

Basic OpenGL Transformations

- ❑ `glTranslate* (tx, ty, tz);`
 - `glTranslatef (25.0, -10.0, 0.0);`
- ❑ `glRotate* (theta, vx, vy, vz)`
 - `glRotatef (90.0, 1.0, 0.0, 0.0);`
 - Vector $v = (vx, vy, vz)$ defines the orientation for a rotation axis that passes through the coordinate origin
- ❑ `glScale* (sx, sy, sz);`
 - `glScalef (2.0, -3.0, 1.0);`

1

OpenGL Matrix Operation

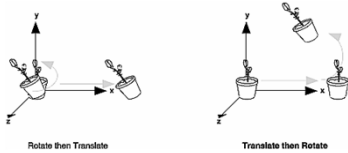
- ❑ `glMatrixMode (GL_MODELVIEW);`
 - Modelview matrix is used to store and combine geometric transformations
- ❑ `glLoadIdentity ();`

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$
- ❑ OpenGL maintains a matrix stack for each matrix mode
- ❑ You may want to save the composite matrix to create multiple views
- ❑ `glPushMatrix ();` copies the current matrix at the top of stack
- ❑ `glPopMatrix ();` destroys the matrix at the top stack, and the second matrix becomes the current matrix

2

Order of Transformations

- ❑ Each successive transformation command multiplies a new matrix M by the current matrix C to yield CM .
- ❑ Finally, vertices v are multiplied by the current matrix.
- ❑ This process means that the last transformation command called in your program is actually the first one applied to the vertices: CMv .
- ❑ Thus, one way of looking at it is to say that you have to specify the matrices in the reverse order



3

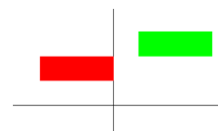
OpenGL Example

- ```
glMatrixMode (GL_MODELVIEW);
glLoadIdentity ();
```
- current matrix  $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ 

```
glColor3f (0.0, 1.0, 0.0);
glRecti (50, 100, 200, 150);
```

```
glColor3f (1.0, 0.0, 0.0);
glTranslatef (-200.0, -50.0, 0.0);
glRecti (50, 100, 200, 150);
```

current matrix  $\begin{bmatrix} 1 & 0 & 0 & -200 \\ 0 & 1 & 0 & -50 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -200 \\ 0 & 1 & 0 & -50 \\ 0 & 0 & 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & -200 \\ 0 & 1 & 0 & -50 \\ 0 & 0 & 1 & 0 \end{bmatrix}$



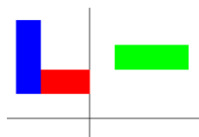
4

## OpenGL Example (cont'd)

- ```
glColor3f (0.0, 0.0, 1.0);
glLoadIdentity ();
```
- current matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

```
glRotatef (90.0, 0.0, 0.0, 1.0);
glRecti (50, 100, 200, 150);
```

current matrix $\begin{bmatrix} 1 & 0 & 0 & \cos 90 & -\sin 90 & 0 \\ 0 & 1 & 0 & \sin 90 & \cos 90 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$



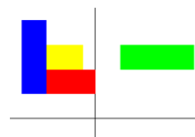
5

OpenGL Example (cont'd)

- ```
glColor3f (1.0, 1.0, 0.0);
glLoadIdentity ();
```
- current matrix  $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ 

```
glScalef (-0.5, 1.0, 1.0);
glRecti (50, 100, 200, 150);
```

current matrix  $\begin{bmatrix} 1 & 0 & 0 & -0.5 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$



6

