Final Exam Resources/Notes

This is not just a copy of the midterm document, I added this brand new description

Resources

Joel's Notes (pre-Midterm & some of post midterm) 👑: Joel CS 3451 Notes

Jake's Notes (2019, text only):
https://jhdeerin.github.io/notesPageTest/htmlNotes/cs3451_compGraphics/13_colorPerception_2_8_19.html

Jake's notes as google docs:
https://drive.google.com/drive/folders/1N4SVkttAA0m-mkufeDsTABvFcBf3Gpl5u?usp=sharing

Jake's Notes (compiled - UPDATED)
https://docs.google.com/document/d/1ldCuMRLQdn-pIT1swtdnvJT38LMZbl6cZ1rMMiy4NTk/edit?usp=sharing

Old Midterm (shoutout Ben): (discussed below) Copy of Midterm_2017

Quizlet with Potential Midterm Questions: (discussed below)
https://quizlet.com/767207142/cs-3451-exam-1-flash-cards/?funnelUUID=e4d8de92-30f7-4c2d-b03f-d7d2724acab1

This ^ but as a downloadable doc:
https://docs.google.com/document/d/1AJcMSKZRRAozX93khiOHw1gHPp4nlp2qxc08lLWmnqA/edit?usp=sharing

*New - an unsolved final found online (discussed below)
https://drive.google.com/file/d/1bhRixaDMrLm_br5rheOfilQR2QPxSAd_/view?usp=sharing

Answers: (please correct if I'm wrong):

1. A,C,D
2. C
3. A
4. B
5. ?
6. B?

First 4 answers of old final exam ^:

(please correct mistakes!)

Sample Midterm

(Explanations for the answers here)

1. Historically, most GPUs have not supported ray-tracing
2. The point is directly between points 1 and 2, so its color is just the average of the two (the graphic on the pdf helps show this)
3. Magenta is red+blue in RBG (check out a color wheel)
4.
5.
6.
7.
8. Yes, If a highlight lies in the middle of a polygon, but does not spread to the polygon's vertex, it will not be apparent in a Gouraud rendering.

Quizlet

(Copied here. Cleaned up/removed dupes)

Most graphics cards (GPUs) use which algorithm that is built into their hardware to render triangles?

- rasterization, z-buffer (used because it is faster than ray tracing)

Metameters: different spectral distributions that have the same appearance to the human eye

The mantis shrimp has the largest number of photoreceptor types

True or False: magenta is a non-spectral color, so it has no complementary color.

- False, magenta has a complementary color even though it is non-spectral (so do cyan and yellow)

In traditional ray tracing, the first rays that are shot have their origin at the eye (camera).
```
Why is double-buffering a popular technique to use for display devices?
it helps avoid flickering or tearing of the screen when there is an animated image

E-ink is easier to read in bright sunlight than LCD

Uniform scaling and rotations always commute

The idea behind Phong interpolation during rasterization is to interpolate surface normals across the polygon for shading.

Which optical effect is used as the basis of liquid crystal displays?

- polarization

Given two linearly independent vectors A and B, the cross-product between any such pair of vectors will be perpendicular to both A and B.

Most LCDs use red, green, and blue filters to create color

Both the painter's algorithm & z-buffer algorithm are designed to draw an image in which only the visible surfaces can be seen. Of these two, only the z-buffer algorithms always produces the correct visible surfaces

How does the z-buffer algorithm determine visibility? What is the method?

- storing a per-pixel z-value, and potentially update this z-value during polygon rasterization

The HSV color space was designed to help people select colors more intuitively.
```

The shading of a diffuse surface does not depend on which of these information pieces?

1. the surface normal
2. **the eye position**
3. the light position

Assume you are drawing a 2D scene. You have been given a routine called hand() that draws a picture of a human hand pointing up. The center is at (10, 5) and you wish to rotate the hand 90 degrees counterclockwise, but want the hand to stay in the current position. What sequence of code would accomplish this?

```
pushMatrix();
translate (10, 5);
rotate(90);
translate(-10, -5);
hand();
popMatrix();
```

Old Final Found Online

Answers + explanations

[‘]

Someone should really check these im just guessing cuz no one has yet

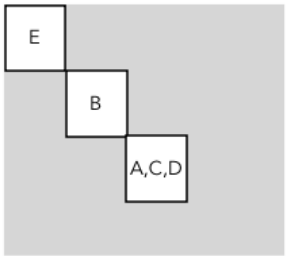
1. A,C, D (above) – CORRECTION: I think it’s **C,B,E**
    a. Idk how A and D are supposed to be the same tbh.
2. C (above)
3. Intersection math yields 34,-29,4 (Jakes notes 14)
4. B at a glance
5. A (from chatGpt). I got 8.47… from doing distance math
6. B
7. ABCDEF(Is this all correct?)
    a. Phong interpolates normals. If theyre all the same it will all be same color
    b. Gourard interpolates colors calculated at vertices. If they were all calculated with same vertex normal, all three corners will be same color
    c. Flat is all same color
8. Idk what clipping is. Ima guess its 4 and 5 6
9. C, 5 (just not the ceiling since directly below)
10. A, B, C, D (I think),
    a. ABCE (all but D) seem correct from the equation and comment on MathExchange?
    b. Yeah you’re right
        i. Nvm if RHS = 2, only face/edge relationship guaranteed
    c. I think it is just E. It is definitely not D because g=0, so RHS is 2. The mathExchange relationships in that comment are based off the assumption that RHS is negligible (0), and don’t hold when RHS != 0.
11. V = ⅙ | AB X AC X AD | = ⅓ ← this is wrong I think
    a. (1,1,1)-(0,1,0) = (1,0,1), (2,2,2)-(0,1,0) = (2,1,2), (-1,0,1)-(0,1,0) = (-1,-1,1)
    b. (2,1,2)x(-1,-1,1) = (3,-4,-1)
    c. (3,-4,-1)*(1,0,1) = 2
    d. 2/6 = ⅓ (wow its the same whatttt)

For a tetrahedron with vertices $\mathbf{a} = (a_1, a_2, a_3)$, $\mathbf{b} = (b_1, b_2, b_3)$, $\mathbf{c} = (c_1, c_2, c_3)$, and $\mathbf{d} = (d_1, d_2, d_3)$, the volume is $\frac{1}{6}|\det(\mathbf{a} - \mathbf{d}, \mathbf{b} - \mathbf{d}, \mathbf{c} - \mathbf{d})|$, or any other combination of pairs of vertices that form a simply connected graph. This can be rewritten using a dot product and a cross product, yielding

$$V = \frac{|(\mathbf{a} - \mathbf{d}) \cdot ((\mathbf{b} - \mathbf{d}) \times (\mathbf{c} - \mathbf{d}))|}{6}.$$

12. Idk - C I think
13. Do more math
14. Do math - A I think, B(t) = (1-t)^3 * P1 + 3(1-t)^2 * t * P2 + 3(1-t) * t^2 * P3 + t^3 * P4
15. Check slopes - BCD I think
16. Use euler’s
17. 0,0
18. Probably got about 4 or 5 correct tbh.

1. Which three of these sequences of OpenGL calls are equivalent? (mark exactly 3 please)



(A)
```
glScalef(2,2,2);
glTranslatef(2,2,2);
```

(B)
```
glScalef(2,2,2);
glTranslatef(1,1,1);
```

(C)
```
glTranslatef(2,2,2);
glScalef(2,2,2);
```

(D)
```
glScalef(1,1,1);
glTranslatef(2,2,2);
```

(E)
```
glTranslatef(−2,−2,−2);
glScalef(2,2,2);
glTranslatef(2,2,2);
```

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2. The matrix representing the planar rotation about $(3,4)$ by 90 degrees *counterclockwise* is:

- Transform to origin
- Rotate 90deg CCW
- Translate back to 3,4

$$\begin{bmatrix}1&0&3\\0&1&4\\0&0&1\end{bmatrix}\begin{bmatrix}0&-1&0\\1&0&0\\0&0&1\end{bmatrix}\begin{bmatrix}1&0&-3\\0&1&-4\\0&0&1\end{bmatrix}$$

(A) $\begin{bmatrix}0&-1&3\\1&0&4\\0&0&1\end{bmatrix}$ (B) $\begin{bmatrix}0&1&3\\-1&0&4\\0&0&1\end{bmatrix}$ (C) $\begin{bmatrix}0&-1&7\\1&0&1\\0&0&1\end{bmatrix}$

Remember: Transformation matrices appear in order from right to left

(D) $\begin{bmatrix}0&-1&-7\\1&0&-1\\0&0&1\end{bmatrix}$ (E). none of these

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Rays defined parametrically:
x(t) = x + t*dx
y(t) = y + t*dy
z(t) = z + t*dz

plug in for (x0,y0,z0) plug in for (dx,dy,dz)

3. Consider the ray with origin at $(2,3,4)$ and direction vector $(-1,1,0)$. What is the intersection point of this ray and the plane $3x+4y+5z=6$?

Intersection equation:
-(ax0 + by0 + cz0 + d) / (a*dx + b*dy + c*dz)

(A) (34,-29,4) (B) (14,-9,4) (C) (-30,35,4) (D) (-10,15,4)
(E) There is no intersection point

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4. Consider triangle with vertices $P_1=(-1,1,0)$, $P_2=(1,1,2)$ and $P_3=(5,0,6)$. The point $(0,1,1)$ (known to belong to the triangle's plane) is:

Parametric lines:
x(t) = x1 + t*(x2-x1)
y(t) = y1 + t*(y2-y1)
z(t) = z1 + t*(z2-z1)

Line between P1 and P2:
x(t) = 2t - 1
y(t) = 1
z(t) = 2t

(A) Inside the triangle and not on any of its edges
(B) On the edge P_1P_2
(C) On the edge P_1P_3
(D) On the edge P_2P_3
(E) Outside the triangle and not on any edge

Plugging (0,1,1) in and solving for t :
0 = 2t - 1 —> t=0.5
1 = 1
1 = 2t —> t = 0.5

t is consistent, so it's on the line yeehaw (I think at least)

['] First, Euler's formula reads $V-E+F=2(1-g)$
where V
is vertices number, E
edges number, F
faces number and g
genus (number of handles in the mesh). Now my book says

Since for most practical applications the genus is small compared to the number of elements, the right hand side of the equation can be assumed to be negligible. Given this and the fact that each triangle is bounded by three edges and that each interior manifold edge is incident to two triangles, one can derive the following

The number of triangles is twice the number of vertices $F\approx 2V$
The number of edges is three times the number of vertices $E\approx 3V$

Since we're talking about a triangle mesh, there is a fixed relationship between the number of edges and the number of faces. To derive this it's helpful to think of the mesh as being made of half-edges. A half-edge is a pair of an edge and a face it borders. The total number of half-edges in the mesh is $2E$, since each edge has two halves; and it's also $3F$, since each face touches three half-edges and this counts all the half-edges exactly once. Therefore $2E=3F$.

By solving for E or F and substituting into the formula $V-E+F\approx 0$, we can easily derive your two facts:

$E=3/2F$, $V-3/2F+F\approx 0$, $V-1/2F\approx 0$, $F\approx 2V$.
$F=2/3E$, $V-E+2/3E\approx 0$, $V-1/3E\approx 0$, $E\approx 3V$.