CPSC 314
Computer Graphics

Dinesh K. Pai

Geometry 1 continued:
vectors, coordinates, transforms

Announcements

- Preliminaries
  - Assignment 1 due date
  - Issue with Assignment distance..
  - Handing in your assignment
  - Extra TA office hour today 1-2pm ICCS 005
  - Coming soon: Signup for Face-to-Face grading
- Today:
  - Essential math for graphics
    (read Textbook Chapter 2)

2

Handin Instructions

- https://my.cs.ubc.ca/docs/handin-instructions
  course: cs314 assignment: a1
  Web version https://my.cs.ubc.ca/docs/hand-in
- **Command line**
  handin [*switches*] *course assignment*
  handin *-l course* (query course assignments)
- Switches are:
  -c --check submissions
  -o --overwrite
  -p --turn off confirmation prompts
  -f file --user provided zipfile

3

- SWITCH TO TABLET

4

L5. Vectors and Transformations

September 15, 2017 7:24 AM

Points ≠ vectors

vectors (Math) ≠ { vec3 etc. in GLSL / a list of numbers

With a basis set $\{\vec{b}_1, \vec{b}_2, \vec{b}_3\}$ (in 3D)

Any vector $\vec{v} = v_1\vec{b}_1 + v_2\vec{b}_2 + v_3\vec{b}_3$

§ Basis Matrix

1x3 3x1

$$\vec{v} = \begin{bmatrix} \vec{b}_1 & \vec{b}_2 & \vec{b}_3 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix}$$

basis matrix

coordinate vector

new notation! $\underline{b}$ $\underline{v}$

§ Linear Transformations

$$\vec{v} \longrightarrow \vec{v}_{new} = \mathcal{L}(\vec{v})$$

$$\mathcal{L}(\vec{u}+\vec{v}) = \mathcal{L}(\vec{u}) + \mathcal{L}(\vec{v})$$

$$\mathcal{L}(a\vec{v}) = a\,\mathcal{L}(\vec{v})$$

Examples of Linear Transformation

Rotation ✓
Scaling ✓
Reflection ✓

translation ✗
$\vec{v}_{new} = \vec{v} + \vec{a}$

§ Coordinates of a transformation

$$\vec{v} = \sum_i v_i \vec{b}_i = \underline{b}\,\vec{v}$$

$$L(\vec{v}) = \sum_i v_i L(\vec{b}_i)$$

$$= \begin{bmatrix} L(\vec{b}_1) & L(\vec{b}_2) & L(\vec{b}_3) \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix}$$

Since $L(\vec{b}_i)$ is a vector, can also represent it in the same (old) basis!!

$$= \begin{bmatrix} \underline{b}\,\bar{L}_1 & \underline{b}\,\bar{L}_2 & \underline{b}\,\bar{L}_3 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix}$$

$$= \underline{b} \begin{bmatrix} \bar{L}_1 & \bar{L}_2 & \bar{L}_3 \end{bmatrix} \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix}$$

3×3 matrix $\begin{bmatrix} \bar{L}_1 & \bar{L}_2 & \bar{L}_3 \end{bmatrix}$

This is what you represent with a mat3 in GLSL

mat3[0] is first column!