CT4510: Computer Graphics

OpenGL: User Interface

BOCHANG MOON

Keyboard Input

- Define a specific action when users press a key
  - glutKeyboardFunc(“your function name”);
    - When a user types for your OpenGL program, your can program a specific action

```
void main(int argc, char* argv[]) {
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGBA);
    glutInitWindowSize(512, 512);
    glutInitWindowPosition(100, 100);
    glutCreateWindow("Computer Graphics");
    glutDisplayFunc(display);
    glutKeyboardFunc(keyboard);
    glutMainLoop();
}
```

Keyboard Input

- Define a specific action when users press a key
  - glutKeyboardFunc("your function name");
    - When a user types for your OpenGL program, your can program a specific action
  - glutPostRedisplay()
    - Explicitly let OpenGL redraw the window

```
double red = 1.0;
double green = 1.0;
double blue = 1.0;
```

```
void keyboard(unsigned char key, int x, int y) {
    if (key == 'r') {
        red = 1.0, green = 0.0, blue = 0.0;
    }

    glutPostRedisplay();
}
```

```
void display() {
    glClearColor(0, 0, 0, 0);   // Clear the screen

    glColor3d(red, green, blue);
    glBegin(GL_TRIANGLES);
    glVertex2d(-0.5, -0.5);
    glVertex2d(-0.5, 0.5);
    glVertex2d(0.5, 0.5);
    glEnd();

    glFlush();
}
```

Keyboard Input

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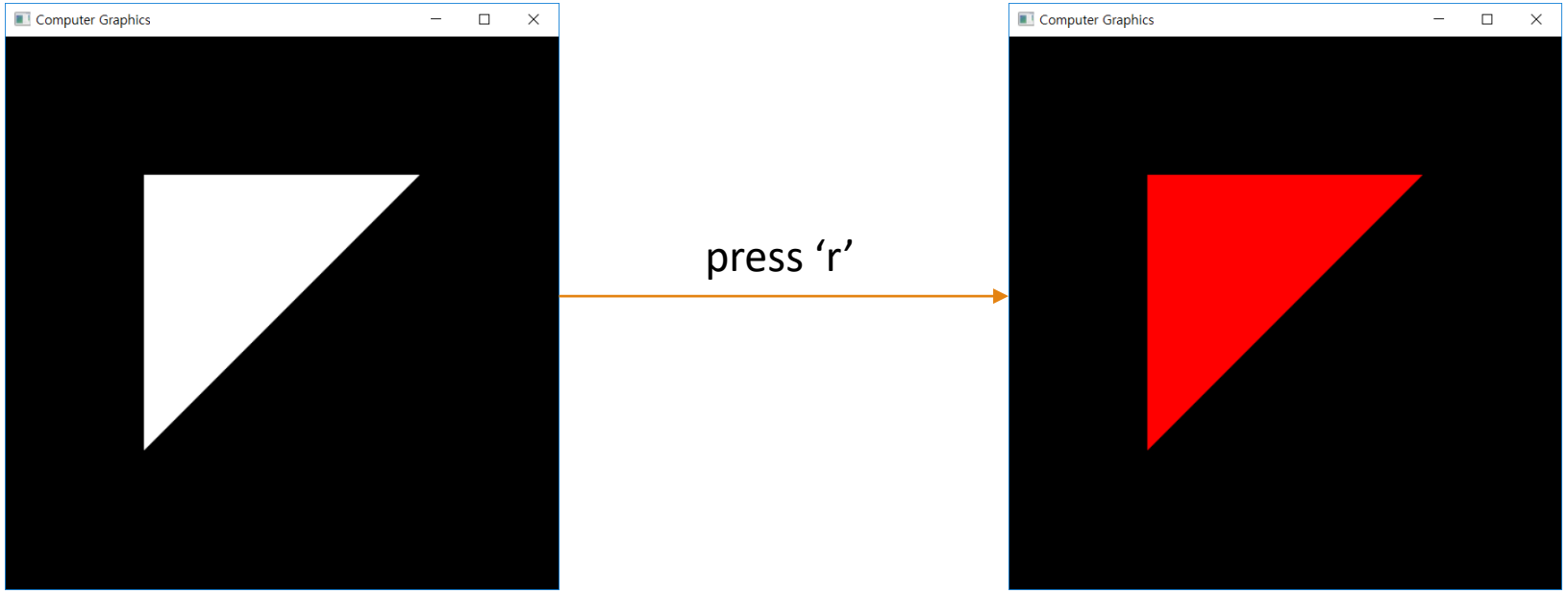


Keyboard Input

- Define a specific action when users press a key
  - glutKeyboardFunc("your function name");
    - When a user types for your OpenGL program, your can program a specific action
  - glutPostRedisplay()
    - Explicitly let OpenGL redraw the window
  - void keyboard(unsigned char key, int x, int y)
    - key: pressed keyboard character
    - x, y: location of the mouse when a key was pressed.

```
void keyboard(unsigned char key, int x, int y) {
    if (key == 'r')
        red = 1.0, green = 0.0, blue = 0.0;
    else if (key == 'g')
        red = 0.0, green = 1.0, blue = 0.0;
    else if (key == 'b')
        red = 0.0, green = 0.0, blue = 1.0;

    glutPostRedisplay();
}
```

Mouse Input

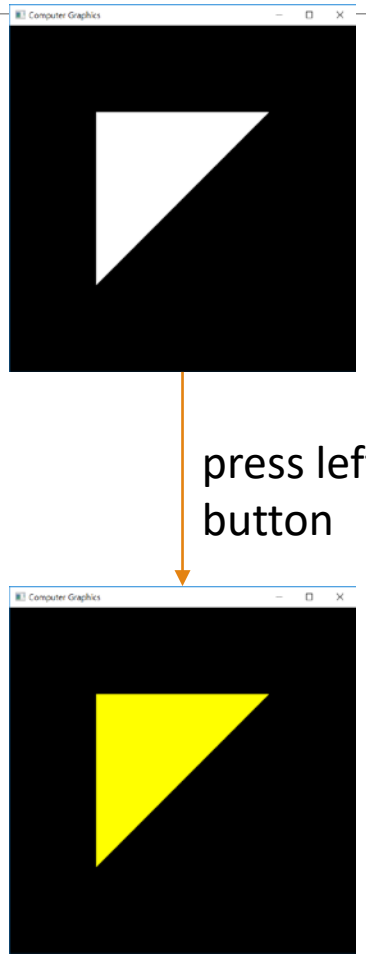
- Define a specific action when users give a mouse action
  - glutMouseFunc("your function name")
    - When a mouse button is pressed or released.
  - glutMotionFunc("your function name")
    - When a mouse pointer moves within your window while one or more mouse buttons are pressed.

  - void mouse(int button, int state, int x, int y)
    - button: GLUT_LEFT_BUTTON, GLUT_MIDDLE_BUTTON, GLUT_RIGHT_BUTTON
    - state: GLUT_UP, GLUT_DOWN
    - x, y: pixel position when the mouse event occurred

Mouse Input

```
void main(int argc, char* argv[]) {
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGBA);
    glutInitWindowSize(512, 512);
    glutInitWindowPosition(100, 100);
    glutCreateWindow("Computer Graphics");
    glutDisplayFunc(display);
    glutKeyboardFunc(keyboard);
    glutMouseFunc(mouse);
    glutMainLoop();
}
```

```
void mouse(int button, int state, int posX, int posY) {
    if (button == GLUT_LEFT_BUTTON) {
        red = 1.0, green = 1.0, blue = 0.0;
    }
}
```



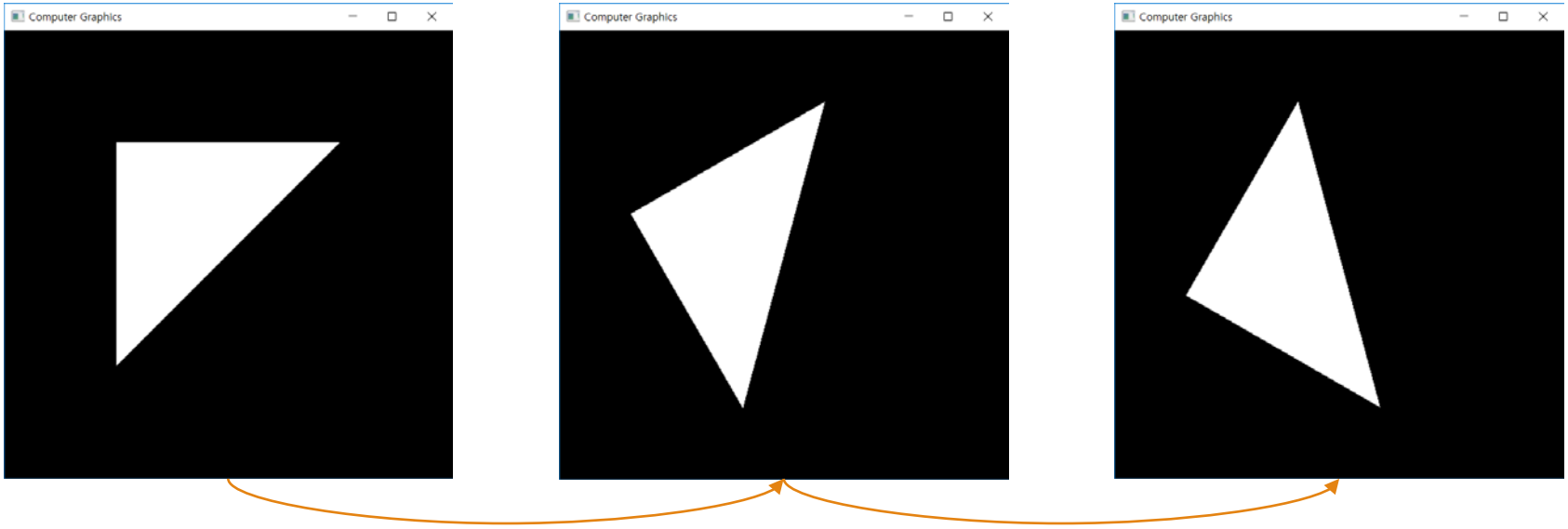
Other Events

- glutDisplayFunc(“display”)
  - Be called whenever your window needs to be redrawn.
  - Can be explicitly called by glutPostRedisplay()

- glutReshapeFunc(“reshape”)
  - Be called whenever your window is resized or moved.

Examples – Rotate Your Triangle

- Problem specification
  - Draw a triangle
  - Rotate your triangle by 30 degrees whenever the left button of your mouse is pressed.



Examples – Rotate Your Triangle

- Recall the 2D transformation matrix
  - $rotate(\theta) = \begin{bmatrix} cos\theta & -sin\theta \\ sin\theta & cos\theta \end{bmatrix}$
  - $x_{new} = x_{old}cos\theta - y_{old}sin\theta$
  - $y_{new} = x_{old}sin\theta + y_{old}cos\theta$

  - Hint: utilize predefined c/c++ function *sin* and *cos*(an angle expressed in radians)
    - $radian = \frac{180}{\pi} \approx 57.2958$
    - $e.g., 30\ degree = 30 \times \frac{\pi}{180}$

- double v1_new_x = v1_x * cos(degree * (PI / 180.0)) - v1_y * sin(degree * (PI / 180.0));
- double v1_new_y = v1_x * sin(degree * (PI / 180.0)) + v1_y * cos(degree * (PI / 180.0));

Examples – Rotate Your Triangle

- Initialize some variables

```
#include <math.h>


const double PI = 3.14159265359;

double v1_x = -0.5, v1_y = -0.5;
double v2_x = -0.5, v2_y = 0.5;
double v3_x = 0.5, v3_y = 0.5;
double degree = 0;
```

- Define your mouse event handler

```
void mouse(int button, int state, int posX, int posY) {
    if ((button == GLUT_LEFT_BUTTON) && (state == GLUT_DOWN)) {
        degree = degree + 30.0;
    }
    glutPostRedisplay();
}
```

Examples – Rotate Your Triangle

- Display function

```
void display() {
    glClearColor(0, 0, 0, 0);       // Specify the background color
    glClear(GL_COLOR_BUFFER_BIT);   // Clear the screen with the background color

    double v1_new_x = v1_x * cos(degree * (PI / 180.0)) - v1_y * sin(degree * (PI / 180.0));
    double v1_new_y = v1_x * sin(degree * (PI / 180.0)) + v1_y * cos(degree * (PI / 180.0));

    double v2_new_x = v2_x * cos(degree * (PI / 180.0)) - v2_y * sin(degree * (PI / 180.0));
    double v2_new_y = v2_x * sin(degree * (PI / 180.0)) + v2_y * cos(degree * (PI / 180.0));

    double v3_new_x = v3_x * cos(degree * (PI / 180.0)) - v3_y * sin(degree * (PI / 180.0));
    double v3_new_y = v3_x * sin(degree * (PI / 180.0)) + v3_y * cos(degree * (PI / 180.0));

    glColor3d(red, green, blue);
    glBegin(GL_TRIANGLES);
    glVertex2d(v1_new_x, v1_new_y);
    glVertex2d(v2_new_x, v2_new_y);
    glVertex2d(v3_new_x, v3_new_y);
    glEnd();

    glFlush();
}
```

Examples – Rotate Your Triangle

- Display function