COS 426, Spring 2012
Exam 2

Name:

NetID:

Honor Code pledge:

Signature:

This exam consists of 5 questions. Do all of your work on these pages (use the back for scratch space), giving the answer in the space provided. This is a closed-book exam, but you may use one page of notes during the exam. **Put your NetID on every page (1 point), and write out and sign the Honor Code pledge before turning in the test:**

"I pledge my honor that I have not violated the Honor Code during this examination."

Question	Score
1	
2	
3	
4	
5	
NetID on every page	
Total	

1. Rendering (16 points)

Which of the following rendering methods:

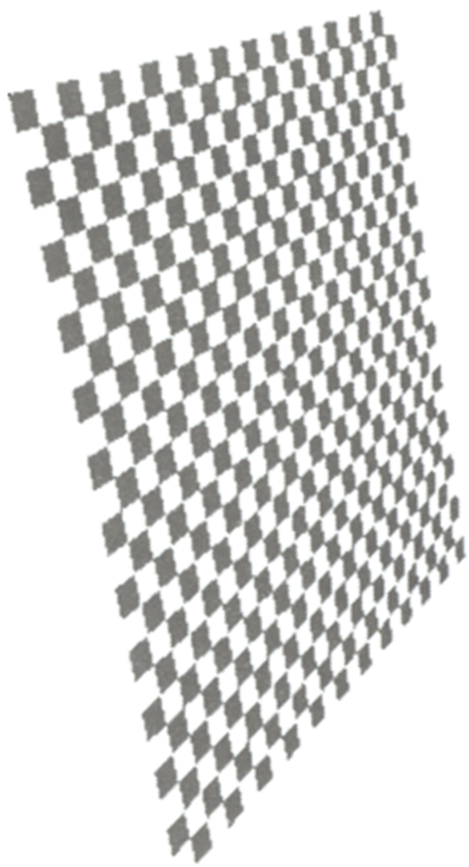
RT: Basic (non-distribution) Ray Tracing
PT: Monte Carlo Path Tracing
Rad: Radiosity
Ras: Rasterization as in OpenGL

have each of the following properties? Choose ***one or more*** correct answers for each.

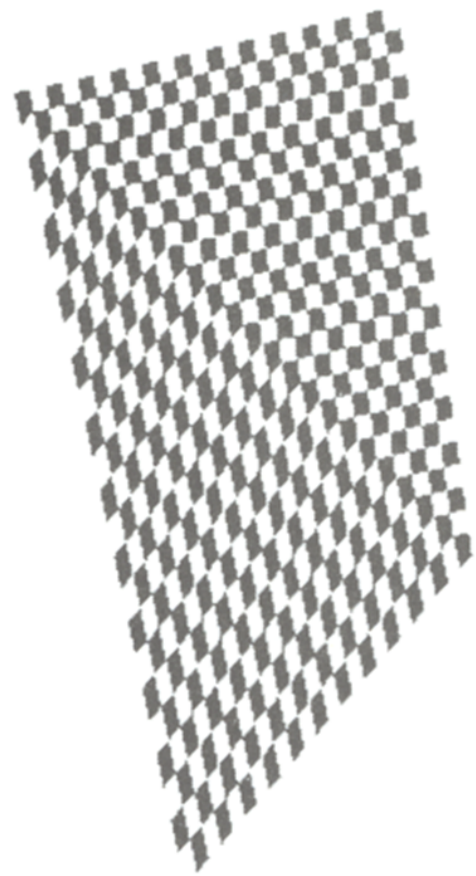
- Supports area lights:
- Supports directional lights:
- Simulates color bleeding:
- Simulates penumbrae:
- Usually requires recursion:
- Usually requires computing form factors:
- Handles scenes with specular objects:
- Handles scenes with diffuse objects:

2. Rasterization Artifacts (24 points)

The following pairs of images each contain one correctly-rendered image, and one with some visual artifact caused by an incorrect implementation of rasterization (or one that deliberately cuts corners in the interests of speed). In each case describe what causes the problem, the conditions under which it can occur, and what is done to fix or avoid it.



Correct

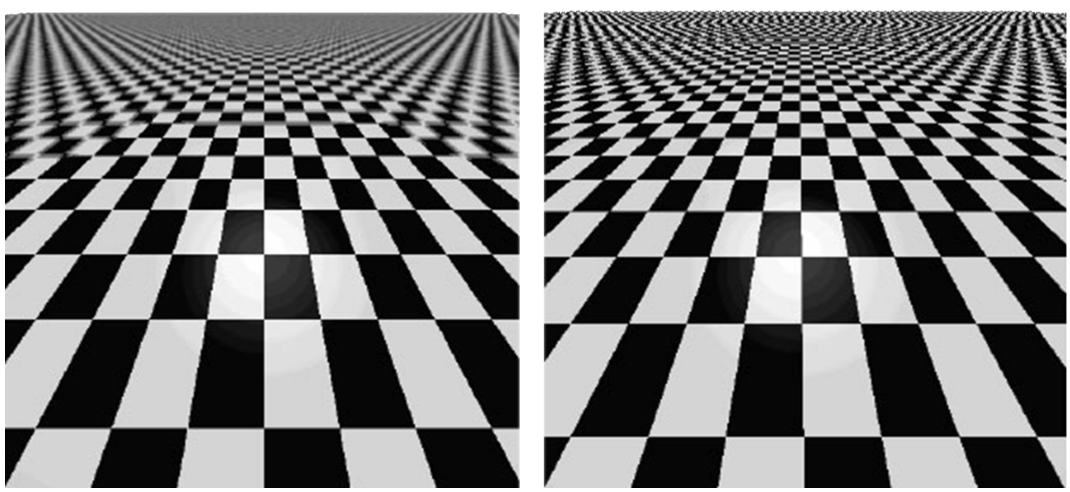


Incorrect

Explanation:

Correct Incorrect

Explanation:

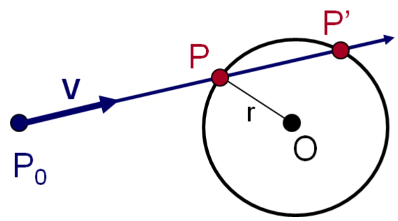


Correct Incorrect

Explanation:

3. Ray/Sphere Intersection (24 points)

Consider the following pseudocode for a ray/sphere intersection algorithm, which is a variant of a method shown in class:



Ray: $P = P_0 + tV$

Sphere: $\|P - O\|^2 - r^2 = 0$

1 $L \leftarrow O - P_0$

2 $t_{ca} \leftarrow L \cdot V$

3 **if** $(t_{ca} < 0)$ **return** 0

4 $d^2 \leftarrow L \cdot L - t_{ca}^2$

5 **if** $(d^2 > r^2)$ **return** 0

6 $t_{hc} \leftarrow \sqrt{r^2 - d^2}$

7 $t \leftarrow t_{ca} - t_{hc}$

8 **if** $(t < 0)$ **return** 0

9 intersection $\leftarrow P_0 + tV$

Explain the roles of the three **if** statements. Under what geometric conditions are they triggered? Is each one necessary for correctness (assuming the other 2 are included), or only for efficiency?

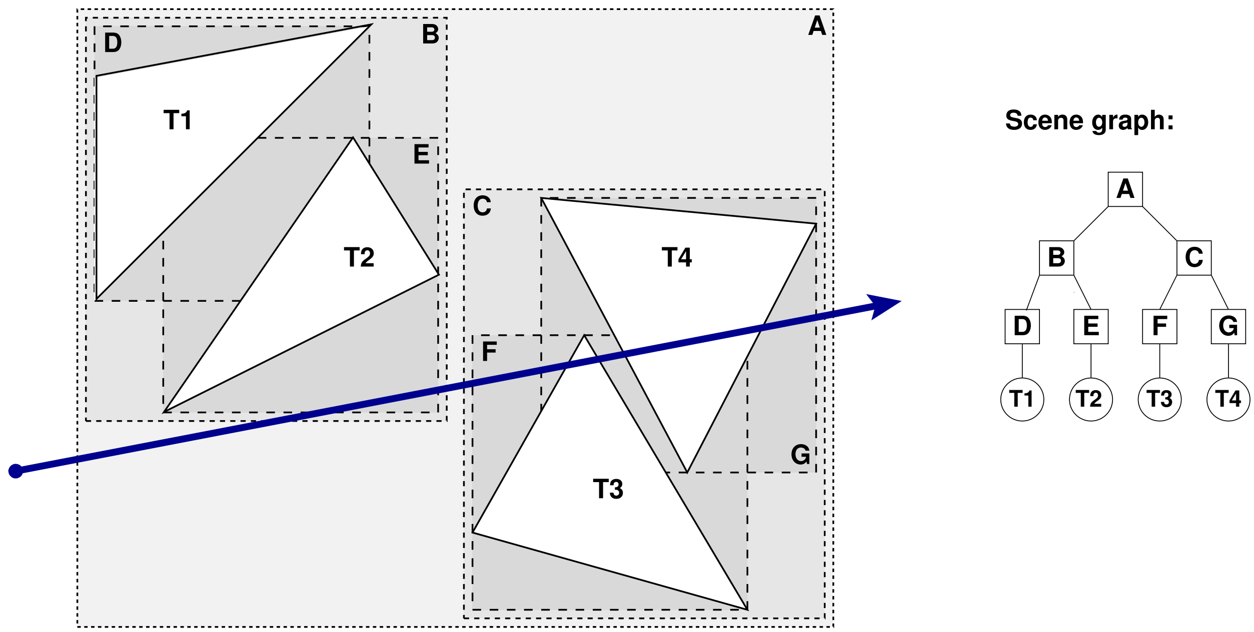
Line 3:

Line 5:

Line 8:

4. Ray Tracing through a Scene Graph (17 points)

Consider this scene, consisting of four primitives (triangles T1 .. T4) and the scene graph hierarchy (with bounding boxes) built upon them:



a) Write the nodes (including both primitives and interior nodes) that will be checked when tracing the indicated ray, ***in the order in which the ray/node intersections will be evaluated***. Assume that this is a primary ray, and that the traversal algorithm implements the optimizations we discussed in class:

b) In your list, ***circle*** the tests for which an intersection is ***not*** found.

c) Repeat parts (a) and (b) assuming the ray is a shadow ray:

5. Animation (18 points)

Consider a humanoid character animated using:

K: (Forward) Kinematics
IK: Inverse Kinematics
D: Active Dynamics with a Motion Controller

Which strategy has each of the following properties? Choose the ***single best*** answer for each.

- Requires optimization:
- Requires joint-angle interpolation:
- Requires solving differential equations:
- Offers easy incorporation of motion capture data:
- Offers easy artist control over foot-plant locations:
- Offers easy adaptability when new contraints are added:
- Most likely to have issues with numerical stability:
- Most likely to result in unintended intersections:
- Most likely to obey the laws of physics: