10/01/2020

The midterm will be delayed by at least a week.

Transformation

From CG11

- Linear Independence
- Dimensions
- Coordinate System
- Frame – Coordinate System + Origin
- Homogeneous coordinate system coordinates –
  - The fourth dimension 'w'
    - Enables – 1) every OGL transformation involves matrix multiplication
    - 2) distinguishing between points (vertices) and vectors components of OGL
- Transformation – a change of frames

Consider glVertex(1, 2, 3)
Rendered on the screen.

You would like to translate this to: The equivalent of glVertex(2, 3, 4)
glVertex(1+1, 2+1, 3+1)
glVertex(1+d1, 2+d2, 3 +d3)

glVertex(x, y z) into glVertex(x + dx, y + dy, z + dz)
for every vertex in the scene.
Translate by (dx, dy, dz)

CG 11 - 15, 16.

The same vector in two 2 different frames
Two representation $[\alpha_1, \alpha_2, \alpha_3]$ in one
$[\beta_1, \beta_2, \beta_3]$ in the second

We can "move" from frame 1 to frame 2 via a transformation.
The 3D transformations of rotation and scaling can be done
via multiplying a matrix of 3x3 by the $[x, y, z]$ coordinates of
the vertex (3x3 by 3x1 or 1x3 by 3x3).

Getting translation using multiplication requires
homogeneous coordinates

In 19 we add the origin (Q_0) 4x4 matrix

Affine Transformations

Linear Transformation is a change of frame
Translation, rotation, and scaling.

Affine Transformations
Preserve lines.

We are considering Rigid body transformations
Every element of the body goes through the same transformations

We can apply our transformations to vertices. Same to all of them
It preserves the edges.

In OGL moving the camera is done via translation and rotation of the objects

CG-12 Transformations

Slide 3 transformation of "Point to point" "vector to vector"

Slide 4 rigid body (like balls in a pool table)

Translation

Translate P to P' ($P' = P + \overline{D}$) adding a vector $\overline{D}$ to P
P = [x, y, z, 1] P' defined in the slide
$\overline{D}$ $[dx, dy, dz, 0]$

$P + \overline{D}$ = P' = $[x + dx,\ y + dy,\ z + dz]$

10 shows the translation matrix.

Consider The matrix A

1	2	3	0
5	6	7	0
8	9	10	0
11	12	13	1

Consider the point P

X
Y
X
1

What is the results of $A \times P$

What is the result of $I \times P$

I - 4x4

1	0	0	0
0	1	0	0
0	0	1	0
0	0	0	1

By P 4x1

X
Y
Z
1

Multiplying a matrix by point → point.

$I \times P$

Eventually send an email with answers to the questions:

1) What is 4x4 times 4x1
2) $I \times P$ (convince me)

Email to dt19@txstate.edu

Subject in class attendance activity

Inside – the solution

Can do it on a piece of paper send a jpeg image or in soft form

Send by 6:02

1	0	0	0		X		1x + 0Y + 0Z + 01
0	1	0	0	times	Y	equal	Row by column
0	0	1	0		Z		
0	0	0	1		1		

Sum of products

In-class problem.

Multiply the translation matrix T

1	0	0	5
0	1	0	-6
0	0	1	7
0	0	0	1

By the point P
$[1, 2, 3, 1]^T$

Send me an email
With the result of
T times P
Explain the way

1	0	0	1		X		X+1
0	1	0	-2	times	Y	equal	Y-2
0	0	1	3		Z		Z+3
0	0	0	1		1		1

$[X, Y, Z, 1]^T$
$[X+1, Y-2, Z+3, 1]^T$

Slide 3 several matrices; Our main interest is in the projection matrix and the model view matrix.
We can only operate on one of the two at a given time
Operate using functions

The functions change the default matrices (I)

Slide 5 operations on a matrix (the CTM matrix C)
Current Transformation Matrix default is I
CTM = $M \times P$ i.e., the result of multiplying the current model
view by the current projection

OGL functions as in slide 5 can change either P or M thereby changing the CTM
The CTM is multiplied by every vertex before rendering.

Slide 9 relevant instructions for the model view transformation

Moving to CG13 (backwards next week)

glRotate(30, 0, 0, 1) will rotate
all the points in the scene around the vector [0, 0, 1, 0]
(x, y) plan Z=0 plan by 30 degrees.

Slide 10 contains example of rotation.

```
glMatrixMode(GL_MODELVIEW); // We are working on the model view matrix
glLoadIdentity();    //initialize to I
glTranslatef(1.0, 2.0, 3.0); tranlste
glRotatef(30.0, 0.0, 0.0, 1.0); rotate about z
glTranslatef(-1.0, -2.0, -3.0); translate
```

Grades in assignment S1 are over 10. So, 9 is 9/10; 10 is 10/10;   11 is 11/10