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Classical Viewing

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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 be constructed from flat *principal faces*
 - Buildings, polyhedra, manufactured objects



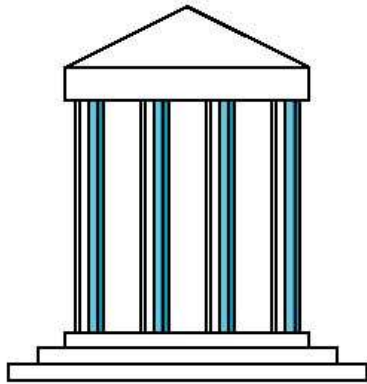
Planar Geometric Projections

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

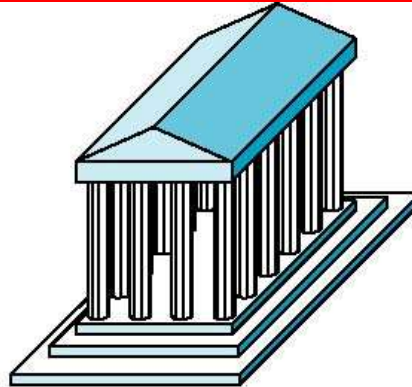


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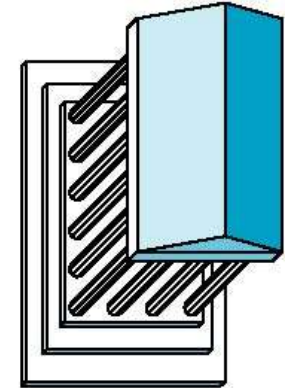
Classical Projections



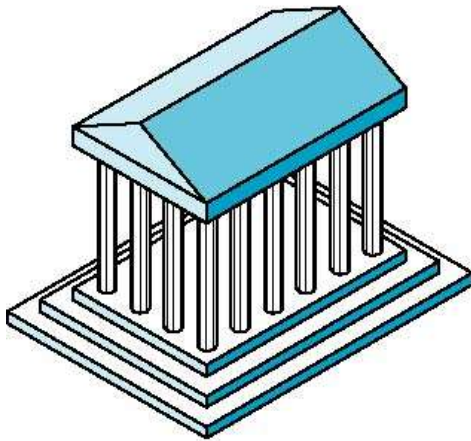
Front elevation



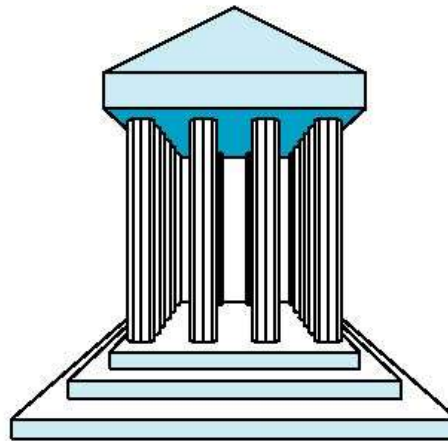
Elevation oblique



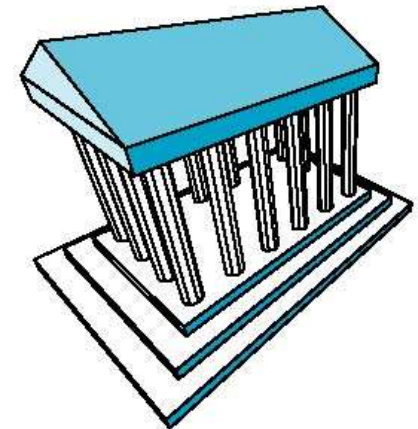
Plan oblique



Isometric



One-point perspective



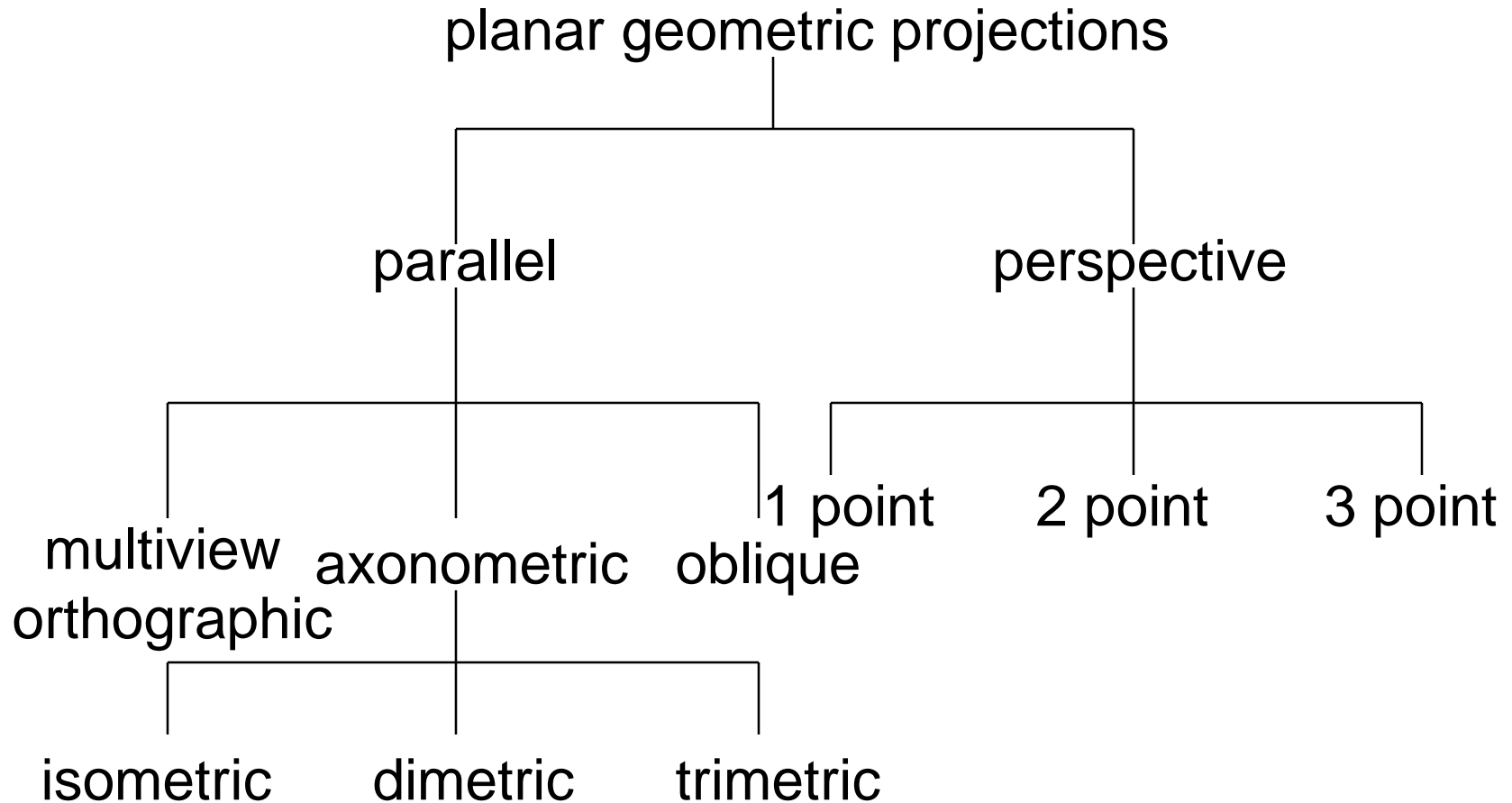
Three-point perspective



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

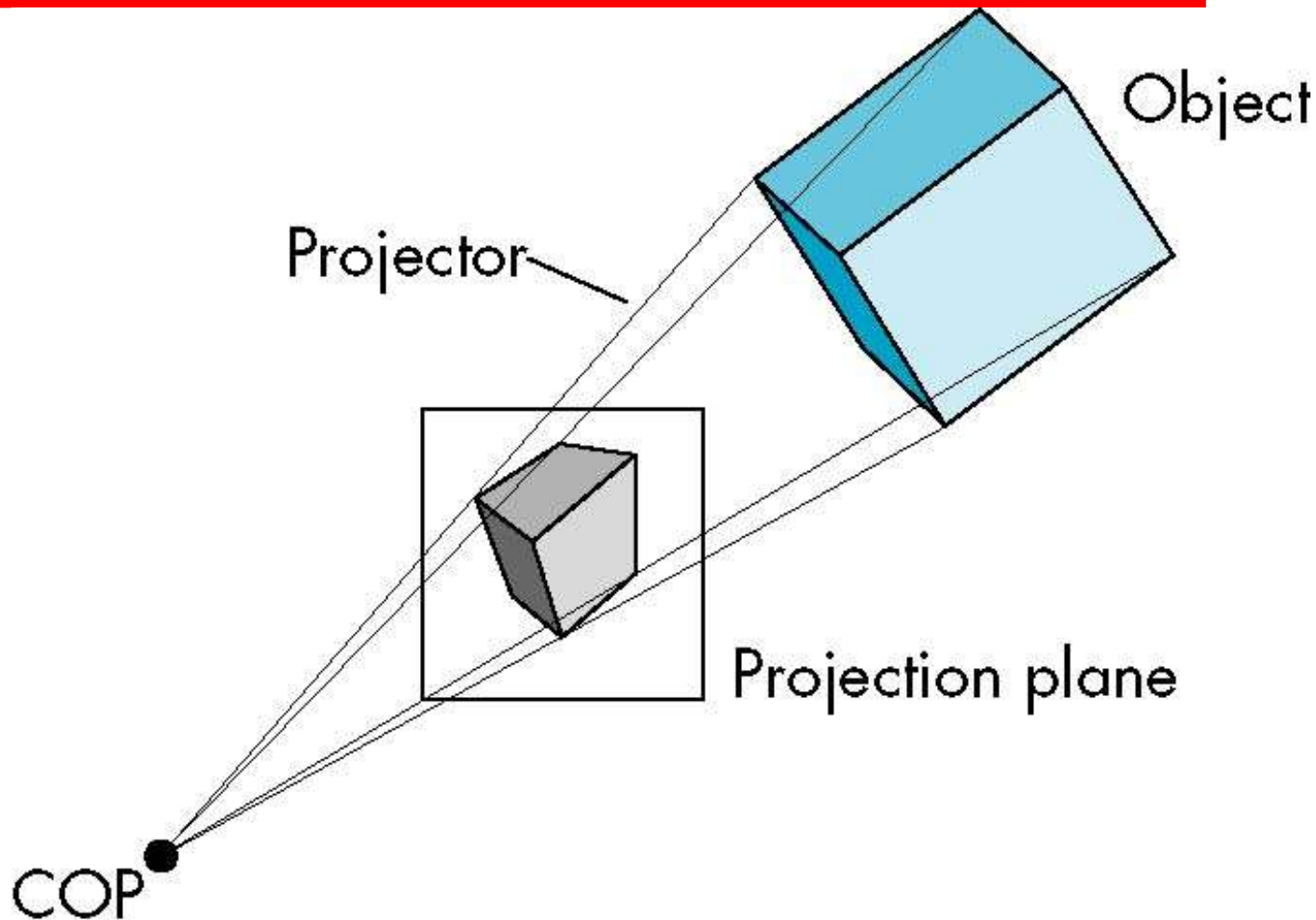
Taxonomy of Planar Geometric Projections





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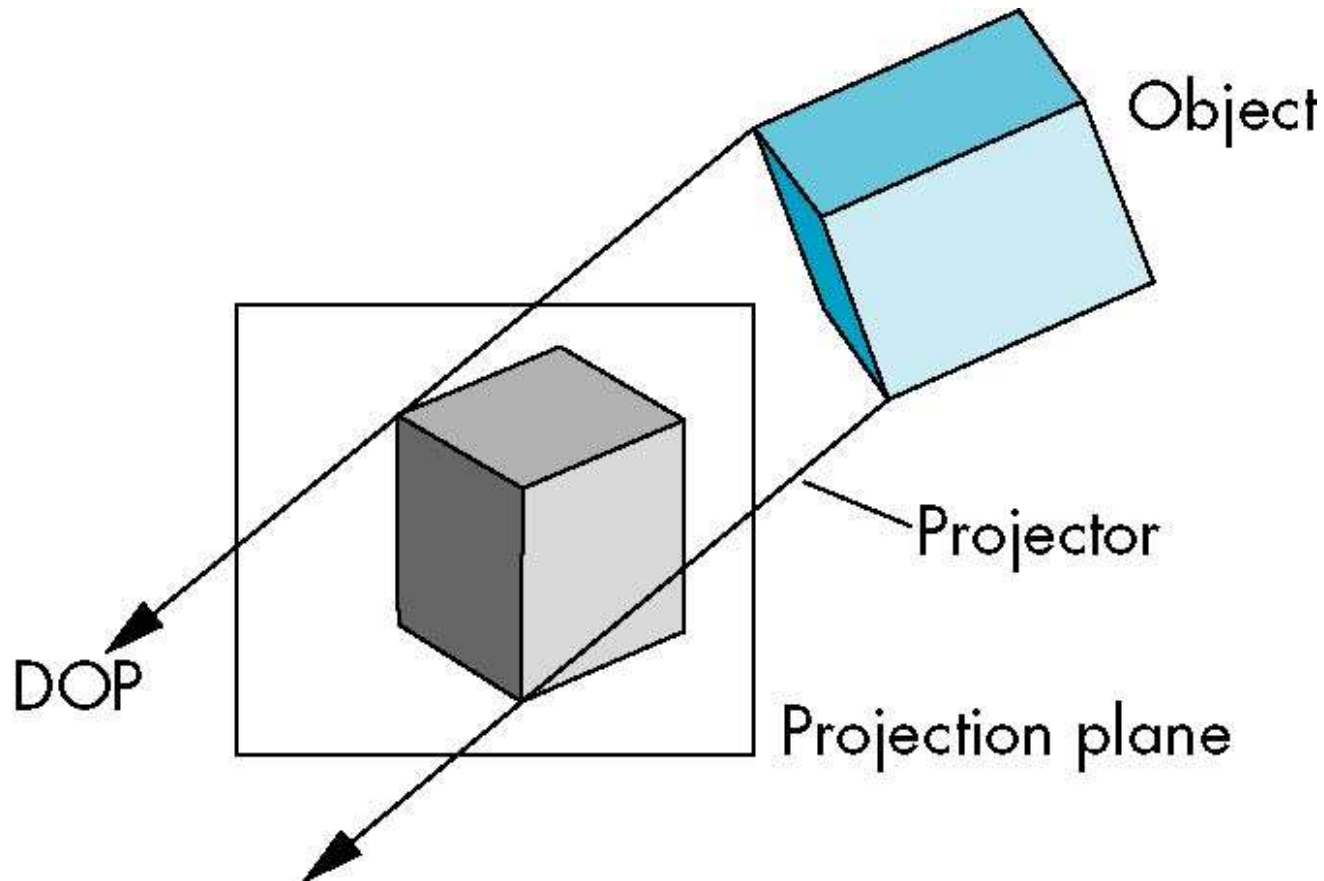
Perspective Projection





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Parallel Projection

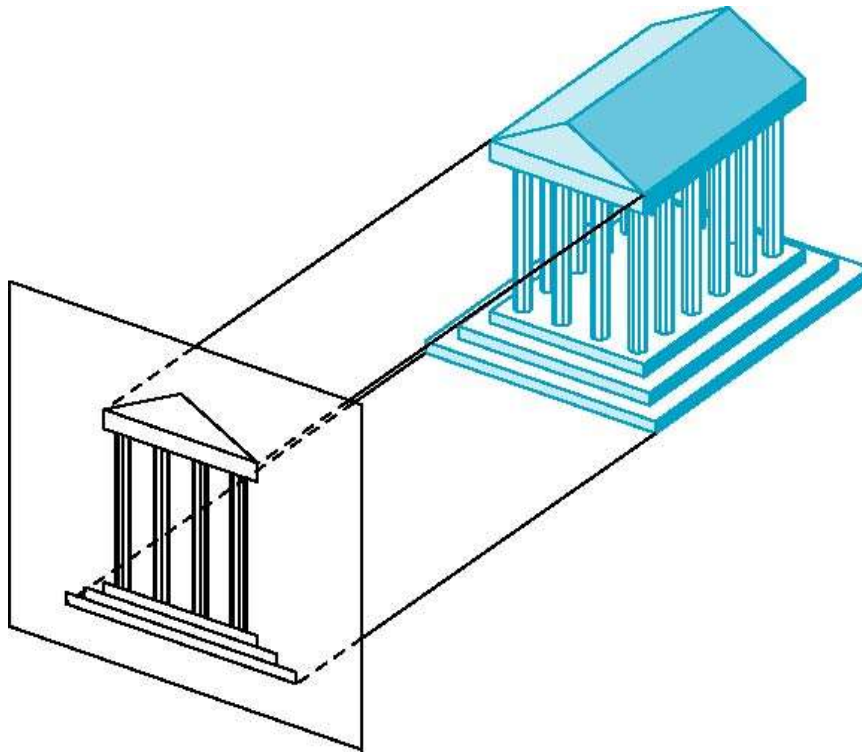




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Orthographic Projection

Projectors are orthogonal to projection surface





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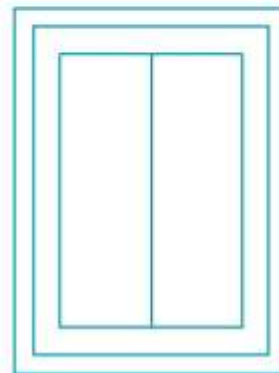
Multiview Orthographic Projection

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

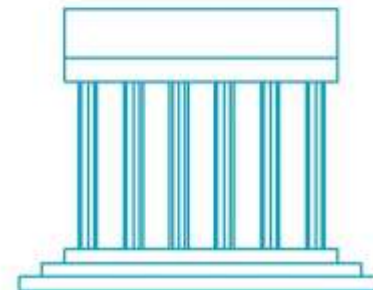
isometric (not multiview orthographic view)



front



top



side

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



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



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Axonometric Projections

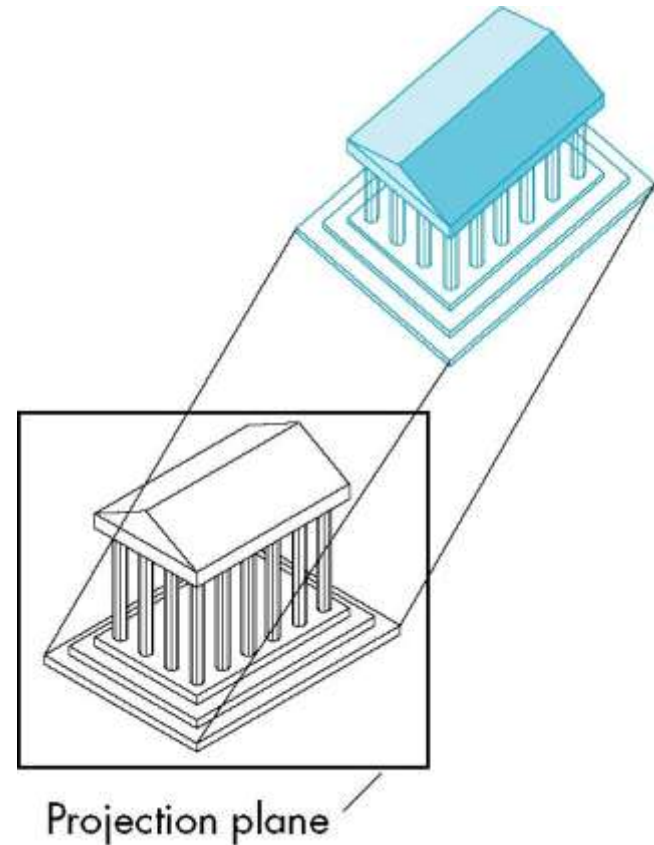
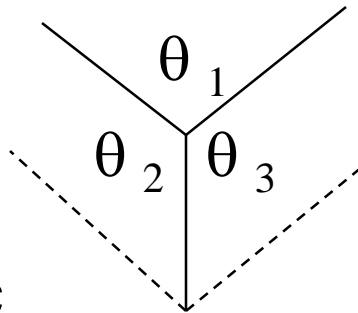
Allow projection plane to move relative to object

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

none: trimetric

two: dimetric

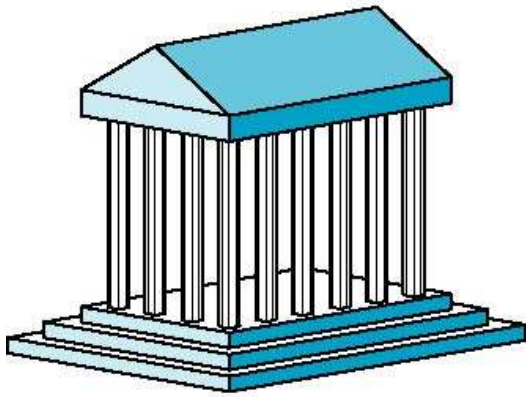
three: isometric



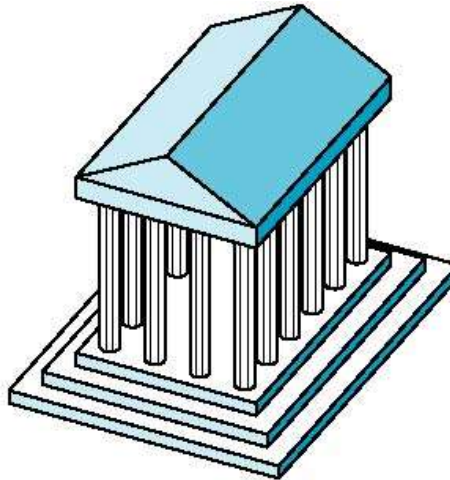


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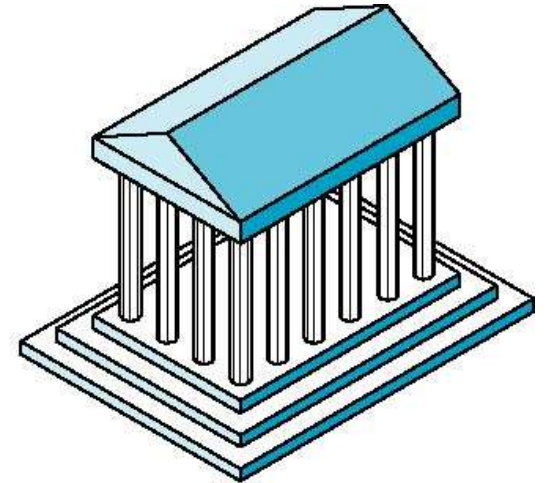
Types of Axonometric Projections



Dimetric



Trimetric



Isometric



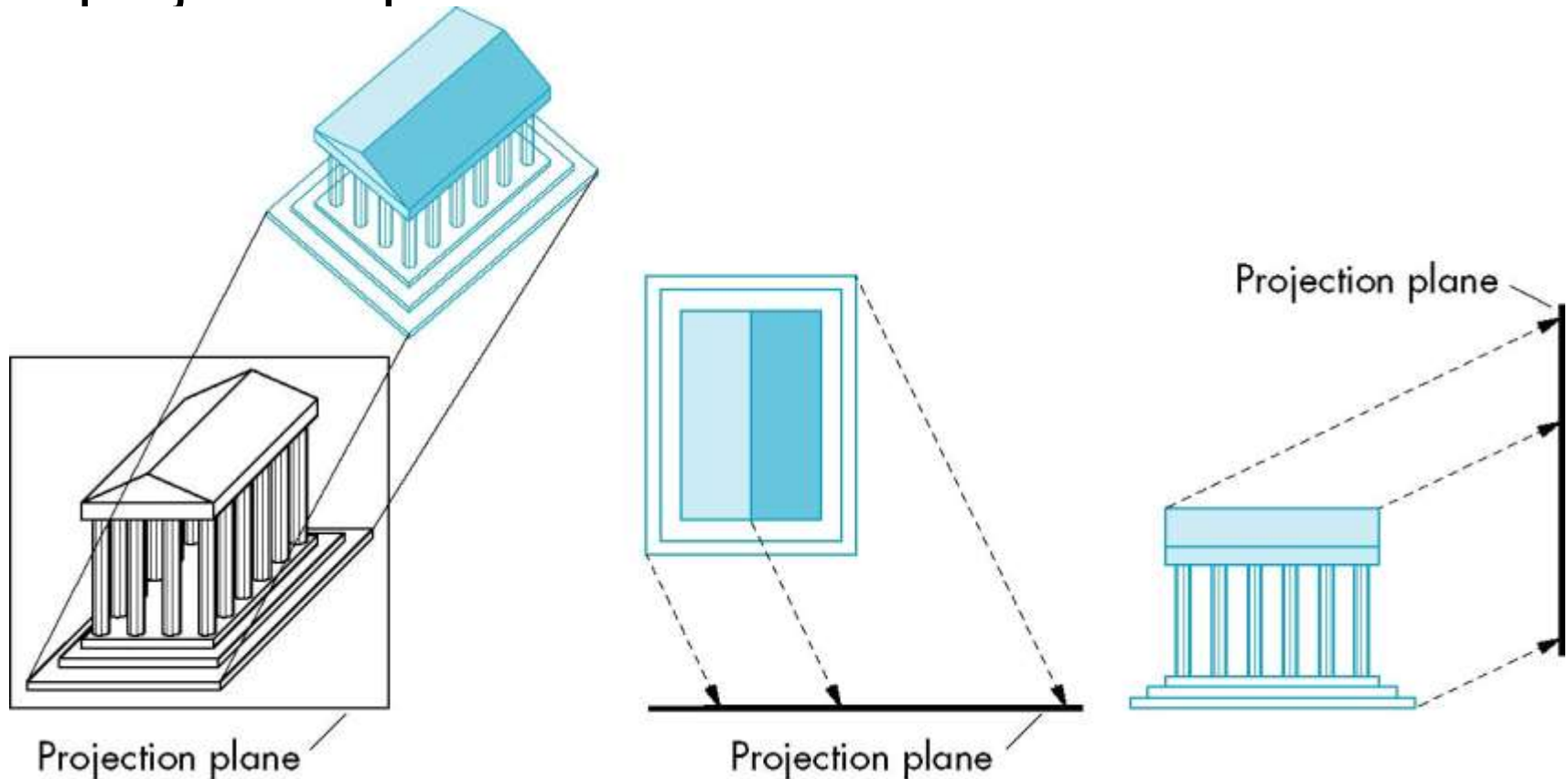
Advantages and Disadvantages

- 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



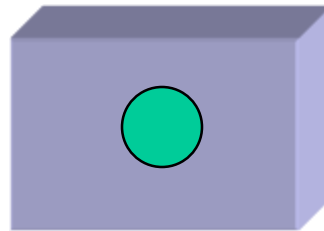
Oblique Projection

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



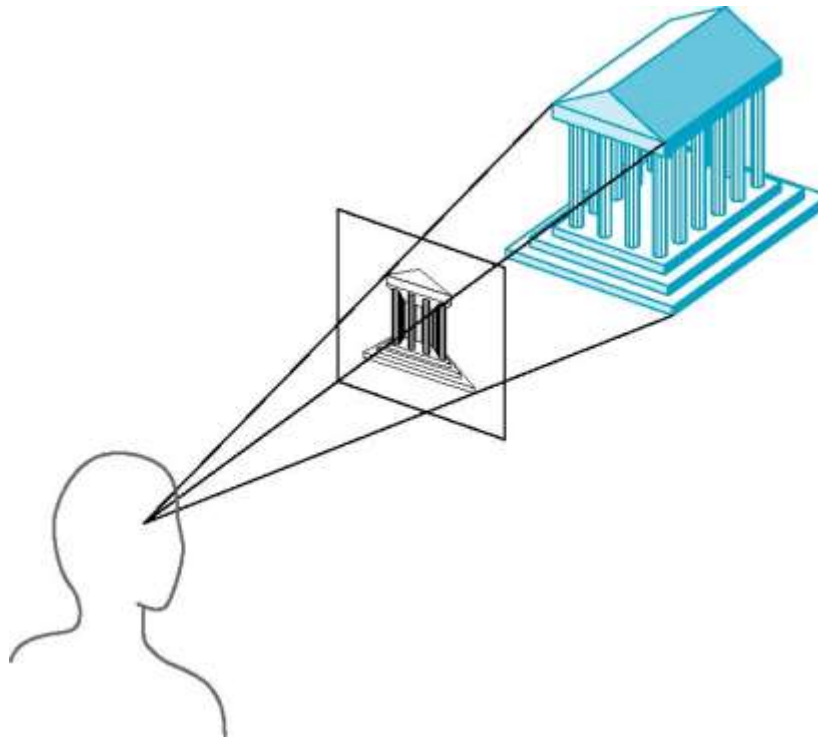
- In physical world, cannot create with simple camera; possible with bellows camera or special lens (architectural)



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Perspective Projection

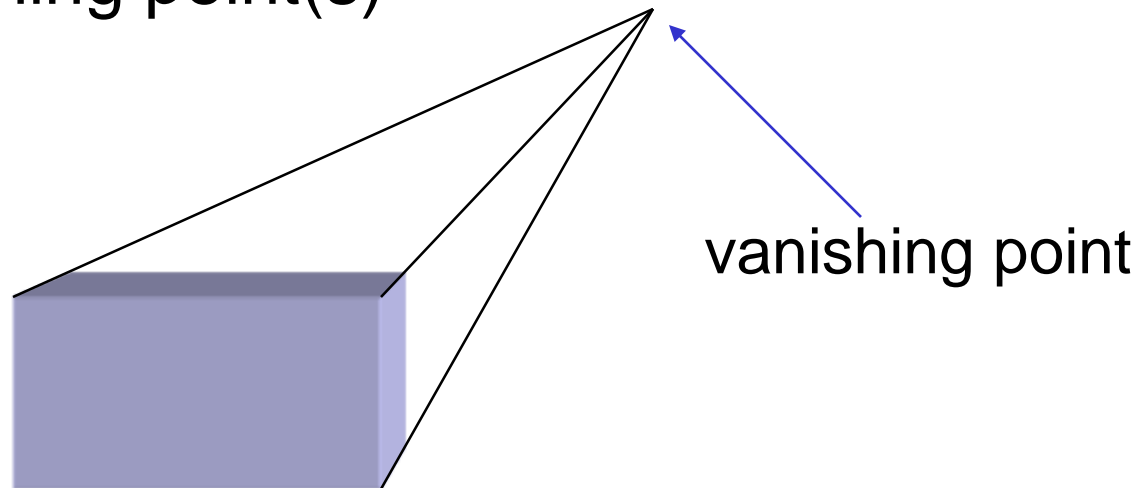
Projectors converge at center of projection





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

- 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)