COMPUTER GRAPHICS

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Basic Interactivity with GLUT
Graphical Primitives

GLUT– Mouse and Keyboard

OpenGL – Drawing with triangles

- GLUT supports a range of input devices:

    - Mouse
    - Keyboard
    - Trackball
    - Tablet

- Using these devices implies **writing functions to process the respective events**, and

- **Registering these functions** with GLUT.

Keyboard – Callback Registry

- Regular keys (letters, numbers , etc…)

To register the callback use:

```
glutKeyboardFunc(function_name);
```

Function signature:

```
void function_name (unsigned char key, int x, int y);
```

This function will be called by GLUT when a regular key is pressed. The parameters are the key itself and the actual mouse coordinates relative to the window.

Keyboard – Callback Registry

- Special Keys (F1..F12, Home, End, Arrows, etc...)

To register the callback use:

```
glutSpecialFunc(function_name);
```

Function signature:

```
void function_name(int key_code, int x, int y);
```

The key codes are constants defined in glut.h. Some examples are: GLUT_KEY_F1 and GLUT_KEY_UP.

Mouse – Callback Registry

- Mouse: pressing and releasing a button

To register the callback use:

```
glutMouseFunc(function_name);
```

Function signature:

```
void function_name (int button, int state, int x, int y);
```

The parameters are:
- Which button (GLUT_LEFT_BUTTON, GLUT_MIDDLE_BUTTON, GLUT_RIGHT_BUTTON);
- Button state (GLUT_UP, GLUT_DOWN);
- Mouse position in window relative coordinates.

- Mouse: passive and active motion

To register the callback use:

```
glutMotionFunc(function_name);
glutPassiveMotionFunc(function_name);
```

Function signature:

```
void function_name(int x, int y);
```

The parameters are the window relative mouse coordinates.

Resource Management

- When using the idle function, GLUT is constantly redrawing the scene.

- For static scenes we only need to redraw when the camera moves.

- To avoid unnecessary redraw we can call the following function when the camera moves

  `glutPostRedisplay()`

- `glutPostRedisplay` generates an event stating that the window needs to be redrawn. The event will be placed in the event queue for later processing.
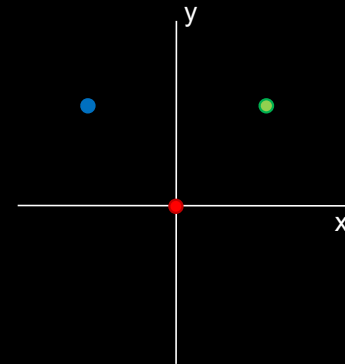
3D Modelling

- 3D vertex definition

  ```
  glVertex3f(x,y,z);
  ```
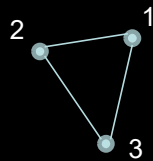
- To draw a triangle:

  ```
  glBegin(GL_TRIANGLES);
      glVertex3f(0.0f, 0.0f, 0.0f);
      glVertex3f(1.0f,  1.0f, 0.0f);
      glVertex3f(-1.0f, 1.0f, 0.0f);
  glEnd();
  ```
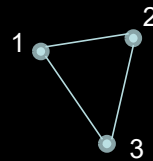
- Polygon orientation

  - OpenGL allows for optimization by only drawing polygons which are facing the camera. To define the front face of a polygon we use the right hand rule.
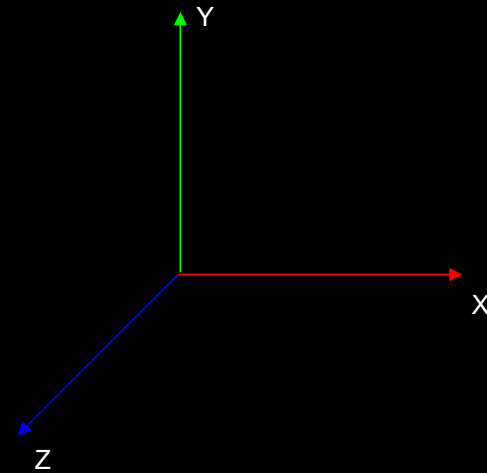

Poligon facing forward   Poligon facing backward

- Drawing Axis with lines

```
glBegin(GL_LINES);
    // X axis in red
    glColor3f(1.0f, 0.0f, 0.0f);
    glVertex3f(-100.0f, 0.0f, 0.0f);
    glVertex3f( 100.0f, 0.0f, 0.0f);
    // Y Axis in Green
    glColor3f(0.0f, 1.0f, 0.0f);
    glVertex3f(0.0f, -100.0f, 0.0f);
    glVertex3f(0.0f,  100.0f, 0.0f);
    // Z Axis in Blue
    glColor3f(0.0f, 0.0f, 1.0f);
    glVertex3f(0.0f, 0.0f, -100.0f);
    glVertex3f(0.0f, 0.0f,  100.0f);
glEnd();
```

3D Modelling

- Face Culling

  ```
  glEnable(GL_CULL_FACE);
  glCullFace(GL_FRONT ou GL_BACK);
  ```

- Defining default polygon orientation:

  ```
  glFrontFace(GL_CW ou GL_CCW);
  ```

3D Modelling

- Drawing polygon mode

  `glPolygonMode(face,mode);`

- possible values for face:
  - `GL_FRONT, GL_BACK, GL_FRONT_AND_BACK`

- possible values for mode:
  - `GL_FILL, GL_LINE, GL_POINT`

Required Functions

- OpenGL and GLU

```
glTranslatef(x,y,z); // moves the object

glRotatef(angle,x,y,z); // angle is in degrees

glScalef(x,y,z); // scale factors for each axis

glColor3f(r,g,b); // color in RGB. Each component varies between 0 and 1. (1,1,1) is
    white, (0,0,0) is black.

gluLookAt(px,py,pz,  lx,ly,lz,  ux,uy,uz);
    // px,py,pz – camera position
    // lx,ly,lz – look at point
    // ux,uy,uz – camera tilt, by default use (0.0, 1.0, 0.0)
```

DI-UM COMPUTAÇÃO GRÁFICA

Assignment

- Complete the provided code skeleton to create an interactive application with a pyramid (each face with a different colour).

- The keyboard should allow to move the pyramid in the XZ plane, rotate it around its vertical axis, and scale its height.
  - Try swapping the order of the geometric transformations. Interpret the result.

- Use the keyboard to select the drawing mode (`GL_FILL, GL_LINE, GL_POINT`).

- Use `glutPostRedisplay;`

The Pyramid