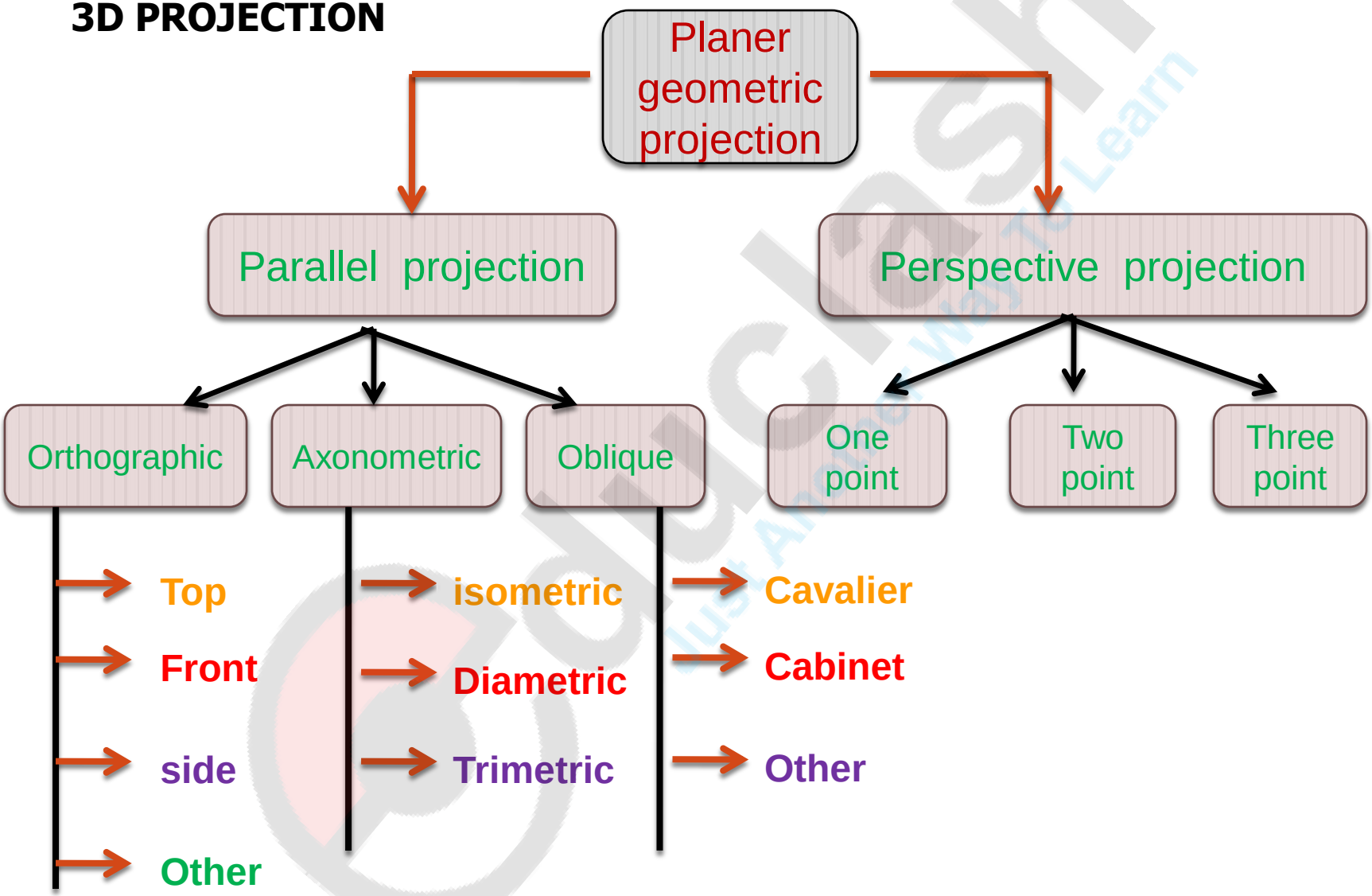
3D DISPLAY METHODS

3D DISPLAY METHODS

- The problem of representing a three-dimensional object or scene in a two-dimensional medium – is known as the problem of *projection*.
- Viewing 3D objects on a 2D display requires a mapping from 3D to 2D.
- Ways of projecting objects onto the view plane:
  - **Parallel projection** and
  - **Perspective projection**.

3D PROJECTION



Parallel Projection

Basic Principles

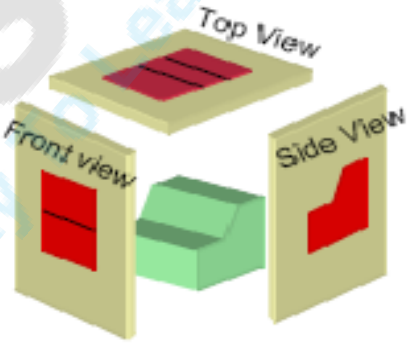
- Used by drafters and engineers to create working drawings of an object which preserves its scale and shape.
- In parallel projection, z-coordinate is discarded and parallel lines from each vertex on the object are extended until they intersect the view plane.
- The point of intersection is the projection of the vertex.
- We connect the projected vertices by line segments, which correspond to connections on the original object.

Type of Parallel Projection

- There are two types, Depending on the relation between the direction of projection and the normal to the view plane.
  - Orthographic parallel projection.
  - Oblique parallel projection
- When the direction of the projection is perpendicular to the view plane, we have **orthographic parallel projection**.
- Otherwise, we have an **oblique parallel projection**.

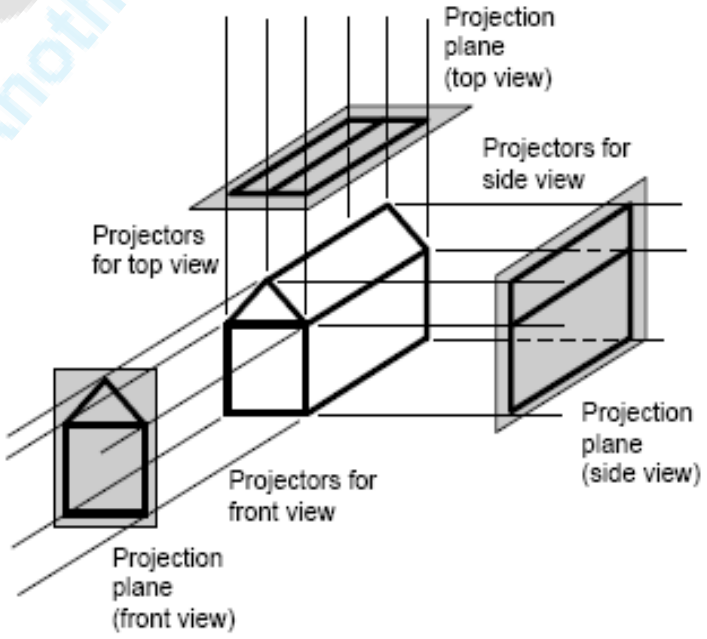
ORTHOGRAPHIC PARALLEL PROJECTION

- Types of Orthographic parallel projection:
  - **Front projection**
  - **Top projection**
  - **side projection**.



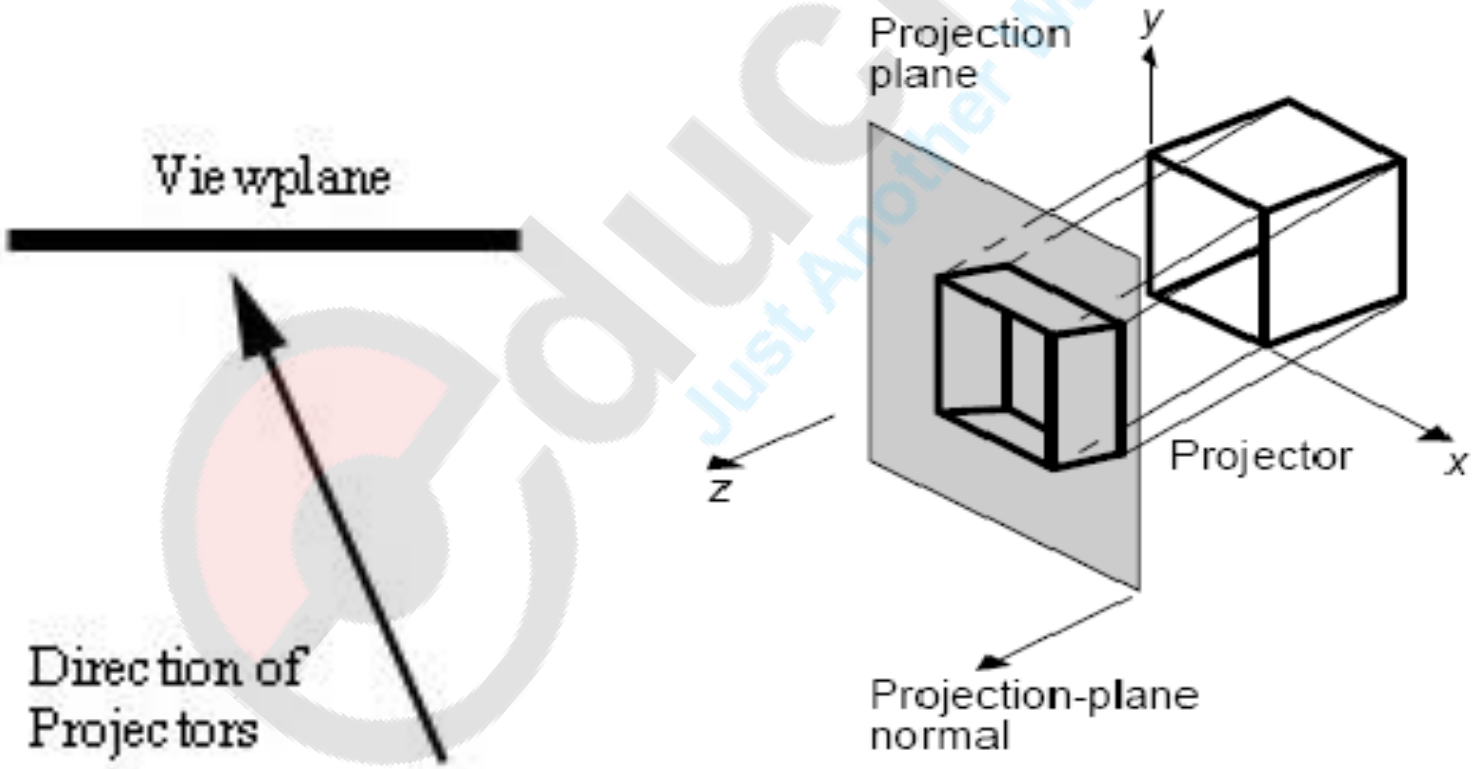
- In all these, the projection plane (view plane) is perpendicular to the principle axis

- **Used** : In engineering drawing to depict machine parts, buildings and so on.



OBLIQUE PARALLEL PROJECTION

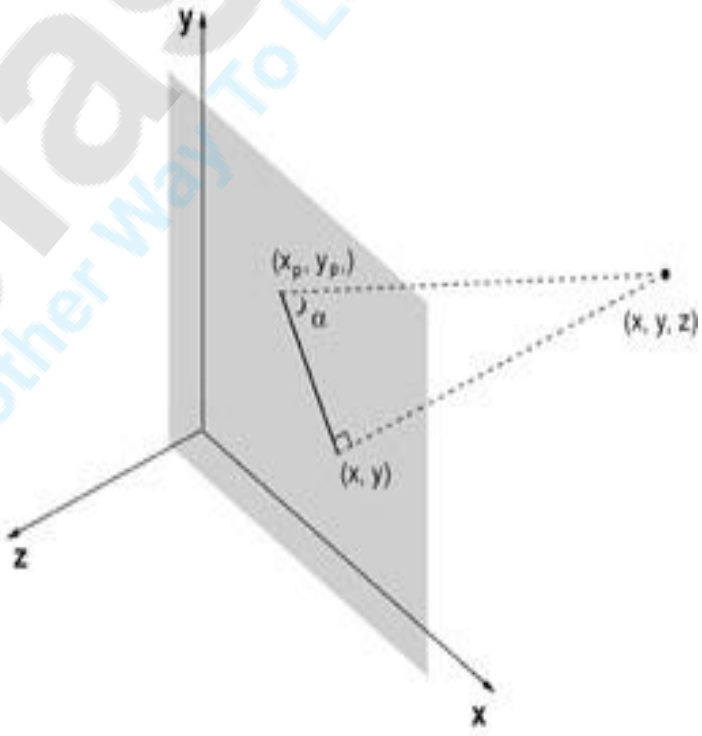
- If the direction of projection is not perpendicular to the projection plane then it is an **oblique** projection.



OBLIQUE PARALLEL PROJECTION

- Types:
  - **Cavalier**
  - **cabinet projections**.
- Cavalier and cabinet projections differ by the value used for the angle *alpha*.
- Angle *alpha* is defined as the angle between the oblique projection line from (x, y, z) to (x_p, y_p) and the line on the view plane from (x, y) to (x_p, y_p) .
- Two commonly used values for

  alpha = 45°, and alpha = 63.40°,



OBLIQUE PARALLEL PROJECTION

1) Cavalier projection:

- In, this direction of projection is chosen so that there is no foreshortening of lines perpendicular to the xy plane.
- When *alpha* = 45 , the projection is a **cavalier** projection.
- all lines perpendicular to the projection plain are projected with no change in length.
- **Alpha = 45°, tan (Alpha) = 1 , L1 = 1**

2) Cabinet projection:

- The direction of projection is chosen so that lines perpendicular to the xy planes are foreshortened by half their lengths.
- When *alpha* = 63.4°, the projection is labeled as a **cabinet** projection.
- **Alpha= 63.40°, tan (Alpha) = 2 , L1 = 1 / 2**

PARALLEL PROJECTION

- **Axonometric orthographic projection:**

  The orthographic projection can display more than one face of an object. Such orthographic projection is called **axonometric** orthographic projection.

- It uses projection planes (view planes) that are not normal to a principle axis.
- Parallelism of lines is preserved but angles are not.

Types of Axonometric projections

1) **Isometric**

The direction of projection makes equal angles with all of the three principal axes

2) **Dimetric**

The direction of projection makes equal angles with exactly two of the principal axes

3) **Trimetric**

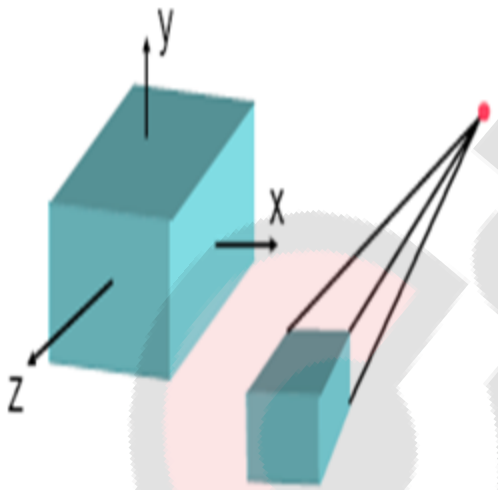
The direction of projection makes unequal angles with the three principal axes

TYPES OF PERSPECTIVE PROJECTION

- The perspective projection of any set of parallel lines that are not parallel to the projection plane converge to a **vanishing point**.
- The vanishing point for any set of lines that are parallel to one of the three principle axes of an object is referred to as a **principle vanishing point** or **axis vanishing point**.
- There are at most three such points, corresponding to the number of principle axes cut by the projection plane.

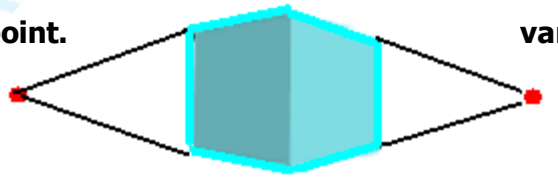
PERSPECTIVE PROJECTION

- The perspective projection is classified according to number of principle vanishing points in a projection:
- **one-point, two-points or three-point projections.**



One point (z axis)
Perspective Projection

X axis
vanishing point.



Z axis
vanishing point.

Two point.
Perspective Projection

Q. Write a note on Perspective projection ? 5m

Q. Compare & contrast Parallel and perspective projection ? 5m

Q. Discuss types of projection in computer graphics ? 10m

Q. Explain three dimensional display methods ? 10m

Difference between parallel and perspective projection:

1. In parallel projection there is no vanishing point . In Perspective projection there is vanishing point
2. If the distance between center of projection to the projection plane is infinite the projection is parallel, while if it is finite the projection is perspective

3. perspective views require a distance between a theoretical camera and target point. Small distances produce harsh perspective effects; large distances produce mild effects.

fig shows the same model in both a parallel projection and perspective projection. Both are based on the same viewing direction.

Parallel projection

Perspective projection

4. The parallel projection lacks the realistic effects of foreshortening. which is an attribute of perspectivity

5. Describing perspective transformation we specify center of projection while we specify direction in case of parallel projection

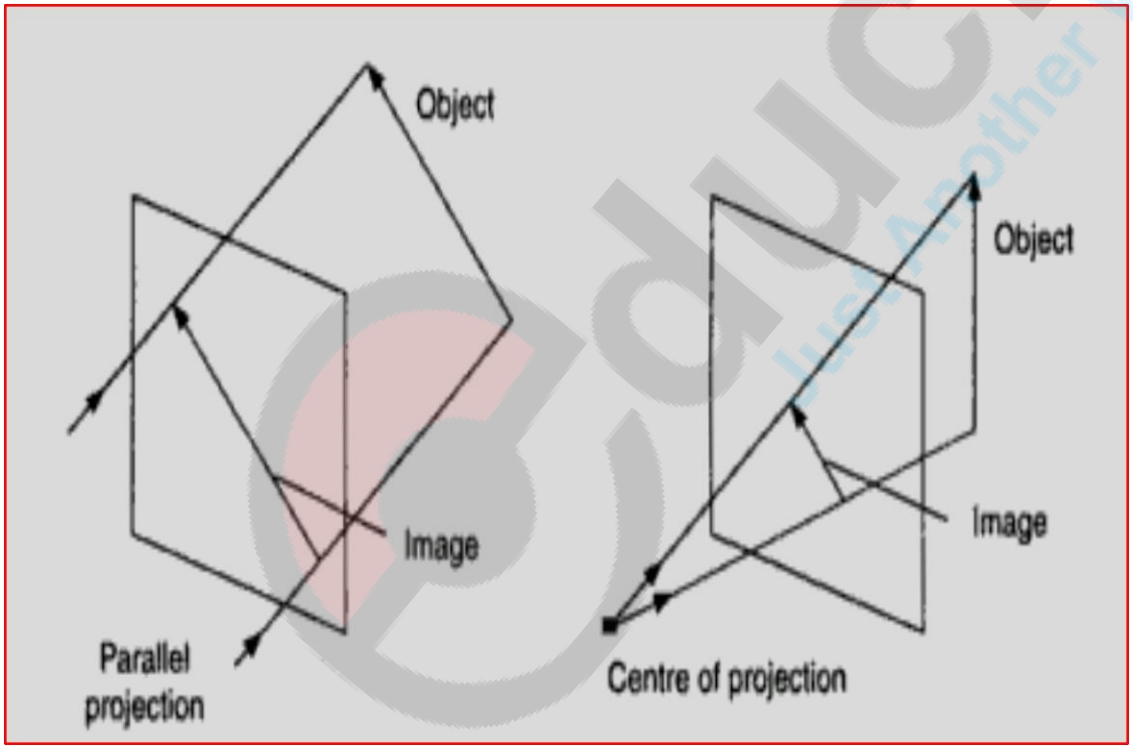


Fig
(a) parallel projection
(b) Perspective projection

A parallel projection is perspective projection with center of projection at infinite