

Lighting and Shading wrapup Quiz 2 prep

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Today

- Assignment 3 is now available, due March 13
- Lighting and Shading, odds and ends
 - Global illumination and ambient
 - Blinn-Phong reflection and the halfway vector
 - Toon shading
- Quiz 2 preparation

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Note about Assignment 3

- This assignment has a slightly different flavor from the previous two
 - This is mostly classical OpenGL material. Simple and lots of sample code available on the Web (some pointers next slide). Please do look at this code, but implement it yourself so that you really understand what's going on
 - Grading will focus on whether you understand the parts you implemented

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Lighting and Shading odds and ends

- Phong shading vs. Gouraud shading
 - Gouraud == per-vertex normals and illumination. Interpolate vertex colors to fragments
 - Phong == Interpolate vertex normals, per-fragment illumination
- Phong reflection vs. Phong shading
 - P. reflection == an approximation of BRDF, into specular + diffuse + **ambient** + ...
- Global illumination and ambient
 - Ambient term is a crude approximation of global illumination


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Global Illumination Cornell box




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

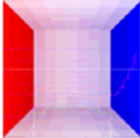
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History of the Cornell Box


Cornell University Program of Computer Graphics





The Original Cornell Box

This is the original Cornell box, as simulated by Cindy M. Goral, Kenneth E. Torrance, and Donald P. Greenberg for the 1984 paper *Modeling the interaction of Light Between Diffuse Surfaces*, *Computer Graphics (SIGGRAPH '84 Proceedings)*, Vol. 18, No. 3, July 1984, pp. 213-222. Because form factors were computed analytically, no occluding objects were included inside the box.



Hemicube Form Factors

This simulation of the Cornell box was done by Michael F. Cohen and Donald P. Greenberg for the 1985 paper *The Hemi-Cube, A Radiosity Solution for Complex Environments*, Vol. 19, No. 3, July 1985 pp. 31-40. The hemi-cube allowed form factors to be calculated using scan

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Lighting and Shading odds and ends

- Switch to pen for
 - Blinn-Phong reflection and the halfway vector
 - Toon shading

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Lighting and Shading Resources

- There are a huge number, esp. for per-vertex lighting and shading in OpenGL. The math is mostly the same.
- Per-fragment (Phong shading) examples
 - <http://www.lighthouse3d.com/tutorials/glsl-core-tutorial/lighting/>
 - <http://www.arcsynthesis.org/gltut/Illumination/Illumination.html>
 - Sample chapter of this book is on lighting and shading <http://www.packtpub.com/opengl-development-cookbook/book>

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- Blinn-Phong Reflection Model
(a different way to compute the Specular term)



Phong: $\rho = B(\vec{l}) \cdot \vec{v}$

Halfway vector

$$\vec{h} = \text{normalize}(\vec{l} + \vec{v}) \quad \text{easy to compute in GLSL}$$

Blinn: $\rho = (\vec{h} \cdot \vec{n})^{\alpha}$ ← a "shininess" exponent

Produces similar results if $\vec{l}, \vec{n}, \vec{v}$ are in the same plane. But not the same.

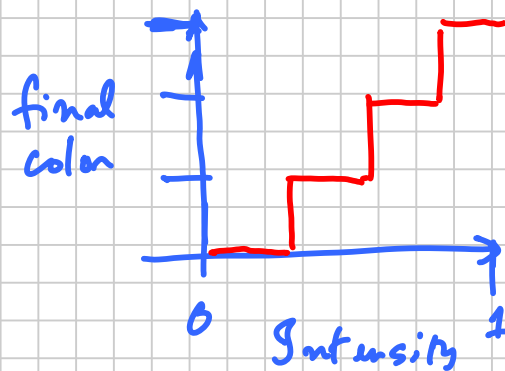
α has to be generally higher to get a comparable effect

§ Toon Shader a.k.a. Cell Shading

Two qualitative features of Cartoons

(1) Small palette of colors

Take diffuse color, and quantize it



(2) Silhouette edges



Quiz 2 Preparation

- In class, Wednesday March 4 1-1:50. Please be on time.
- Review lecture notes, and assignments.
- Everything covered in lecture could be on the exam
- Everything covered in listed textbook chapters could be on the exam
- Doing first part of Assignment 3 will be helpful

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Quiz 2 Preparation

- Textbook. Read **ALL** of these, except as noted
 - Ch 3.6 (transformation of normals)
 - Ch 5.4 Hierarchies of transformations
 - Ch 9.1 Interpolation (intro parts as covered on Monday)
 - Ch 10, 11.3 Projection. Mainly focus on lecture notes
 - Ch 12 From Vertex to Pixel. Skip 12.3, 12.4
 - Ch 14 Materials (shading and lighting)
- **Topics from Quiz 1 will be assumed as pre-requisites (e.g., it is assumed you now know coordinate frames and how to transform them)**

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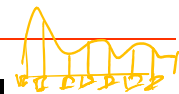
Texture mapping

A brief intro and motivation

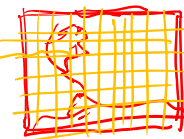
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First example How to model the earth?

Monday:
Interpolation
is a key

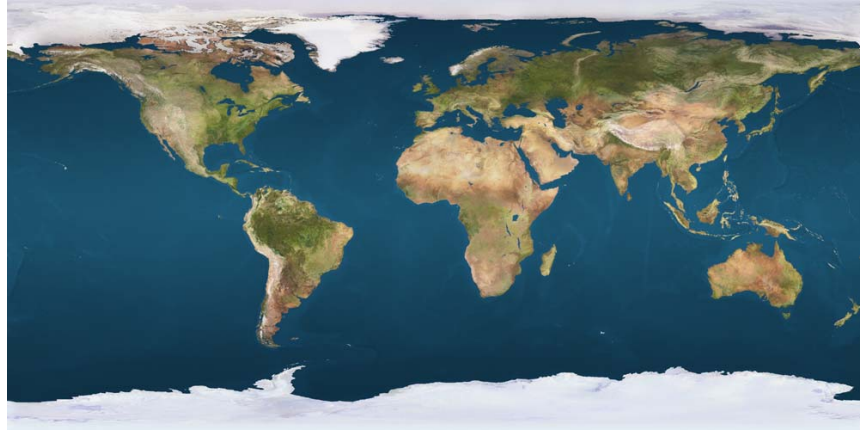


A discrete
representation
of a
continuous
function



Map at
2D image

Earth texture



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