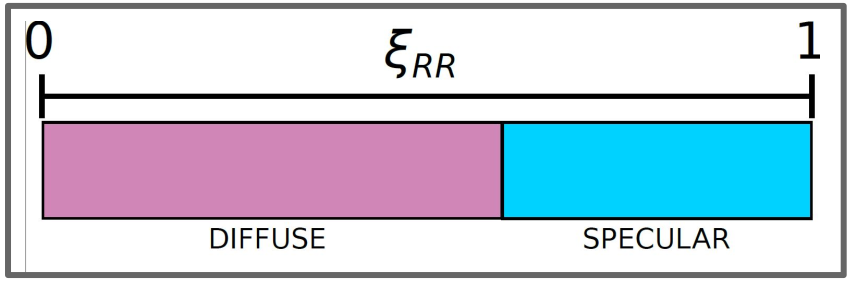
Random number $\xi_{RR} \in [0, 1]$:

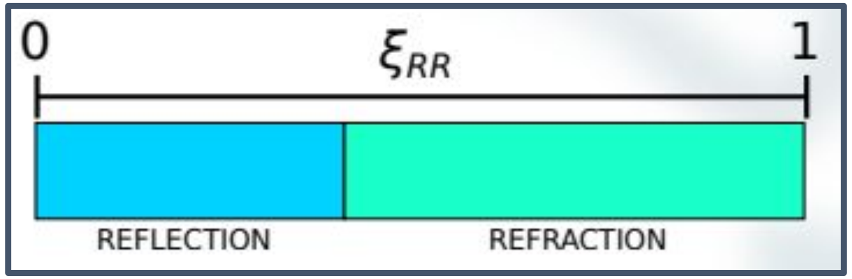


- After evaluating each event, divide by its probability:

$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = \qquad k_s \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}} \boxed{\cdot \frac{1}{p_s}}$$

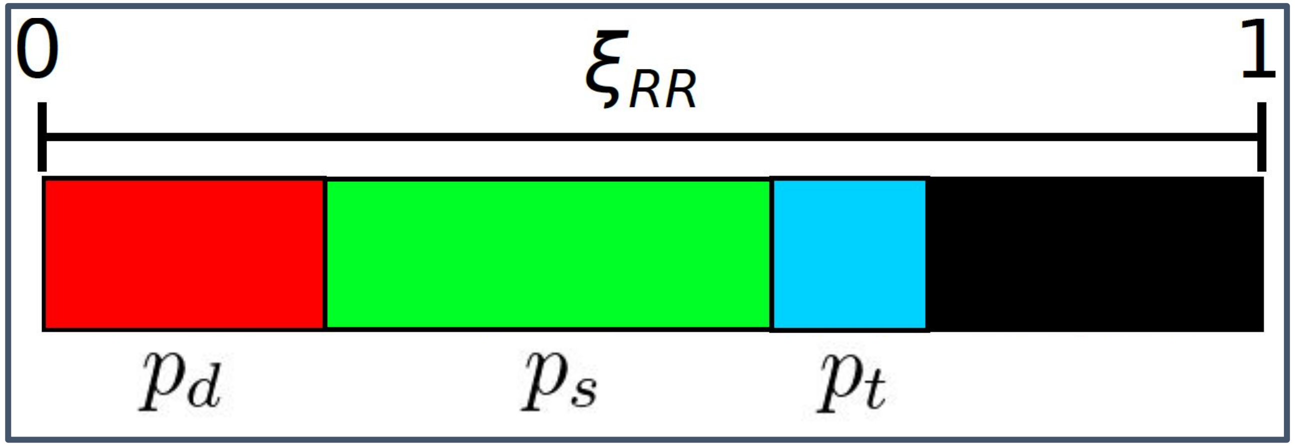
Material combinations





Path termination

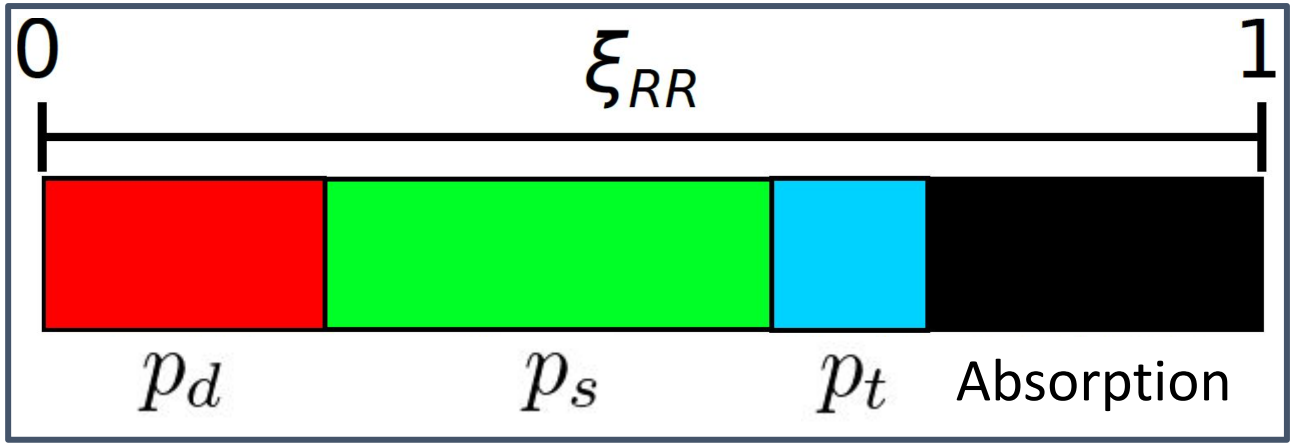
- Until now we have defined three events for Russian Roulette
  - Diffuse, perfect specular, perfect refractive



$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = k_d \frac{1}{\pi} + k_s \frac{\delta_{\omega_\mathbf{r}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}} + k_t \frac{\delta_{\omega_\mathbf{t}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}}$$

Path termination

- Until now we have defined three events for Russian Roulette
  - Diffuse, perfect specular, perfect refractive
- New: “absorption” event as a path termination condition

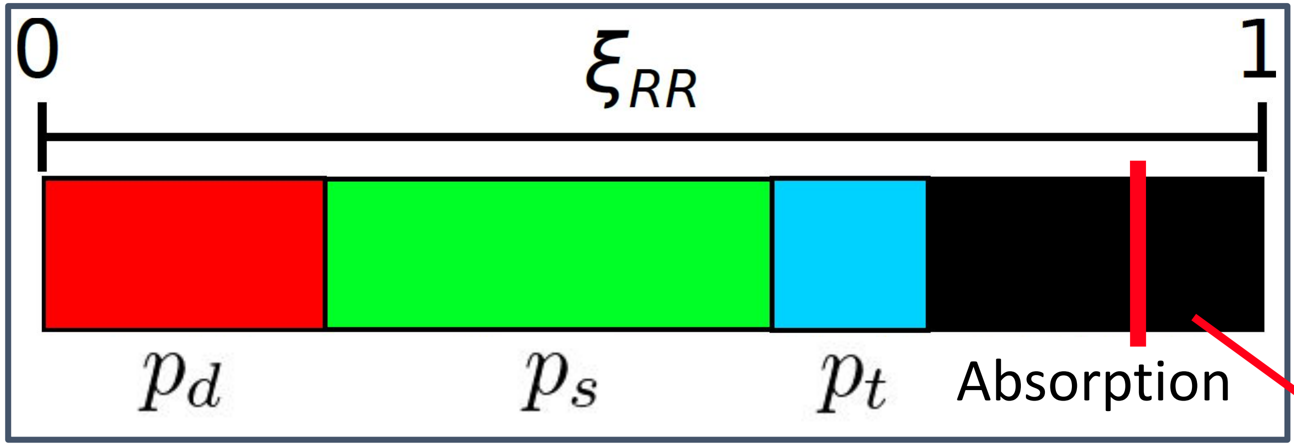


$$1 - (p_d + p_s + p_t)$$

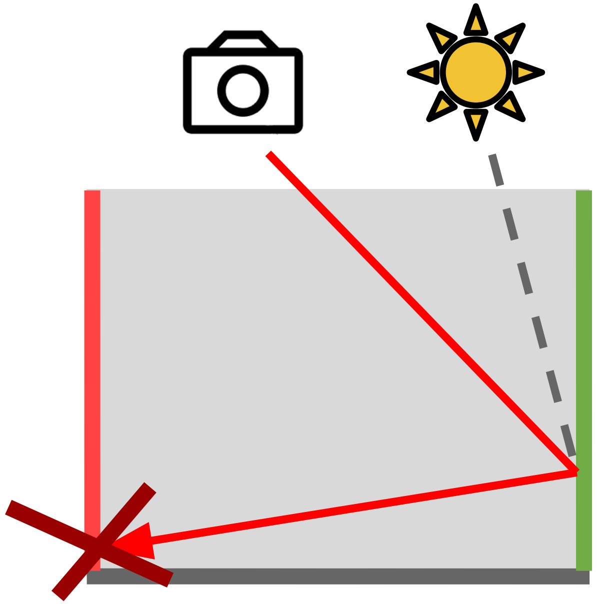
$$f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o}) = k_d \frac{1}{\pi} + k_s \frac{\delta_{\omega_\mathrm{r}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}} + k_t \frac{\delta_{\omega_\mathrm{t}}(\omega_\mathbf{i})}{\mathbf{n} \cdot \omega_\mathbf{i}}$$

Path termination

- Until now we have defined three events for Russian Roulette
  - Diffuse, perfect specular, perfect refractive
- New: “absorption” event as a path termination condition



$$1-(p_d+p_s+p_t)$$



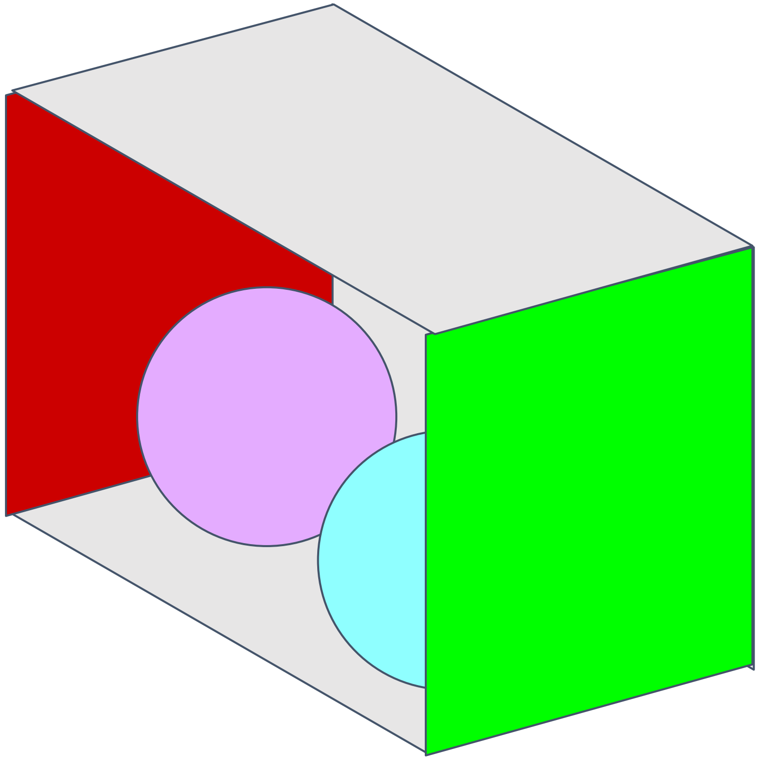
$$f_r(\mathbf{x},\omega_\mathrm{i},\omega_\mathrm{o})=k_d\frac{1}{\pi}+k_s\frac{\delta_{\omega_\mathrm{r}}(\omega_\mathrm{i})}{\mathbf{n}\cdot\omega_\mathrm{i}}+k_t\frac{\delta_{\omega_\mathrm{t}}(\omega_\mathrm{i})}{\mathbf{n}\cdot\omega_\mathrm{i}}$$

Path termination

- Until now we have defined three events for Russian Roulette
  - Diffuse, perfect specular, perfect refractive
- New: “absorption” event as a path termination condition
  - Remember previous termination path conditions:
    - Ray does not intersect
    - Ray intersects with an area light
    - Number of bounces > N (not required with Russian Roulette)

Example scene: Cornell Box

- **Geometry**



Planes defined by normal (n) and distance (d)

Left plane	n = (1, 0, 0), d = 1
Right plane	n = (-1, 0, 0), d = 1
Floor plane	n = (0, 1, 0), d = 1
Ceiling plane	n = (0, -1, 0), d = 1
Back plane	n = (0, 0, -1), d = 1

Spheres defined by center (c) and radius (r)

Left sphere c = (-0.5, -0.7, 0.25), r = 0.3

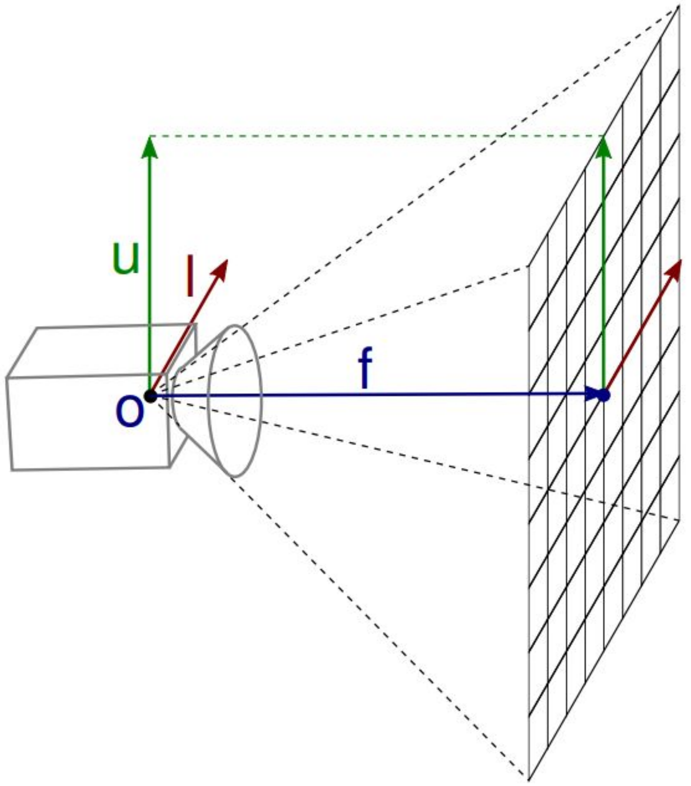
- Mix of blue diffuse + specular

Right sphere c = (0.5, -0.7, -0.25), r = 0.3

- Mix of specular and refraction, η = 1.5

Example scene: Cornell Box

- **Camera & light sources**

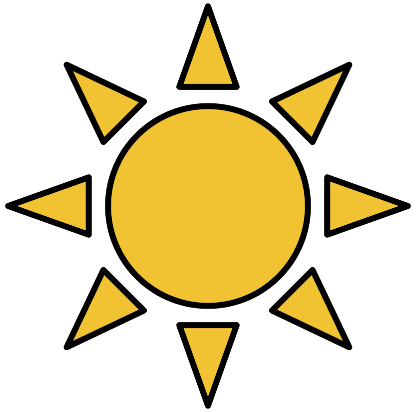


Camera and image plane defined by

Origin	O = (0, 0, -3.5)
Left	L = (-1, 0, 0)
Up	U = (0, 1, 0)
Forward	F = (0, 0, 3)
Size	256x256 pixels

Example scene: Cornell Box

- **Light sources**



Center and power (emission)

Center c = (0, 0.5, 0)

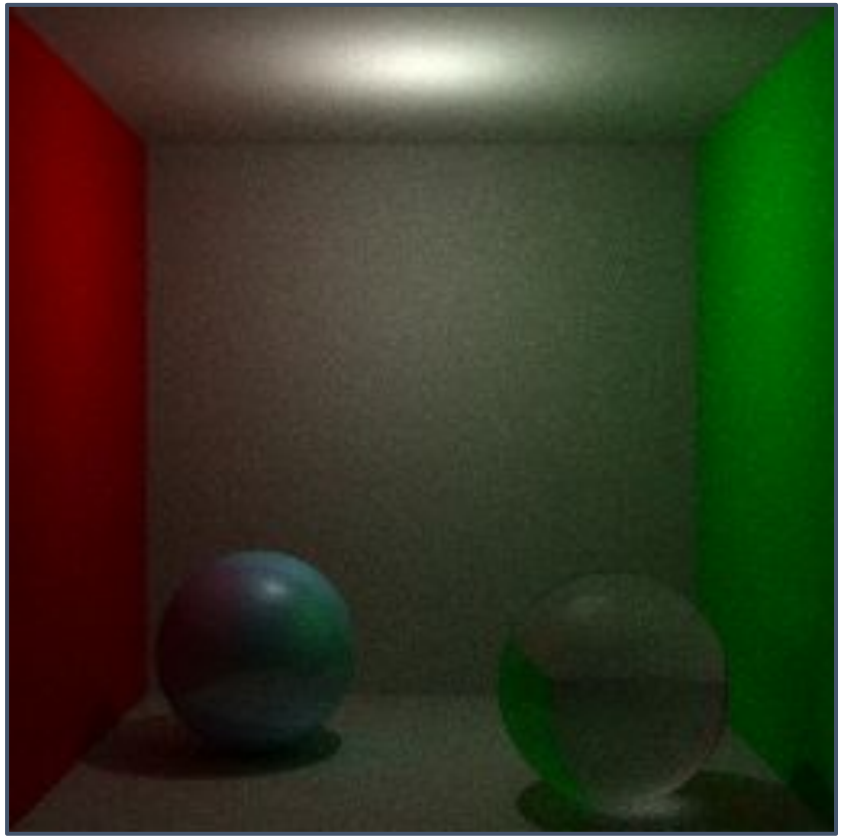
Power can be any number e.g. p = (1, 1, 1)

Just be careful with the #MAX

```
P3
# feep.ppm
#MAX=<maximum of your RGB memory values>
4 4
15
 0  0  0    0  0  0    0  0  0   15  0 15
```

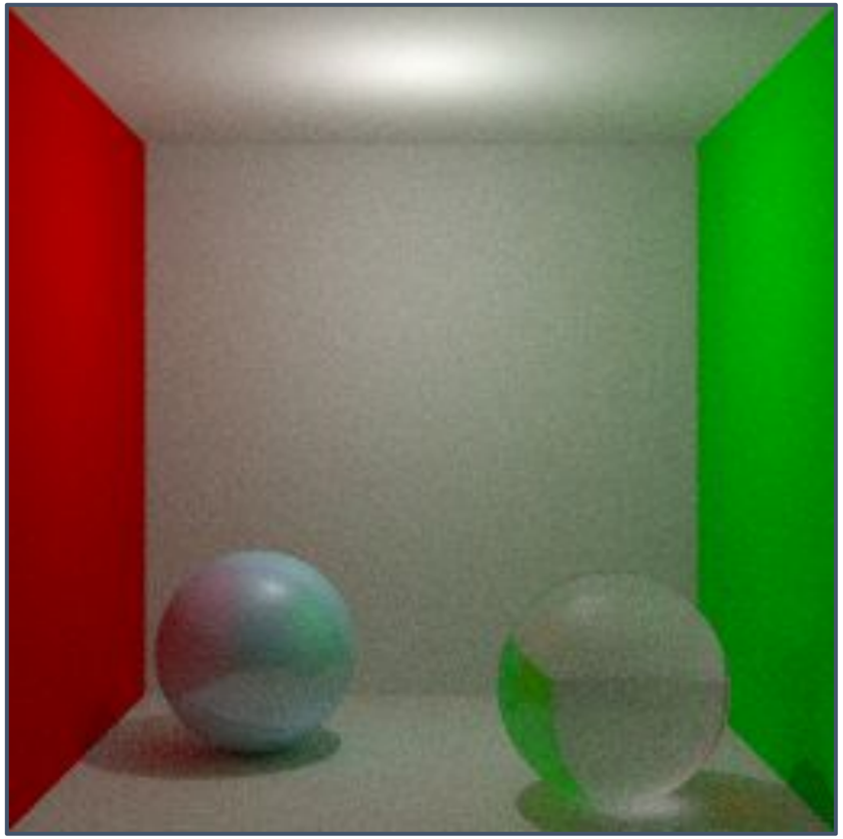
Example scene: Cornell Box

- **Results (no area lights + point light)**



Using a point light

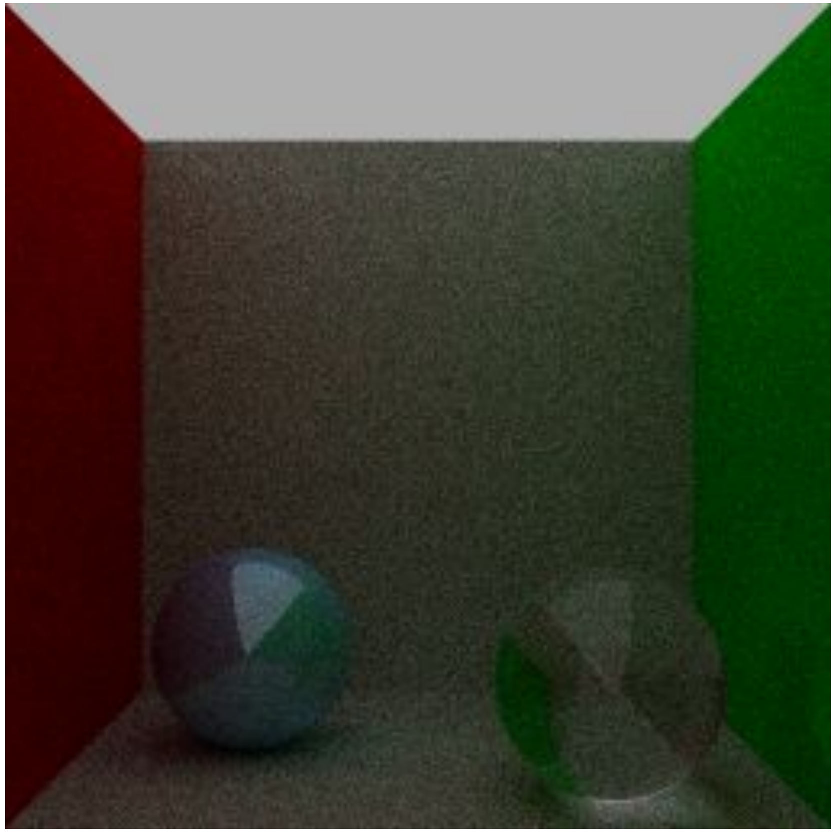
Equalization
Gamma = 2.2



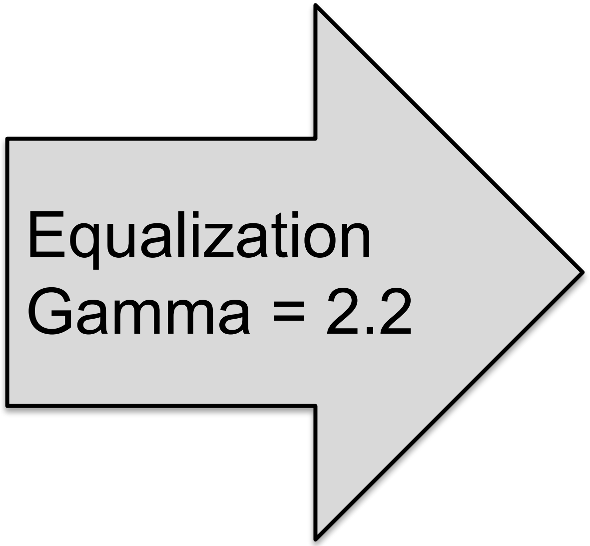
With tone mapping

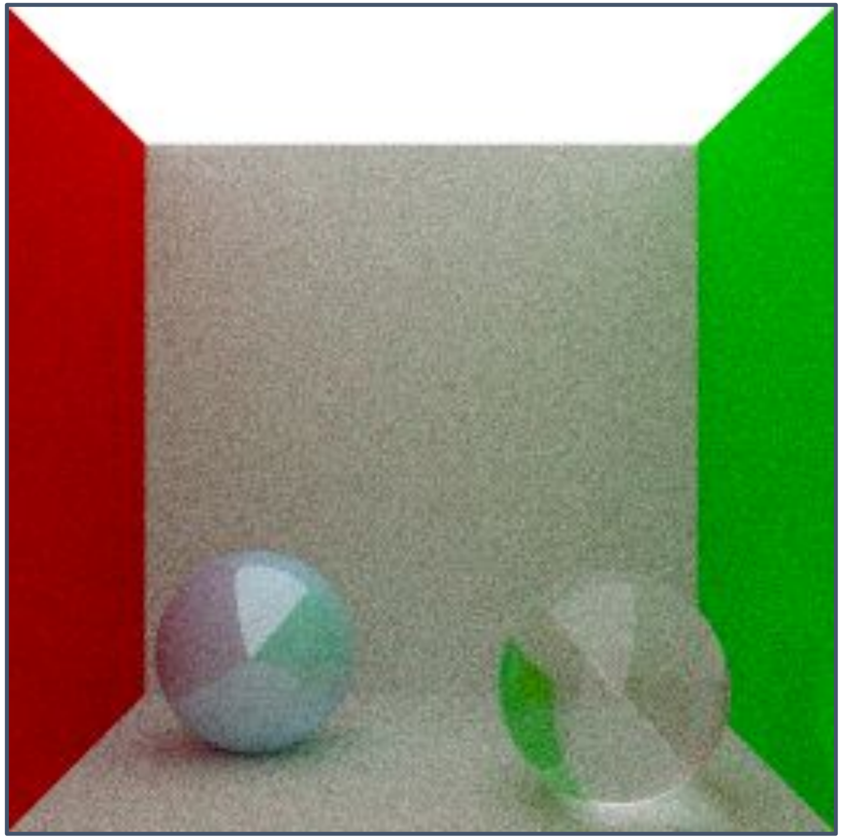
Example scene: Cornell Box

- **Results (no point light + ceiling plane is an area light)**



Using an area light





With tone mapping

Questions

DO ASK questions, either now or after the lab

But be reasonable, please :)

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What to expect from this session

Graphics and Imaging Lab

In the programming language of your choice implement:

- Perfect specular and refractive BSDFs (add k_s and k_t for each material)
  - Extend **“evaluate”** and **“sample”** functions
- Apply Russian Roulette **at each intersection** to select an event:
  - (1) Diffuse, (2) Perfect specular, (3) Perfect refractive, (4) Absorption
  - Sample BSDF based on selected event, evaluate and divide by event’s probability
- Recommended deadline: November 13th (moodle: January 11th)
  - Extensions (do not count towards recommended deadline):
    - **Recommended to finish base path tracer for next week before any optionals**
    - **Realistic coefficients:** Modulate specular/refractive coefficients ks and kt using Fresnel equations
    - **Textures:** make material coefficients on hit position
    - **Fresnel effects:** make material coefficients depend on viewing direction

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