

cs174A-dis1B-week1

October 11, 2019

1 CS-174A Discussion 1B, Week 1

@ Yunqi Guo

@ DODD 161 / Friday / 12:00pm-1:50pm

@ <https://github.com/luckiday/cs174a-1b-2019f> (Short link: <https://bit.ly/32Zt3sg>)

1.1 Outline

- Making Shapes in Code
- Transformations
- Programming with tiny-graphics.js

1.2 Making Shapes in Code

- We're mostly trying to draw functions that are not linear or even polynomial.

Discretization - We don't know how to tell a computer to draw most shapes - Instead, we linearize those shapes: Break them up - Use a finite number of line segments between N discrete points

1.2.1 Discretization

1.2.2 Demo 1: Draw a Cube

1.3 Transformations

- Translation
- Scale
- Rotation

1.3.1 Translation

$$\begin{pmatrix} x' \\ y' \\ z' \\ 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & t_x \\ 0 & 1 & 0 & t_y \\ 0 & 0 & 1 & t_z \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$$

1.3.2 Scale

$$\begin{pmatrix} x' \\ y' \\ z' \\ 1 \end{pmatrix} = \begin{pmatrix} s_x & 0 & 0 & 0 \\ 0 & s_y & 0 & 0 \\ 0 & 0 & s_z & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$$

1.3.3 Rotation

Rotate about Z:

$$\begin{pmatrix} x' \\ y' \\ z' \\ 1 \end{pmatrix} = \begin{pmatrix} \cos(\theta) & -\sin(\theta) & 0 & 0 \\ \sin(\theta) & \cos(\theta) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$$

E.g. when $\theta = \pi/4$,

$$R = \begin{pmatrix} \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} & 0 & 0 \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Q: Rotate about Y

1.3.4 Order of Transformations

An example of transformation order as we repeatedly modify a matrix:

```
[...]rotation(Math.PI/2, new Vec( 0,1,0 ) ); // Rotate
this.shapes.cube.draw(...);
[...]translation([ 10,0,0 ]) ); // Translate
this.shapes.cube.draw(...);
[...]scale([ 1,1,3 ]) ); // Scale
this.cube.draw(...);
```

1.4 Programming with tinyGraphics.js

- [Demo](#)