CPSC 314 Homework 8

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This final problem sheet deals with ray-tracing and stochastic sampling. The solutions will be published online, and discussed in the labs on March 30/31 (labs in the second half of that week will be used for project demos).

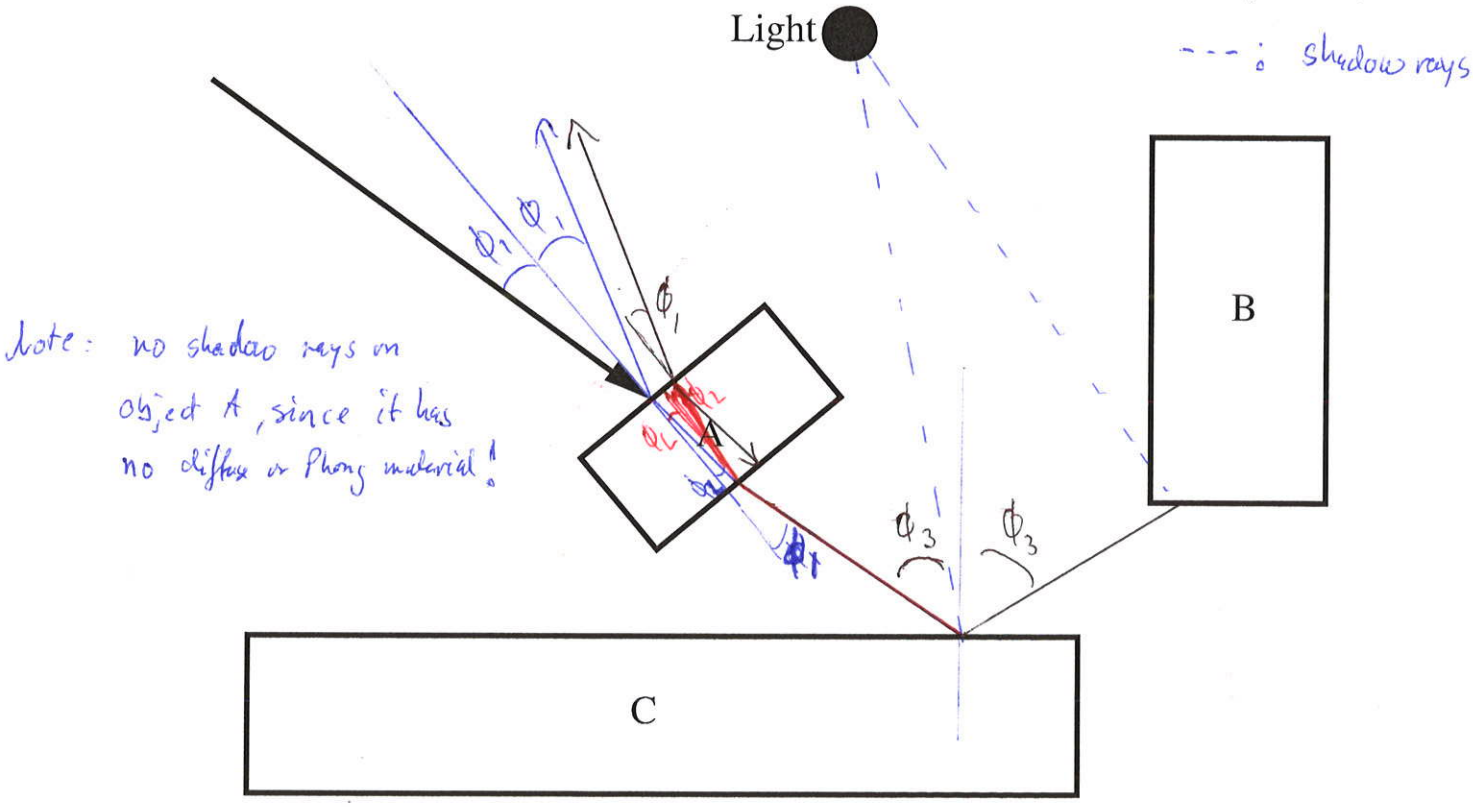
1 Ray-Tracing

Sketch the ray-tree for the scene and primary ray depicted below **up to level 3** (the primary ray is level 0). Assume the following material properties:

Surface A : transparent and specular surface (like glass). No diffuse or Phong contribution.

Surface B : Diffuse and Phong reflection, but not specular or transparent.

Surface C : Diffuse, Phong, and specular reflection, no transparency.



2 Monte Carlo Sampling

Assume you are given a bi-variate function $f(x, y)$, and want to compute the integral

$$\int_c^d \int_a^b f(x, y) dx dy.$$

Unfortunately, you cannot compute this integral analytically since f is too complicated. You can only evaluate $f(x, y)$ for specific values of x and y.

How would you evaluate the above integral using Monte Carlo sampling? First describe the general idea, then give a specific formula for the above case.

- Evaluate the function at N randomly chosen samples x_i, y_i
- average the result
- multiply with the area of the domain, i.e. $(d-c) \cdot (b-a)$

Thus:

$$\int_c^d \int_a^b f(x, y) dx dy \approx \frac{(d-c)(b-a)}{N} \sum_{i=1}^{N} f(x_i, y_i)$$