

CSCI 4530/6530 Advanced Computer Graphics — Quiz 2
Tuesday, April 29, 2014 — 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	/ 6
2	/ 17
3	/ 17
4	/ 10
Total	/ 50

1 Shadow Techniques [/6]

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

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

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.

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

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.

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

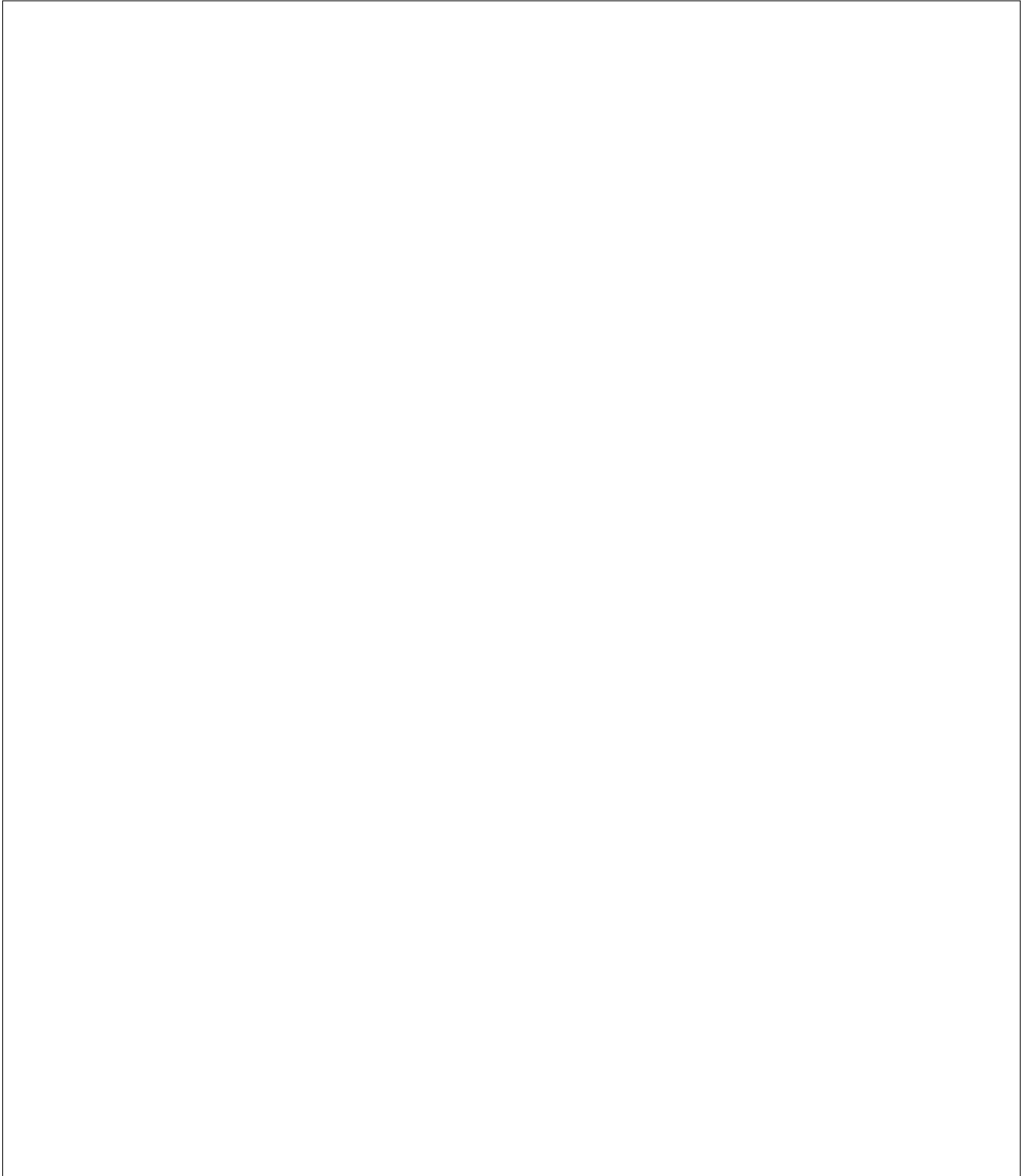
Accurate caustic shadows from transparent objects are required.

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.

2 (Pseudo) Code Monkeys [/17]

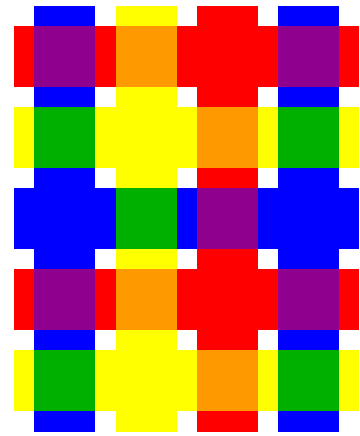
2.1 Fly a Kite Sampling [/8]

Describe (with pseudo-code and a diagram) how to generate points *uniformly at random* within the bounds of a kite. Remember that a kite is a quadrilateral with two pairs of equal length edges. Each pair of equal length edges are adjacent to each other rather than opposite of each other (that would instead be a parallelogram). 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 Primary Plaid Procedural Modeling [/9]

Write a simple C++ function or GLSL fragment shader (detailed pseudo-code ok) to create the repeating primary color plaid texture shown to the right. The width of each band of red, yellow, or blue color is w , and the width of the smaller white space between each band is s . Where the horizontal and vertical bands intersect, the additive colors orange, green and purple appear. Your function should take in one argument, a `Vec2f` or `glm::vec2` that represents the two dimensional position, and return a `Vec3f` or `glm::vec3` that is the texture color at that point.



3 Short Answer [/17]

3.1 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.

3.2 Sketching the Evil Epsilon [/3]

What is the purpose and necessity of *epsilon* in a ray tracing implementation? Draw a simple sketch illustrating one example of the problem and write 2 or 3 complete and concise sentences explaining your sketch and how the careful use of epsilon addresses the problem.

3.3 Texture Synthesis [/4]

What are the quality and performance tradeoffs for using a larger template window search size for the Hidden Markov Model texture synthesis algorithms by Efros & Leung and Wei & Levoy? Write 2 or 3 concise and well written sentences.

3.4 Non Photo Realistic Rendering [/5]

Which paper did you read? "Where Do People Draw Lines?" by Cole et al. or "Painterly rendering with curved brush strokes of multiple sizes" by Hertzmann? Describe in detail one key contribution and one key limitation of this paper. Write 3-4 concise and well-written sentences.

4 Truthiness [/10]

Most 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 Rendering Methods [/2]

True or False Fog, skin, and marble are examples of materials that cannot be rendered using a Monte-Carlo participating media ray tracer and instead must be processed by the graphics pipeline.

4.2 Image Processing [/2]

True or False The paper “Fast Bilateral Filtering for the Display of High-Dynamic-Range Images” by Durand & Dorsey (SIGGRAPH 2002) can be used to automatically de-blur video footage of fast-paced sports such as horse racing.

4.3 Real-Time Rays [/2]

True or False In the paper “Ray Tracing on Programmable Graphics Hardware” by Purcell, Buck, Mark, & Hanrahan (SIGGRAPH 2002) the scene geometry and voxel acceleration data structure are stored in texture memory and the “geometry” processed by the graphics pipeline generates eye rays and intersects triangles.

4.4 Helmholtz Duality [/2]

True or False The principle of “Helmholtz Reciprocity” and the duality between light sources and cameras proves that it is impossible to read an opponent’s hidden cards while playing poker.

4.5 Radiosity Rendering Equation [/2]

True or False The Rendering Equation is a approximation of the general-purpose Radiosity framework for calculating global illumination.