Computer Graphics Worksheet
Camera and Lens Models

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Problem 1. Primary Ray-Generation

A Perspective Camera Model can be defined by the following parameters:
- Camera origin (center of projection) **pos**
- Viewing direction **dir**
- Up-vector **up**
- (Vertical) full opening angle of the viewing frustum (in degrees) **angle**
- Sensor resolution resX × resY **resolution**

Given the above camera description, derive the **ray.dir** for given pixel coordinates *x, y* (*e.g.* 128.5, 5.5 through the center of the pixel). Pixels are squared and the projection plane is perpendicular to the **ray.dir**. Please incorporate the *aspect ratio* as well as the *focus* (distance from camera position to image plane along **dir**).

Problem 2. Depth of Field

Please see the *thin lens model* below, which is described with the thin lens equation:

$$\frac{1}{f} = \frac{1}{b} + \frac{1}{g},$$ where f is the focal length, g - distance to the object and b - distance to the screen.

Please draw the projections of the blue and red objects. Show with your sketch which of these two objects will appear sharp and which will be smoothed due to the Depth of Field effect. Show the *circle of confusion* (CoC) at your sketch.

Hint: This problem should be solved graphically. No formulas are needed.