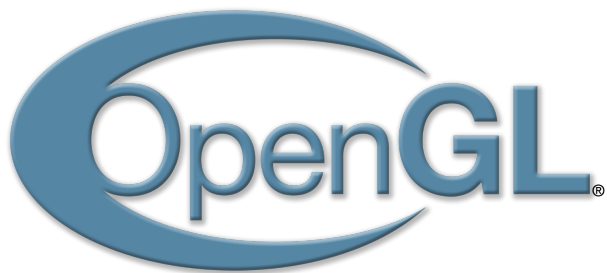




# OpenGL

Изграждане на  
Геометрични обекти



*гл. ас. д-р А. Пенев*

# Изчистване на Изображението (1/3)

```
void glClear(GLbitfield mask)
```

mask :

**GL\_COLOR\_BUFFER\_BIT**

на Цвета

**GL\_DEPTH\_BUFFER\_BIT**

на Дълбочината

**GL\_ACCUM\_BUFFER\_BIT**

на Натрупване

**GL\_STENCIL\_BUFFER\_BIT**

на Маската

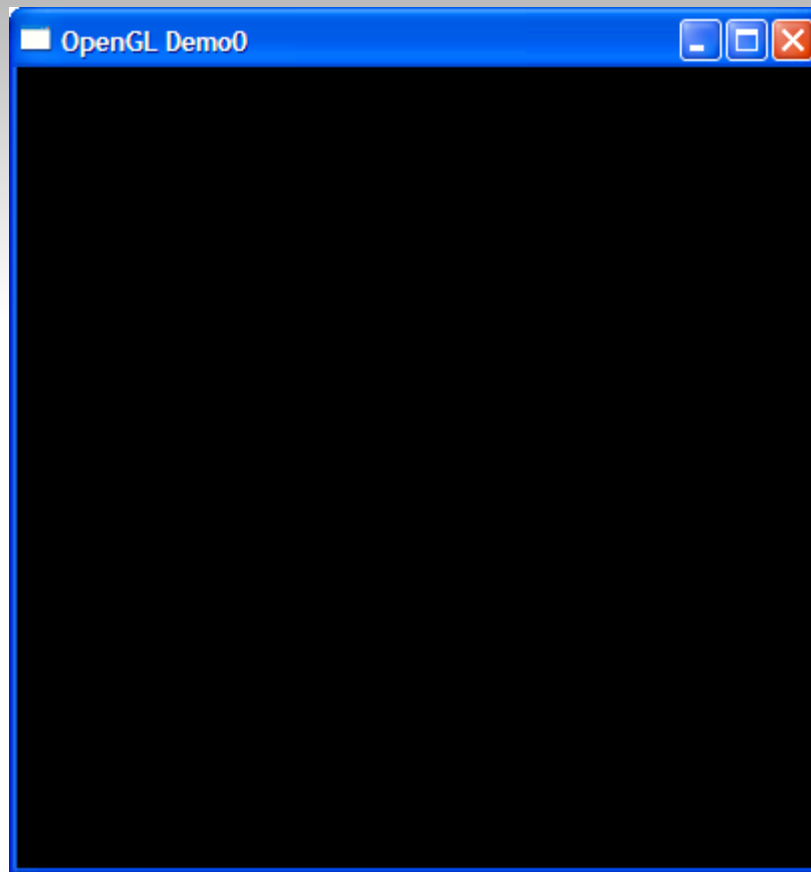
## Изчистване на Изображението (2/3)

```
void glClearColor(GLclampf red,  
                 GLclampf green, GLclampf blue,  
                 GLclampf alpha)
```

Пример :

```
glClearColor(0,0,0,0);  
glClear(GL_COLOR_BUFFER_BIT |  
        GL_DEPTH_BUFFER_BIT);
```

# Изчистване на Изображението (3/3)



*Повече в лекцията за Работа с Буфери...*

# glFlush и glFinish

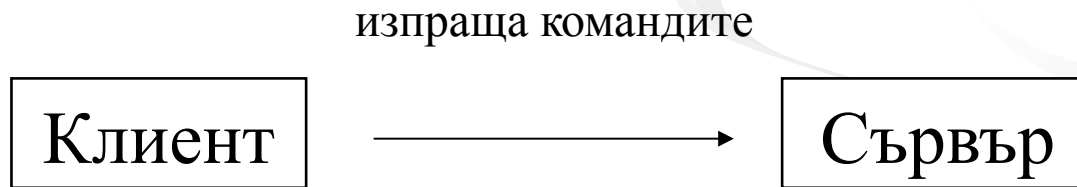
```
void glFlush(void)
```

```
void glFinish(void)
```

```
void glutSwapBuffers(void)
```

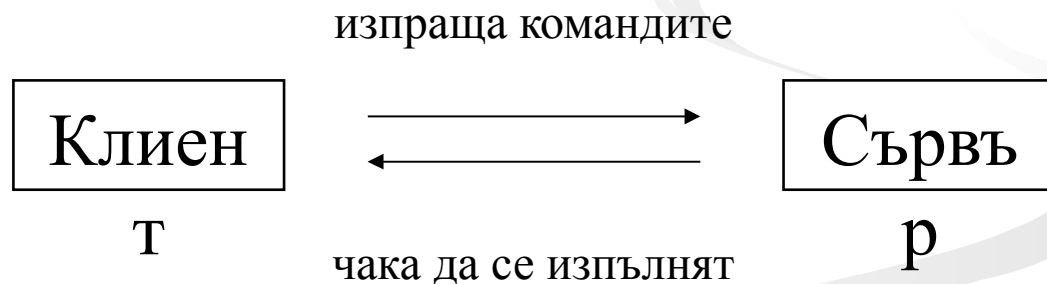
# glFlush

```
glClearColor(0,0,0,0);  
glClear(GL_COLOR_BUFFER_BIT);  
...  
glFlush();
```



# glFinish

```
glClearColor(0, 0, 0, 0);  
glClear(GL_COLOR_BUFFER_BIT);  
...  
glFinish();
```



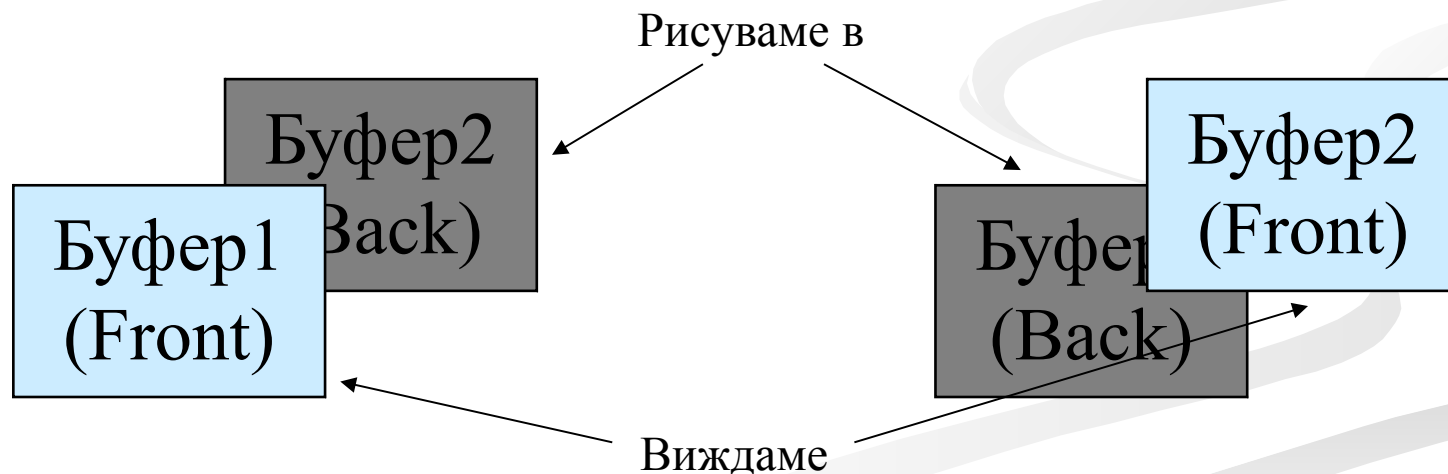
# glutSwapBuffers

```
glClearColor(0,0,0,0);
```

```
glClear(GL_COLOR_BUFFER_BIT);
```

...

```
glutSwapBuffers(); //извършва и Flush
```





# glVertex

Основна команда за дефиниране на  
геометрията на сцената

```
void glVertex... (x, y, z, w)
```

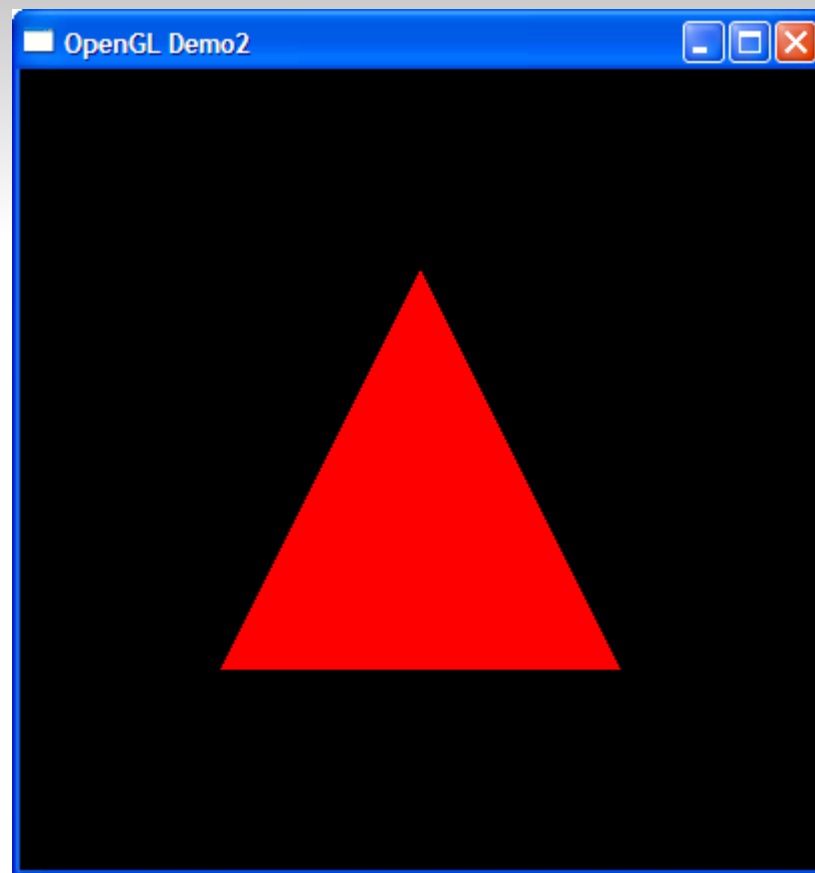
# “Рисуване”

```
void glBegin (GLenum mode)  
void glEnd (void)
```

Пример :

```
glColor3d (1, 0, 0) ;  
glBegin (GL_TRIANGLES) ;  
    glVertex2d (-1.0, -1.0) ;  
    glVertex2d (1.0, -1.0) ;  
    glVertex2d (0.0, 1.0) ;  
glEnd () ;
```

# Пример 1



# glBegin режими

**GL\_POINTS**

Точки

**GL\_LINES**

Отсечки

**GL\_LINE\_STRIP**

Начупена линия

**GL\_LINE\_LOOP**

Затворена начупена линия

**GL\_TRIANGLES**

Триъгълници

**GL\_TRIANGLE\_STRIP**

Ивица от триъгълници

**GL\_TRIANGLE\_FAN**

Ветрило от триъгълници

**GL\_QUADS**

Четириъгълници

**GL\_QUAD\_STRIP**

Ивица от четириъгълници

**GL\_POLYGON**

Многоъгълник

# GL\_POINTS

● V0

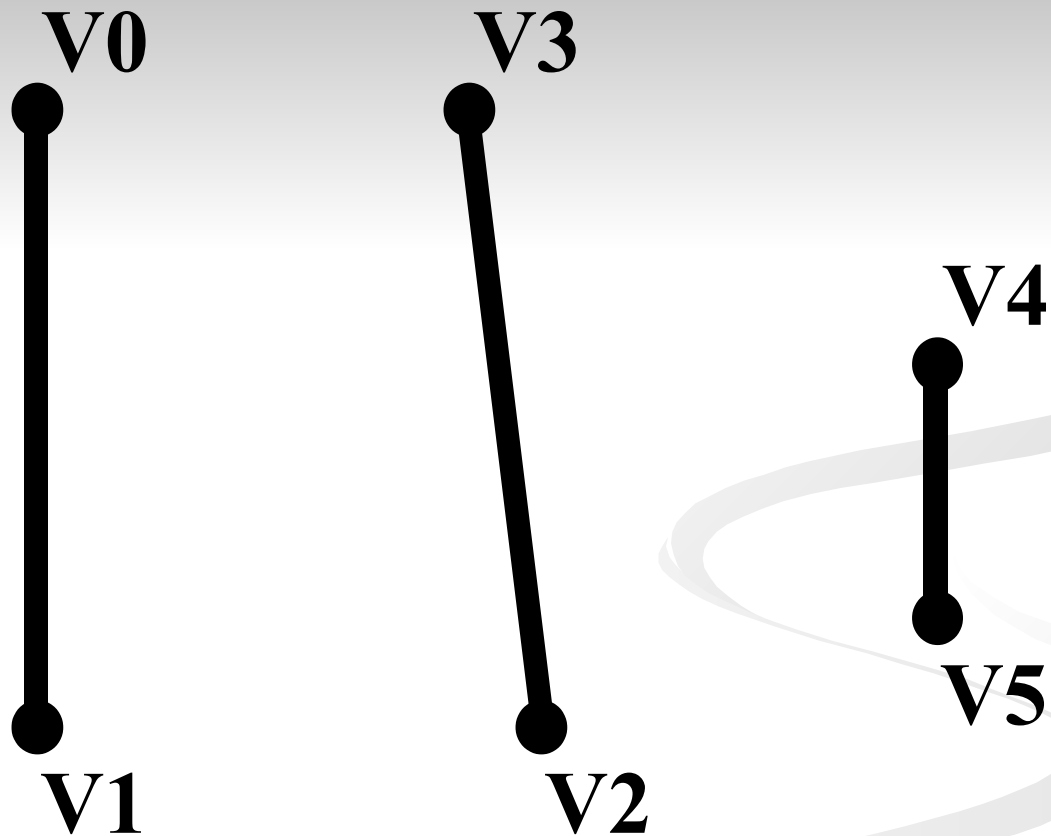
● V3

● V4

● V1

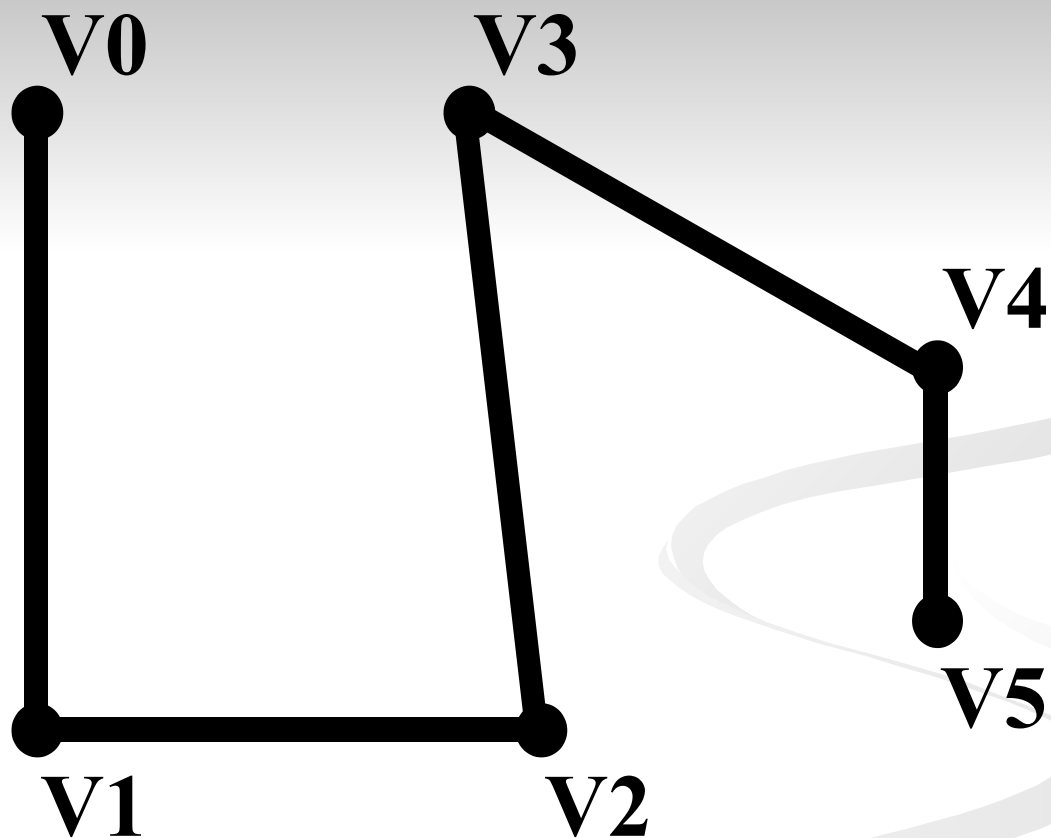
● V2

# GL\_LINES



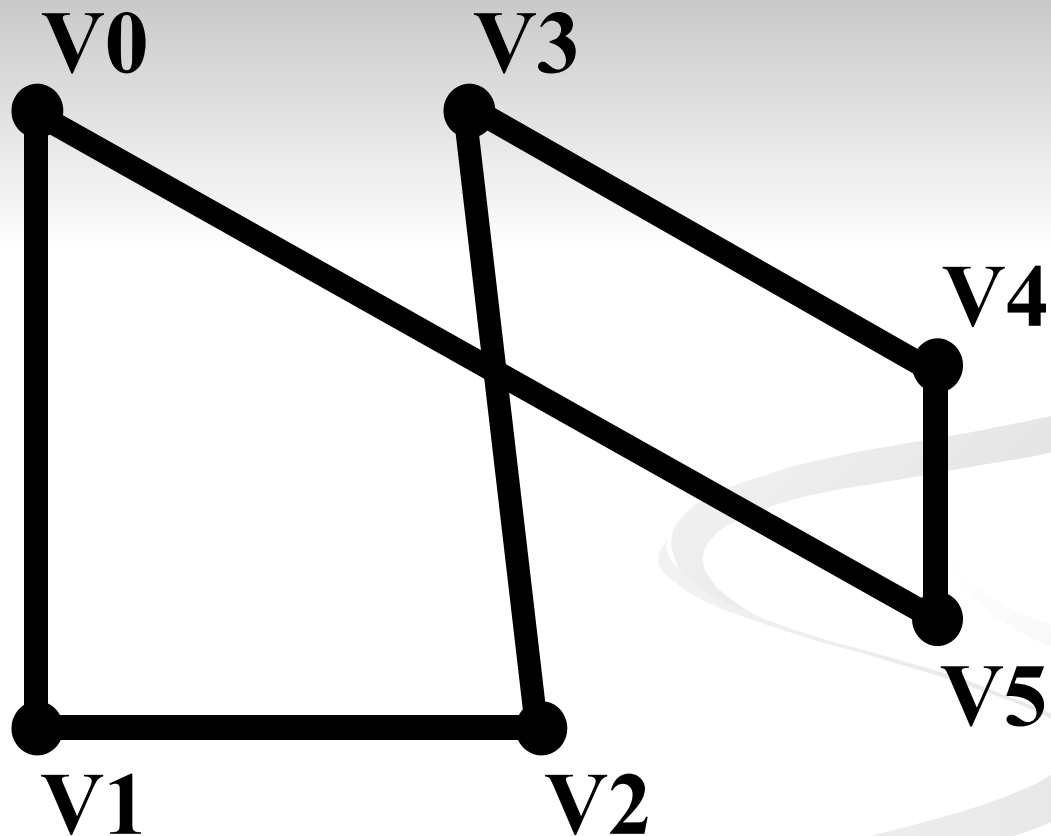
Забележка: Точките не се визуализират

# GL\_LINE\_STRIP



Забележка: Точките не се визуализират

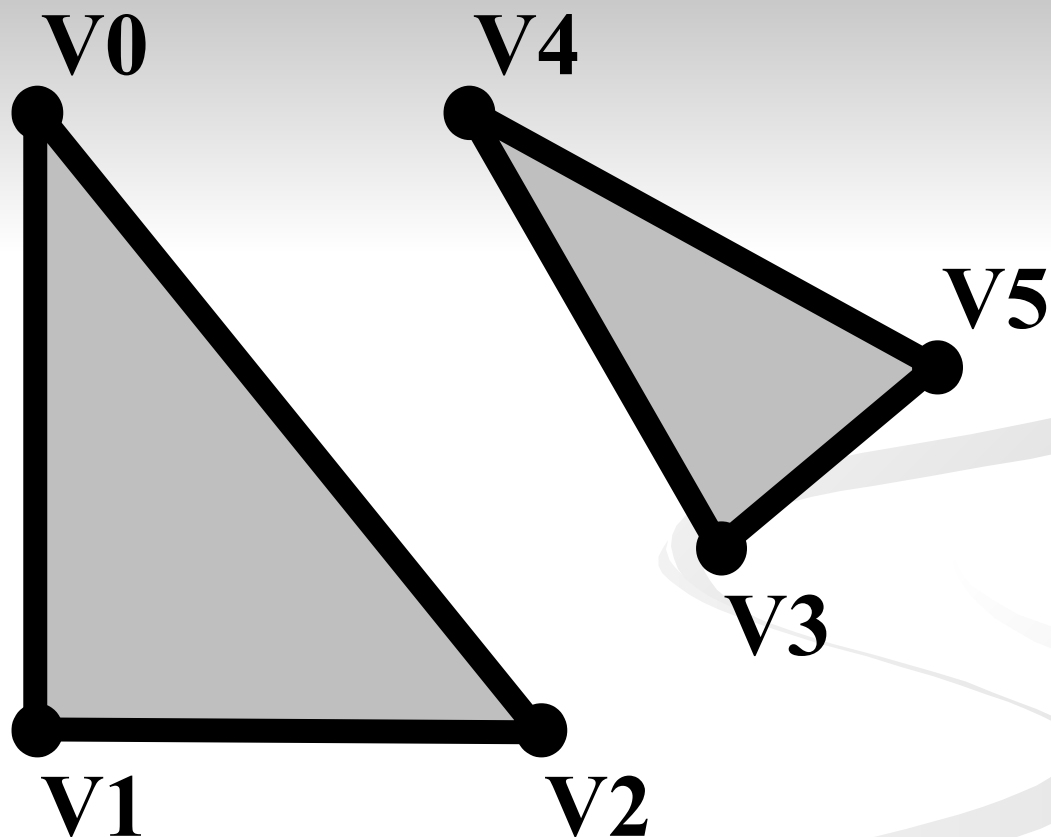
# GL\_LINE\_LOOP



Забележка: Точките не се визуализират

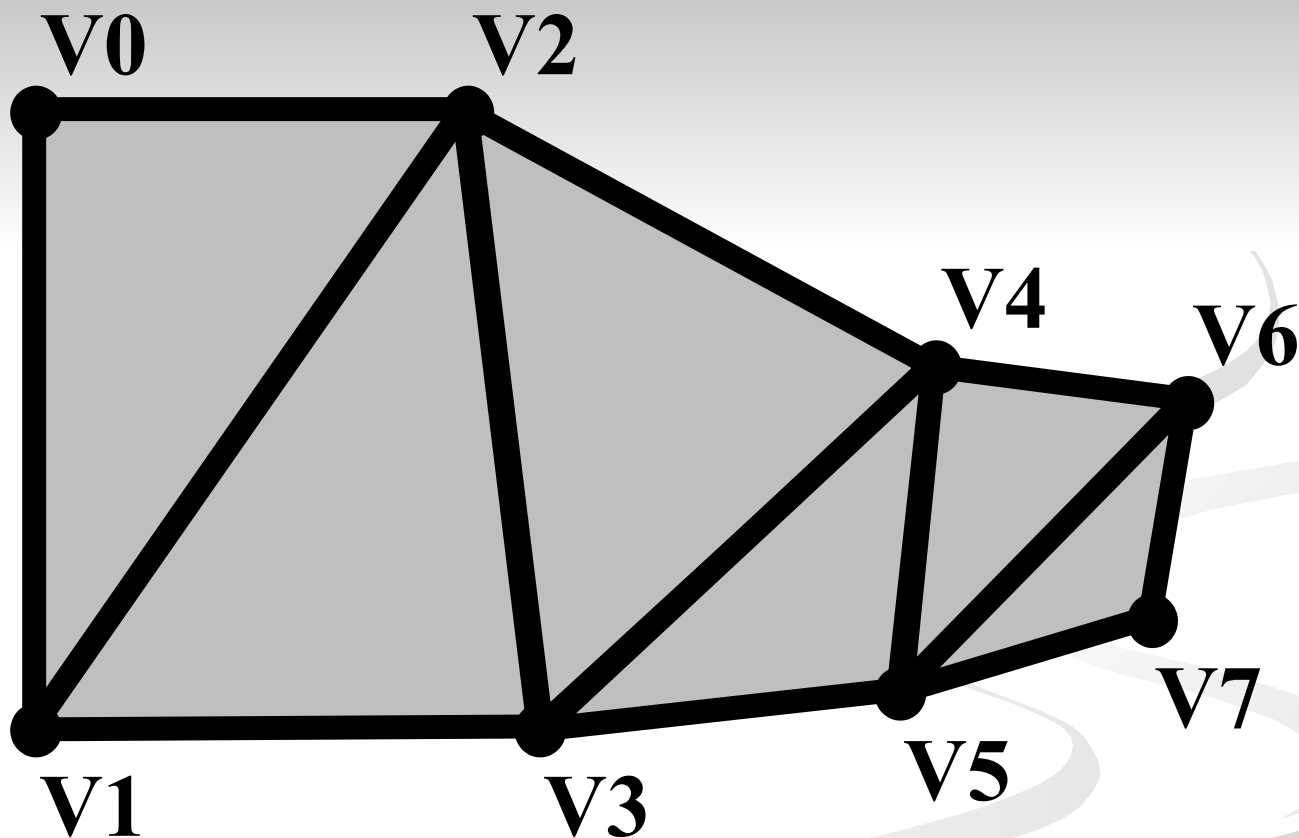


# GL\_TRIANGLES



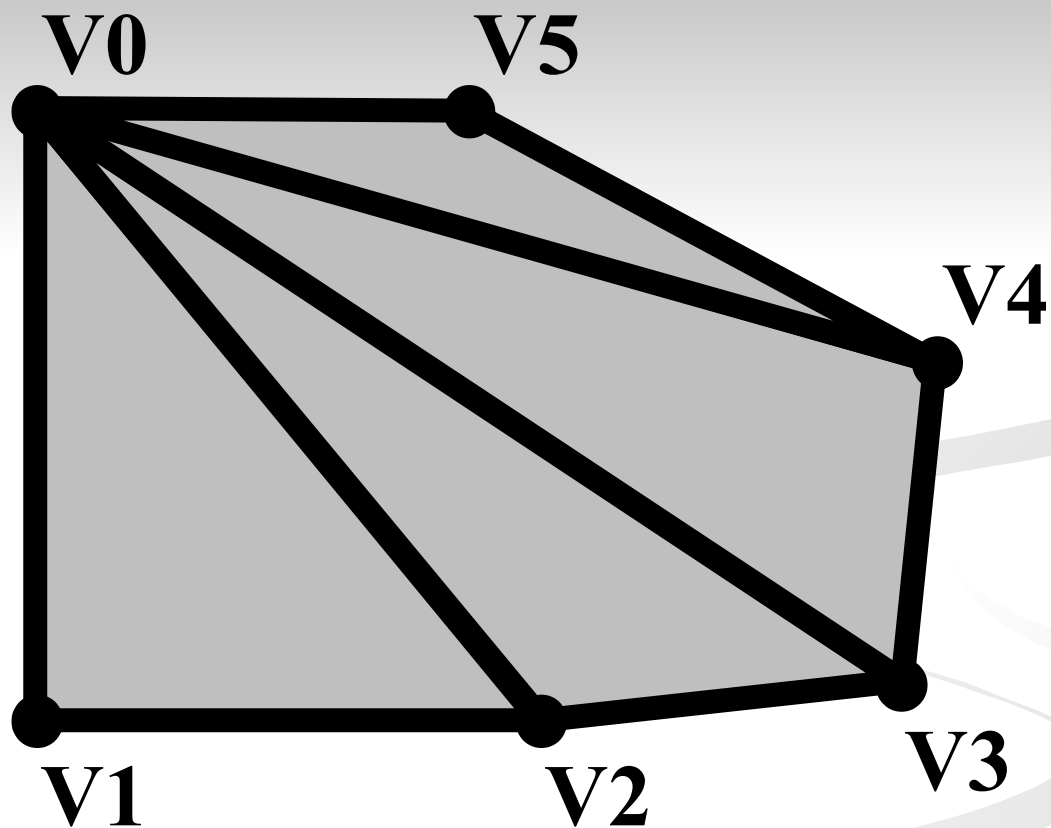
Забележка: Точките и линиите не се визуализират

# GL\_TRIANGLE\_STRIP



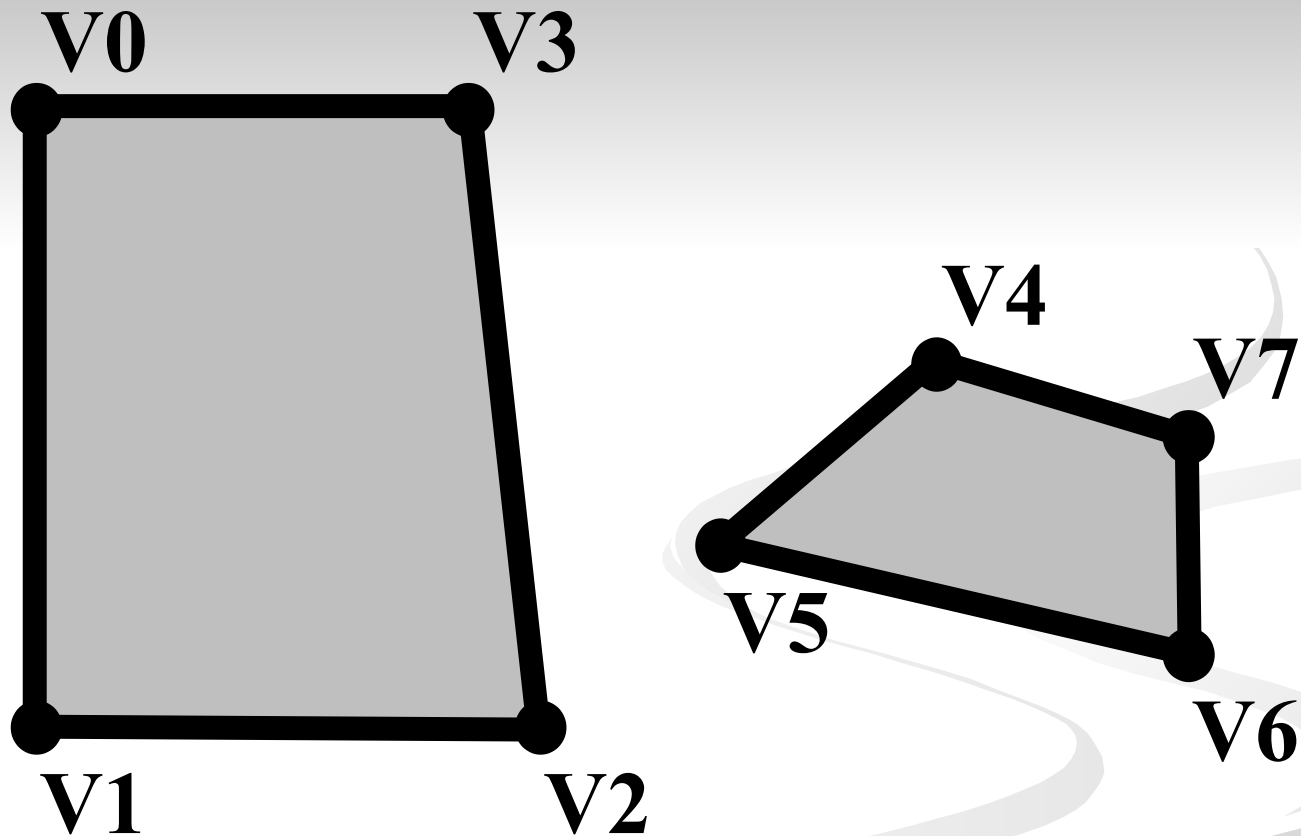
Забележка: Точките и линиите не се визуализират

# GL\_TRIANGLE\_FAN



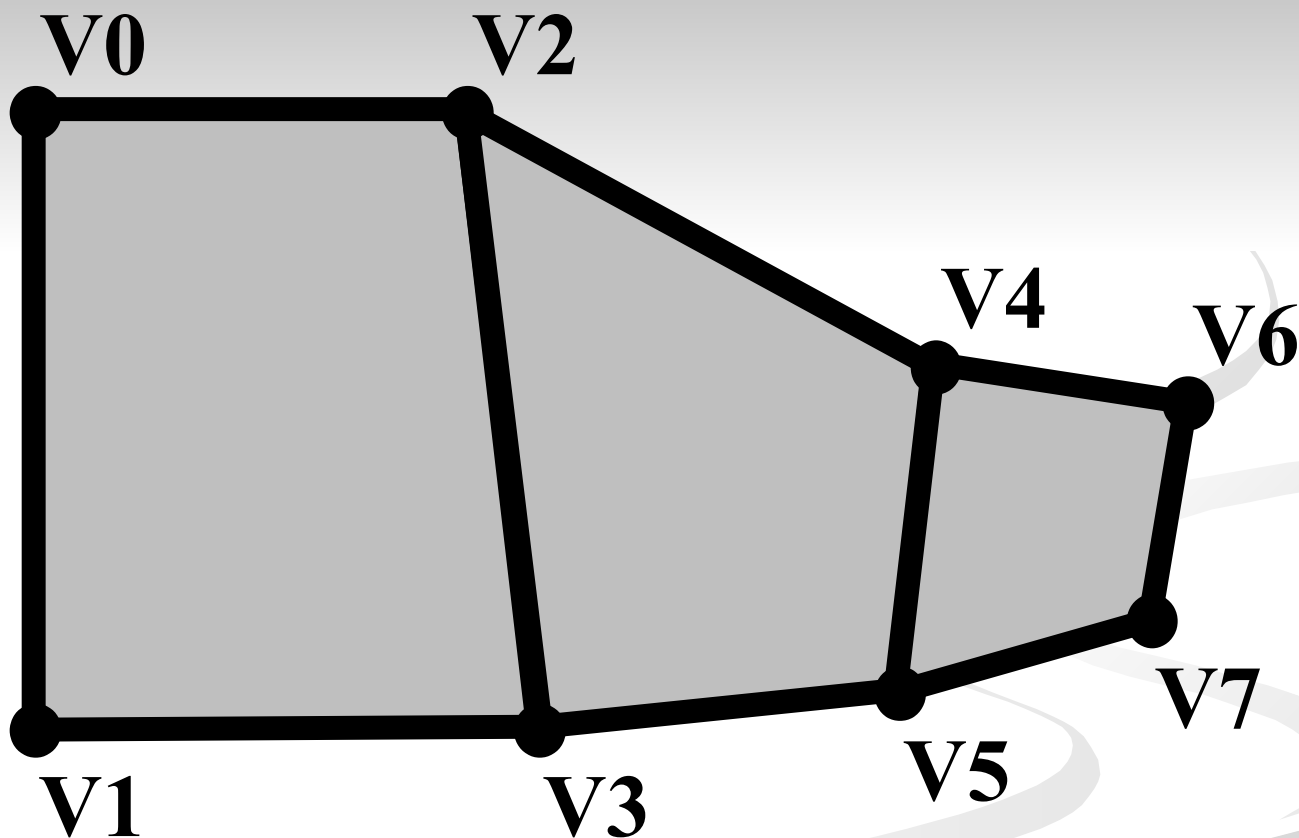
Забележка: Точките и линиите не се визуализират

# GL\_QUADS



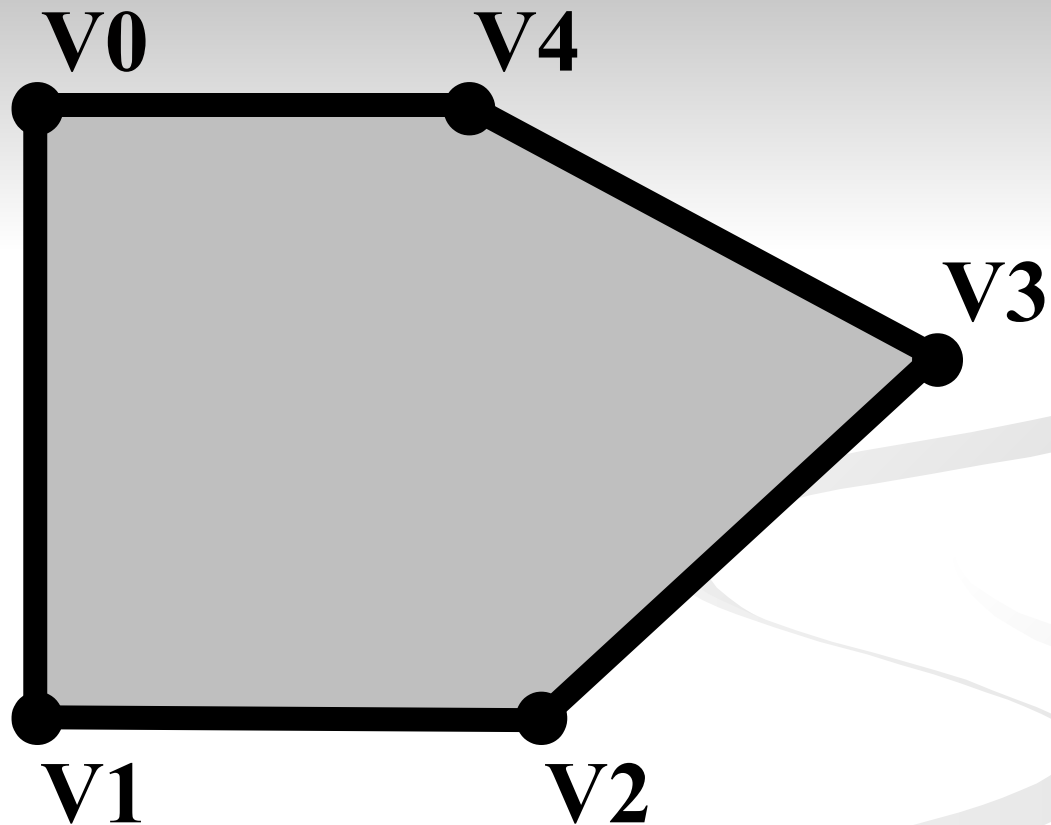
Забележка: Точките и линиите не се визуализират

# GL\_QUAD\_STRIP



Забележка: Точките и линиите не се визуализират

# GL\_POLYGON

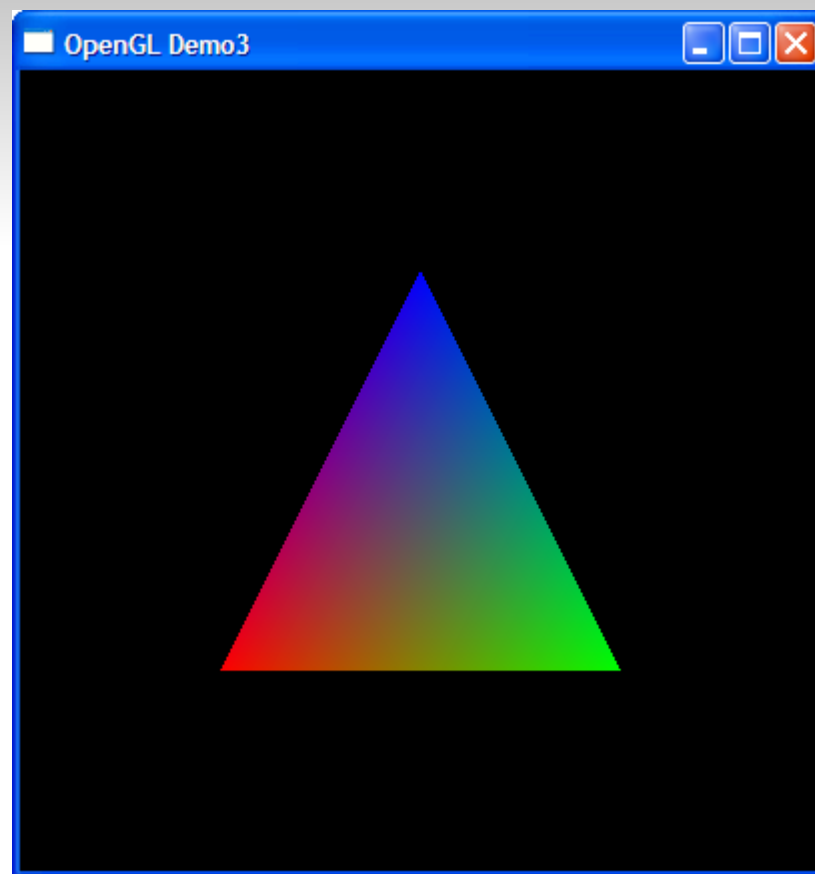


Забележка: Точките и линиите не се визуализират

# Характеристики на Връх

```
glBegin (GL_TRIANGLES) ;  
    glColor3d (1, 0, 0) ;  
    glVertex2d (-1.0, -1.0) ;  
    glColor3d (0, 1, 0) ;  
    glVertex2d (1.0, -1.0) ;  
    glColor3d (0, 0, 1) ;  
    glVertex2d (0.0, 1.0) ;  
glEnd () ;
```

# Пример 2





# Характеристики на връх

```
void glColor... (red, green, blue, a)  
void glIndex... (color_index)  
void glNormal3... (nx, ny, nz)
```

**... и много други, които няма да разглеждаме сега.**

# Точки

```
void glPointSize (GLfloat size)
```

```
glGetFloatv (GL_POINT_SIZE, &s);
```

```
glGetFloatv (GL_POINT_SIZE_RANGE, &s);
```

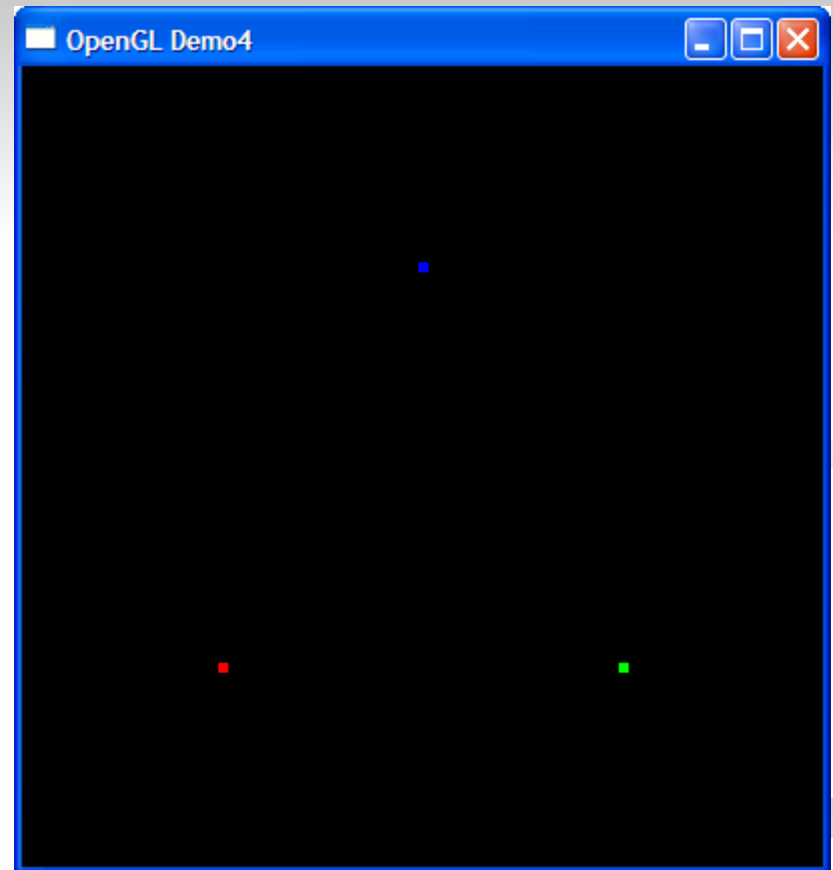
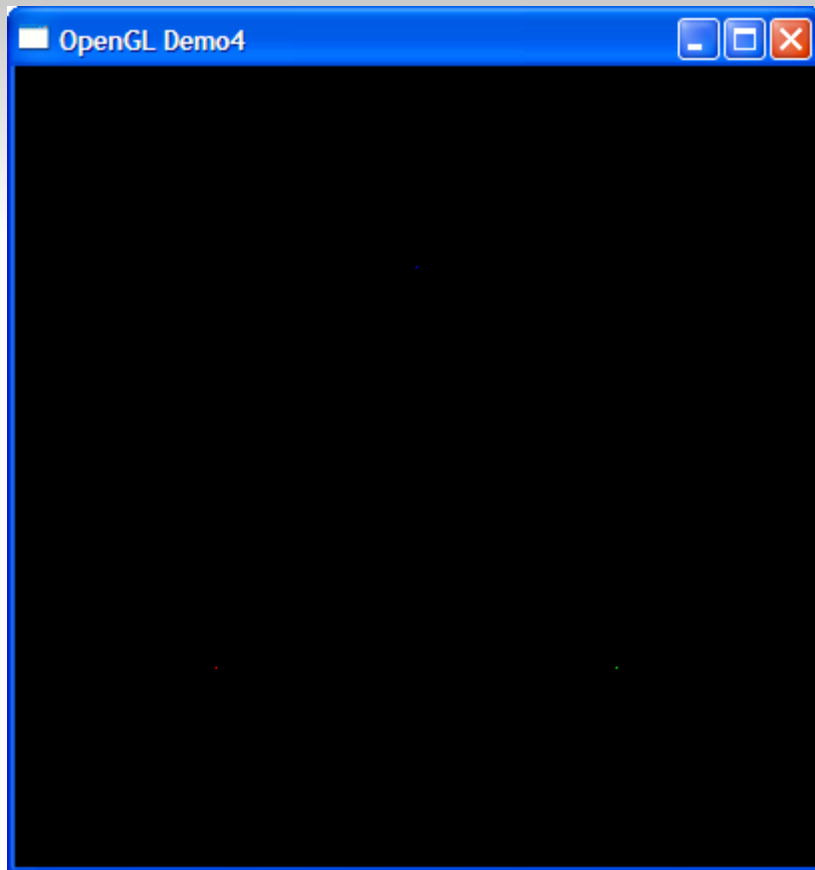
```
glEnable (GL_POINT_SMOOTH);
```

```
glDisable (GL_POINT_SMOOTH);
```

# Пример 3 (1/2)

```
glPointSize(5);  
glBegin(GL_POINTS);  
    glColor3d(1,0,0);  
    glVertex2d(-1.0, -1.0);  
    glColor3d(0,1,0);  
    glVertex2d(1.0, -1.0);  
    glColor3d(0,0,1);  
    glVertex2d(0.0, 1.0);  
glEnd();
```

# Пример 3 (2/2)



# Линии

```
void glLineWidth(GLfloat width)
```

```
void glLineStipple(GLint factor,  
GLushort pattern)
```

```
glGetFloatv(GL_LINE_WIDTH, &w);
```

```
glGetFloatv(GL_LINE_WIDTH_RANGE, &w);
```

```
glEnable(GL_LINE_STIPPLE);
```

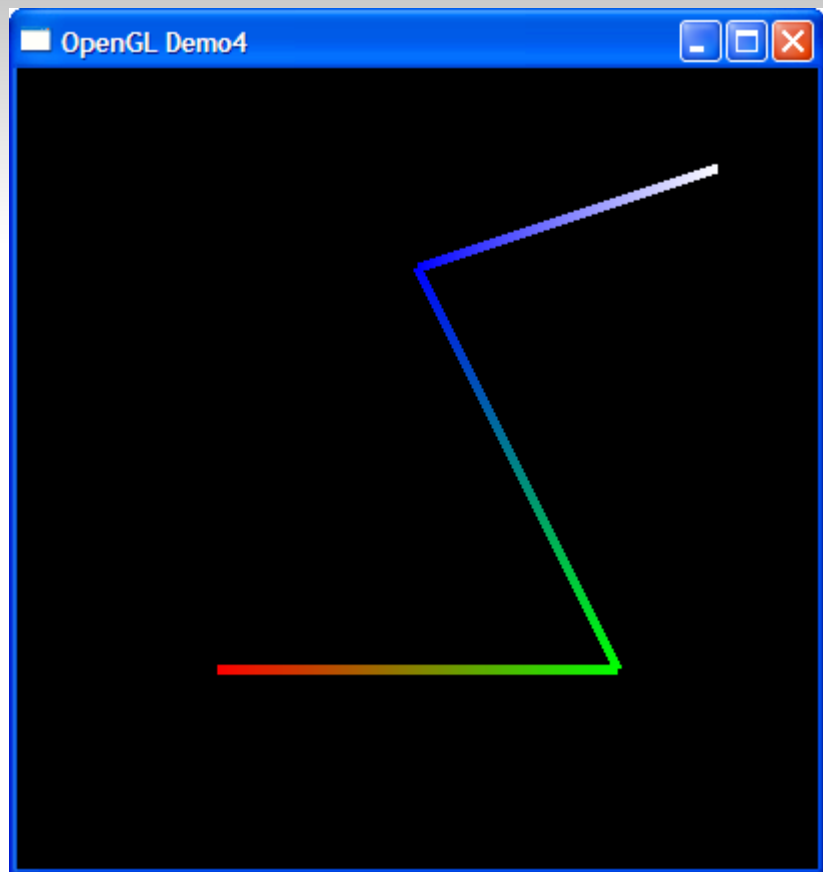
```
glEnable(GL_LINE_SMOOTH);
```

```
glDisable(GL_LINE_SMOOTH);
```

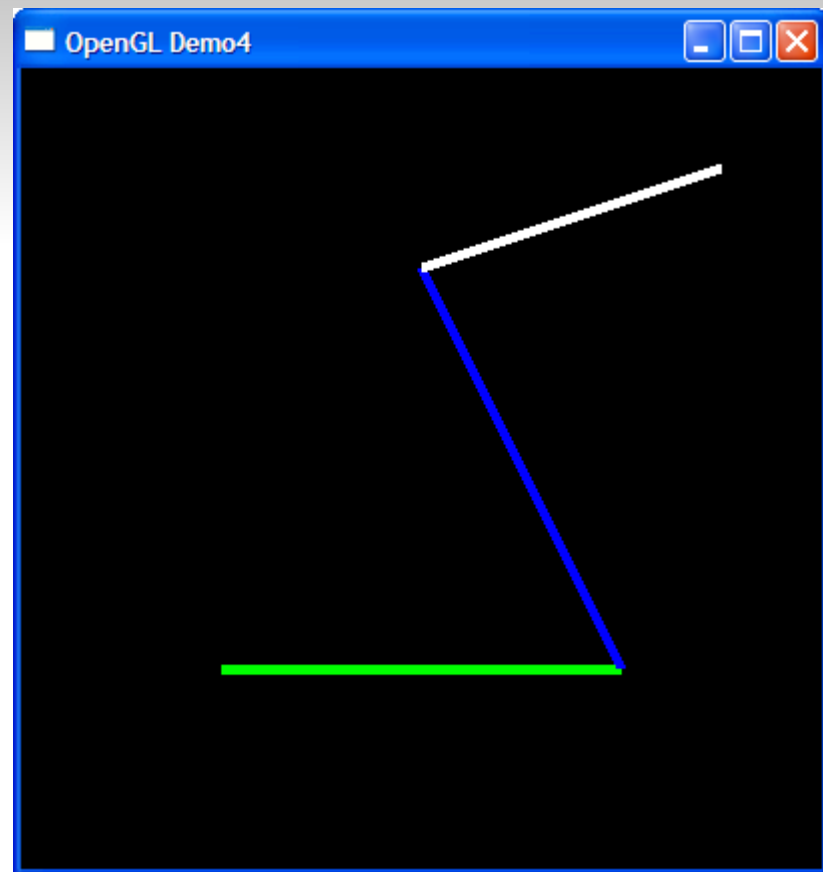
# Пример 4 (1/2)

```
glShadeModel (GL_FLAT) ;  
glLineWidth (5) ;  
glBegin (GL_LINE_STRIP) ;  
    glColor3d (1, 0, 0) ;  
    glVertex2d (-1.0, -1.0) ;  
    glColor3d (0, 1, 0) ;  
    glVertex2d (1.0, -1.0) ;  
    glColor3d (0, 0, 1) ;  
    glVertex2d (0.0, 1.0) ;  
    glColor3d (1, 1, 1) ;  
    glVertex2d (1.5, 1.5) ;  
glEnd () ;
```

# Пример 4 (2/2)



`glShadeModel(GL_SMOOTH)`



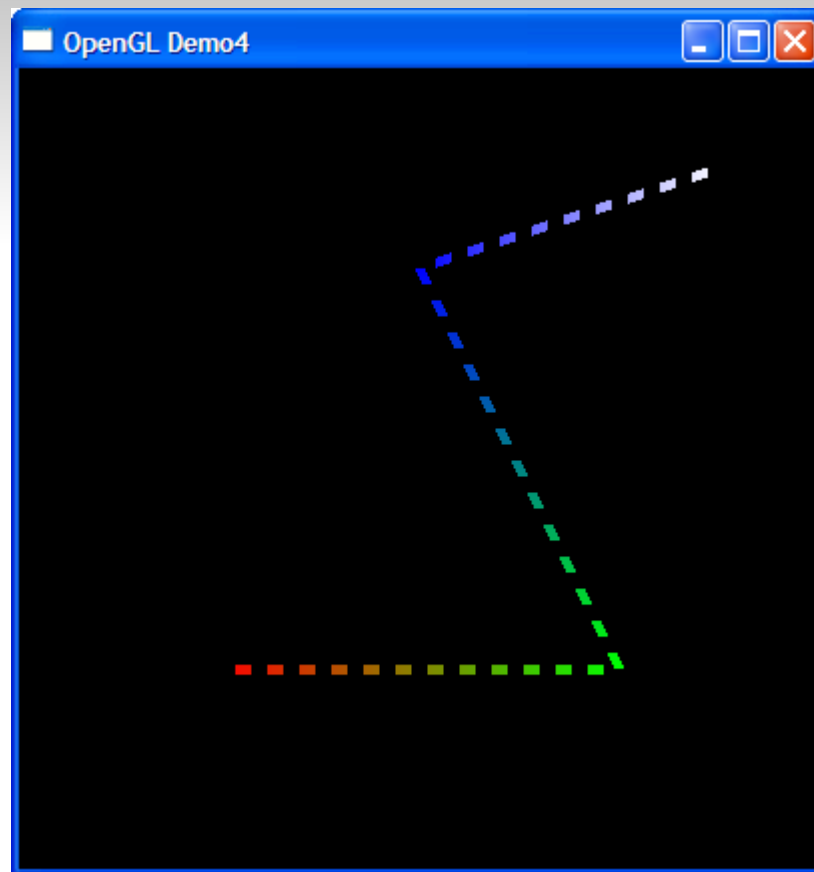
`glShadeModel(GL_FLAT)`

# Пример 5 (1/2)

```
glEnable(GL_LINE_STIPPLE);  
glLineStipple(1, 0xFF00);  
glLineWidth(5);  
glBegin(GL_LINE_STRIP);  
    glColor3d(1,0,0);  
    glVertex2d(-1.0, -1.0);  
    glColor3d(0,1,0);  
    glVertex2d(1.0, -1.0);  
    glColor3d(0,0,1);  
    glVertex2d(0.0, 1.0);  
    glColor3d(1,1,1);  
    glVertex2d(1.5, 1.5);  
glEnd();
```



# Пример 5 (2/2)



# Многоъгълници

```
void glPolygonMode(GLenum face, GLenum mode)
```

face:

**GL\_FRONT**

само за предна страна

**GL\_BACK**

само за задна страна

**GL\_FRONT\_AND\_BACK**

и за двете страни

mode:

**GL\_POINT**

само върхове

**GL\_LINE**

само ребра

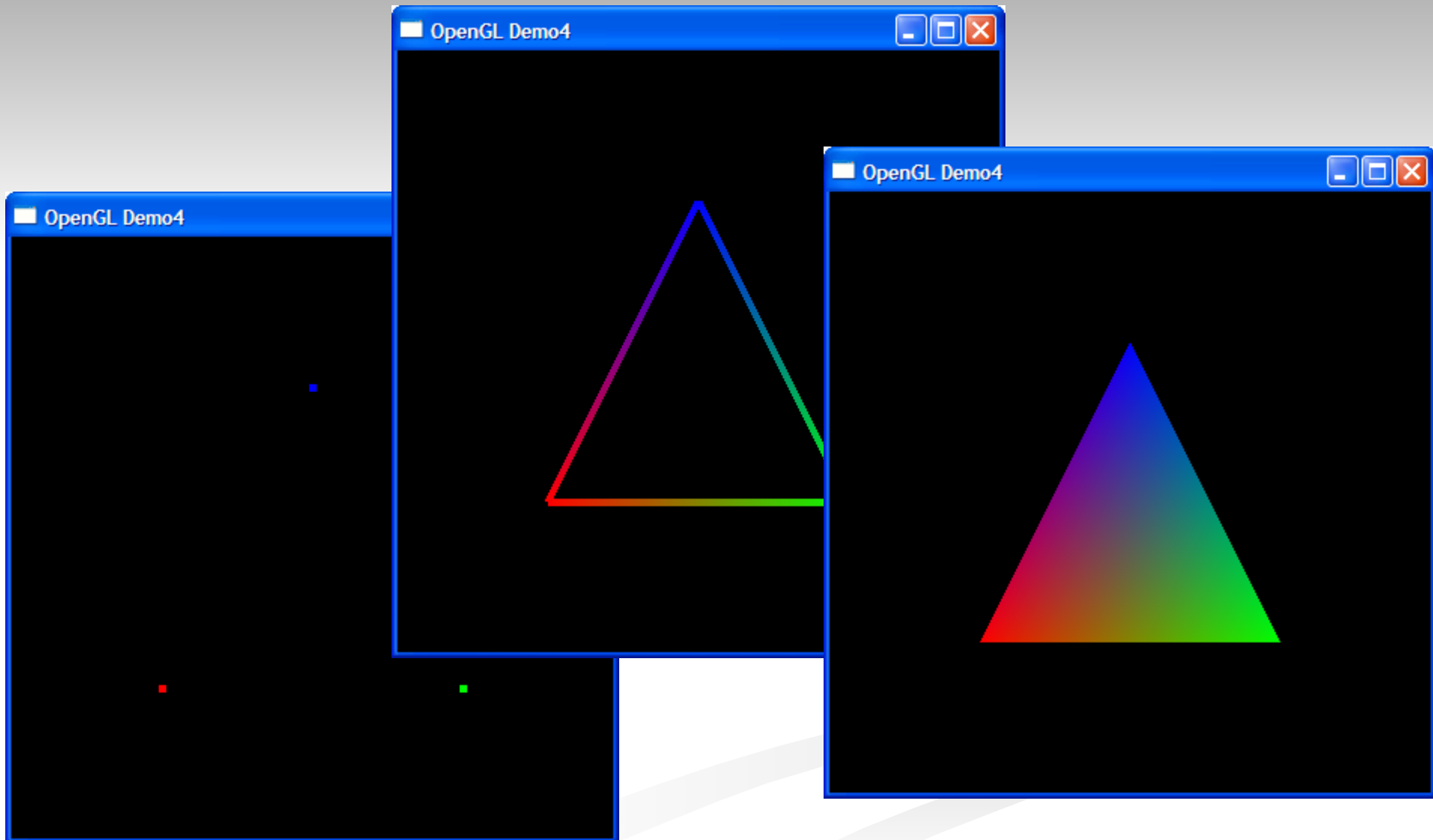
**GL\_FILL**

запълнен

# Пример 6 (1/2)

```
glPointSize(5);  
glLineWidth(5);  
glPolygonMode(GL_FRONT_AND_BACK, GL_POINT);  
//glPolygonMode(GL_FRONT_AND_BACK, GL_LINE);  
//glPolygonMode(GL_FRONT_AND_BACK, GL_FILL);  
glBegin(GL_TRIANGLES);  
    glColor3d(1,0,0);  
    glVertex2d(-1.0, -1.0);  
    glColor3d(0,1,0);  
    glVertex2d(1.0, -1.0);  
    glColor3d(0,0,1);  
    glVertex2d(0.0, 1.0);  
glEnd();
```

# Пример 6 (2/2)



# Щриховка на многоъгълници

```
void glPolygonStipple(const GLubyte *mask)
```

```
void glGetPolygonStipple(GLubyte *mask)
```

```
void glPolygonOffset(GLfloat factor, GLfloat  
units)
```

# Предна страна на многоъгълник

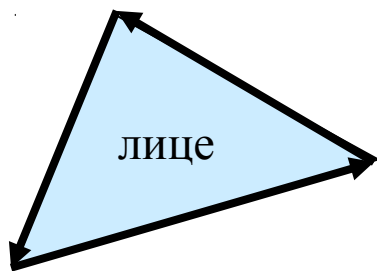
```
void glFrontFace (GLenum mode)
```

mode :

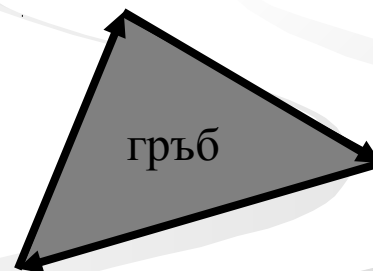
**GL\_CCW**

**GL\_CW**

обратно на часовата  
по часовата



при  
GL\_CCW



# Бракуване на многоъгълници

```
glEnable(GL_CULL_FACE);
```

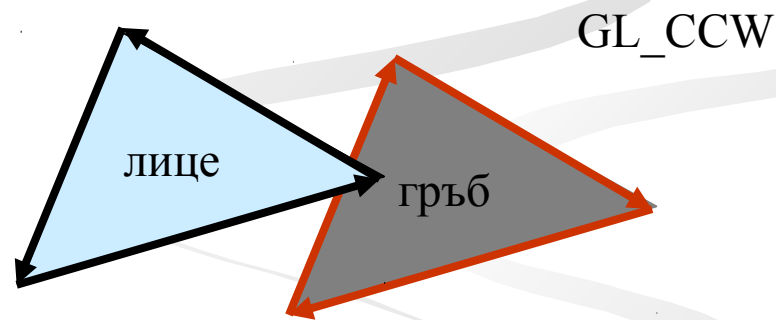
```
void glCullFace(GLenum mode)
```

mode:

```
GL_FRONT
```

```
GL_BACK
```

```
GL_FRONT_AND_BACK
```



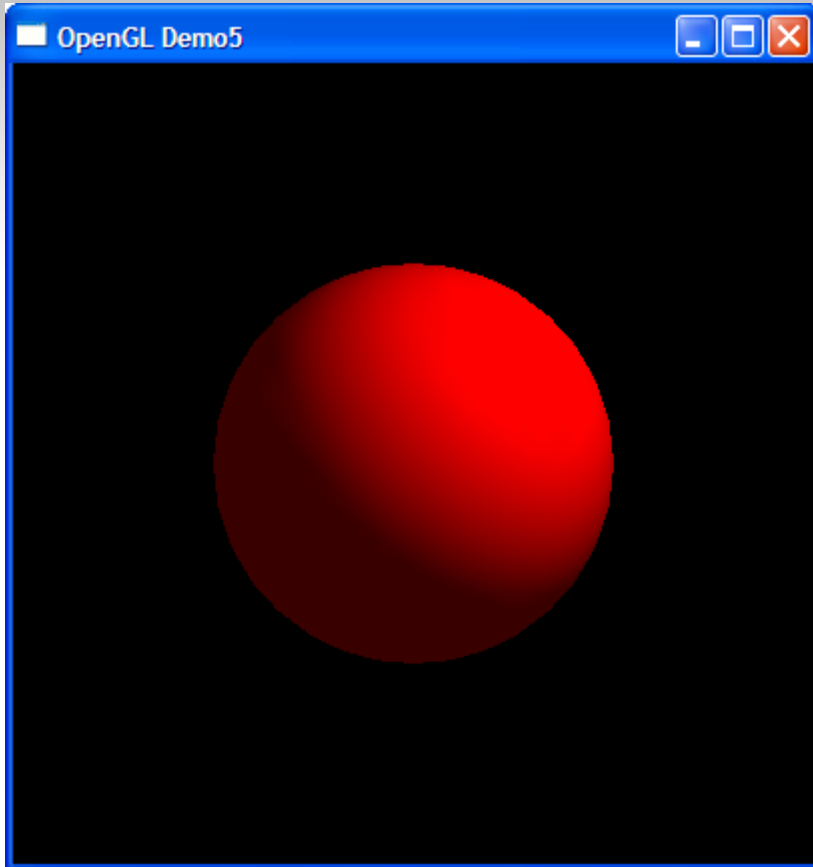
при GL\_BACK  
задните стени не се растеризират

# Пример 7 (1/2)

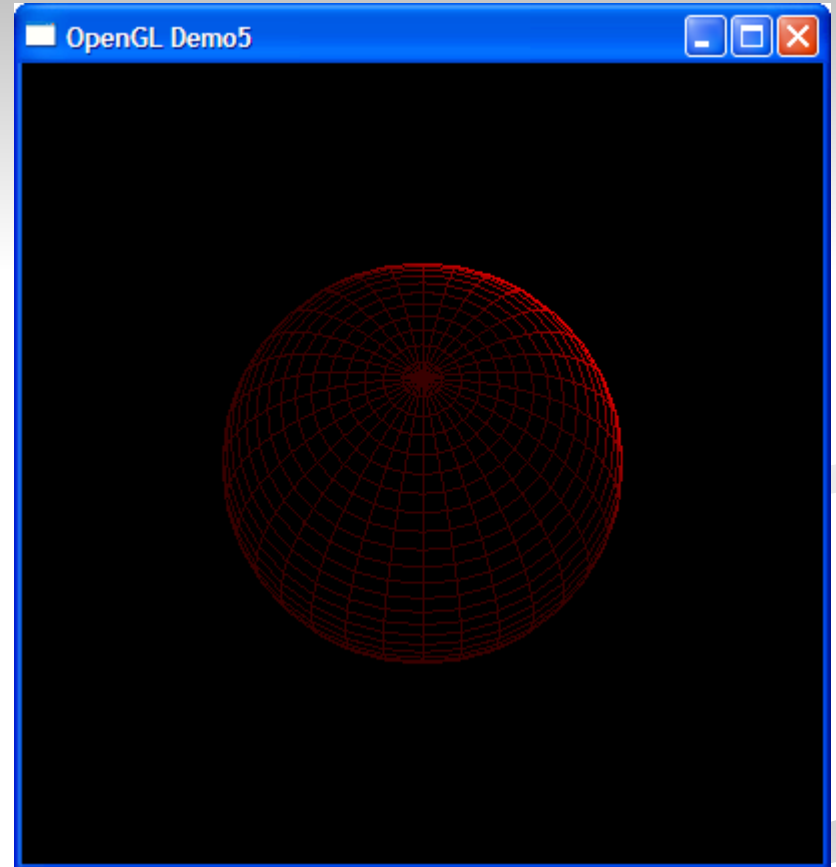
```
glPolygonMode (GL_FRONT, GL_FILL) ;  
glPolygonMode (GL_BACK, GL_LINE) ;  
glEnable (GL_CULL_FACE) ;  
glFrontFace (GL_CCW) ; // GL_CW  
glCullFace (GL_FRONT) ; //GL_BACK  
  
glColor3d (1, 0, 0) ;  
glutSolidSphere (1, 32, 32) ;
```



# Пример 7 (2/2)



`glCullFace(GL_BACK)`



`glCullFace(GL_FRONT)`

# Скриване на ребра

```
void glEdgeFlag... (GLboolean flag)
```

**GL\_TRUE**

реброто се показва

**GL\_FALSE**

реброто не се показва

# OpenGL Изграждане на Геометрични обекти

Въпроси?