CSCI 4530/6530 Advanced Computer Graphics — Quiz 2
Friday, April 21, 2017 — 2-3:50pm

Name:

RCS username:

1	/ 7
2	/ 16
3	/ 17
4	/ 10
Total	/ 50

This quiz is closed book & closed notes except for one 8.5x11 (double-sided) sheet of notes.

Please state clearly any assumptions that you made in interpreting a question.

Write your answer in the box provided below each question. Be sure to write neatly. If we can't read your solution, we won't be able to give you full credit for your work.

1 Lightning Lighting & Rendering Fill-in-the-Blank [/7]

Match each letter in these sentences with one of the terms below. Each letter will be used exactly once.

To make an image of a sphere look round and not like a flat disk, we rely on [A], which uses a BRDF (the simplest example of which is [B]). More physically accurate renderings require [C]. Two examples of [C] are [D] and [E], although [D] only works with diffuse (a.k.a. [F]) materials. Our raytraced sphere might have jaggy pixel boundaries, which is an example of [G], which can be solved by supersampling the eye rays. If our sphere is modeled as a polygonal shape, [H] can help disguise the edges between planar faces. Using [I] in a fragment or pixel shader will ensure that the specular highlights are correctly rendered in the middle of big planar faces, though to ensure that the polygonal silhouettes don't give us away we'll need to use [J]. To reproduce [K] from reflective or refractive objects we'll need to use forward ray tracing and to see headlight beams on a foggy night we'll need to use [L].

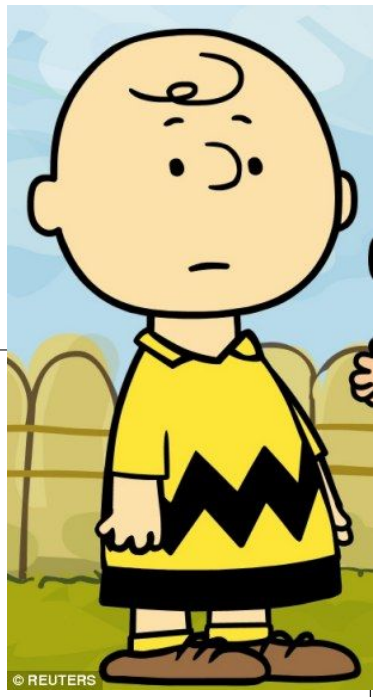
	Phong model		radiosity		displacement mapping
	global illumination		aliasing		sub-surface scattering / participating media
	Gouraud shading		Lambertian		Phong normal interpolation
	irradiance caching		caustics		local illumination

2 (Pseudo) Code Monkeys [/16]

2.1 Sampling [/8]

Describe (with pseudo-code and a diagram) how to generate k points *uniformly at random* on the surface of a cylinder of height h, with radius r. Your method should generate points on the main body of the cylinder and also on the top and bottom caps. Consider the efficiency of your method (e.g., total number of calls to the rand() function, number of arithmetic operations, etc.) Your first priority is to ensure that the sampling is uniformly dense, and the second priority is to make it efficient.

2.2 It's the Great Pumpkin, Charlie Brown [/8]



Write a simple C++ function or GLSL fragment shader (detailed pseudo-code is ok) to create the fabric for Charlie Brown's shirt and shorts. The length of his shorts is 6", the horizontal distance between peaks in the 45 degree slope zigzag is 8". Draw a neat diagram labeling any unspecified distances with reasonable values. Your function should take in one argument, a `Vec2f` or `glm::vec2` that represents the 2D position, and return a `Vec3f` or `glm::vec3` that is the color at that point.

3 Short Answer [/17]

3.1 The Graphics Pipeline [/4]

Name three of the stages of a traditional (non-programmable) graphics pipeline and describe the key function of each of those stages.

3.2 Procedural Construction or Growth [/4]

Which paper did you read? "Feature-Based Cellular Texturing for Architectural Models", "Procedural Modeling of Cities", "Procedural Modeling of Buildings", or something from Algorithmic Botany? In 2-3 concise and well-written sentences, describe the technical contribution that you found most impressive.

3.3 Photon Mapping [/5]

Why is a spatial acceleration data structure essential for Photon Mapping? Describe the details of how the kd-tree was used for the Photon Mapping portion of Homework 3. Write 3-4 concise and well-written sentences.

3.4 Radiosity Precomputation [/4]

Radiosity is a multi-step algorithm:

1. divide scene into patches
2. compute form factors
3. solve radiosity matrix
4. render the image

Fortunately, much of the work can be performed as a precomputation and may be reused. For each of the scenarios below indicate which steps must be redone and relatively how expensive the change will be:

	steps to be redone	relative cost
Change the camera position		
Change the light position (which patch emits light)		
Change the total energy emitted by the light source		
Add a light source		
Change the color of one of the walls		
Move an object within the scene		
Add an object		

4 Truthiness [/10]

Almost all of the statements that follow are false. Identify each statement as false or true, and correct each false statement so that it is true (but still informative).

4.1 Shadow Volume Limitations [/2]

True or False The shadow volumes technique produces accurate soft shadows from area light sources but cannot be engineered to correctly handle the case when the eye or camera is in shadow.

4.2 Texture Synthesis [/2]

True or False The texture synthesis algorithms by Efros & Leung and Wei & Levoy used a Markov Model to assign pixels in the output texture in scan-line order with an overall logarithmic running time.

4.3 Ray - Sphere Intersection [/2]

True or False The intersection of a ray and sphere is easy to calculate because the equation of the sphere is implicit and the equation of the ray is explicit.

4.4 Distributed Ray Tracing [/2]

True or False "Distributed Ray Tracing" by Cook et al. describes a system for improving the performance of traditional Whitted ray tracing through the use of distributed computing.

4.5 What's a BRDF? [/2]

True or False BRDF stands for Boundary Refraction Diffusion Formula.