



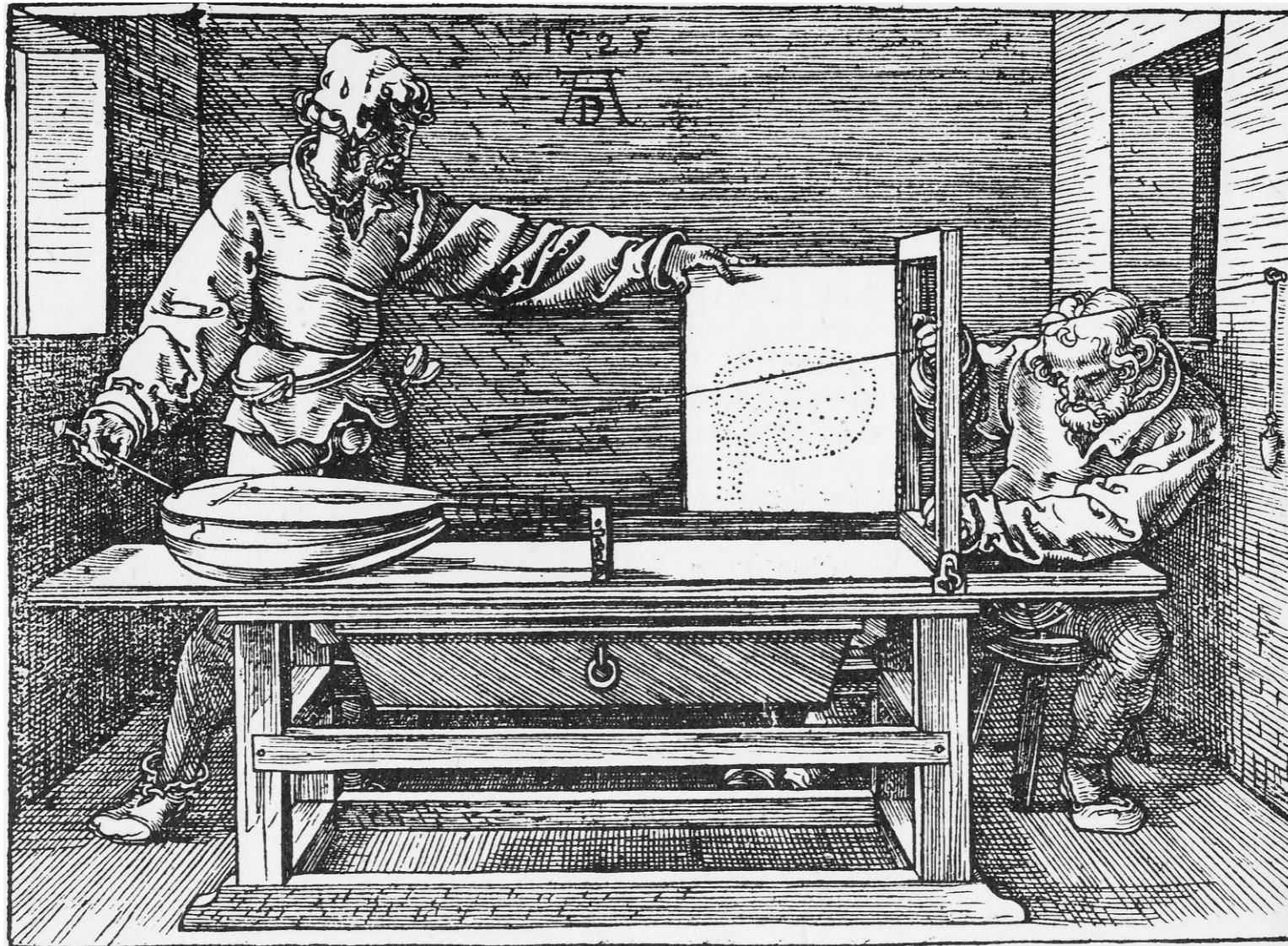
Viewing I

Overview of Projections

Introduction to Computer Graphics
CSE 533/333

Historical Perspective

- The 2D image is formed by the intersections of converging light rays with a picture plane

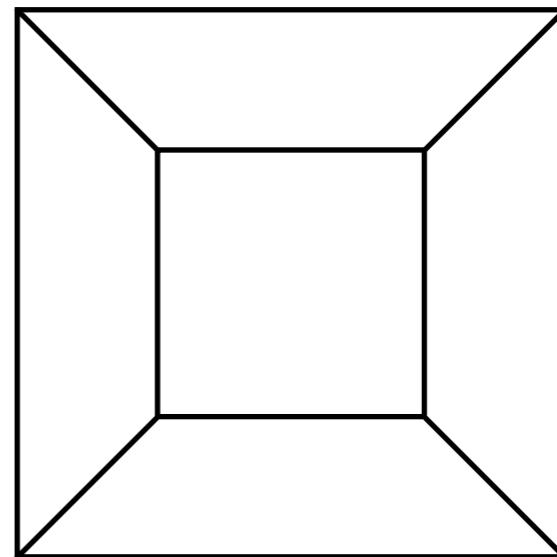


Woodcut from Albrecht Durer's work about art of measurement. "Underweysung der Messung"

Historical Perspective

Rules of linear perspective

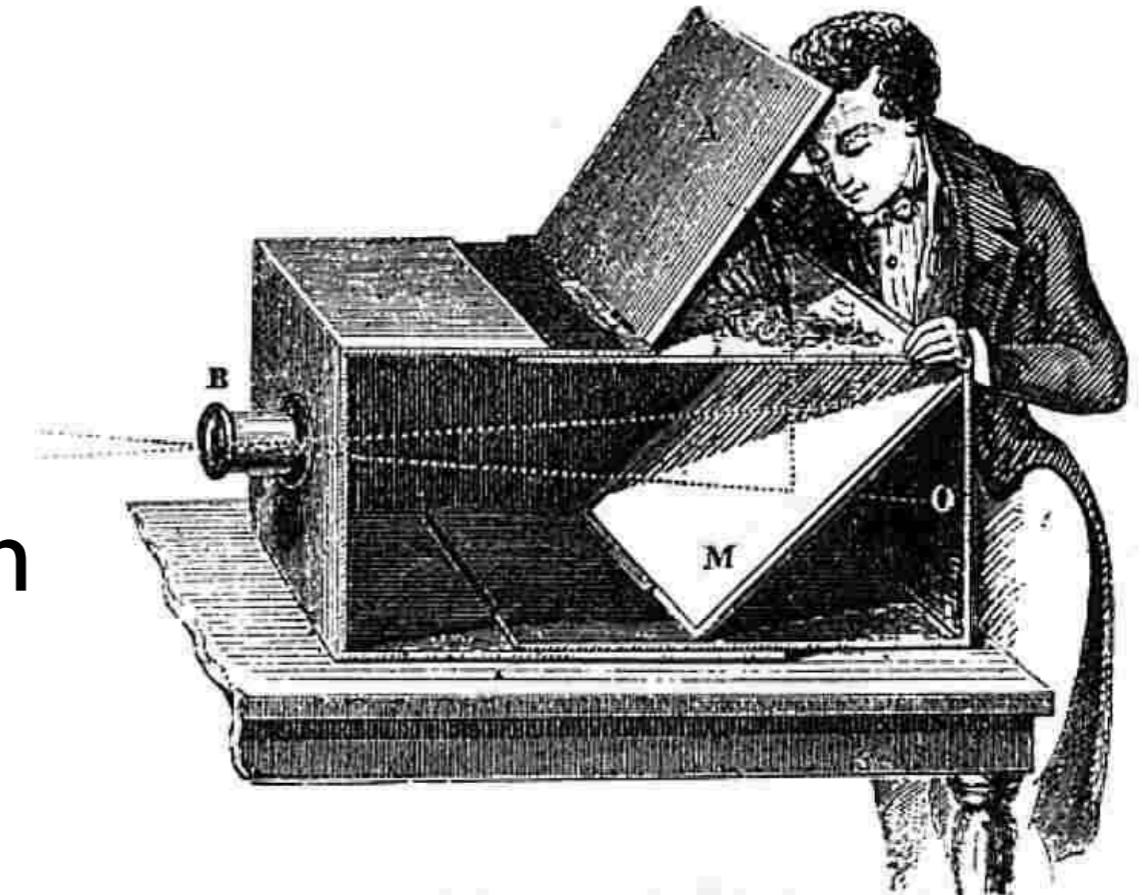
- Parallel lines converge to a vanishing point
- Objects further away are foreshortened than closer ones
- Example:
Perspective cube



Historical Perspective

Camera Obscura

- An optical device that projects an image of its surroundings on a screen
- Artist *David Hockney* proposed that many Renaissance artists might have been aided by camera obscura while painting their masterpieces, raising a big controversy.



Historical Perspective

Masters of Illusion

Short intro to perspective projections
discovered during the renaissance period

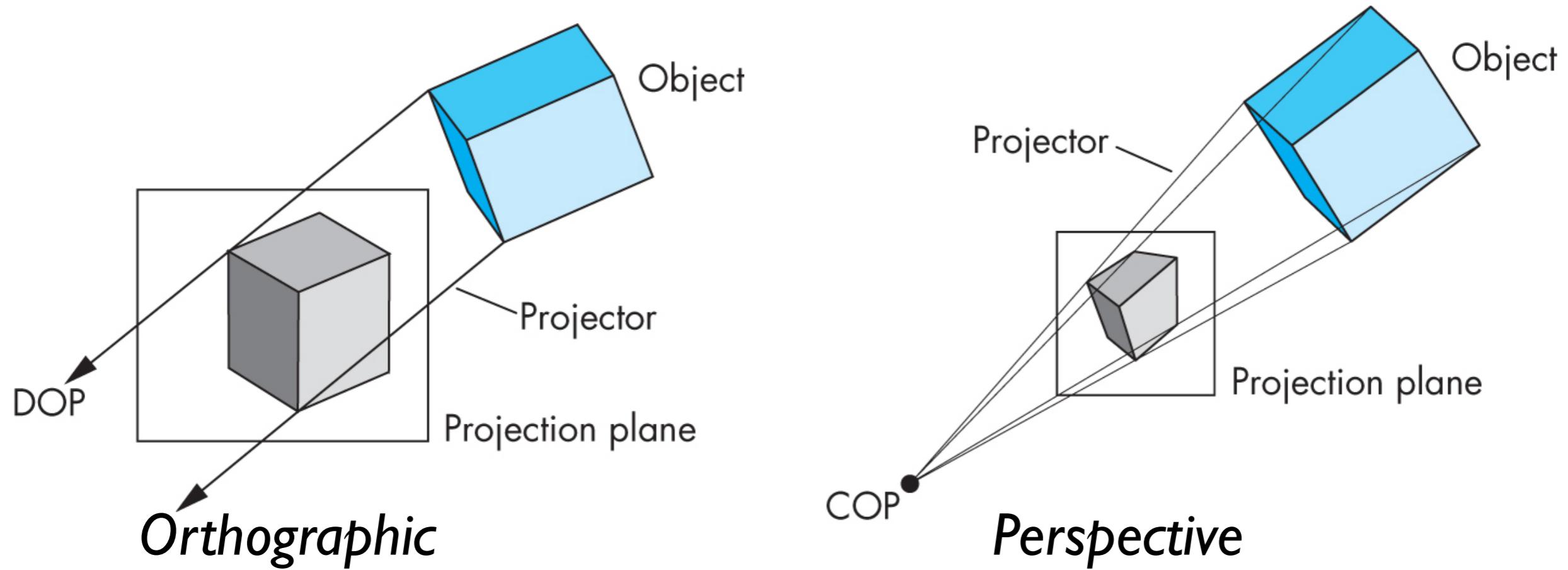
<https://www.youtube.com/watch?v=YU5khzhizNI>

©National Gallery of Art, USA

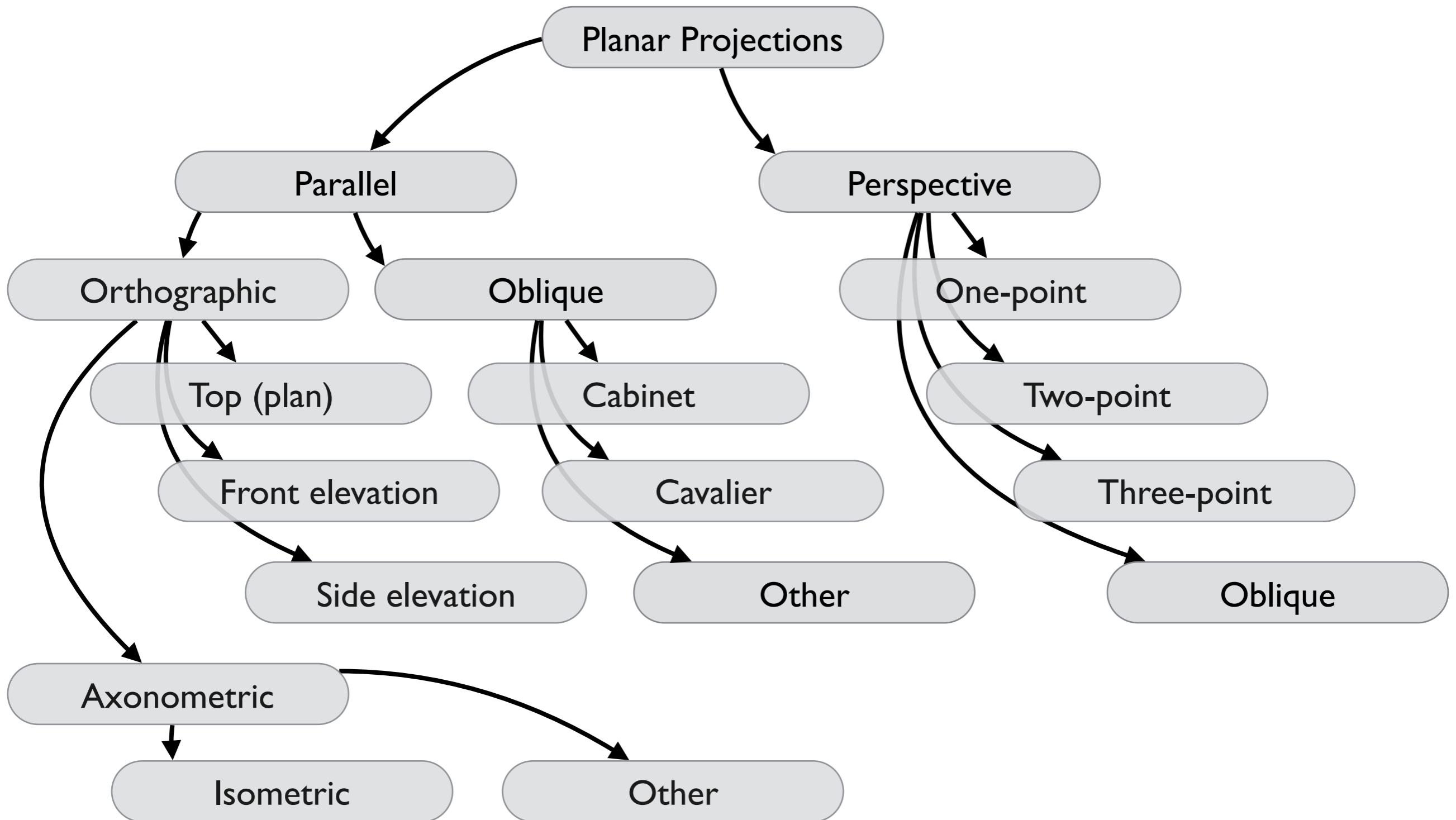
Types of Projections

Orthographic: determined by *direction of projection*

Perspective: determined by *centre of projection*

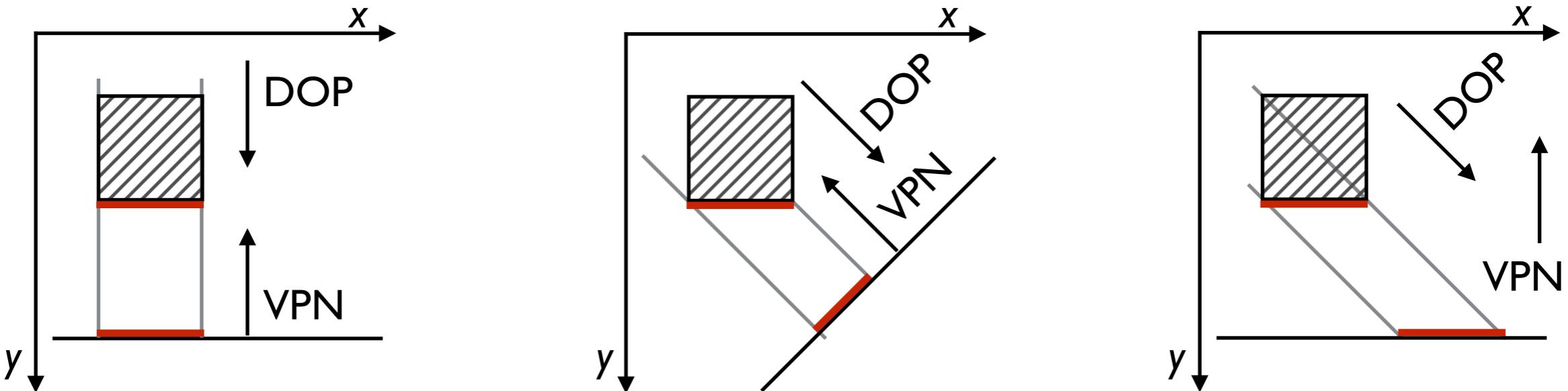


Types of Projections



Parallel Projections

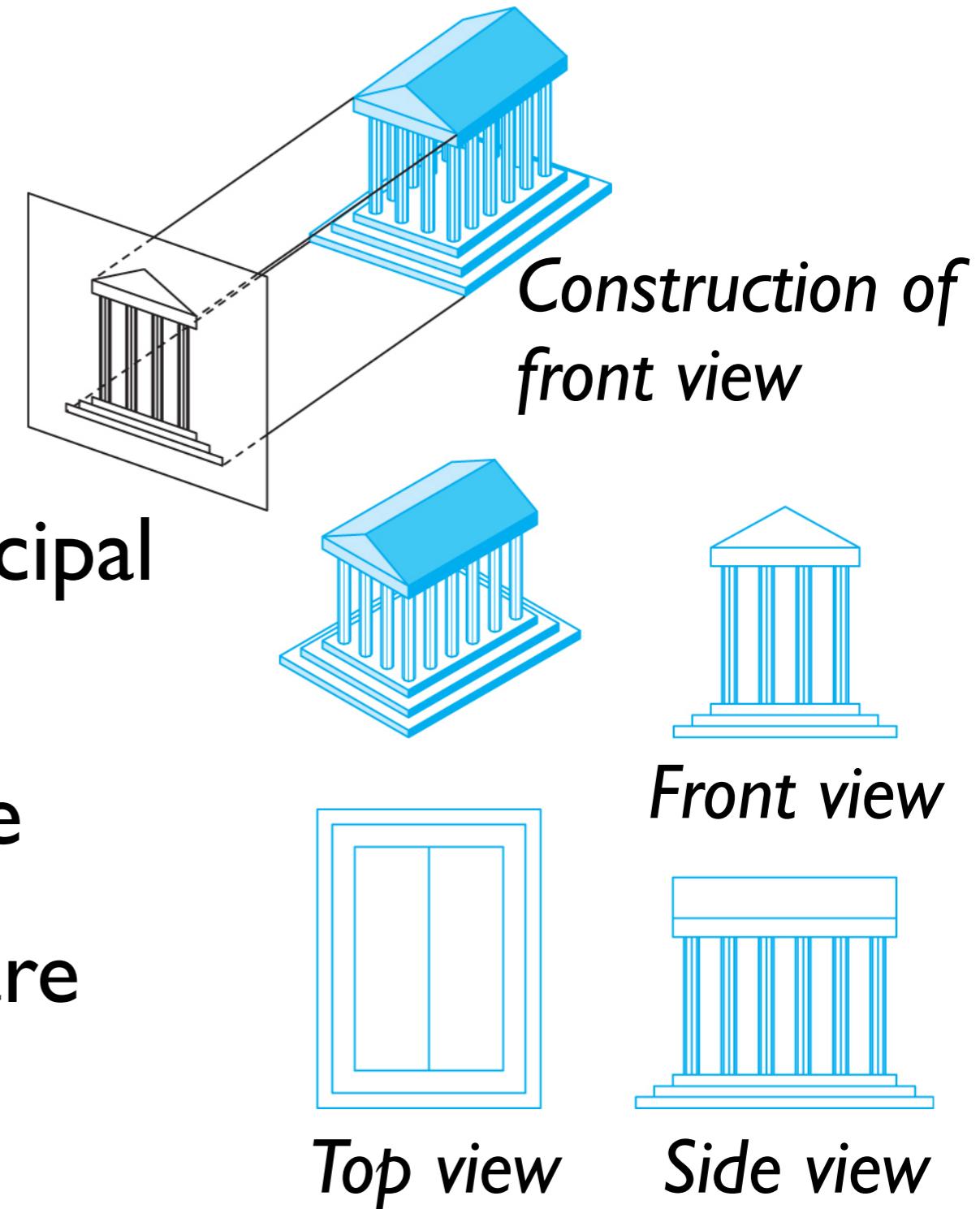
Assume object face of interest lies in principal plane
(DOP: direction of projection, VPN: view plane normal)



Multiview Orthographic	Axonometric	Oblique
<ul style="list-style-type: none">• $\text{VPN} \parallel$ a principal axis• $\text{DOP} \parallel \text{VPN}$• Shows a single face, exact measurements	<ul style="list-style-type: none">• $\text{VPN} \nparallel$ a principal axis• $\text{DOP} \parallel \text{VPN}$• Adjacent faces, none exact, uniformly foreshortened	<ul style="list-style-type: none">• $\text{VPN} \parallel$ a principal axis• $\text{DOP} \nparallel \text{VPN}$• adjacent faces, one exact, others uniformly foreshortened

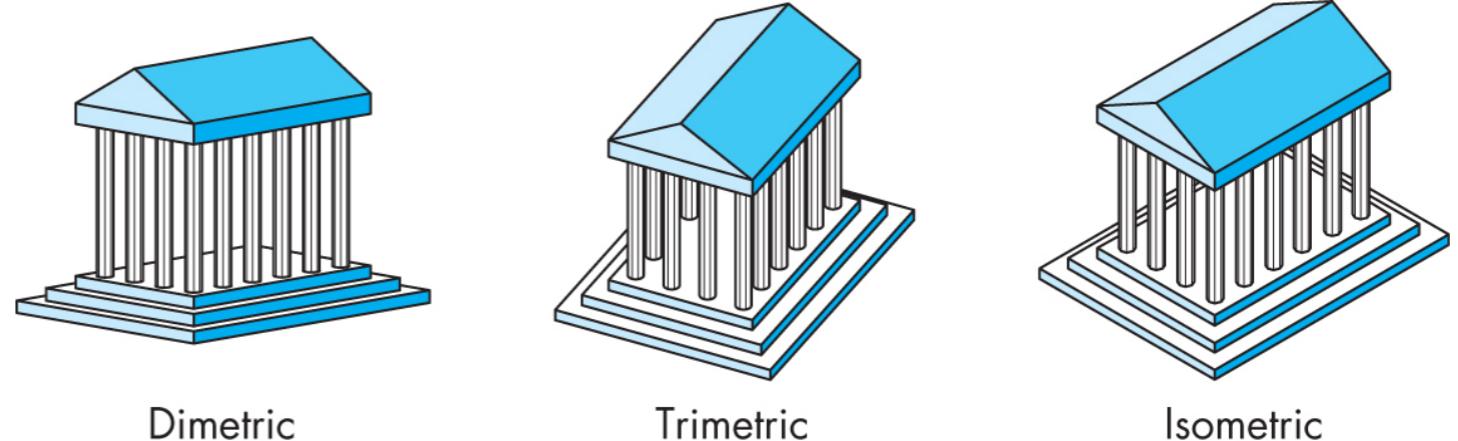
Multiview Orthographic

- Projectors are orthogonal to the projection plane
- Projection plane is parallel to one of the principal planes (XY, YZ, or ZX)
- All views are at same scale
- Accurate measurements are possible



Axonometric

- Projectors are orthogonal to the projection plane
- Projection plane is **not** parallel to one of the principal planes



- Parallel lines are equally foreshortened

Dimetric

- Angles between two of the principal axes equal
- Need two scale ratios

Trimetric

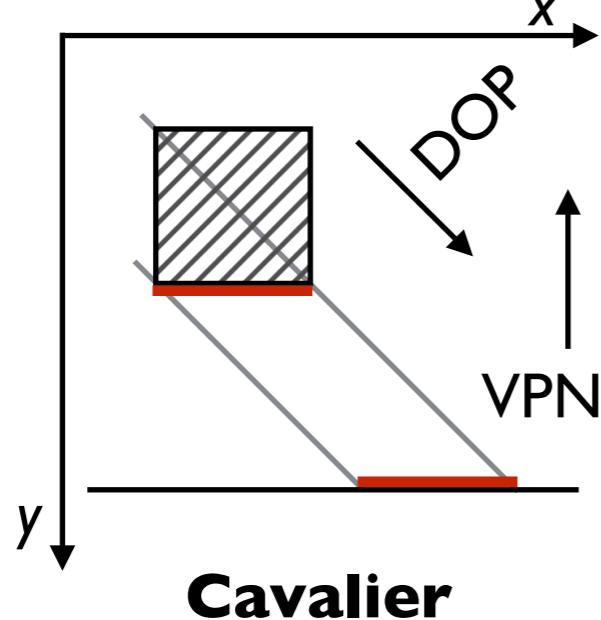
- Angles between all three principal axes different
- Need three scale ratios

Isometric

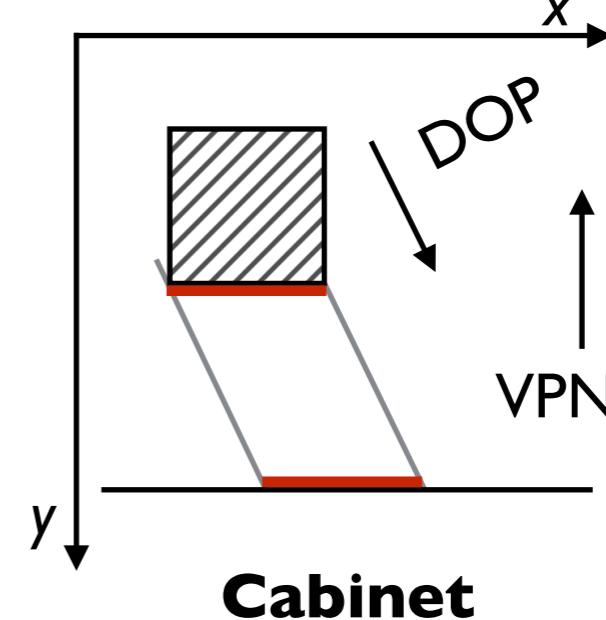
- Angles between all three principal axes equal (120°)
- Same scale ratio applies along each axis

Oblique

- Projectors at oblique angle to projection plane
- Can represent exact shape of one of the faces
- Can be used to emphasize a particular face



Cavalier



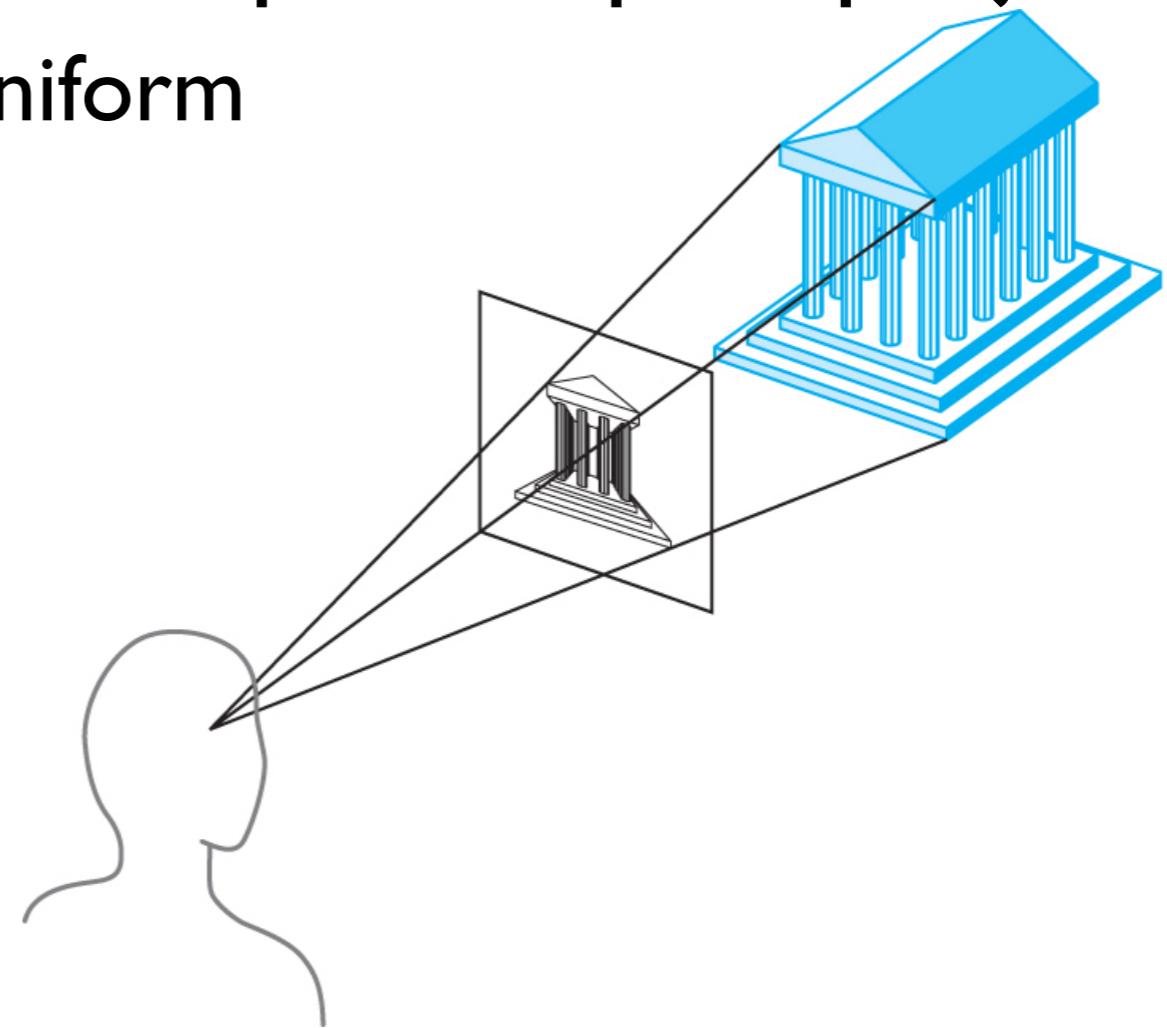
Cabinet

- Angle between projectors and projection plane is 45°
- Perpendicular faces projected at full scale

- Angle between projectors and projection plane is $\tan^{-1}(2) = 63.4^\circ$
- Perpendicular faces projected at 50% scale

Perspective Projections

- Depicts the way we see objects in nature
- Parallel lines do not remain parallel post projection
 - Foreshortening is not uniform
- Two concepts:
Vanishing point, and
View Point



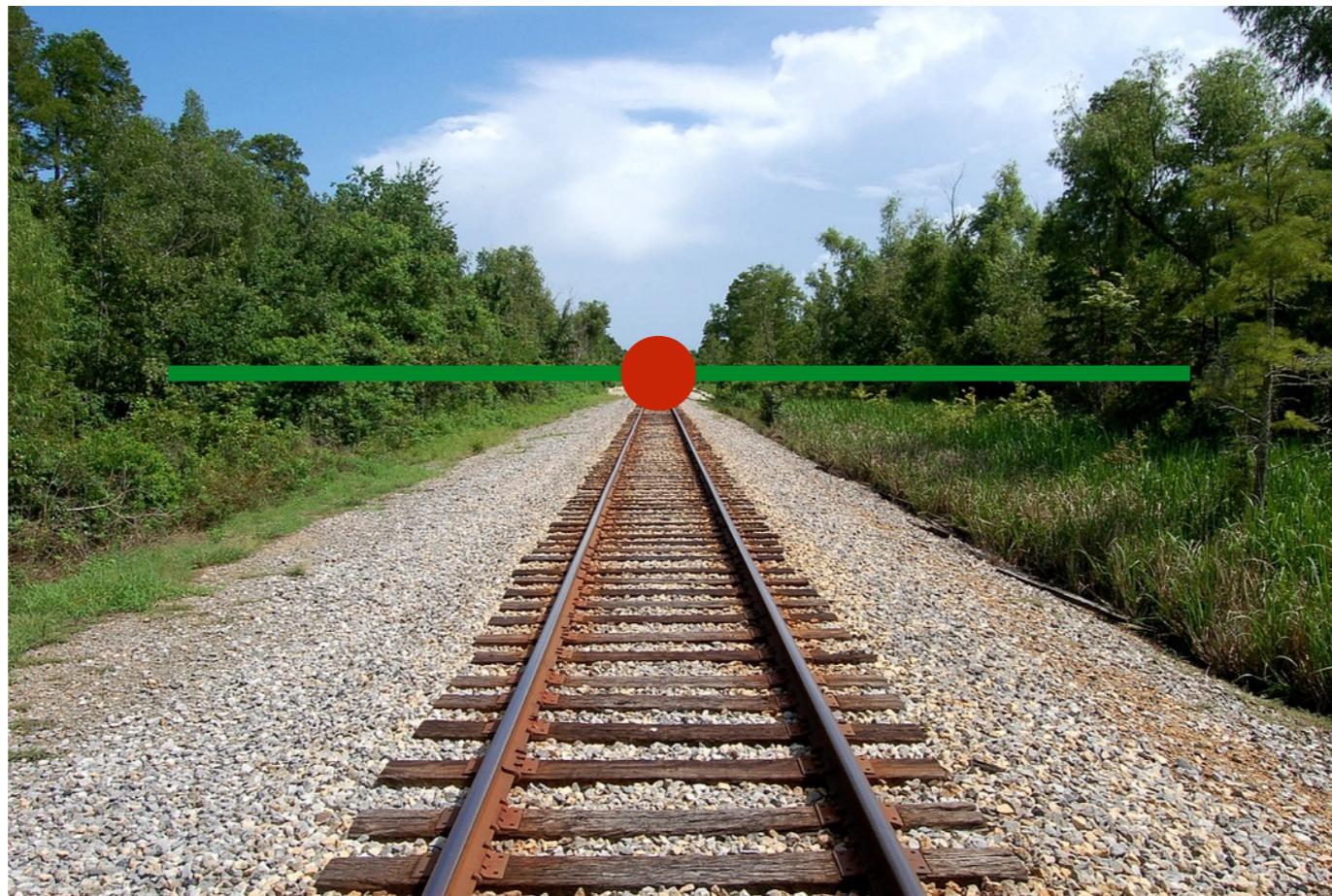
Perspective Projections



Source: <http://orthographic.weebly.com/single-point-perspective.html>

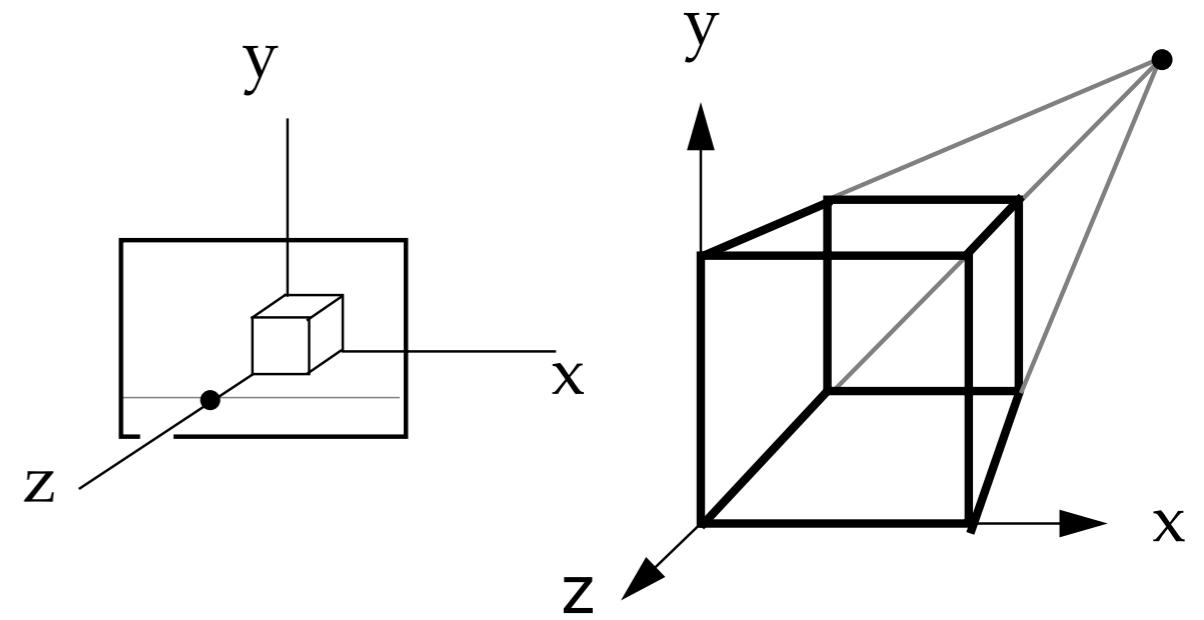
Vanishing Points

- Point of intersection (in the image plane) of projections of a set of parallel lines in space



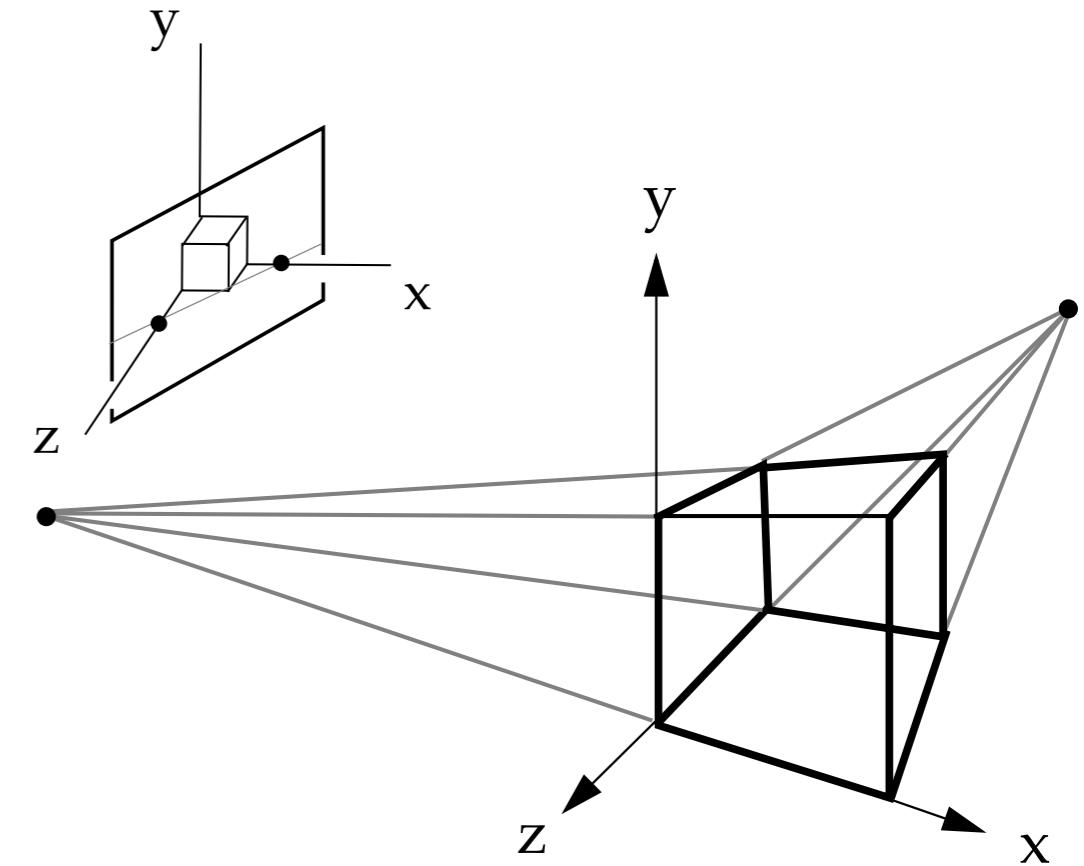
One-Point Perspective

- Verticals and horizontals are parallel
- All lines of perspective meet at a single vanishing point on the horizon



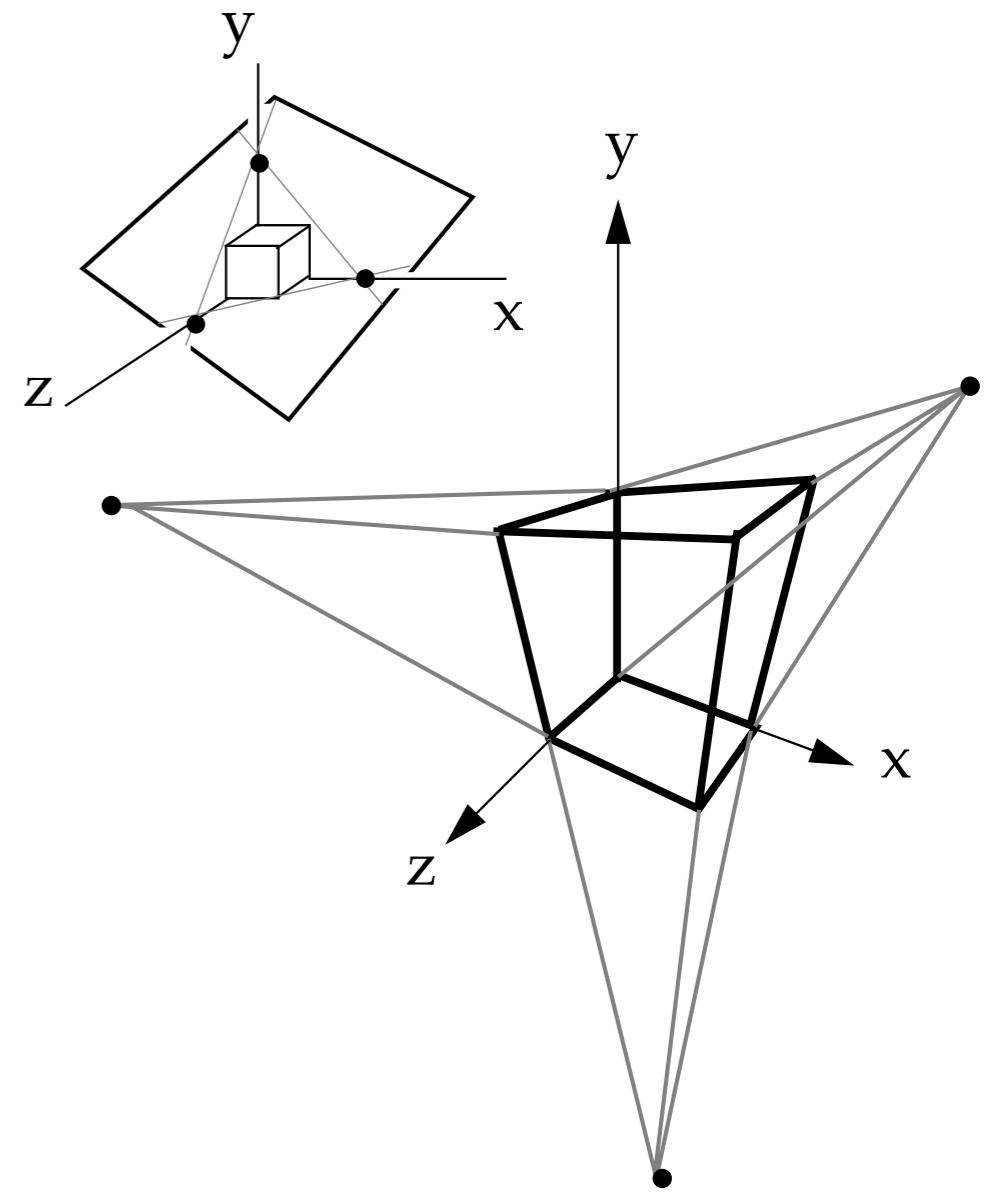
Two-Point Perspective

- Verticals are parallel
- Contains two vanishing points on the horizon

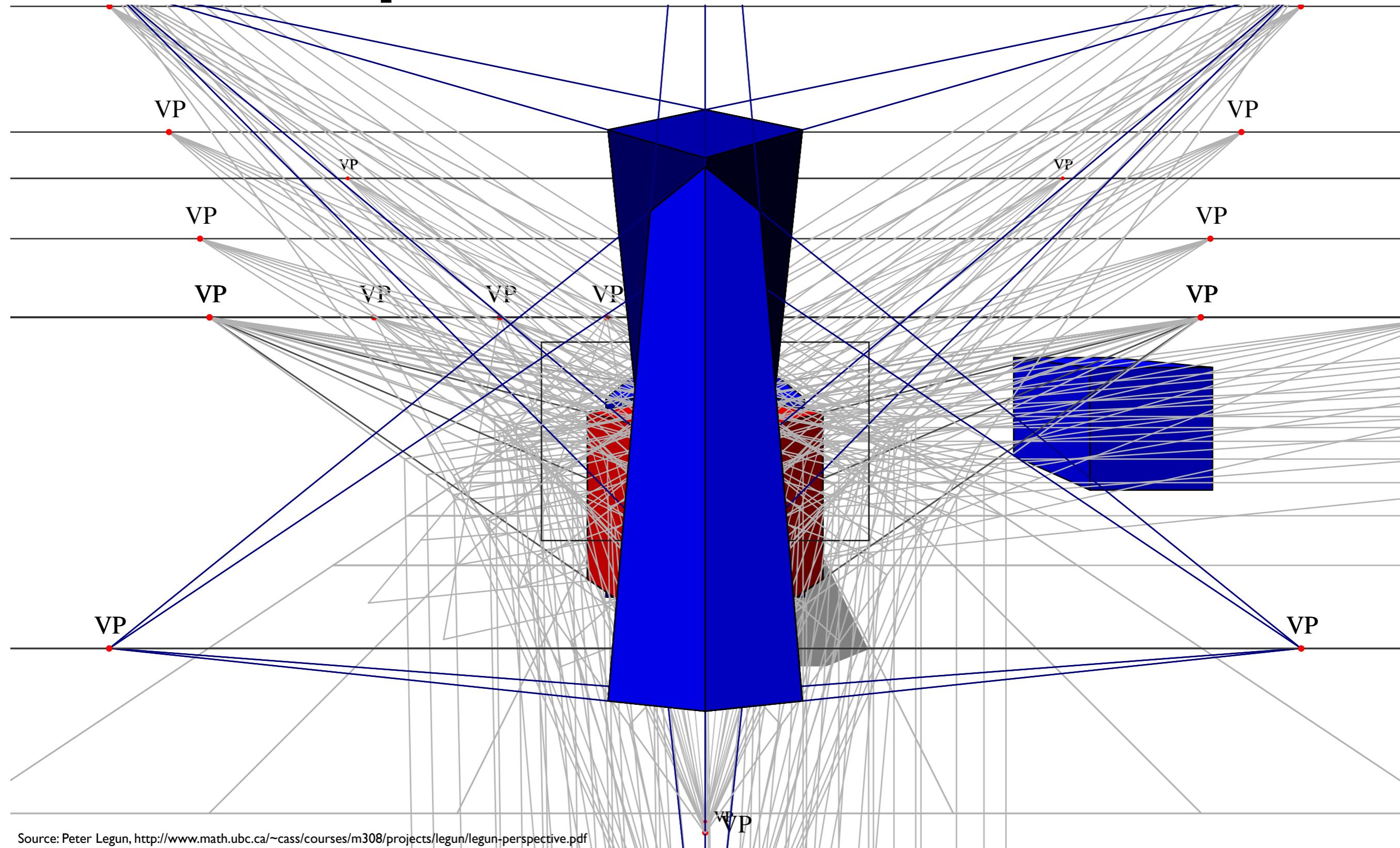


Three-Point Perspective

- No parallel sides
- Contains three vanishing points



Perspective Illustration



Source: Peter Legun, <http://www.math.ubc.ca/~cass/courses/m308/projects/legun/legun-perspective.pdf>

Reading

- ICG: 4.1, 4.2 (see [Viewing_I_Notes.pdf](#))
- History of perspective (see [History of perspective.pdf](#))

ICG: Interactive Computer Graphics, E. Angel, and D. Shreiner, 6th ed.

FCG: Fundamentals of Computer Graphics, P. Shirley, M. Ashikhmin, and S. Marschner, 3rd ed.