Computer Graphics Worksheet
Texturing and Color

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Problem 1. Texturing

We would like to apply a texture image of resolution *width* x *height* to a sphere, such that the whole sphere will be covered with the whole texture. The sphere is located at point $\vec{s}(x_0, y_0, z_0)$ and has radius r. The ray hits the sphere at point $\overrightarrow{h}(x, y, z)$. Please derive the texture coordinates (u, v) for point $\overrightarrow{h}$.

Hint: You can use the following formulas for transition from spherical to cartesian coordinate systems:

$$x = x_0 + r \sin\theta \cos\varphi$$

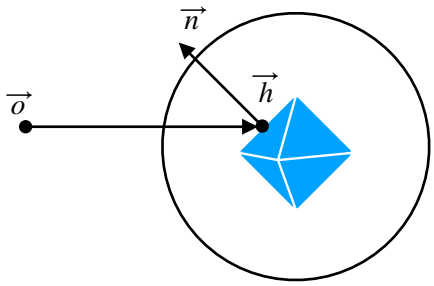
$$y = y_0 + r \sin\theta \sin\varphi$$

$$z = z_0 + r \cos\theta$$

where $\theta \in [0; \pi]$ and $\varphi \in [0; 2\pi)$

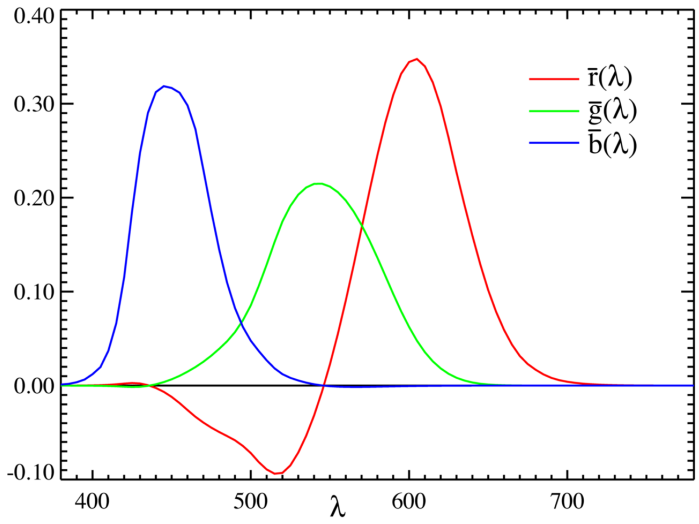
Problem 2. Reflection Texturing

Given a ray hit-point $\overrightarrow{h}$, the origin of the ray from camera $\overrightarrow{o}$ and the local surface normal $\overrightarrow{n}$ (all expressed in world space), compute the pixel coordinates that have to be accessed in the reflection map texture. This texture is stored so that uv-coordinates map to spherical coordinates (normalized in [0, 1]).



Problem 3. Color Models

On the image below you can see the CIE RGB color matching functions, which are the numerical description of the chromatic response of the *observer.* As you know these functions were estimated empirically during the color matching experiments:



Please explain with your own words

a) How it is possible that the red curve becomes negative?
b) How the negative values were estimated?