Working with Callbacks

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Objectives

- Learn to build interactive programs using GLUT callbacks
  - Mouse
  - Keyboard
  - Reshape
- Introduce menus in GLUT

The mouse callback

```
glutMouseFunc(mymouse)
void mymouse(GLint button, GLint
 state, GLint x, GLint y)
```

- Returns
  - which button (**GLUT_LEFT_BUTTON**, **GLUT_MIDDLE_BUTTON**, **GLUT_RIGHT_BUTTON**) caused event
  - state of that button (**GLUT_UP**, **GLUT_DOWN**)
  - Position in window

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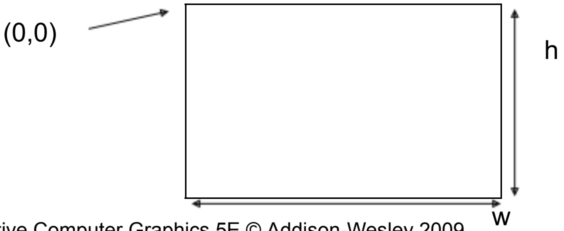
Positioning

- The position in the screen window is usually measured in pixels with the origin at the top-left corner
- Consequence of refresh done from top to bottom
- OpenGL uses a world coordinate system with origin at the bottom left
- Must invert *y* coordinate returned by callback by height of window
- *y = h – y;*



Obtaining the window size

- To invert the *y* position we need the window height
  - Height can change during program execution
  - Track with a global variable
  - New height returned to reshape callback that we will look at in detail soon
  - Can also use query functions
    - `glGetIntv`
    - `glGetFloatv`

    to obtain any value that is part of the state

Terminating a program

- In our original programs, there was no way to terminate them through OpenGL
- We can use the simple mouse callback

```
void mouse(int btn, int state, int x, int y)
{
  if(btn==GLUT_RIGHT_BUTTON && state==GLUT_DOWN)
     exit(0);
}
```

Using the mouse position

- In the next example, we draw a small square at the location of the mouse each time the left mouse button is clicked
- This example does not use the display callback but one is required by GLUT; We can use the empty display callback function

```
mydisplay(){}
```

Drawing squares at cursor location

```
void mymouse(int btn, int state, int x, int y)
{
  if(btn==GLUT_RIGHT_BUTTON && state==GLUT_DOWN)
     exit(0);
     if(btn==GLUT_LEFT_BUTTON && state==GLUT_DOWN)
       drawSquare(x, y);
}
void drawSquare(int x, int y)
{
   y=w-y; /* invert y position */
   glColor3ub( (char) rand()%256, (char) rand )%256,
  (char) rand()%256); /* a random color */
   glBegin(GL_POLYGON);
       glVertex2f(x+size, y+size);
       glVertex2f(x-size, y+size);
       glVertex2f(x-size, y-size);
       glVertex2f(x+size, y-size);
    glEnd();
}
```

Using the motion callback

- We can draw squares (or anything else) continuously as long as a mouse button is depressed by using the motion callback
```
glutMotionFunc(drawSquare)
```
- We can draw squares without depressing a button using the passive motion callback
```
glutPassiveMotionFunc(drawSquare)
```

Using the keyboard

```
glutKeyboardFunc(mykey)
void mykey(unsigned char key,
      int x, int y)
```

Returns ASCII code of key depressed and mouse location

```
void mykey()
{
    if(key == 'Q' | key == 'q')
        exit(0);
}
```

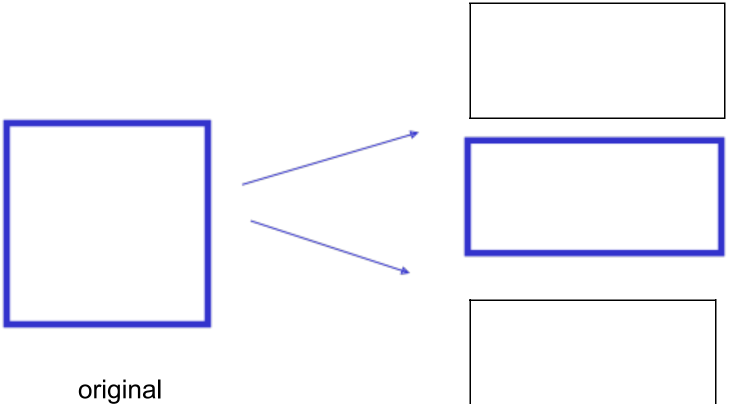
Special and Modifier Keys

- GLUT defines the special keys in **`glut.h`**
  - Function key 1: **`GLUT_KEY_F1`**
  - Up arrow key: **`GLUT_KEY_UP`**
- **`if(key == 'GLUT_KEY_F1'`** ……
- Can also check of one of the modifiers
  - **`GLUT_ACTIVE_SHIFT`**
  - **`GLUT_ACTIVE_CTRL`**
  - **`GLUT_ACTIVE_ALT`**
  - is depressed by
    `glutGetModifiers()`
  - Allows emulation of three-button mouse with one- or two-button mice

Reshaping the window

- We can reshape and resize the OpenGL display window by pulling the corner of the window
- What happens to the display?
  - Must redraw from application
  - Two possibilities
    - Display part of world
    - Display whole world but force to fit in new window
      - Can alter aspect ratio

Reshape possiblities



The Reshape callback

```
glutReshapeFunc(myreshape)
void myreshape( int w, int h)
```

- Returns width and height of new window (in pixels)
- A redisplay is posted automatically at end of execution of the callback
- GLUT has a default reshape callback but you probably want to define your own

- The reshape callback is good place to put viewing functions because it is invoked when the window is first opened

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Example Reshape

- This reshape preserves shapes by making the viewport and world window have the same aspect ratio

```
void myReshape(int w, int h)
{
   glViewport(0, 0, w, h);
   glMatrixMode(GL_PROJECTION); /* switch matrix mode */
   glLoadIdentity();
   if (w <= h)
       gluOrtho2D(-2.0, 2.0, -2.0 * (GLfloat) h / (GLfloat) w,
           2.0 * (GLfloat) h / (GLfloat) w);
   else  gluOrtho2D(-2.0 * (GLfloat) w / (GLfloat) h, 2.0 *
           (GLfloat) w / (GLfloat) h, -2.0, 2.0);
   glMatrixMode(GL_MODELVIEW); /* return to modelview mode */
}
```

Toolkits and Widgets

- Most window systems provide a toolkit or library of functions for building user interfaces that use special types of windows called *widgets*
- Widget sets include tools such as
    - Menus
    - Slidebars
    - Dials
    - Input boxes
- But toolkits tend to be platform dependent
- GLUT provides a few widgets including menus

Menus

- GLUT supports pop-up menus
  - A menu can have submenus
- Three steps
  - Define entries for the menu
  - Define action for each menu item
    - Action carried out if entry selected
  - Attach menu to a mouse button

Defining a simple menu

- In **main.c**

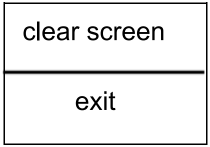
```
menu_id = glutCreateMenu(mymenu);
glutAddmenuEntry("clear Screen",
1);

gluAddMenuEntry("exit", 2);

glutAttachMenu(GLUT_RIGHT_BUTTON);
```

entries that appear when right button depressed

identifiers



Menu actions

Menu callback

```
void mymenu(int id)
{
    if(id == 1) glClear();
    if(id == 2) exit(0);
}
```

Note each menu has an id that is returned when it is created

Add submenus by

```
glutAddSubMenu(char *submenu_name, submenu id)
```

entry in parent menu

Other functions in GLUT

- Dynamic Windows
  Create and destroy during execution
- Subwindows
- Multiple Windows
- Changing callbacks during execution
- Timers
- Portable fonts
  `glutBitmapCharacter`
  `glutStrokeCharacter`