



# Classical Viewing

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# Objectives

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- 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



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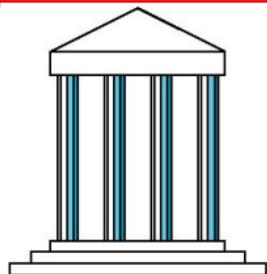
# Planar Geometric Projections

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

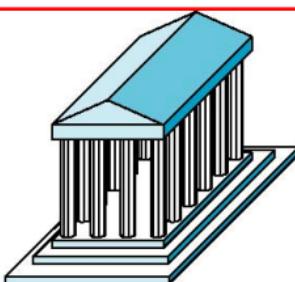


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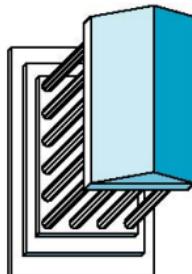
# Classical Projections



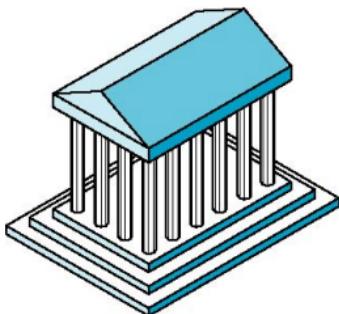
Front elevation



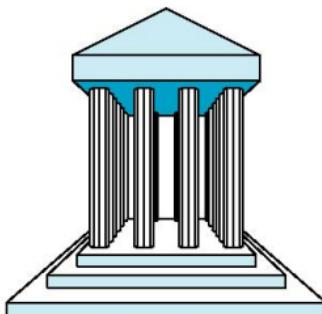
Elevation oblique



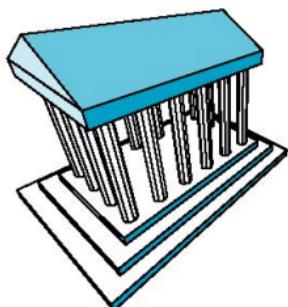
Plan oblique



Isometric



One-point perspective



Three-point perspective



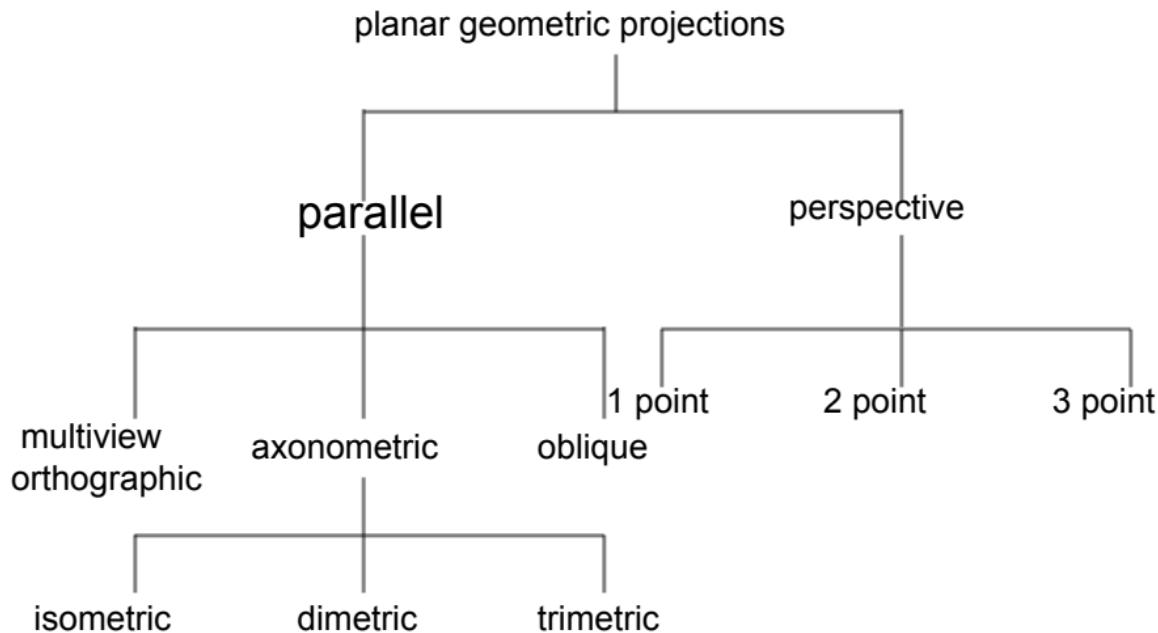
# Perspective vs Parallel

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- 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



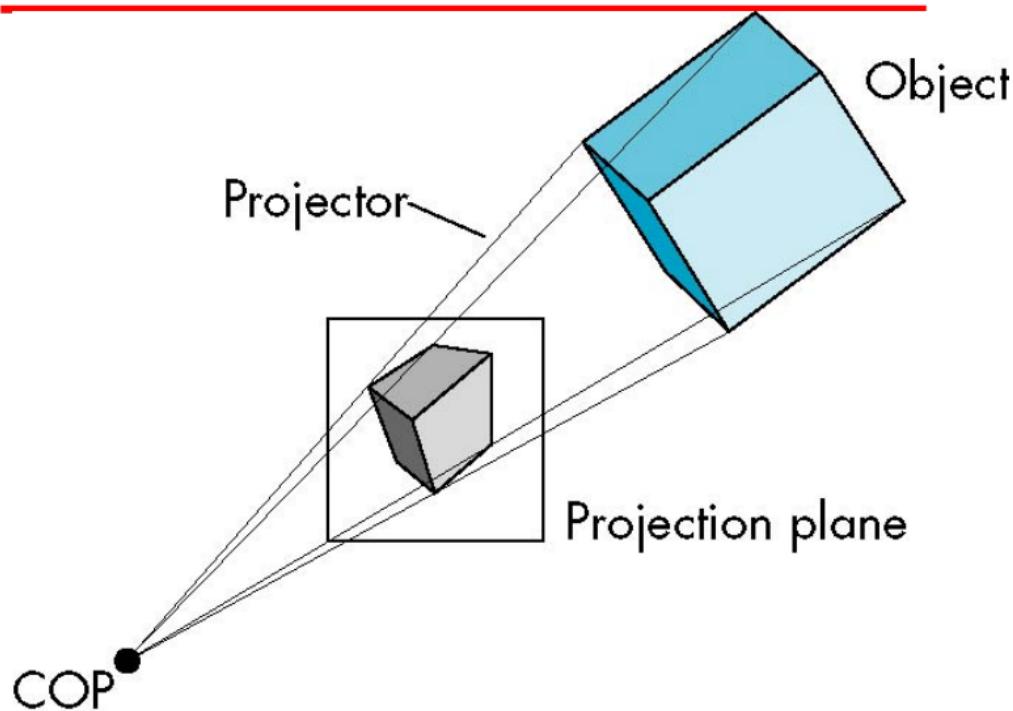
# Taxonomy of Planar Geometric Projections





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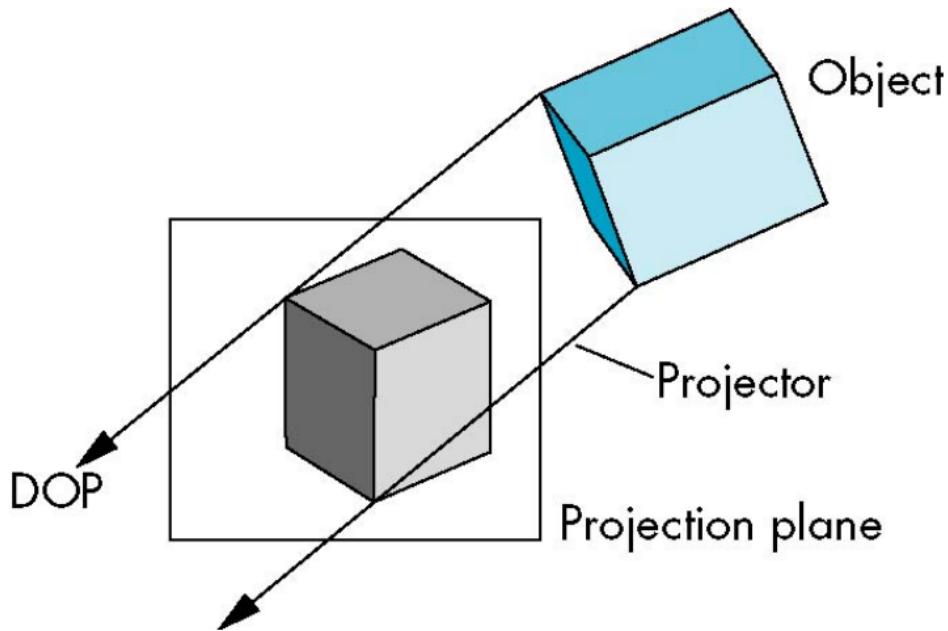
# Perspective Projection





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# Parallel Projection



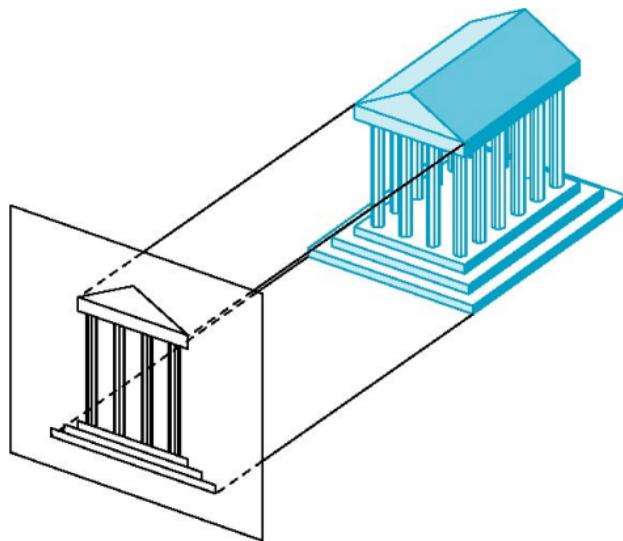


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# Orthographic Projection

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Projectors are orthogonal to projection surface



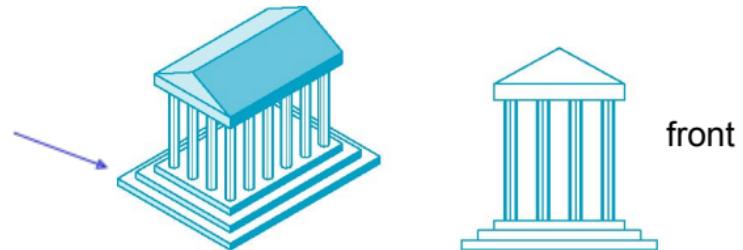


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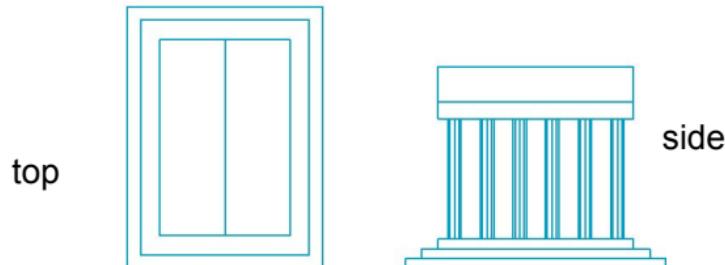
# Multiview Orthographic Projection

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

isometric (not multiview  
orthographic view)



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





# Advantages and Disadvantages

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- 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

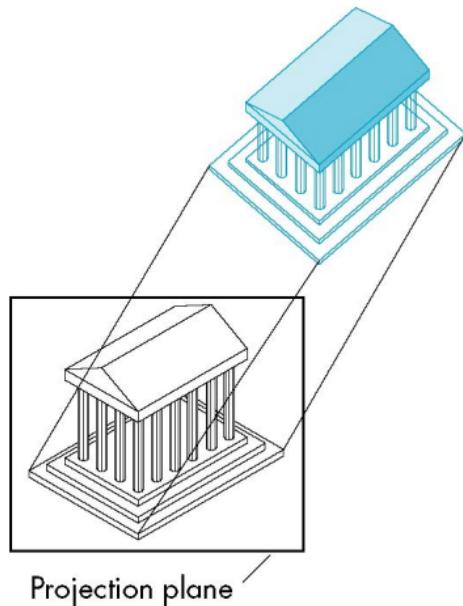
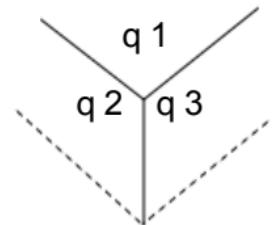


# Axonometric Projections

Allow projection plane to move relative to object

classify by how many angles of  
a corner of a projected cube are  
the same

- none: trimetric
- two: dimetric
- three: isometric

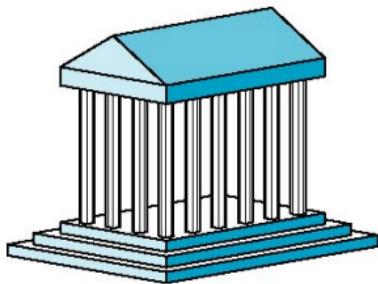




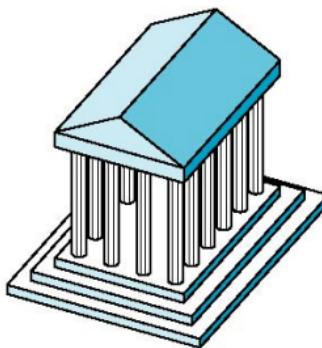
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# Types of Axonometric Projections

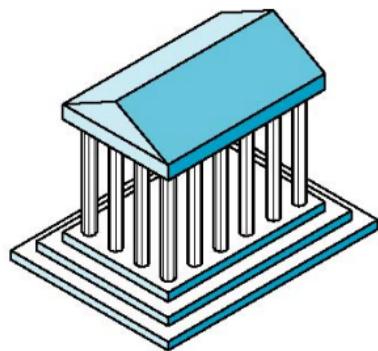
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Dimetric



Trimetric



Isometric



# Advantages and Disadvantages

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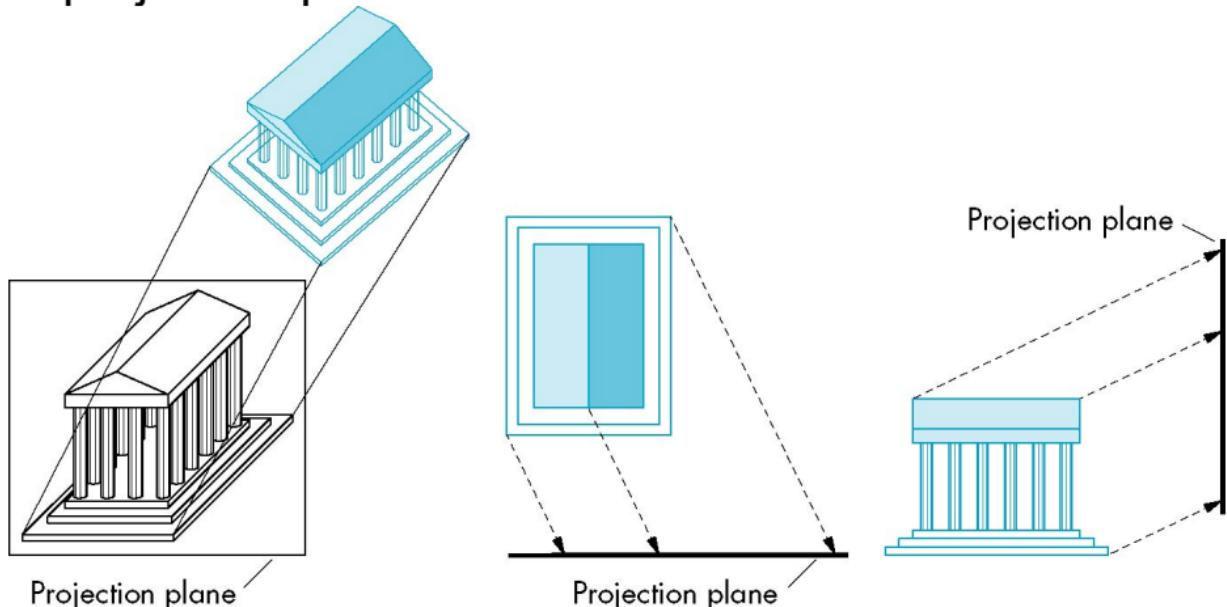
- Lines are scaled (*foreshortened*) but can find scaling factors
- Lines preserved but angles are not
  - Projection of a circle in a plane not parallel to the projection plane is an ellipse
- Can see three principal faces of a box-like object
- Some optical illusions possible
  - Parallel lines appear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



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# Oblique Projection

Arbitrary relationship between projectors and projection plane

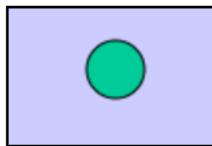




# Advantages and Disadvantages

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- 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)

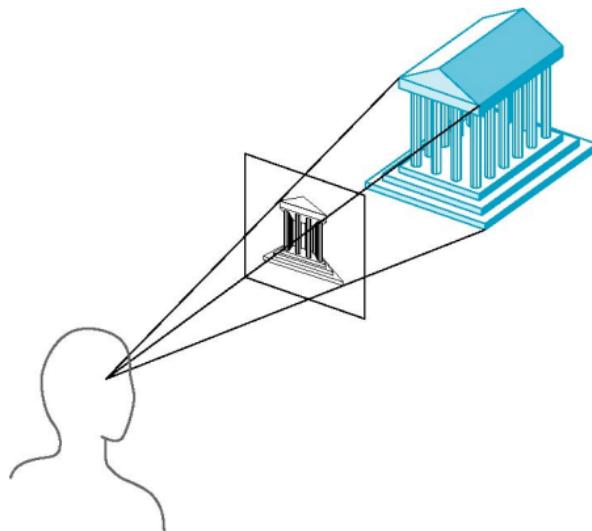


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# Perspective Projection

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Projectors converge at center of projection

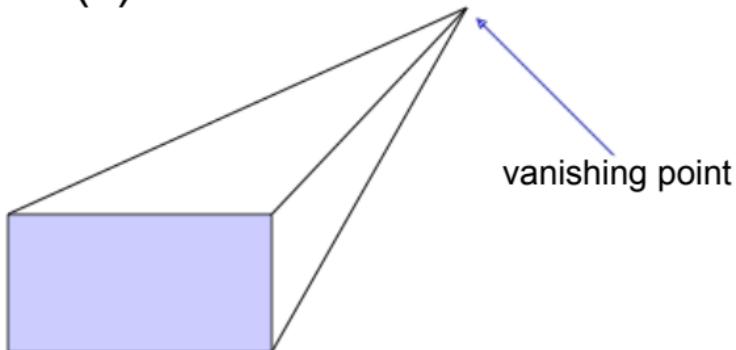




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# Vanishing Points

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





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# Three-Point Perspective

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





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# Two-Point Perspective

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





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# One-Point Perspective

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





# Advantages and Disadvantages

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- 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)