

# CSCI 4530/6530 Advanced Computer Graphics — Quiz 2

## Friday April 30, 2010 — 2-3:30pm

Name:

RCS username:

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	/ 7
2	/ 18
3	/ 17
4	/ 8
Total	/ 50

### 1 Shadow Techniques [ /7]

Match each application/situation described below with an appropriate shadow algorithm (or lack thereof). Each letter should be used exactly once.

- A) Planar Fake Shadows      B) Projective Shadow Textures      C) Shadow Maps  
D) Shadow Volumes      E) Ray Casting Shadows      F) None of the above

The dynamic foreground object can easily be separated from the static background environment. Self-shadowing of the foreground object is not an important effect for this application and may be omitted by the algorithm.

Accurate caustic shadows from transparent objects are required.

Fast and accurate shadows are necessary, but the complex dynamic geometry and dynamic light source mean that CPU computation of the silhouette edges will be costly and should be avoided.

The camera and light source will typically be placed at opposite extremes within the scene (nearly pointing at each other). Artifacts from a limited resolution intermediate image representation are undesirable and must be avoided.

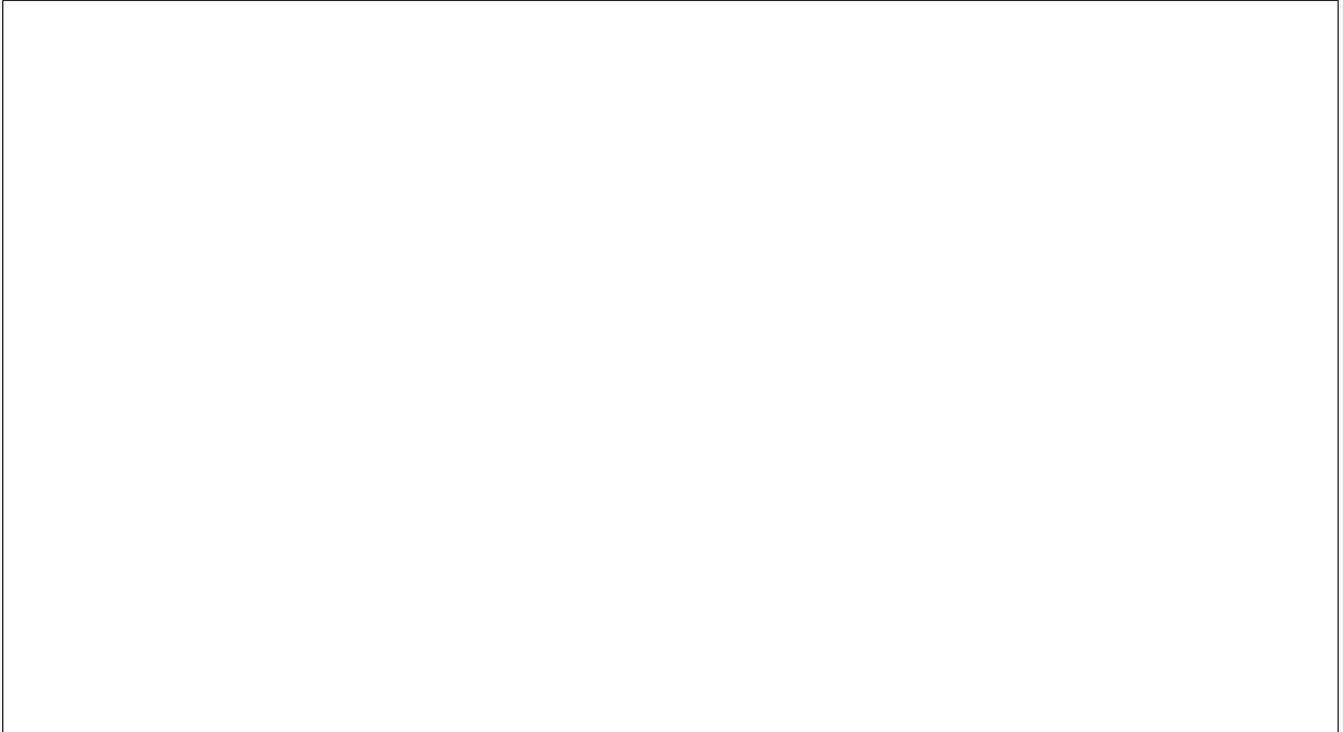
A hand-held video game with strict polygon count and computation restrictions. Shadows should help indicate contact between the characters and the ground.

Soft shadows from large area light sources must be correctly rendered without artifacts.

## 2 Rendering [ /18]

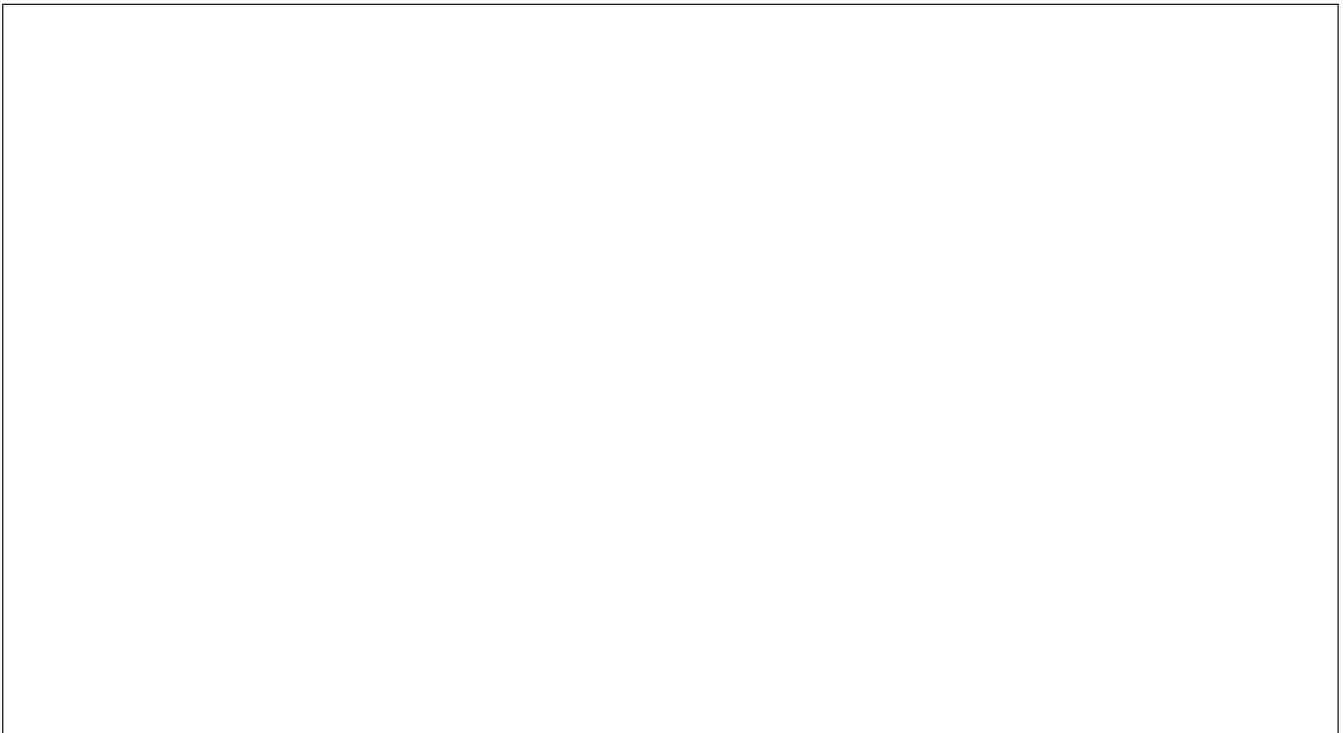
### 2.1 The Graphics Pipeline [ /4]

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



### 2.2 Non-Photorealistic Rendering for Architecture [ /4]

What image characteristics are important for architectural design and pre-visualization? Discuss NPR versus photorealism for this application in 2-3 concise and well-written sentences.



### 2.3 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.

### 2.4 Meshing for Radiosity [ /5]

Why is mesh discretization important for Radiosity? What types of errors or performance problems will occur if the mesh is too coarse or too fine? Why might a non-uniform mesh be advantageous? Write 3-4 concise and well-written sentences.

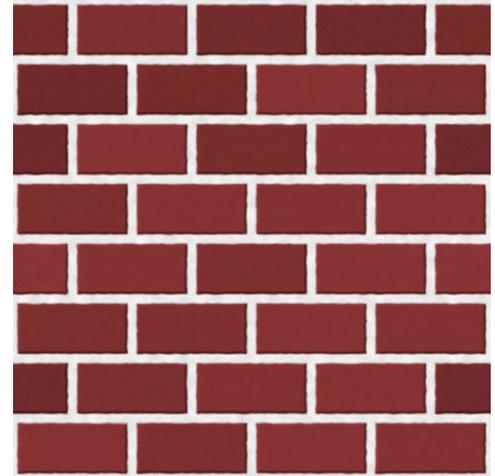
### 3 Back-of-the-Envelope [ /17]

#### 3.1 Sampling [ /8]

Describe how to generate points *uniformly at random* within the bounds of an isosceles trapezoid. Remember that an isosceles trapezoid is a quadrilateral with two opposite sides that are parallel and the two other sides are of equal length. 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.

### 3.2 Procedural Texturing [ /9]

Write a simple C++ function or GLSL fragment shader to create the simple brick texture shown to the right. The texture should look correct when applied to planar surfaces that are perpendicular to the z-axis. The x-axis runs along a row of bricks and the y-axis is “up”. The width and height of each brick are  $w$  and  $h$ , and the width of the mortar joints is  $m$ . The brick and mortar colors are  $c_{brick}$  and  $c_{mortar}$ . Your function should take in one argument, a `Vec3f` that represents the position, and return a `Vec3f` that is the texture color at that point.



## 4 Truthiness [ /8]

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

### 4.1 What's a BRDF? [ /2]

*True or False* BRDF stands for Boundary Refraction Diffusion Formula.

### 4.2 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.

### 4.3 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.

### 4.4 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.