SNS COLLEGE OF ENGINEERING

Kurumbapalayam(Po), Coimbatore – 641 912
Accredited by NAAC-UGC with 'A' Grade
Approved by AICTE, Recognized by UGC & Affiliated to Anna University, Chennai

Department of Information Technology

Course Name –Computer Graphics

III Year / V Semester

Unit 1– INTRODUCTION TO COMPUTER GRAPHICS

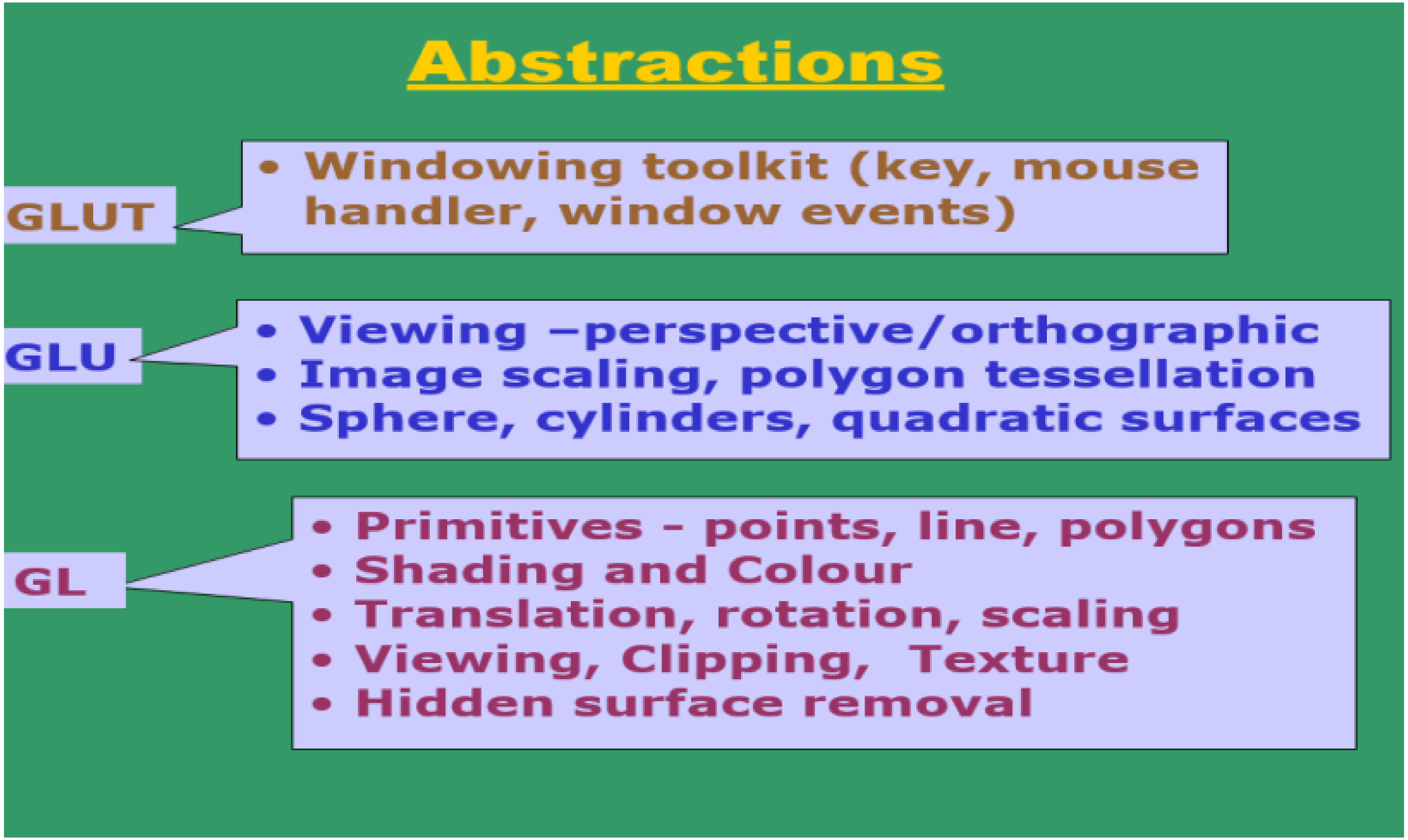
Topic :OPENGL Basics Primitives

WHAT IS OPENGL

- A low-level graphics library specification.
- OpenGL (Open Graphics Library) is a widely used graphics API (Application Programming Interface) that allows developers to create 2D and 3D graphics in various applications, including video games, simulations, and graphical user interfaces
- A small set of geometric primitives
  - Points
  - Lines
  - Polygons
  - Images
  - Bitmaps

$\left.\begin{array}{l}\text{Points}\\ \text{Lines}\\ \text{Polygons}\end{array}\right\}$ Geometric primitives

$\left.\begin{array}{l}\text{Images}\\ \text{Bitmaps}\end{array}\right\}$ Image primitives



Abstractions

GLUT

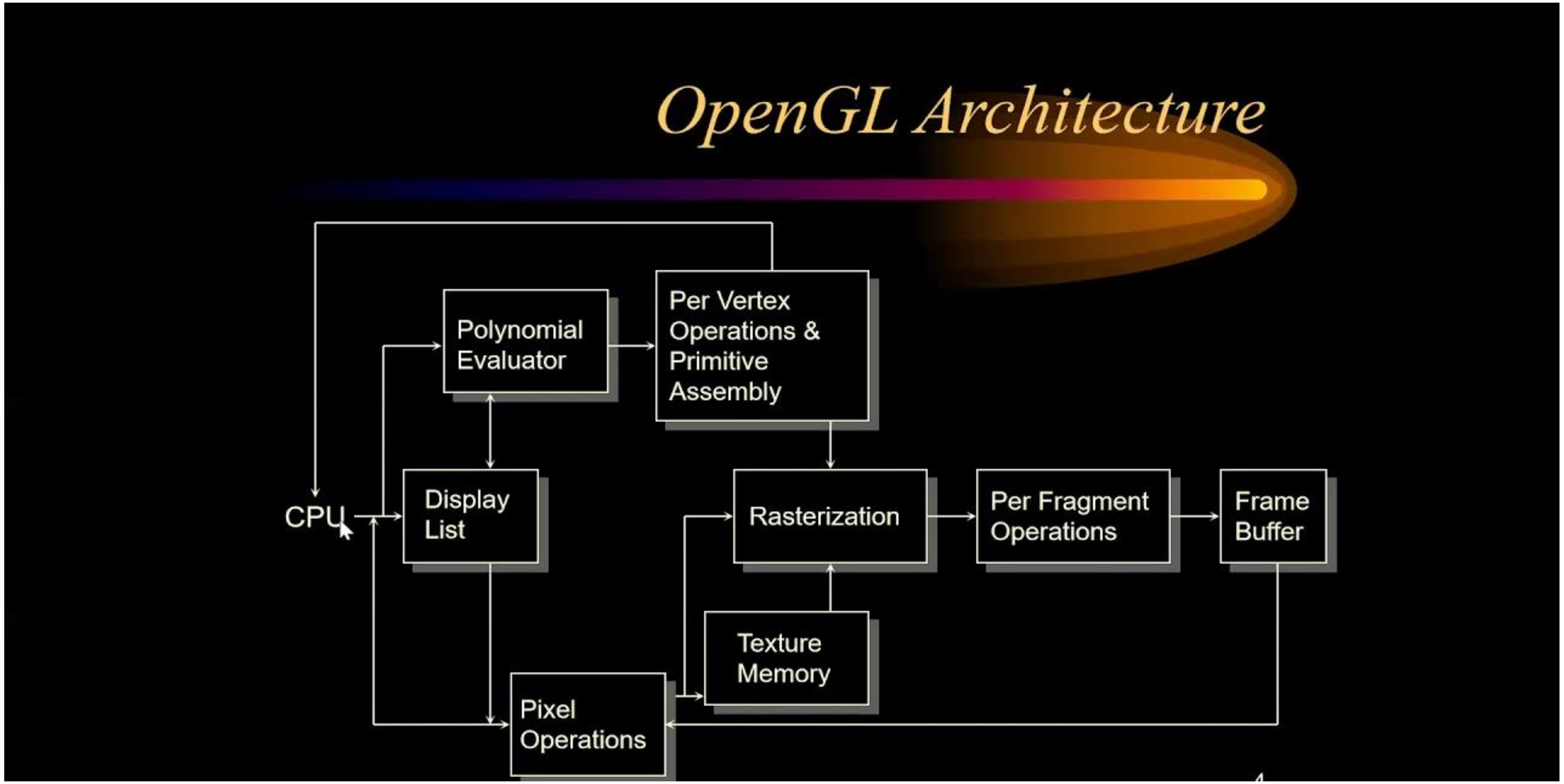
- Windowing toolkit (key, mouse handler, window events)

GLU

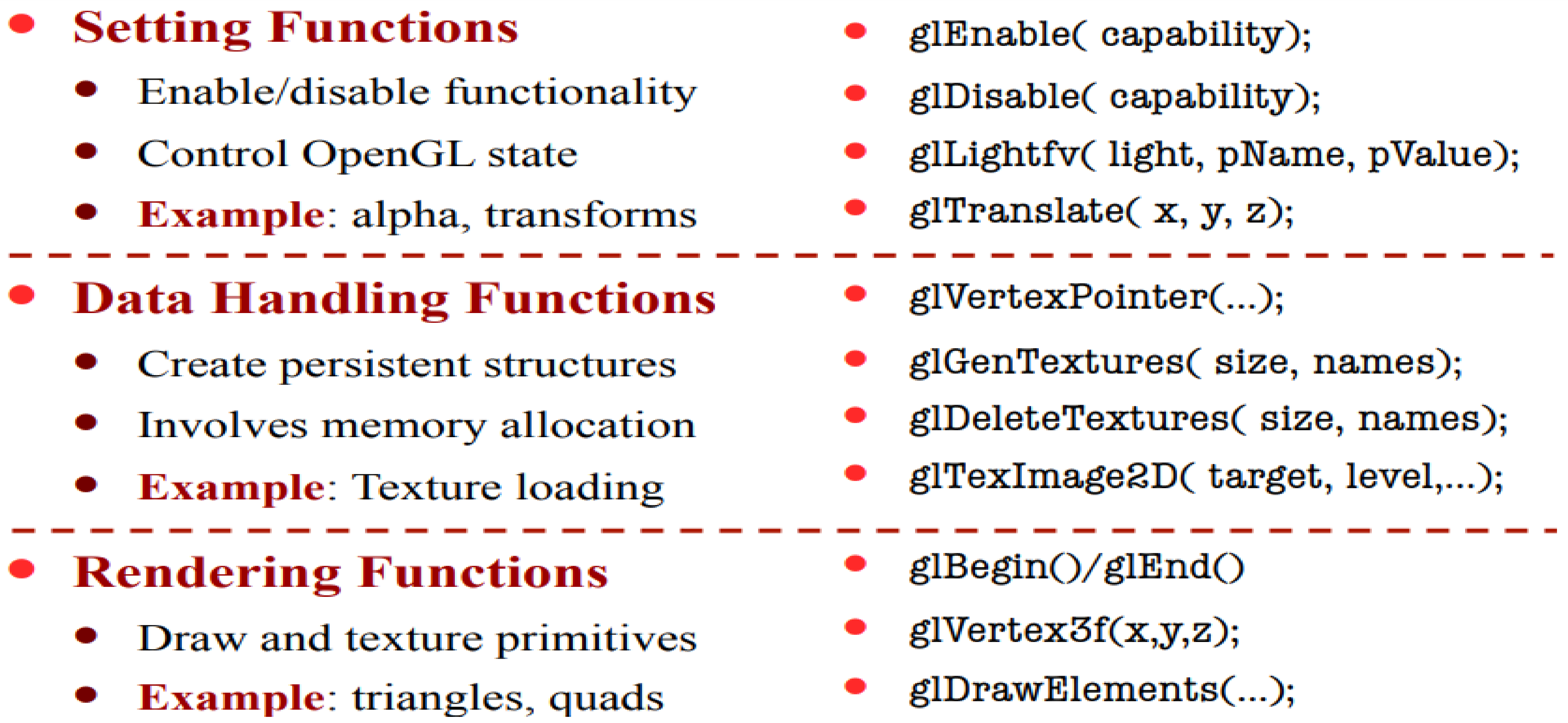
- Viewing –perspective/orthographic
- Image scaling, polygon tessellation
- Sphere, cylinders, quadratic surfaces

GL

- Primitives - points, line, polygons
- Shading and Colour
- Translation, rotation, scaling
- Viewing, Clipping, Texture
- Hidden surface removal


OpenGL Architecture
CPU
Polynomial Evaluator
Per Vertex Operations & Primitive Assembly
Display List
Rasterization
Per Fragment Operations
Frame Buffer
Texture Memory
Pixel Operations

TYPES OF OPENGL FUNCTIONS



- **Setting Functions**
  - Enable/disable functionality
  - Control OpenGL state
  - **Example**: alpha, transforms

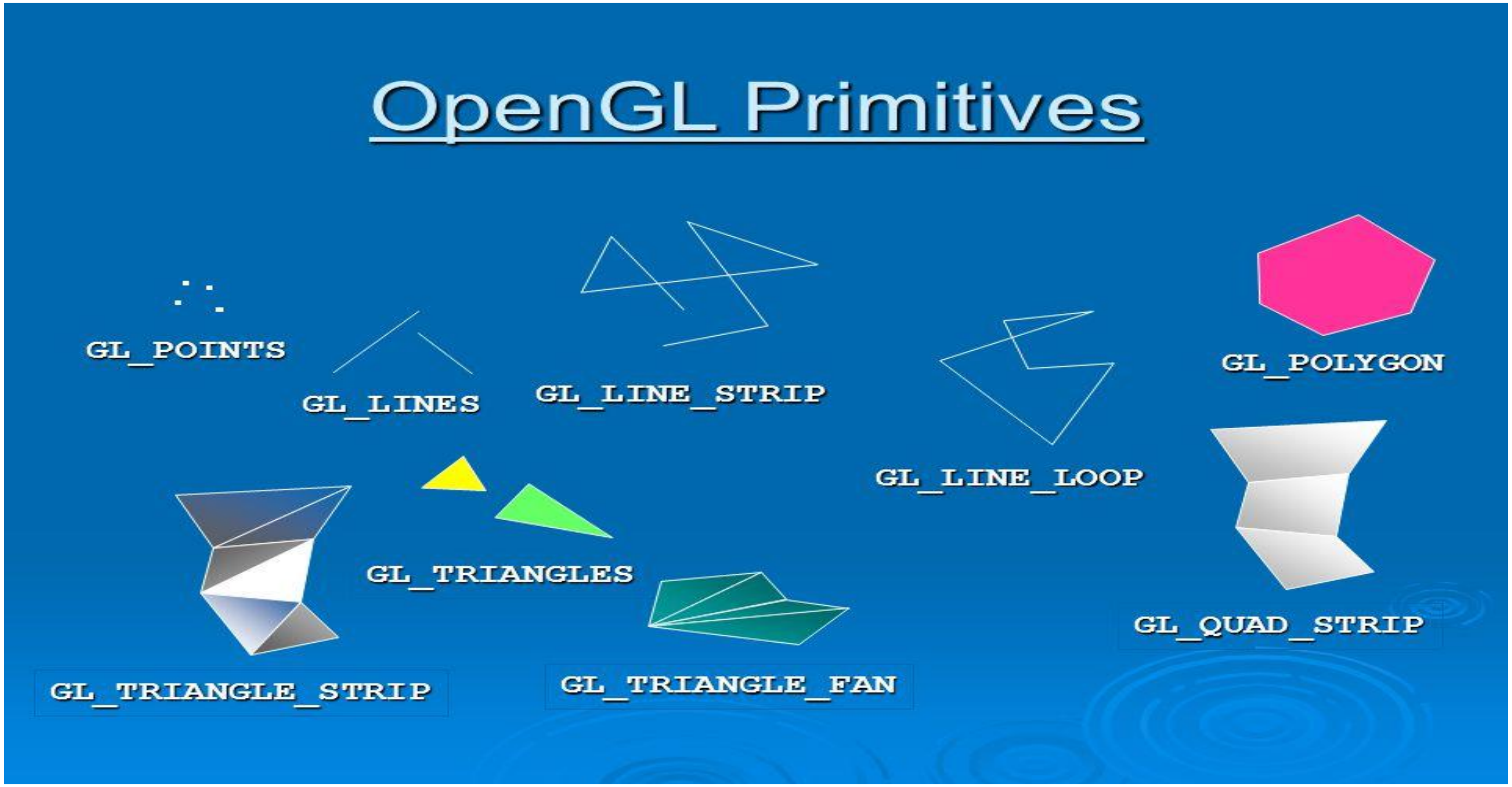
- glEnable(capability);
- glDisable(capability);
- glLightfv(light, pName, pValue);
- glTranslate(x, y, z);

- **Data Handling Functions**
  - Create persistent structures
  - Involves memory allocation
  - **Example**: Texture loading

- glVertexPointer(...);
- glGenTextures(size, names);
- glDeleteTextures(size, names);
- glTexImage2D(target, level,...);

- **Rendering Functions**
  - Draw and texture primitives
  - **Example**: triangles, quads

- glBegin()/glEnd()
- glVertex3f(x,y,z);
- glDrawElements(...);


OpenGL Primitives

```
glVertex2f(x1,y1);���������2�(�1,�1);
glEnd();
```

GL_POINTS:

- Treats each vertex as a single point.
- Vertex n defines a point n.
- N points are drawn.
- Sample:

$$glBegin(GL_POINTS);$$

$$glVertex2f(x1,y1);$$

$$glEnd();$$

GL_LINES:

- Treats each pair of vertices as an independent line segment.
- Vertices 2n-1 and 2n define a line n.
- N/2 lines are drawn.
- Sample:

$$glBegin(GL_LINES);$$

$$glVertex2f(x1,y1);$$

$$glVertex2f(x2,y2);$$

$$glEnd();$$

GL_LINE_STRIP:

- Draws a connected group of line segments from the first vertex to the last.
- Vertices n and n+1 define line n.
- N-1 lines are drawn.
- Sample:

$$glBegin(GL_LINE_STRIP);$$
$$glVertex2f(x1,y1);$$
$$glVertex2f(x2,y2);$$
$$glVertex2f(x3,y3);$$
$$glEnd();$$

GL_LINE_LOOP:

- Draws a connected group of line segments from the first vertex to the last, then back to the first.
- Vertices n and n+1 define line n.
- N lines are drawn.
- Sample

$$glBegin(GL_LINE_LOOP);$$
$$glVertex2f(x1,y1);$$
$$glVertex2f(x2,y2);$$
$$glVertex2f(x3,y3);$$
$$glEnd();$$

GL_TRIANGLES:

- Treats each triplet of vertices as an independent triangle.
- Vertices 3n-2, 3n-1, and 3n define triangle n.
- N/3 triangles are drawn.

$$glBegin(GL_TRIANGLES);$$
$$glVertex2f(x1,y1);$$
$$glVertex2f(x2,y2);$$
$$glVertex2f(x3,y3);$$
$$glEnd();$$

GL_QUADS:

- Treats each group of four vertices as an independent quadrilateral.
- Vertices 4n-3, 4n-2, 4n-1, and 4n define quadrilateral n.
- N/4 quadrilaterals are drawn.
- Sample

$$glBegin(GL_QUADS);$$
$$glVertex2f(x1,y1);$$
$$glVertex2f(x2,y2);$$
$$glVertex2f(x3,y3);$$
$$glVertex2f(x4,y4);$$
$$glEnd();$$

GL_TRIANGLE_STRIP:

- Draws a connected group of triangles.
- One triangle is defined for each vertex presented after the first two vertices.
- For odd n, vertices n, n+1, and n+2 define triangle n.
- For even n, vertices n+1, n, and n+2 define triangle n.
- N-2 triangles are drawn.
- Sample:

$$glBegin(GL_LINE_STRIP);$$

$$glVertex2f(x1, y1);$$

$$glVertex2f(x2, y2);$$

$$glVertex2f(x3, y3);$$

$$glEnd();$$

GL_TRIANGLE_FAN:

- Draws a connected group of triangles that fan around a central point.
- One triangle is defined for each vertex presented after the first two vertices.
- Vertices 1, n+1, and n+2 define triangle n.
- N-2 triangles are drawn.
- Sample:

$$glBegin(GL_TRIANGLE_FAN);$$

$$glVertex2f(x1, y1);$$

$$glVertex2f(x2, y2);$$

$$glVertex2f(x3, y3);$$

$$glVertex2f(x4, y4);$$

$$glEnd();$$

GL_QUAD_STRIP:

- Draws a connected group of quadrilaterals.
- One quadrilateral is defined for each pair of vertices presented after the first pair.
- Vertices 2n-1, 2n, 2n+2, and 2n+1 define quadrilateral n.
- N/2-1 quadrilaterals are drawn.
- Sample:

$$glBegin(GL_QUAD_STRIP);$$

$$glVertex2f(x1, y1);$$

$$glVertex2f(x2, y2);$$

$$glVertex2f(x3, y3);$$

$$glVertex2f(x4, y4);$$

$$glVertex2f(x5, y5);$$

$$glVertex2f(x6, y6);$$

$$glEnd();$$

GL_POLYGON:

- Draws a single and convex polygon.
- Vertices 1 through N define this polygon.
- A polygon is convex if all points on the line segment between any two points in the polygon or at the boundary of the polygon lie inside the polygon
- sample:

$$glBegin(GL_{P}OLYGON);$$

$$glVertex2f(x1, y1);$$

$$glVertex2f(x2, y2);$$

$$glVertex2f(x3, y3);$$

$$glVertex2f(x4, y4);$$

$$glVertex2f(x5, y5);$$

$$glEnd();$$

Thank You