

**Test 2**  
**CS 5610/6610**  
**Advanced Computer Graphics**  
**Spring 2016**

*Solution*

Name: \_\_\_\_\_

Student ID: \_\_\_\_\_

**Rules:**

1. One page of notes
2. No calculators, computers, or phones
3. CS 5610 students, answer any 4 questions (no extra credit)
4. CS 6610 students, answer all 5 questions

1. Definitions [20 points] Be sure to answer the WHY portions!

[5 pts] Name an image-space shadow method (explain why you chose this)

shadow map

uses an image from the light's point of view. All comparisons are done in image space

[5 pts] When does the stencil operation take place with respect to the fragment shader?

after, along with the depth comparison

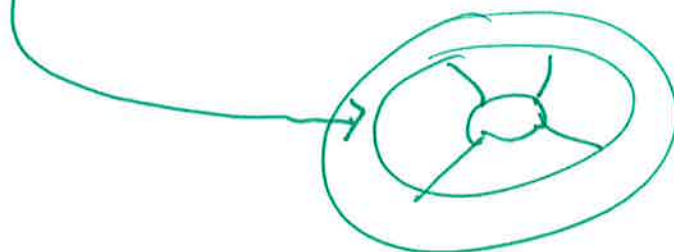
[5 pts] Name an object space shadow method (explain why you chose this)

shadow frustums

- create shadow frustums in object space

[5 pts] What part of a spherical environment map has the worst resolution and why?

outside edge because many parts of the scene are encoded in just a few pixels it is the portion ~~behind~~ behind the reflective sphere



2a. [5 pts] What is the difference between a skybox and an environment map?

a sky box is infinitely far and represents the scene's background. It is always drawn in relation to the camera

An Environment is used for reflections whereas the skybox is used to represent the 'far-away' parts for the scene

2b. [5 pts] Which has more aliasing problems: Shadow Maps or Shadow Volumes?

Shadow maps have many more aliasing problems

2c. [5 pts] How many passes does the scene have to be rendered to create a cube map and is it the same for a cube-map and spherical environment map?

6 passes with a  $90^\circ$  frustum  
centered on the object which reflects.  
it is the same for cube maps &  
spherical env. maps

2d. [5 pts] Can an environment map do self reflection? Explain why or why not.

no, it assumes it is reflecting all  
other objects in the scene

3a. [10 pts] Describe two aliasing artifacts with Shadow Maps

self-shadowing / bias

shadow acne  
moiré patterns

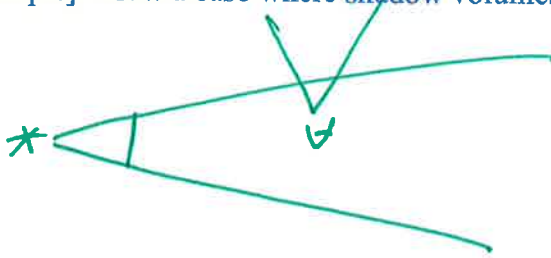
double frustra

when the surface being shadowed is nearly  
orthogonal to the light

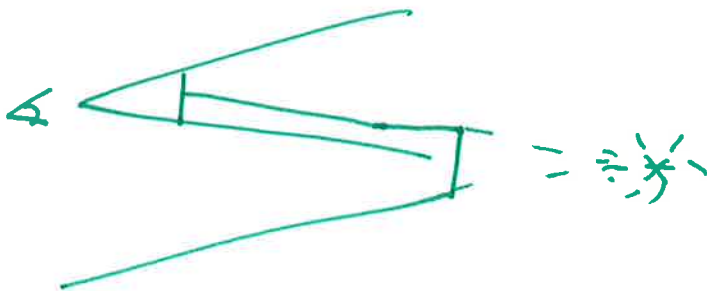


poor resolution of the shadow map

3b. [10 pts] Draw a case where shadow volumes may have a problem.



viewer in the shadow volume



shadow quad  
clipping near plane

4. [20 pts] Give the OpenGL code that would leave the non-intersecting pixels of two filled polygons in the stencil buffer, represented as a value of '1' with all other locations having a value of zero. (hint: write out the steps involved, then write the OpenGL calls to achieve those steps.

Assume:

The ModelView and Projection matrix are appropriately set (no viewing calls are required).

The stencil buffer and depth buffer are cleared.

There are two routines: DrawPolygonA(), DrawPolygonB()

You must set all other necessary state.

You must use appropriate stenciling calls (glStencilFunc and glStencilOp)

**glStencilFunc( GLenum func, GLint ref, GLuint mask )**

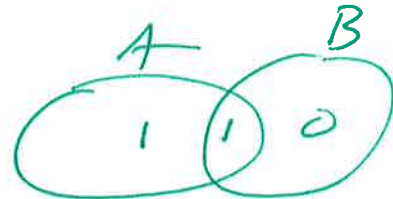
**glStencilOp( GLenum fail, GLenum zfail, GLenum zpass )**

Shaded region has 1's in stencil buffer



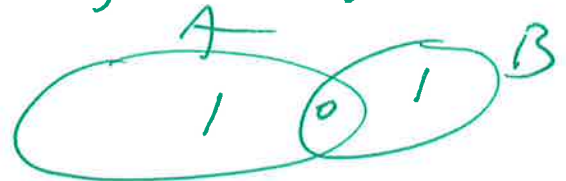
```
glStencilFunc( GL_ALWAYS, 0x1, 0xFF );
glStencilOp( GL_REPLACE, GL_REPLACE, GL_REPLACE );
```

Draw Polygon A();



```
glStencilFunc( GL_EQUAL, 0x1, 0xFF );
glStencilOp( GL_REPLACE, GL_ZERO, GL_ZERO );
```

Draw Polygon B();



5a. [10 pts]: Which is more fill bound and why: shadow maps or shadow volumes

shadow volumes: because the shadow quads create more geom to be rasterized

5b. [10 pts] Silhouettes can be approximated in image space in a fragment shader. Describe how you would do this and what would need to be varying/interpolated across the polygon to the fragment to accomplish it.

1) use interpolated normals. Threshold where nearly orthogonal to the view point

2) use a depth map; look for discontinuities