Classical Viewing

Objectives

- Introduce the classical views
- Compare and contrast image formation by computer with how images have been formed by architects, artists, and engineers
- Learn the benefits and drawbacks of each type of view

Classical Viewing

- Viewing requires three basic elements
  - One or more objects
  - A viewer with a projection surface
  - Projectors that go from the object(s) to the projection surface
- Classical views are based on the relationship among these elements
  - The viewer picks up the object and orients it how she would like to see it
- Each object is assumed to constructed from flat *principal faces*
  - Buildings, polyhedra, manufactured objects

Planar Geometric Projections

- Standard projections project onto a plane
- Projectors are lines that either
  - converge at a center of projection (COP)
  - are parallel
- Such projections preserve lines
  - but not necessarily angles
- Nonplanar projections are needed for applications such as map construction

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Classical Projections

Front elevation   Elevation oblique   Plan oblique

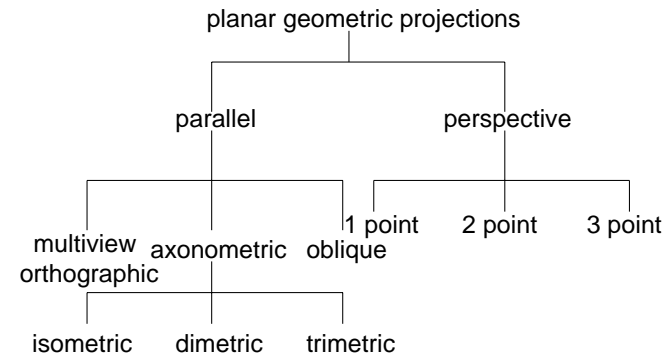Isometric   One-point perspective   Three-point perspective
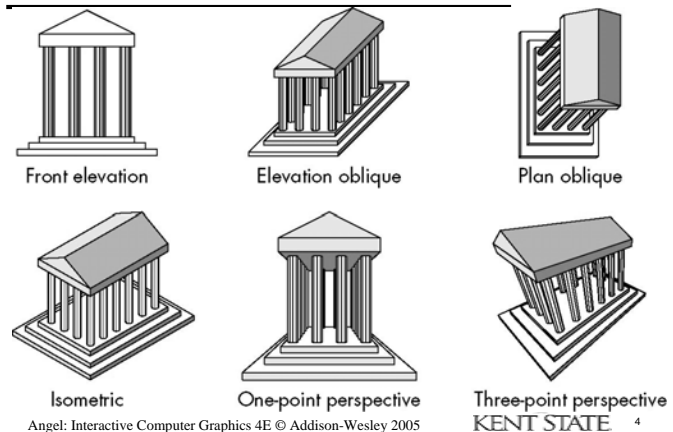
Perspective vs Parallel

- Computer graphics treats all projections the same and implements them with a single pipeline
- Classical viewing developed different techniques for drawing each type of projection
- Fundamental distinction is between parallel and perspective viewing even though mathematically parallel viewing is the limit of perspective viewing

Taxonomy of Planar Geometric Projections

planar geometric projections

parallel   perspective

                                    1 point   2 point   3 point

multiview   axonometric   oblique
orthographic

isometric   dimetric   trimetric

Perspective Projection
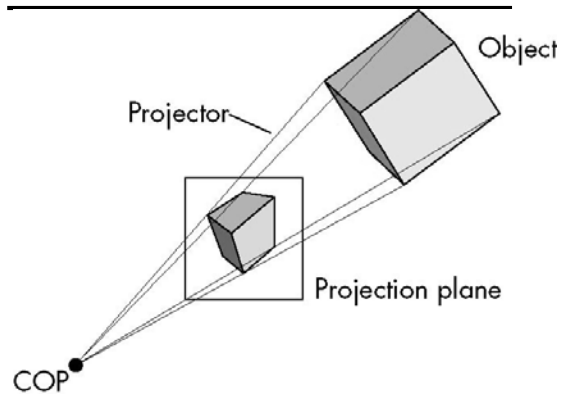
Parallel Projection
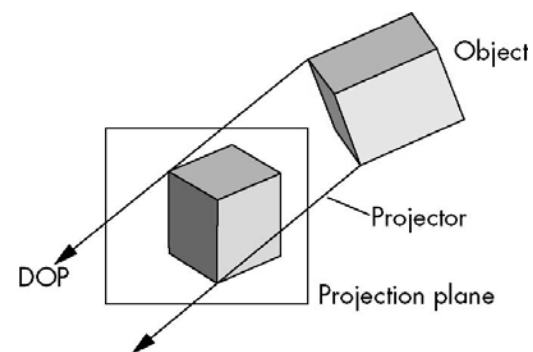
Orthographic Projection
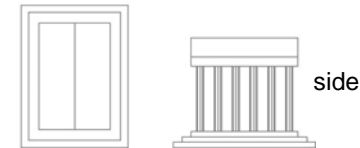
Projectors are orthogonal to projection surface
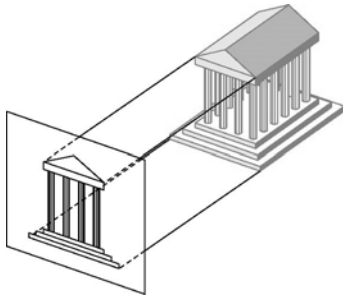
Multiview Orthographic Projection

- Projection plane parallel to principal face
- Usually form front, top, side views

isometric (not multiview orthographic view)

front

in CAD and architecture, we often display three multiviews plus isometric

top

side

Advantages and Disadvantages

- Preserves both distances and angles
  - Shapes preserved
  - Can be used for measurements
    - Building plans
    - Manuals
- Cannot see what object really looks like because many surfaces hidden from view
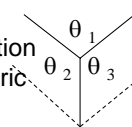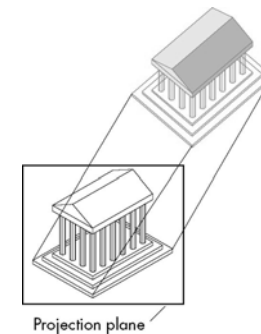 - Often we add the isometric

Axonometric Projections

Allow projection plane to move relative to object

classify by how many angles of a corner of a projected cube are the same *or*
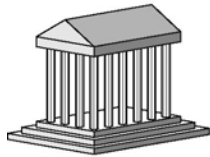no. of principal faces the projection plane is symmetric with respect to

θ_1

θ_2 θ_3

none: trimetric
two: dimetric
three: isometric

Projection plane

3

Types of Axonometric Projections

Dimetric   Trimetric   Isometric
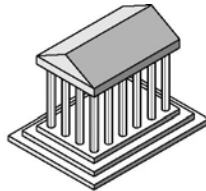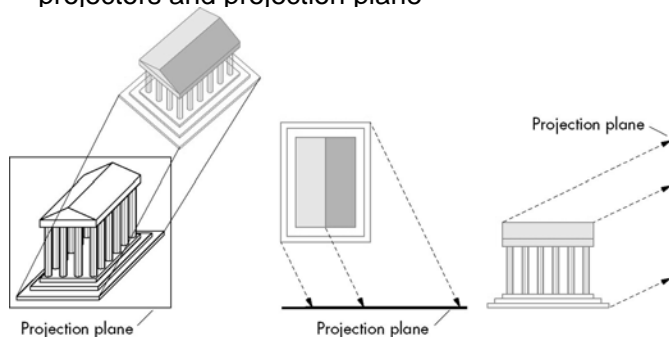
Advantages and Disadvantages

- Lines are scaled (*foreshortened*) but can find scaling factors
- Lines preserved but angles are not
  - Projection of a circle in a plane not parallel to the projection plane is an ellipse
- Can see three principal faces of a box-like object
- Some optical illusions possible
  - Parallel lines appear to diverge
- Does not look real because far objects are scaled the same as near objects
- Used in CAD applications

Oblique Projection

Most General : Arbitrary relationship between projectors and projection plane

Advantages and Disadvantages

- Can pick the angles to emphasize a particular face
  - Architecture: plan oblique, elevation oblique
- Angles in faces parallel to projection plane are preserved while we can still see "around" side
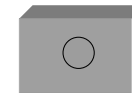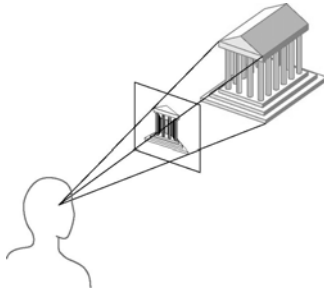

- In physical world, cannot create with simple camera; possible with bellows camera or special lens (architectural)

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Perspective Projection

Projectors coverge at center of projection

Vanishing Points

- Parallel lines (not parallel to the projection plane) on the object converge at a single point in the projection (the *vanishing point*)
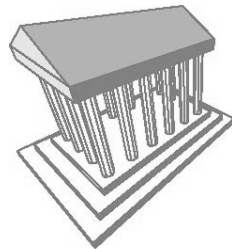- Drawing simple perspectives by hand uses these vanishing point(s)
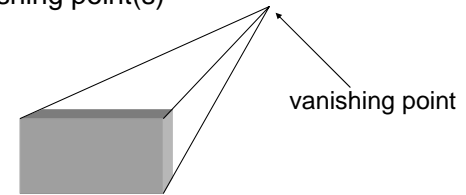
vanishing point

Three-Point Perspective

- No principal face parallel to projection plane
- Three vanishing points for cube

Three-Point Perspective

- No principal face parallel to projection plane
- Three vanishing points for cube

Two-Point Perspective

- On principal direction parallel to projection plane
- Two vanishing points for cube
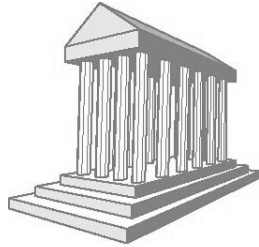
Two-Point Perspective

- One principal direction parallel to projection plane
- Two vanishing points for cube
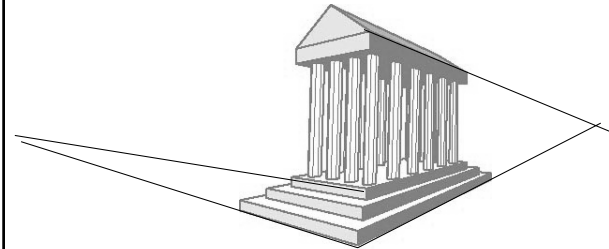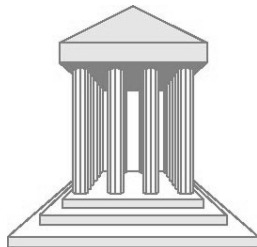
One-Point Perspective

- One principal face parallel to projection plane
- One vanishing point for cube

One-Point Perspective

- One principal face parallel to projection plane
- One vanishing point for cube

Advantages and Disadvantages

- Objects further from viewer are projected smaller than the same sized objects closer to the viewer (*diminution*)
  - Looks realistic
- Equal distances along a line are not projected into equal distances (*nonuniform foreshortening*)
- Angles preserved only in planes parallel to the projection plane
- More difficult to construct by hand than parallel projections (but not more difficult by computer)

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