Day 5

CMPS 160

Thursday Week 2
10-6-11

Linear/Bilinear Interpolation Review

\[ z = \frac{2 + 9(9 - z)}{10 - 0} \]

Nearest neighbor

Bilinear interpolations

6-spline interpolations

Different types of curves defined by a set of points

Cubic Bézier Curve

Matrix representations

Both cubic, just different polynomials

Cubic B-splines

Can get put together easier

NURBS - Non Uniform Rational B-spline

different spacing of polynomials rather than cubic
Cubic Bézier Curve

Deo-Sabin Subdivision
rules of how to subdivide.
Ex: do we keep edges or make them smooth?

Transformations
If something has to move, it could screw up all animations.
Could vector add, scale, etc

\[
\begin{bmatrix}
  x'
  \\
  y'
\end{bmatrix} =
\begin{bmatrix}
  r & 0 \\
  0 & s
\end{bmatrix}
\begin{bmatrix}
  x
  \\
  y
\end{bmatrix}
\]

\((x, 1) = (r, s)\)

\[
\begin{bmatrix}
  x'
  \\
  y'
\end{bmatrix} =
\begin{bmatrix}
  \cos & \sin \\
  \sin & -\cos
\end{bmatrix}
\begin{bmatrix}
  x
  \\
  y
\end{bmatrix}
\]

Fundamental Transformations
\(T + X = \text{translation} \quad R_x = \text{rotation} \quad S_x = \text{scale}\)

\(S(R(T)x + T)\)
Switch to Homogenous Coordinates
Adding 3rd coordinate of just 1 to make math easy...
...summarize many matrices to 1
more complex [ shear ]

\[
\begin{bmatrix}
1 & a \\
0 & 1
\end{bmatrix}
\begin{bmatrix}
x \\
y
\end{bmatrix} =
\begin{bmatrix}
x + ay \\
y
\end{bmatrix}
\]

OpenGL constructs these matrices through translate/rotate/scale.

Example

\[
\begin{bmatrix}
1 & 0 & 1.25 \\
0 & 1 & 2.35 \\
0 & 0 & 1
\end{bmatrix}
\]

For 2D picture this is certainly a translation matrix.

\[
\begin{bmatrix}
.85 & 1.29 & 2.25 \\
2.4 & .85 & 1.89 \\
0 & 0 & 1
\end{bmatrix}
\]

This is some complex rotation.

Rotations/translations-scaling matrices applied... order applied often matters.
3D (scaling, translation)  
...rotation

Rotation is confusing  
rotate around specified axes

\( R_x = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \end{bmatrix} \)  
Rotating around other axes is swapping of these columns/rows

"Rotations are a mess" (numbers stay same)

\( \Arrow{\text{Left}}\)  
\( \text{yay google} \)

Rotate 30° around the axis?  
motion is in axes not being rotated around

...so think about

1) where do I move axis too  
2) how do I rotate it

(I'm confused)

Example problems! check 'em out

rotate, translate, etc command generate  
these matrices & add them to the stack

remember order matters

Modeling Hierarchies

\( \text{frame} \rightarrow \text{house} \)  
\( \text{push} \)

house \( \rightarrow \text{world} \)

(forever, but check this slide out)
Write matrix for this

\[
\begin{bmatrix}
[m] \\
[R] \\
[T]
\end{bmatrix}
\]

Rotate then translate

\[
[\begin{bmatrix}
[m] \\
[R] \\
[T]
\end{bmatrix}]
\]

\[
[\begin{bmatrix}
[P] \\
\end{bmatrix}]
\]

P' is rotated
P'' is rotated then translated

In code it's this order
1. Identity [I]
2. Transl [I*T]
3. Rotate [I*T*R]

feels backwards

Minimal GL question

create boxes using only given functions

load Identity()
push() so we can get back
draw_box()
Trans Y()
Trans X()
draw Box()
push()

Midterm coming
review next time, bring questions
check sample questions online
may bring a page study guide
Cheat sheet

mostly calculations, short answers
no multiple choice

Next Tuesday!
Lab 3

Cube / Sphere / Cone s
Can just be created

Make our creatures look like their moving naturally

Make animation able to stop and rotate different pieces