

# Matrices, GL Transformations

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# Matrices

GL Transformations

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Matrices

Push and Pop

Transform in  
OpenGL

glRotate

glScale

glScale

Second  
Section

Matrix math is the building block of everything OpenGL does. Matrices add a  $W$  to our  $X$ , and  $Y$  coordinate system.  $W$  will specify whether or not it is a point in space, or a direction. Much like functions, matrices are in a stack in OpenGL and can be “pushed” or “popped”.

# Push and Pop Matrices

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Second  
Section

There are at least 2 matrices on our OpenGL stack at any given moment. However whenever we use 3D graphics there will be at least 32 matrices. We can push and pop these matrices just like we can functions on a stack.

```
glPopMatrix(void);
```

Pops the current matrix, replacing the matrix below it.

```
glPushMatrix(voidX);
```

Pushes the current matrix, adding a matrix above it.

# glRotate

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## Matrices

Push and Pop

## Transform in OpenGL

### glRotate

glScale

glScale

## Second Section

glRotate rotates by angle around our shape. The function generates a rotation matrix, that is multiplied by our current matrix. The product of this multiplication replaces our current matrix.

```
void glRotatef(GLfloat angle, GLfloat x, GLfloat y, GLfloat z);
```

- angle – specifies in degrees how far to rotate the matrix.
- x, y, z – The angles to be rotated. simply pass 0 in if you wish to not rotate by that dimension simply pass 0.0 as the parameter.

$$\begin{pmatrix} x^2(1-c)+c & xy(1-c)-zs & xz(1-c)+ys & 0 \\ yx(1-c)+zs & y^2(1-c)+c & yz(1-c)-xs & 0 \\ xz(1-c)-ys & yz(1-c)+xs & z^2(1-c)+c & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

# glScale

## GL Transformations

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## Matrices Push and Pop

## Transform in OpenGL

glRotate  
glScale  
glScale

## Second Section

glScale will scale differently to each axis, unless the scale factor for x, y, and z are all equal. Each parameter represents the scale to factor each axis

```
void glScalef(GLfloat x, GLfloat y, GLfloat z);
```

- x, y, z – factor of how each axis should be scaled.

$$\begin{pmatrix} x & 0 & 0 & 0 \\ 0 & y & 0 & 0 \\ 0 & 0 & z & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

# glTranslate

## GL Transformations

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## Matrices Push and Pop

## Transform in OpenGL

glRotate  
glScale  
glScale

## Second Section

glTranslate produces a translation matrix that is multiplied by our current matrix. Our current matrix is replaced by the product.

```
void glTranslated(GLdouble x, GLdouble y, GLdouble z);
```

- x, y, z – factor of how each axis should be translated.

$$\begin{pmatrix} 1 & 0 & 0 & x \\ 0 & 1 & 0 & y \\ 0 & 0 & 1 & z \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Lists in OpenGL allow us to compile code at runtime, and assign a tag to the code that was compiled. Useful when maximizing information hiding when using classes.

# References

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## Matrices

Push and Pop

## Transform in OpenGL

glRotate

glScale

glScale

## Second Section



<https://www.opengl.org/> (2015)

