Nov 3 2008
Midterm Review
453 (1)

The course thus far:

- Display
  - monitors
  - pixels
  - frame buffer
  - colours → indexed
  - refresh rates
- Fractals
  - self-similarity
  - fractal dimension
- Geometry
  - points → cross product
  - vectors → dot product
  - normals
  - tangents
  - scalar
- Affine Transformations
  - $P = \alpha_1 P_1 + \alpha_2 P_2 + \alpha_3 P_3 + \ldots$ → point to point, → vector to vector
  - rotation, scale, translation
  - homogeneous coordinates
  - matrix multiplication → mechanics, order of ops.
  - rotate around fixed point, arb. axis → trackball
  - define a basis

Modeling
- parametric vs implicit
- Bezier Curves → $Q(u) = \sum_{i=0}^{d} P_i B_{i,d}(u)$
  - → relation between # point & degree
  - → convex hull
  - → de Casteljau Algorithm
  - → weaknesses

  how do you get tangent? normal?
- B-Spline Subdivisions → strengths
  - → piecewise
  - → Chaikin & cubic
  - → subdivision matrix
  - → Open vs Closed
- Surfaces → tensor product
  - → surface of revolution

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Meshes

- redundancy, flexibility → queries → adj faces to vertex; → operations → add, remove, vertex neighborhood
- face normals vs vertex normals
- winding CW or CCW
- texture mapping
- "obj style" → vertex list, triangle list
- Half Edge

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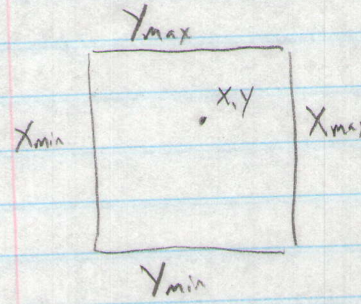
2.9

glViewport(u, v, w, h)

gluOrtho2D(Xmin, Xmax, Ymin, Ymax)

→ Show math to go from $(x, y) \rightarrow (X_s, Y_s)$

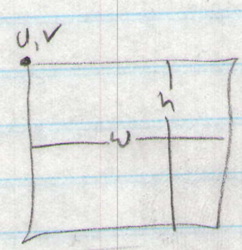


→ get fraction across the screen

$$X' = \frac{X - X_{min}}{X_{max} - X_{min}}$$

if $X_{min} \le X \le X_{max}$
then $\cancel{X'}\ 0 \le x' \le 1$

$$y' = \frac{y - Y_{min}}{Y_{max} - Y_{min}}$$



$$X_s = w x' + u$$
$$Y_s = h y' + v$$

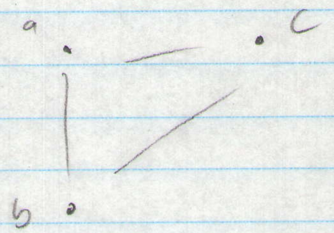
Another way:

maintain ratio $\frac{X - X_{min}}{X_{max} - X_{min}} = \frac{X_s - u}{w}$

http://www.cs.unm.edu/~angel/BOOK/

→ solutions to odd exercises

4.18 Test to see if 3 points colinear



#1 Cross Product

$$\|\vec{a} \times \vec{b}\| = \|a\| \, \|b\| \sin\theta$$

$$\left.\begin{array}{l} \text{if } |b-a| > 0 \ \&\& \\ \quad |b-c| > 0 \ \&\& \end{array}\right\} \text{important tests}$$

$$\|(b-a) \times (b-c)\| == \emptyset$$

then colinear

else not!

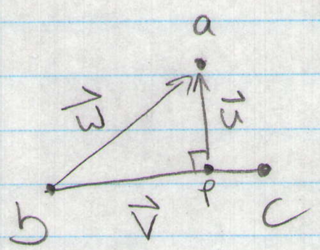
#2 ~~Slope~~

vectors $(b-a) = (u, v, t)$ and $b-c = (q, r, s)$ ~~have same slope~~

$$(u, v, t) = \mu \, (q, r, s) \qquad \mu = \frac{u}{q}, \frac{v}{r}, \frac{s}{t}$$

if $\frac{u}{q} = \frac{v}{r} = \frac{s}{t}$ all are colinear!

#3 Distance from point to line



$$p = b + \alpha \vec{v} \qquad \vec{v} = c - b$$
$$\vec{w} = a - b$$

$$\vec{w} = \alpha \vec{v} + \vec{u}$$

if $\vec{u}$ ortho to $\vec{v}$ then $\vec{u} \cdot \vec{v} = \emptyset$

$$\vec{w} \cdot \vec{v} = (\alpha \vec{v} + \vec{u}) \cdot \vec{v} = \alpha \vec{v} \cdot \vec{v} + \emptyset = \alpha \vec{v} \cdot \vec{v}$$

$$\alpha = \frac{\vec{w} \cdot \vec{v}}{\vec{v} \cdot \vec{v}} \qquad \vec{u} = \vec{w} - \frac{\vec{w} \cdot \vec{v}}{\vec{v} \cdot \vec{v}} \vec{v}$$

if $|\vec{u}| = \emptyset$ colinear