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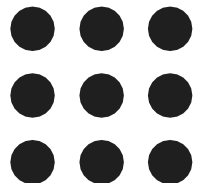
**Department of Information Technology & Artificial
Intelligence & DataScience**

Course Name – COMPUTER GRAPHICS

III Year / V Semester

**Unit 3 : MODELING AND TRANSFORMATIONS OF
OBJECTS**

**Topic : – INTRODUCTION TO SOLID MODELING WITH
POLYGONAL MESHES**



Introduction to Solid Modeling with Polygonal Meshes

GEOMETRIC MODELLING

- Geometric Modeling is the computer/software-generated mathematical representation of an object's geometry.
- It includes both graphical and non-graphical information.
- This information is stored in a database and displayed as a picture.
- It is then possible to edit and analyze the model in different ways.

REPRESENTATION OF GEOMETRIC MODELS

- There are two basic types of geometric models: a two-dimensional model, which is used for technical drawing, and a three-dimensional model, which is used for computer-aided design and manufacturing.
- **Two-Dimensional or 2D:** It projects a two-dimensional view and is used for flat objects.
- **Three-Dimensional or 3D:** This representation permits complete three-dimensional viewing of the model with intricate geometry. The leading process of geometric modeling in 3D is Solid modeling.

TYPES OF GEOMETRIC MODELINGS

Wireframe geometric modeling: Wireframe modeling uses information about vertices and edges to build the object.

❑ For example, a rectangle wireframe has 8 vertices and 12 edges.

❑ Some advantages of using wireframe are simple construction, less requirement of computer time and memory. However, users need to input both geometry and topology information.

Surface Modelling: Surface modeling is defining an object's exterior with an infinitesimally thin skin.

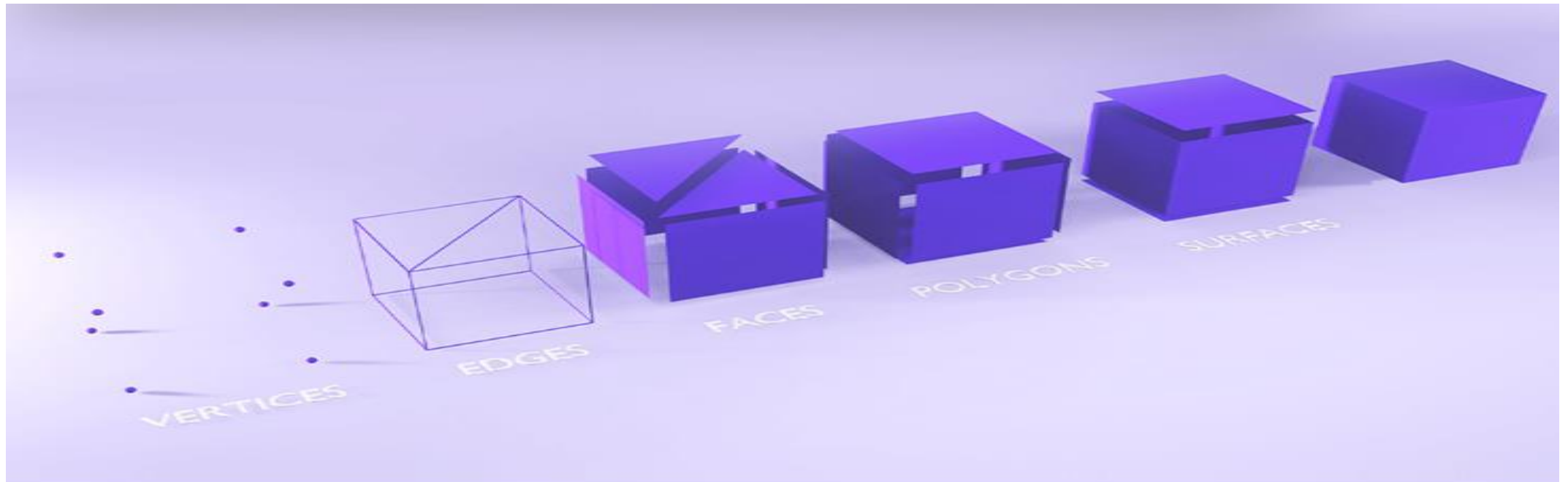
TYPES OF GEOMETRIC MODELINGS

Solids modelling

- ❖ Solid modeling also known as volume modeling, this is the most widely used method, providing a complete description of solid modeling.
- ❖ Solid modeling tools allow you to build many sides of an object at once. Solid models make multiple sides at once, reducing the ambiguity in surface modeling.

POLYGON MESH

- **A polygon mesh is the collection of vertices, edges, and faces used to define the shape and the contour of the 3D object. It is the oldest form of geometry representation used in computer graphics to create objects in 3D space.**



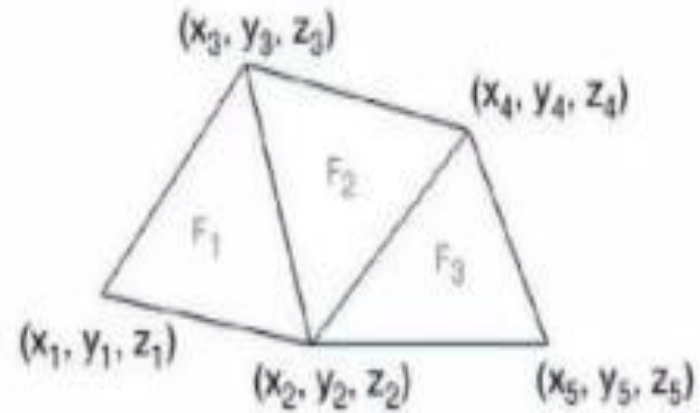
POLYGON MESH: ELEMENTS

- **Vertices** — points in 3D space that comprise a face and store the x, y, and z coordinates information.
- **Edges** — lines that connect two vertices.
- **Faces** — closed set of edges where three-edged face forms a triangle mesh and a four-edged face — a quad. Faces contain surface information used for lighting and shadows.
- **Polygons** — a set of faces (usually when you have more than four connected vertices).
- **Surfaces** — groups of connected polygons that define different elements of the mesh.

Vertex and Face Tables

Each face lists vertex references

- Shared vertices
- Still no topology information



VERTEX TABLE			
V ₁	X ₁	Y ₁	Z ₁
V ₂	X ₂	Y ₂	Z ₂
V ₃	X ₃	Y ₃	Z ₃
V ₄	X ₄	Y ₄	Z ₄
V ₅	X ₅	Y ₅	Z ₅

FACE TABLE			
F ₁	V ₁	V ₂	V ₃
F ₂	V ₂	V ₄	V ₃
F ₃	V ₂	V ₅	V ₄

POLYGON MESH

- Polygonal Meshes can model both solid shapes and thin skins. –
 - The object is solid if the polygonal faces fit together to enclose space.
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 - In other cases, the faces fit together without enclosing space, and so they represent an infinitesimally thin surface.
 - In both cases we call the collection of polygons a polygonal mesh (or simply a mesh).

Some predefined Solid Models in OpenGL:

```
Cube:      glutSolidCube (Gldouble size) ;  
Sphere:   glutSolidSphere (... ) ;  
Torus:    glutSolidTorus (... ) ;  
Teapot:   glutSolidTeapot (Gldouble size) ;  
Cone:     glutSolidCone (... ) ;
```

Solid Modeling - Example

