Lighting and Shading wrapup

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1

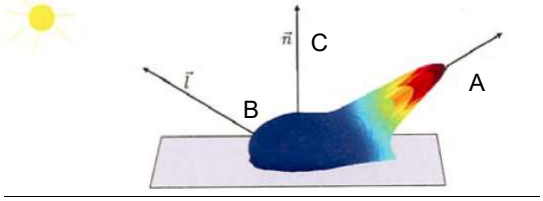
Today

- Lighting and Shading
  - Blinn-Phong reflection and the halfway vector
  - Toon shading
  - Global illumination and ambient
  - Transforming normals

2

Review: Phong Reflection

- Which feature is modelled by the specular component in the Phong reflection model?
- Which feature is modelled by the diffuse component?



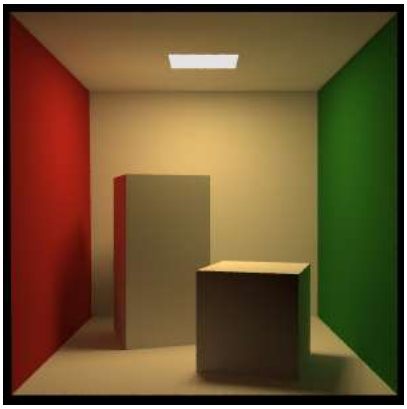
a) A b) B c) C d) All of the above e) None of the above

Lighting and Shading odds and ends

- Global illumination and ambient
- Blinn-Phong reflection and the halfway vector
- Toon shading
- Anisotropic reflection

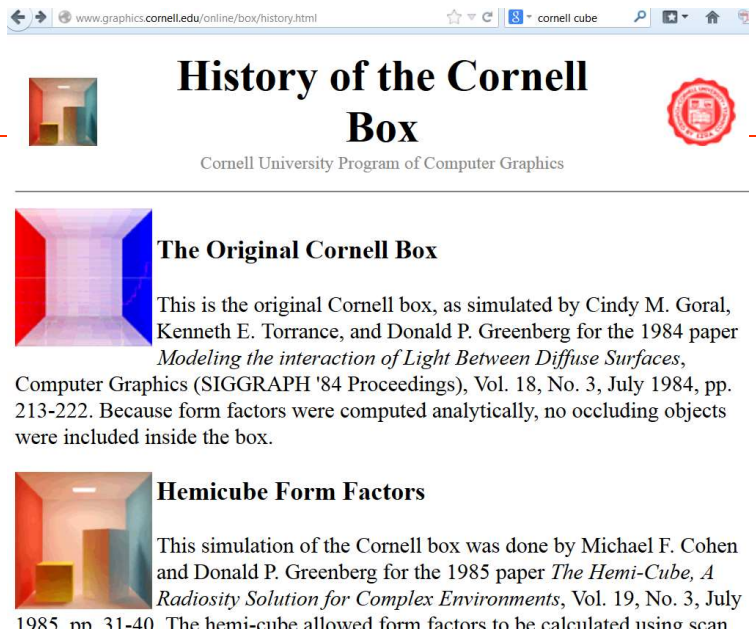
4

Global Illumination
Cornell box



http://en.wikipedia.org/wiki/Cornell_box

5



6

Phong Reflection

October 25, 2017 9:56 AM

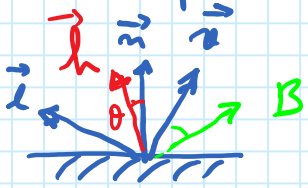
Typically also add an "Ambient" light
doesn't depend on $\vec{l}$ or $\vec{v}$, approximates (crudely) global illumination.

Phong ≅ Diffuse + Specular + Ambient

— x —

Blinn-Phong Reflection Model (Blinn-77)

Applies to specular term only



$\vec{h}$ = halfway vector
= normalize $(\vec{l} + \vec{v})$

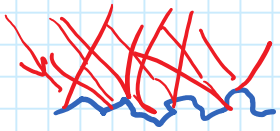
When $\vec{v}$ is aligned with $\vec{B}$
$\vec{h}$ " " " $\vec{n}$

Blinn takes specular to be $(\cos\theta)^{\alpha}$ (α: shininess coefficient, generally larger number than Phong)

$$I_s = (\max(0, \vec{h} \cdot \vec{n}))^{\alpha}$$

Why?

- More consistent with the physics
  $\vec{h}$ is a better "extrinsic" description of illumination



- In practice: better results when $\vec{l}, \vec{n}, \vec{v}$ are not co-planar. If they are coplanar, same as Phong

Toon Shading

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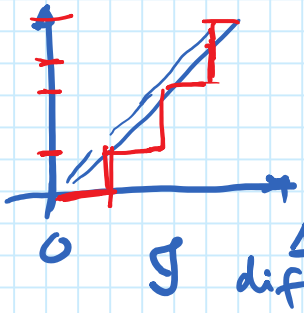
Capture the qualitative features of cartoon

[Whole subfield called NPR
Non-photorealistic Rendering

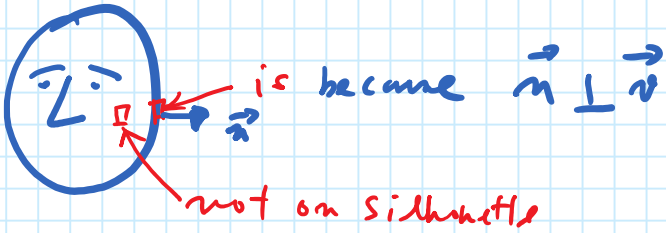
(1) Small palette of colors

Simple algorithm: quantize diffuse component



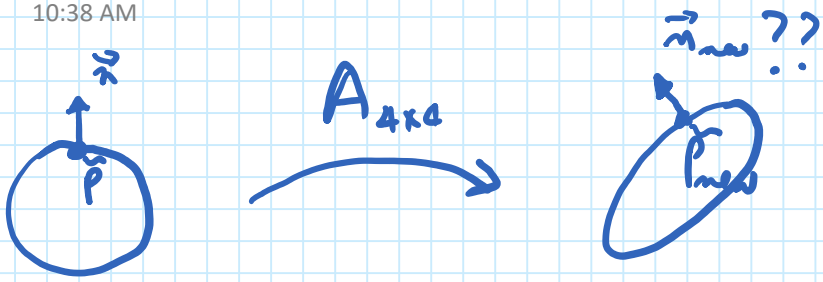
Can also get cartoon like "highlights"

(2) Silhouette edges



Normals are not normal!!

October 25, 2017 10:38 AM

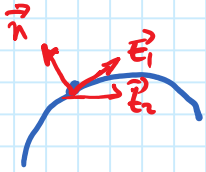


$$p_{new} = A\,p$$

$$n_{new} = A\,n\ ?\ \times$$ Wrong

What is a normal?

A vector that is perpendicular to all tangent vectors



tangent vector is easier to define from A

$$\vec{t} = \lim_{h\to 0} \frac{\hat{p}_h - \hat{p}}{h}$$

So normal vector defined as

$$\vec{n}\cdot\vec{t} = 0$$

$$\vec{n}_{new}\cdot\vec{t}_{new} = 0$$

$$t_{new} = A\,t$$

In coordinates

$$n^T t = n_{new}^T \vec{t}_{new} = n_{new}^T A\,t$$

Holds for all tangent vectors t

So $n^T = n_{new}^T A$

(inverse)

$$n_{new} = (A^{-1})^T n$$