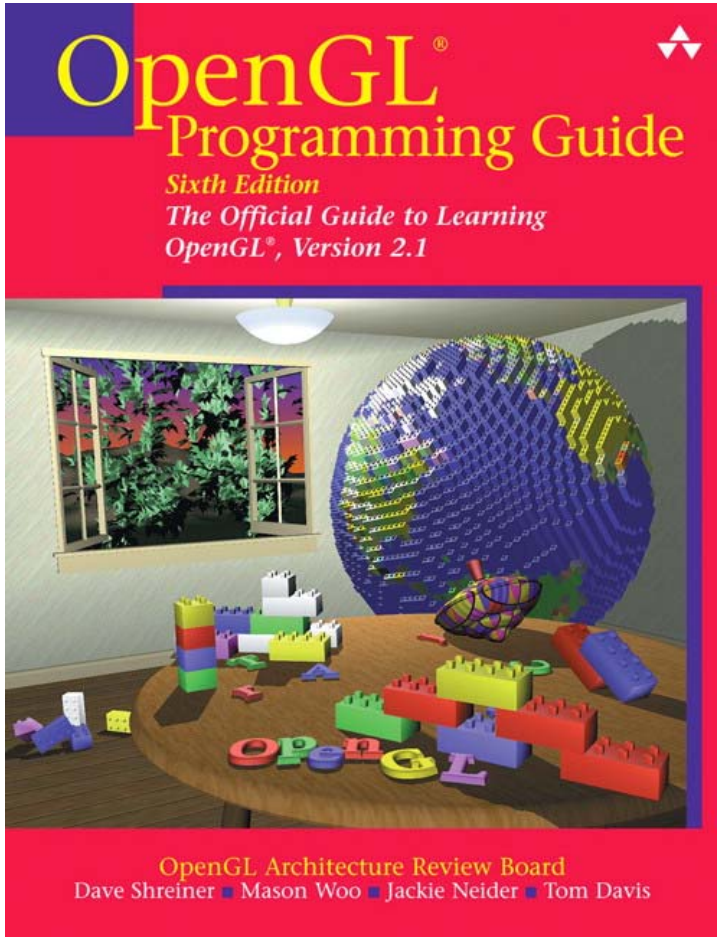
Computergrafik SS 2008

Oliver Vornberger

Kapitel 21:
OpenGl

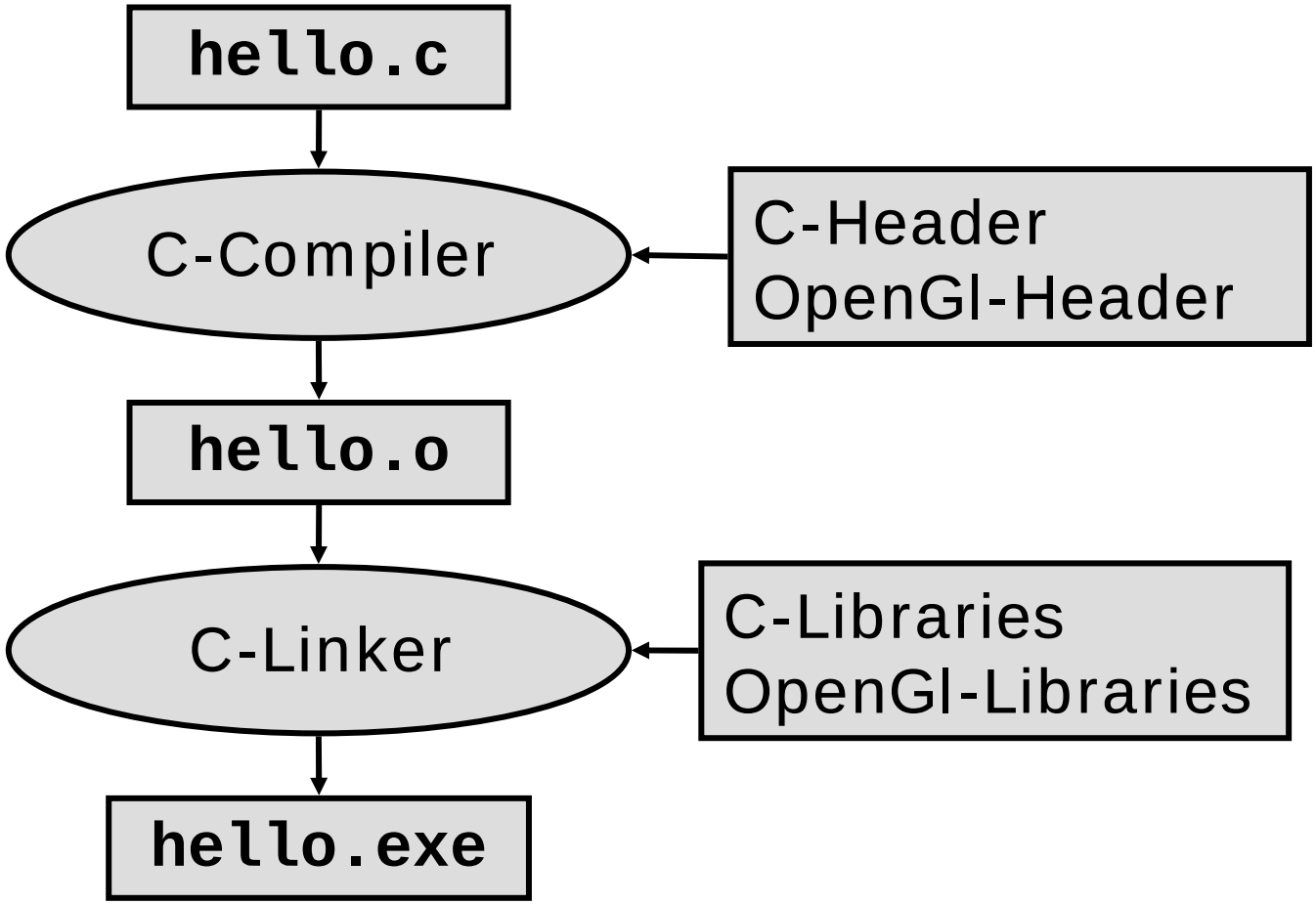
OpenGl Programming Guide



OpenGl

- 200 Befehle in OpenGL Library
  (geometrische Primitive, Attribute)
  `glColor3f(1.0,0.0,0.0);`
  `glRotatef(30.0,0.0,0.0,1.0);`
- 50 Befehle in OpenGl Utility Library
  (NURBS, Projektionsmatrizen)
  `gluPerspective(60.0,1.5,1.0,20.0);`
- 30 Befehle in OpenGl Utility Toolkit
  (Fenstersystem, Objekte)
  `glutInitWindowPosition(100,100);`
  `glutWireCube(2.0);`

Entwicklungszyklus



Programmaufbau

```
#include <GL/glut.h>
#include <stdlib.h>
void init(void){…}
void display(void){…}
void reshape(int w, int h){…}
int main(int argc, char ** argv){
  glutInit(&argc, argv);
  glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB)
  glutInitWindowSize(800, 600);
  glutInitWindowPosition(0,0);
  glutCreateWindow("Hello World");
  init();
  glutDisplayFunc(display);
  glutReshapeFunc(reshape);
  glutMainLoop();
}
```

Datentypen

	Datentyp	OpenGl	C-Äquivalent
b	8-bit integer	GLbyte	signed char
s	16-bit integer	GLShort	short
i	32-bit integer	GLint	int
f	32-bit floating point	GLfloat	float
d	64-bit floating point	GLdouble	double
ub	8-bit unsigned int	GLubyte	unsigned char
us	16-bit unsigned short	GLushort	unsigned short
ui	32-bit unsigned int	GLuint	unsigned int

```
glVertex2i(5,3);
glVertex2f(5.0,3.0);
glVertex3f(5.0,3.0,1.0);
```

Parameterübergabe

Übergabe von 3 Zahlen:

```
glColor3f(1.0,0.8,0.8);
glColor3d(1.0,0.8,0.8);
```

Übergabe von Vektor:

```
GLfloat v[] = {1.0, 0.8, 0.8);
glColor3fv(v);
```

Zustandsmachine

Attribute bleiben gültig bis auf Widerruf:

```
…
glColor3f(1.0,1.0,0.0);
/* ab jetzt in gelb zeichnen */
```

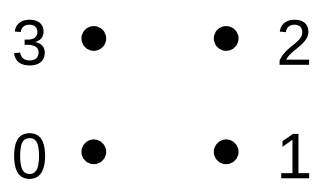
Geometrische Primitive

```
glBegin(GL_POINTS)… … … …  glEnd();
```

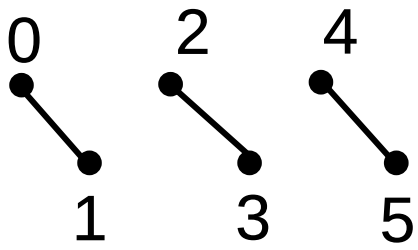
```
GL_LINES
GL_LINE_STRIP
GL_LINE_LOOP
GL_TRIANGLES
GL_TRIANGLE_STRIP
GL_TRIANGLE_FAN
GL_QUADS
GL_QUAD_STRIP
GL_POLYGON
```

Punkte

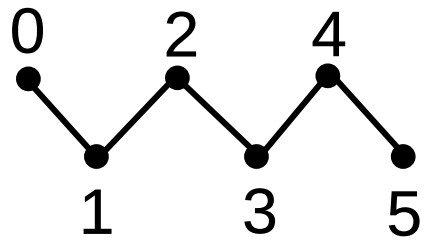
```
glBegin(GL_POINTS)
  glVertex3f(0.25, 0.25, 0.0);
  glVertex3f(0.75, 0.25, 0.0);
  glVertex3f(0.75, 0.75, 0.0);
  glVertex3f(0.25, 0.75, 0.0);
glEnd();
```



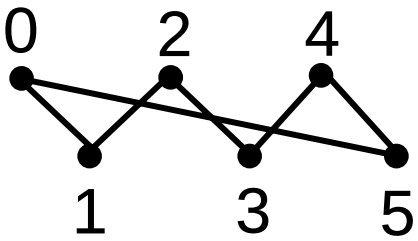
Linien



GL_LINES

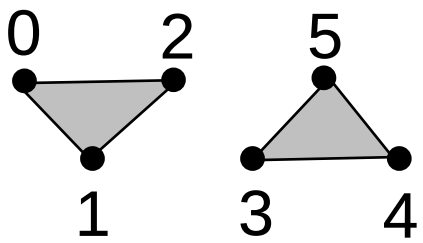


GL_LINE_STRIP

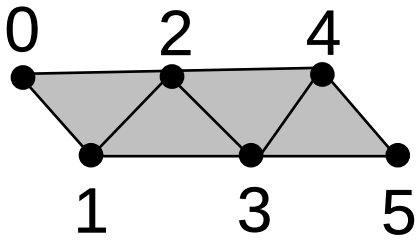


GL_LINE_LOOP

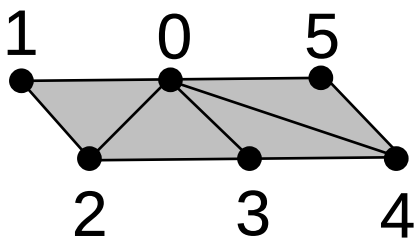
Polygone



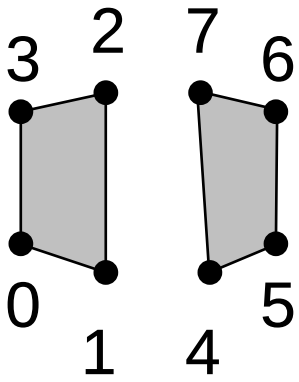
GL_TRIANGLES



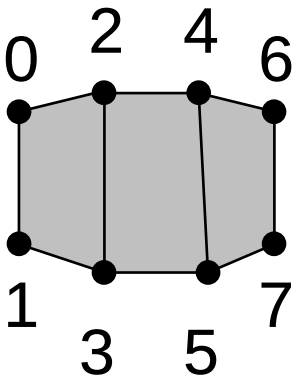
GL_TRIANGLE_STRIP



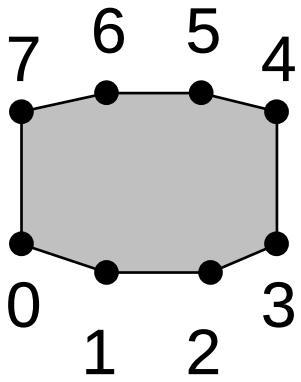
GL_TRIANGLE_FAN



GL_QUADS



GL_QUAD_STRIP



GL_POLYGON

Viewing Pipeline

- Transformationsmatrix
  für Projektion der Szene

- Transformationsmatrix
  für Transformation der Objekte

- Graphische Objekte

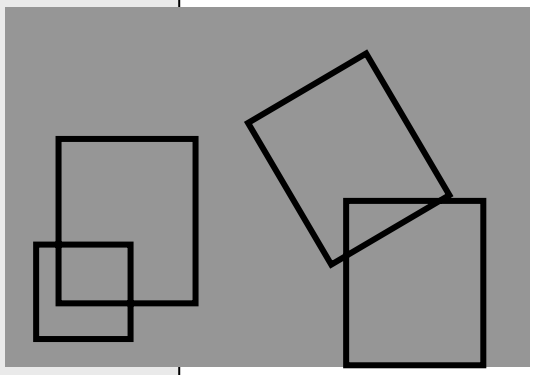
Matrix-Operationen

```
glMatrixMode(GL_PROJECTION);
glMatrixMode(GL_MODEL_VIEW);

GLFloat M[][]={{1.0,0.0,0.0,0.0},
               0.0,1.0,0.0,0.0},
               0.0,0.0,1.0,0.0},
               5.0,7.0,2.0,1.0}};
glMultMatrix(M);
glTranslatef(5.0,7.0,2.0);
```

Transformation eines Quadrats

```
glMatrixMode(GL_MODELVIEW);
glLoadIdentity ();
glRotatef(30.0,0.0,0.0,1.0);
glTranslatef(2.0,-0.5,0.0);
glScale(1.5,2.0,1.0);
glBegin(GL_Polygon)
  glVertex3f(0.25, 0.25, 0.0);
  glVertex3f(0.75, 0.25, 0.0);
  glVertex3f(0.75, 0.75, 0.0);
  glVertex3f(0.25, 0.75, 0.0);
glEnd();
```



Push und Pop

```
…
glTranslatef(0.0,10.0,0.0);
glPushMatrix();
  glTranslatef(10.0,0.0,0.0);
  glutWireCube(1.0);
glPopMatrix();
glPushMatrix();
  glTranslatef(-10.0,0.0,0.0);
  glutWireCube(1.0);
glPopMatrix();
…
```

Projektion mit glOrtho

```
glMatrixMode (GL_PROJECTION);
glLoadIdentity ();
glOrtho(-4,4,-3,3,-5.0,5.0);
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glRotatef(20,1,0,0);
glRotatef(-20,0,1,0);
glutWireCube(1);
```

Projektion mit glFrustum

```
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
glFrustum(-0.8,0.8,-0.6,0.6,1,20);
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glTranslatef(0,0,-4);
glRotatef(20,1,0,0);
glRotatef(-20,0,1,0);
glutWireCube(1);
```

Projektion mit gluPerspektive

```
glMatrixMode (GL_PROJECTION);
glLoadIdentity ();
gluPerspective(60, 1.33, 1, 20);
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glTranslatef(0,0,-4);
glRotatef(20,1,0,0);
glRotatef(-20,0,1,0);
glutWireCube(1);
```

Manipulation durch glLookAt

```
glMatrixMode (GL_PROJECTION);
glLoadIdentity ();
gluPerspective(60, 1.33, 1, 20);
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
gluLookAt (1,1,3,0,0,0,0,1,0);
glutWireCube(1);
```

Reshape

```
void reshape(int w, int h) {
  GLfloat p = (GLfloat) w / (GLfloat) h;
  glViewport(0, 0, w, h);
  glMatrixMode(GL_PROJECTION);
  glLoadIdentity();
  if (p > 1.0)
    glFrustum( -p, p,-1.0,1.0,1,20);
  else
    glFrustum(-1.0,1.0,-1/p,1/p,1,20);
}
```

Programmbeispiele

hello.exe	hello.c
wire-cube.exe	wire-cube.c
wire-prop-cube.exe	wire-prop-cube.c
click.exe	click.c
key.exe	key.c
planet.exe	planet.c
smooth.exe	smooth.c
list.exe	list.c
bezier-curve.exe	bezier-curve.c
bezier-surface.exe	bezier-surface.c
teapot-rotate.exe	teapot-rotate.c
atlantis.exe	atlantis.c dolphin.c

Aufgabe

Roboter mit 3 Freiheitsgraden