Lighting Cheatsheet

1 Definitions

incident light : light hitting surface of object
directional light : light with a uniform direction and intensity
point light : light with a location, direction and intensity depend on relative location and distance

2 Light Sources

l_s : intensity (RGB) of specular component of light from light source l
l_d : intensity (RGB) of diffuse component of light from light source l
l_a : intensity (RGB) of ambient component of light from light source l
a : intensity (RGB) of ambient light

- uniform for entire scene

- base ambient light for scene plus sum of all l_a from individual light sources

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r_l : "radius" ; distance from light source l to fragment, only applicable to point point lights

3 Materials

m_s : specular reflection constant of material m

- ratio of incident light reflected specularly

- may be a single constant, or a $(red, greenblue)$ triple

m_d : diffuse reflection constant of material m

- ratio of incident light reflected diffusely

- may be a single constant, or a $(red, greenblue)$ triple

m_a : ambient reflection constant of material m

- ratio of ambient light reflected

- may be a single constant, or a $(red, greenblue)$ triple

α : shininess constant

- higher for smoother, more mirror-like surfaces

- lower for rougher, duller surfaces

- high α means small, bright specular reflection

- low α means large dim specular reflection

C : color (RGB) of surface

- if m_s, m_d and m_a are (RGB) triples, this is redundant and is not used

- for textured models, often m_s, m_d and m_a are single constants, and C is sampled from a texture and used with illumination (defined below) to determine displayed fragment color

4   Spacial Factors

S_l : normalized vector pointing toward light source l from surface

- if l is a directional light, S_l is just the negation of l's light direction

- if l is a point light, S_l is the unit vector from the surface toward the light source (i.e. $lightPosition - fragPosition$, normalized)

N : surface normal
R_l : direction of light from S_l, perfectly reflected off of surface:

$$2(S_l \cdot N)N - S_l$$

V : normalized direction from surface to viewer / camera

5   Putting it all together

D : set of all directional light sources
P : set of all point light sources
I : illumination (RGB) on surface:

$$I = m_a a + \sum_{l \in D} \Big(m_d(S_l \cdot N)l_d + m_s(R_l \cdot V)^\alpha l_s \Big) + \sum_{l \in P} \frac{\Big(m_d(S_l \cdot N)l_d + m_s(R_l \cdot V)^\alpha l_s \Big)}{\max(r_l^3, 1)}$$

- if m_s, m_d and m_a are (RGB) vectors, use the Hadamard product to multiply them by other vectors

- otherwise, just use scalar multiplication

$FragColor$: color displayed from illiumination I on surface with color C

- if material components are single constants: $FragColor = (I_r C_r, I_g C_g, I_b C_b)$

- if material components are colors: $FragColor = I$