

Test 1

CS 5610/6610

Interactive Computer Graphics

Spring 2016

Name: _____

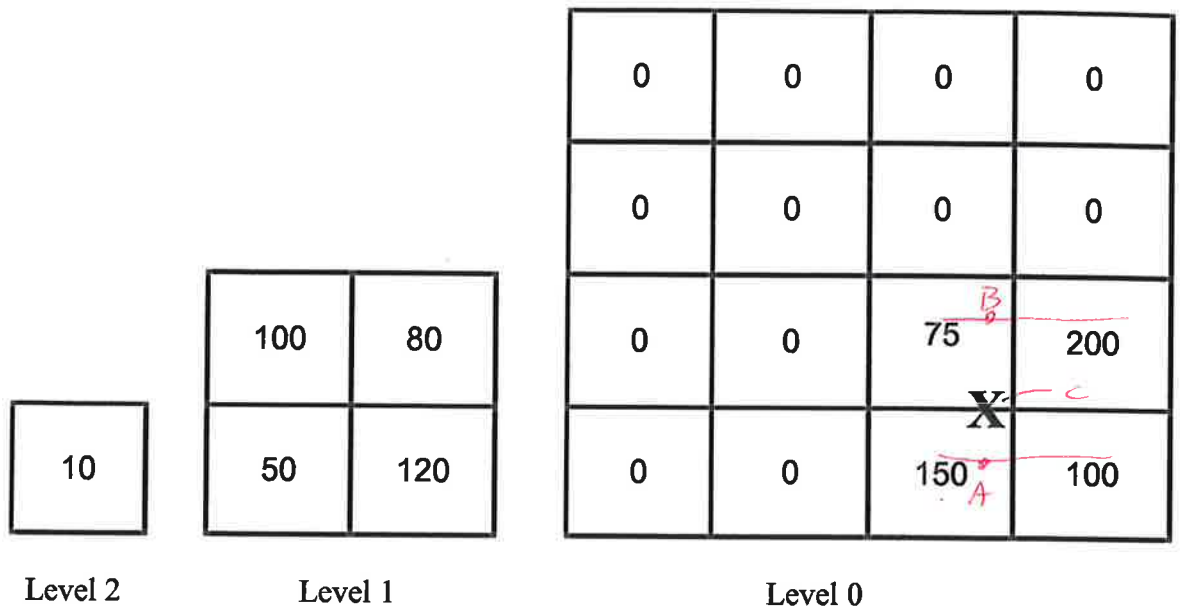
Solution

Student ID: _____

Rules:

1. CS 5610 students, answer any 4 questions (no extra credit)
2. CS 6610 students, answer all 6 questions

One page a notes only!



Given the above luminance texture.
 Counting from zero at **Level 0**,
 a fragment's center falls at the X (25% away from the left-most texel).
 The texel values shown are at the center of the texels (as shown)

It's projection is $d=0.75$.

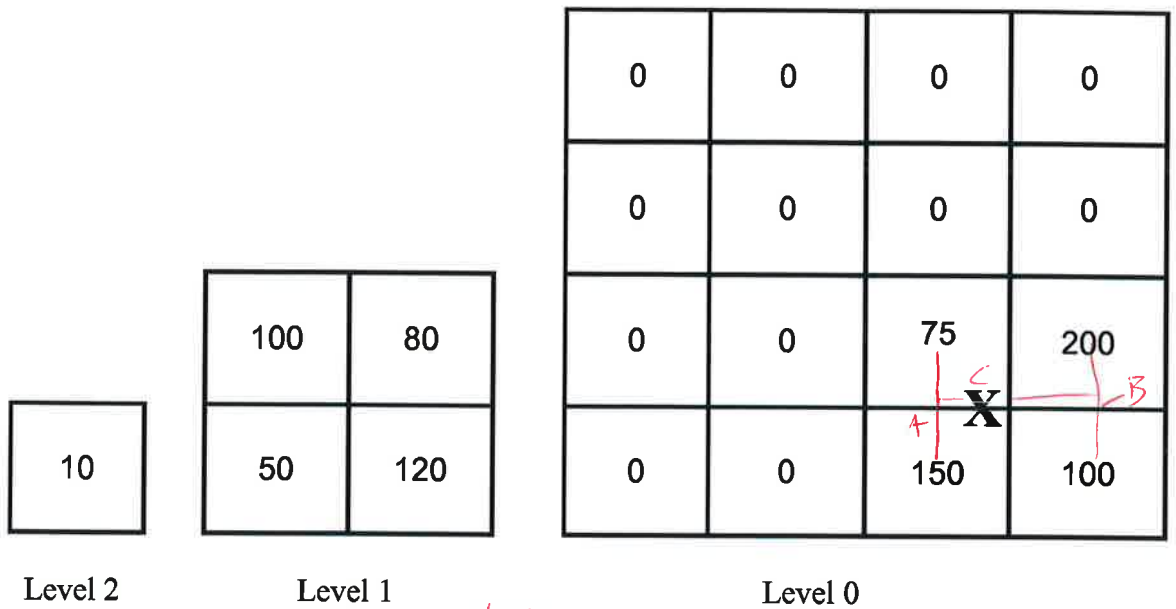
1a. [5 pts] What is the assigned value of a fragment with:
 minification filter set at: **GL_LINEAR**
 magnification filter set at: **GL_LINEAR**

$$\begin{aligned}
 &A \\
 &.75(150) + .25(100) \\
 &112.5 + 25 \\
 &137.5
 \end{aligned}$$

$$\begin{aligned}
 &B \\
 &.75(75) + .25(200) \\
 &56.25 + 50 \\
 &106.25
 \end{aligned}$$

$$\begin{aligned}
 C &= .5(137.5) + .5(106.25) \\
 &68.75 + 53.125 \\
 &121.88
 \end{aligned}$$

1b. [5 pts] What is the final luminance value:
 minification filter set at: **GL_LINEAR_MIPMAP_NEAREST**
 magnification filter set at: **GL_LINEAR**



Given the above luminance texture.
 Counting from zero at Level 0,
 a fragment's center falls at the X (25% away from the left-most texel).
 The texel values shown are at the center of the texels (as shown)

Its projection is $d=0.75$.

1a. [5 pts] What is the assigned value of a fragment with:
 minification filter set at: `GL_LINEAR`
 magnification filter set at: `GL_LINEAR`

Handwritten calculations for part 1a:

$$A: .5(75) + .5(150) = 37.5 + 75 = 112.5$$

$$B: .5(200) + .5(100) = 100 + 50 = 150$$

$$C: .75(112.5) + .25(150) = 84.38 + 37.5 = 121.88$$

1b. [5 pts] What is the final luminance value:
 minification filter set at: `GL_LINEAR_MIPMAP_NEAREST`
 magnification filter set at: `GL_LINEAR`

Handwritten answer: 120

Given the following:

Fragment: (R,G,B,A)=(0.0, 1.0, 1.0, 0.5)

Framebuffer initial values: (1.0, 0.5, 1.0, 0.75)

Assume blending is enabled and the state is correctly setup.
What is the result of the following:

2a. [10 pts] RGBA blend with:

$\text{GLBlendFunc}(\text{GL_SRC_ALPHA}, \text{GL_ONE_MINUS_DST_COLOR})?$

R	G	B	α		D	R	G	B	α
A_s	A_s	A_s	A_s		$1-R_d$	$1-G_d$	$1-B_d$	$1-\alpha_d$	
.5	.5	.5	.5		1-1	1-.5	1-1	1-.25	
S	D	S	D		0	.5	0	.75	.25
$0.0 \times .5 + 0.0 \times 1.0$					$.5 \times 1.0 + .5 \times .5$				
R		G			S	D	S	D	
0.0		.75			B		α		
					$.5(1.0) + (0.0)(1.0)$			$.5(.5) + .25(.75)$	
					.5			$.25 + .1875$	
								.5125	
								$.4375$	

$(0.0, .75, .5, .4375)$

2b. [10 pts] RGBA blend with:

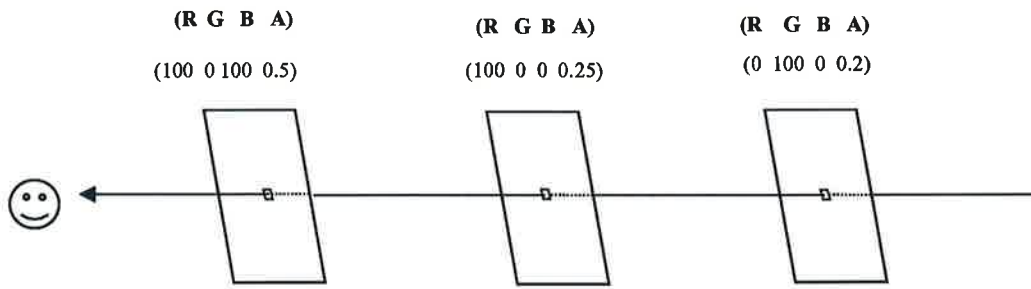
$\text{GLBlendFunc}(\text{GL_DST_ALPHA}, \text{GL_SRC_COLOR})?$

R	G	B	α		D	R	G	B	α
A_d	A_d	A_d	A_d		R_s	G_s	B_s	A_s	
.75	.75	.75	.75		0.0	1.0	1.0	.5	

S	R	D		S	G	D		S	D	
$.75(0.0) + 0.0(1.0)$				$.75(1.0) + 1.0(.5)$				$.75(1.0) + 1.0(1.0)$		
0.0				1.35				1.75		
				1.0				1.0		

S	α	D		S	α	D	
$.75(.5) + .5(.75)$				$.75(.5) + .5(.75)$			
.5125				.5125			
.375				.375			
				.75			

~~(0.0, 1.0, 1.0, .75)~~
 $(0.0, 1.0, 1.0, .75)$



The front-to-back compositing equation is:

$$C_{out} = C_{in} + (1 - \alpha_{in}) \alpha_c C_c$$

$$\alpha_{out} = \alpha_{in} + \alpha_c (1 - \alpha_{in})$$

3. (10pts) For the given pixel, what is the result of front-to-back compositing?
(show all steps):

C_{in}	α_{in}	α_c	C_c	$\alpha_c C_c$	$1 - \alpha_{in}$	$1 - \alpha_{in} (\alpha_c C_c)$	C_{in}	C_{out}
(0 0 0)	0	.5	(100 0 100)	(50, 0, 50)	1.0	(50 0 50)	(0 0 0)	(50, 0, 50)
(50 0 50)	.5	.25	(100 0 0)	(25 0 0)	.5	(12.5 0 0)	(50 0 50)	(62.5, 0, 50)
(62.5 0 50)	.625	.2	(0 100 0)	(0 20 0)	.375	(0 7.5 0)	(62.5, 0, 50)	(62.5, 7.5, 50)

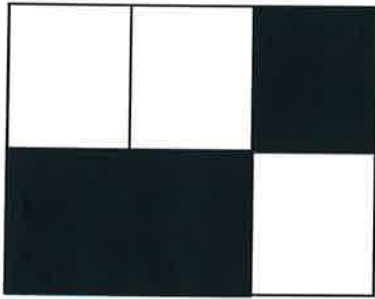
62.5, 7.5, 50

α_{in}	α_c	$1 - \alpha_{in}$	$\alpha_c (1 - \alpha_{in})$	α_{out}
0	.5	1.0	.5	.5
.5	.25	.5	.125	.625
.625	.2	.375	.075 .075	.7

5. [10pts] Given the following texture:

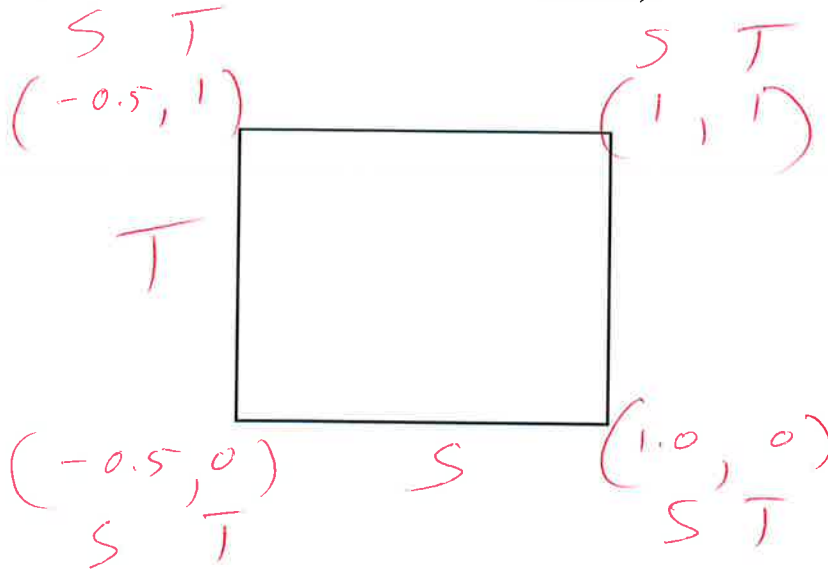


What texture coordinates would you assign to a quad to get this result (include any texture parameter settings?):



Set texture to S ~~repeat~~ ^{clamp}
~~set to repeat~~

Quad (write the texture coordinates at the corner vertices):

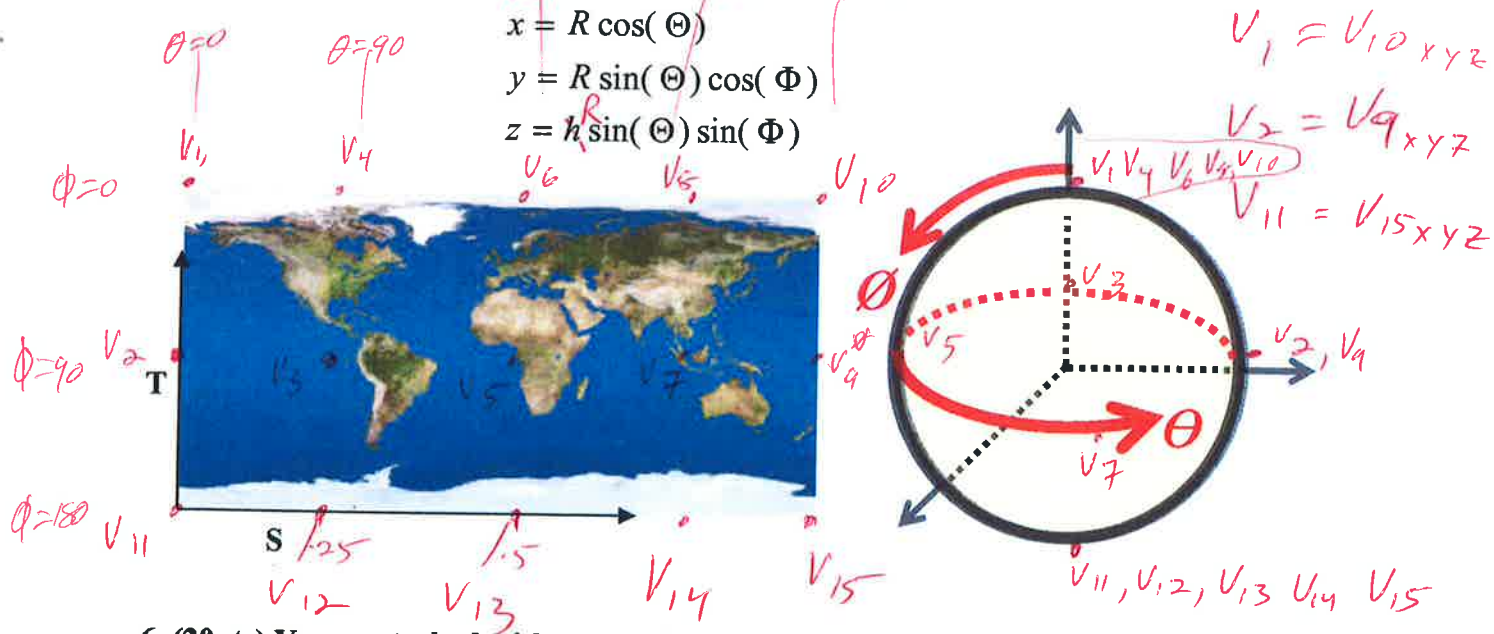


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$$x = R \cos(\Theta)$$

$$y = R \sin(\Theta) \cos(\Phi)$$

$$z = R \sin(\Theta) \sin(\Phi)$$



6. (20pts) You are tasked with generating an image of the earth (like above) wrapped onto a sphere. With a minimal number of vertices, give them below and indicate them on the sphere figure above. What are the texture coordinates required (give them below)? Be sure to describe any assumptions you make. Although the image to be textured does not appear square, you can assume the earth label image is square (S and T vary between zero and one).

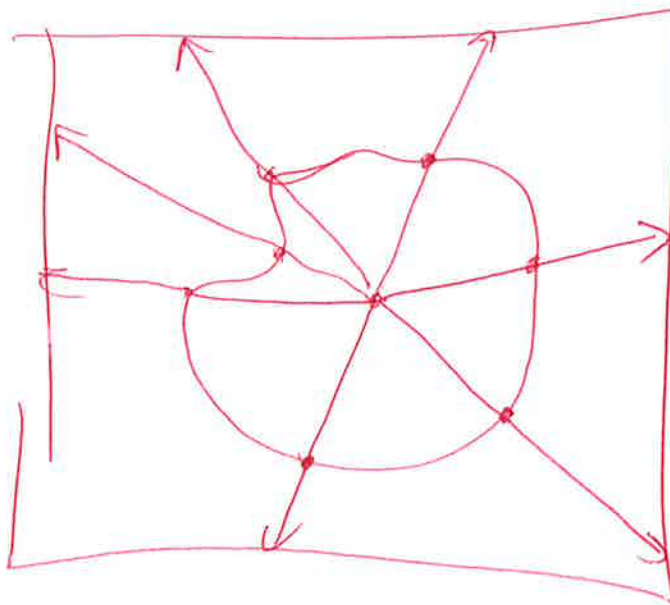
Assumptions (give any assumptions you are making):

Φ	Θ		X	Y	Z	S	T
0	0	V1	$R \cos(0)$	$R \sin(0) \cos(0)$	$R \sin(0) \sin(0)$	0	1
90	0	V2	$R \cos(0)$	$R \sin(0) \cos(90)$	$R \sin(0) \sin(90)$	0	.5
90	90	V3	$R \cos(90)$	$R \sin(90) \cos(90)$	$R \sin(90) \sin(90)$	.25	.5
0	90	V4	$R \cos(90)$	$R \sin(90) \cos(0)$	$R \sin(90) \sin(0)$	.25	1
90	180	V5	$R \cos(180)$	$R \sin(180) \cos(90)$	$R \sin(180) \sin(90)$	.5	.5
0	180	V6	$R \cos(180)$	$R \sin(180) \cos(0)$	$R \sin(180) \sin(0)$	.5	1
90	270	V7	$R \cos(270)$	$R \sin(270) \cos(90)$	$R \sin(270) \sin(90)$	.75	.5
0	270	V8	$R \cos(270)$	$R \sin(270) \cos(0)$	$R \sin(270) \sin(0)$	.75	1
90	360	V9	$R \cos(360)$	$R \sin(360) \cos(90)$	$R \sin(360) \sin(90)$	1	.5
0	360	V10	$R \cos(360)$	$R \sin(360) \cos(0)$	$R \sin(360) \sin(0)$	1	1
180	0	V11	$R \cos(0)$	$R \sin(0) \cos(180)$	$R \sin(0) \sin(180)$	0	0
180	90	V12	$R \cos(90)$	$R \sin(90) \cos(180)$	$R \sin(90) \sin(180)$	.25	0
180	180	V13	$R \cos(180)$	$R \sin(180) \cos(180)$	$R \sin(180) \sin(180)$	.5	0
180	270	V14	$R \cos(270)$	$R \sin(270) \cos(180)$	$R \sin(270) \sin(180)$	.75	0
180	360	V15	$R \cos(360)$	$R \sin(360) \cos(180)$	$R \sin(360) \sin(180)$	1	0

7a. (5 pts) For 2-part texture mapping, what are the 3 of the 4 intermediate objects?

- 1) plane
- 2) Box
- 3) sphere
- 4) ~~box~~ cylinder

7b. (5 pts) For 2-part texture mapping, describe and draw a 2D figure for the object centroid second mapping



8. (10 pts) When environment mapping, what field-of-view of a frustum is required to generate a cube-map and how many frustra are required?

$$\text{FOV} = 90^\circ$$

there are six frustra to render:

Top, Bottom, front, Back, left, right