3D Elementary Graphics

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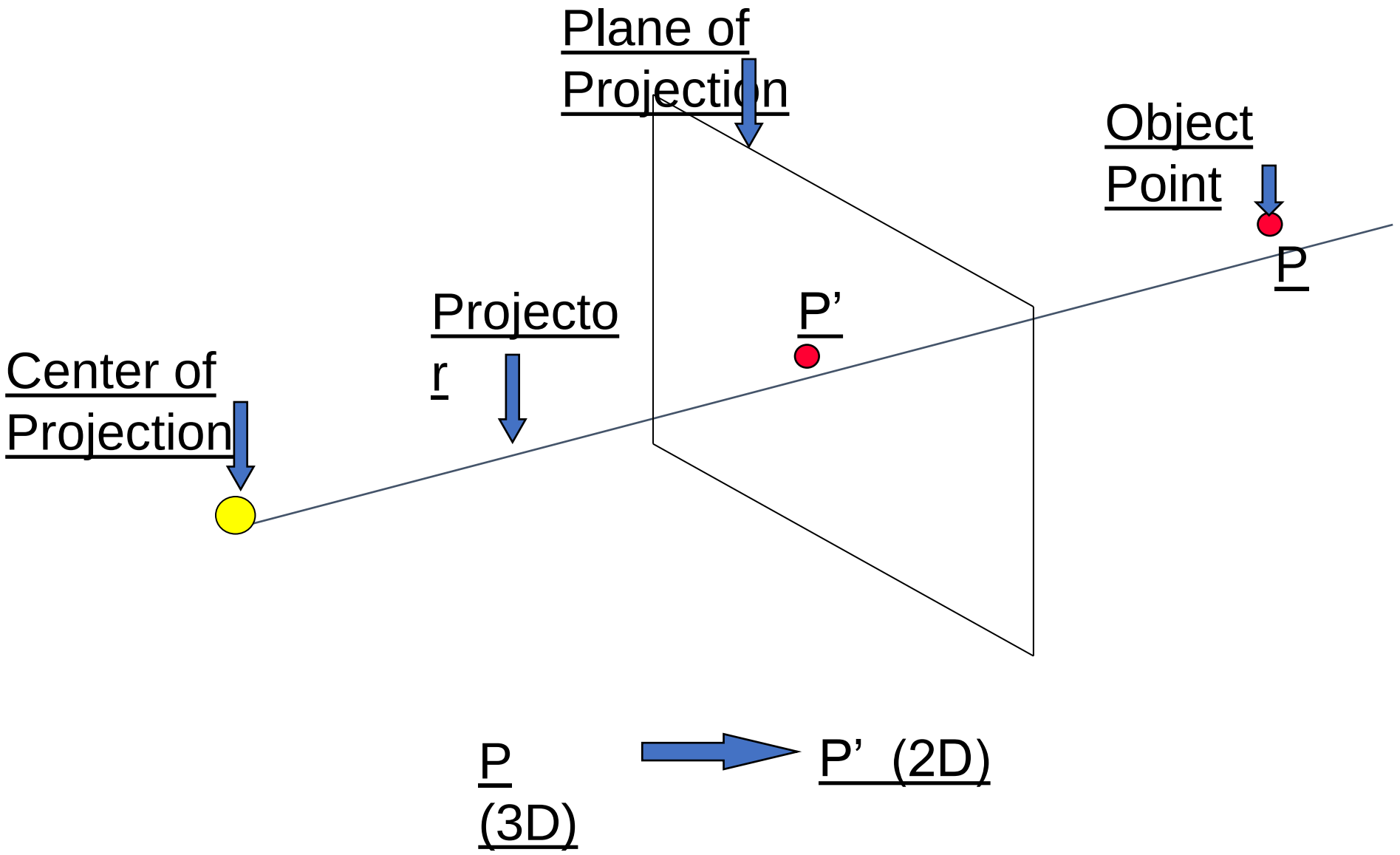
SCOPE, VIT-AP

Module 3

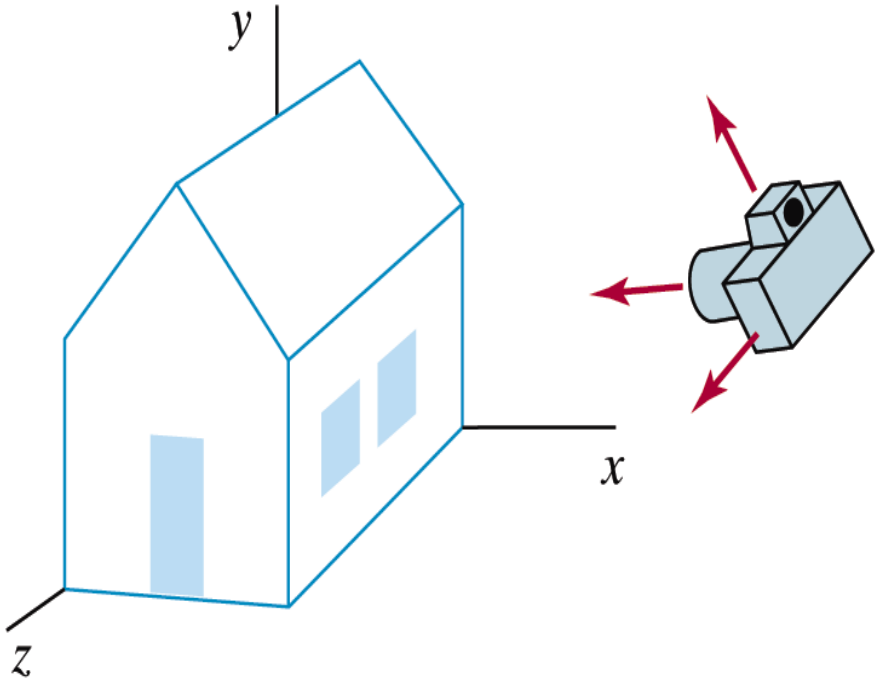
Module No 3	Elementary 3D Graphics	8 hours
Plane projections, Vanishing points, Specification of a 3D view. Camera Models; Viewing classical three-dimensional viewing, computer viewing, specifying views, parallel and perspective projective transformations		

Projection Geometry



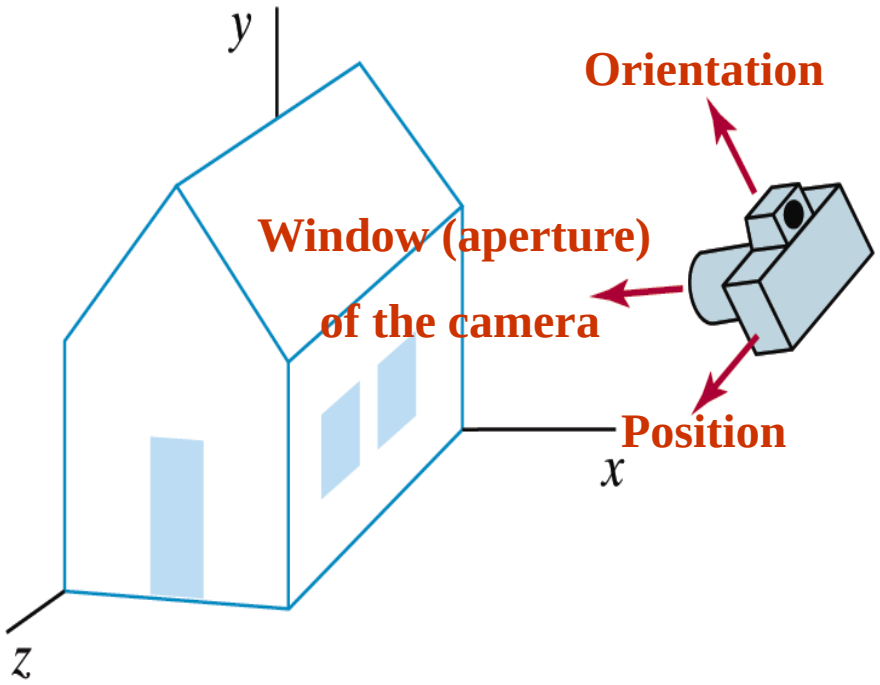
3D Viewing

- The steps for computer generation of a view of a three dimensional scene are somewhat analogous to the processes involved in taking a photograph.



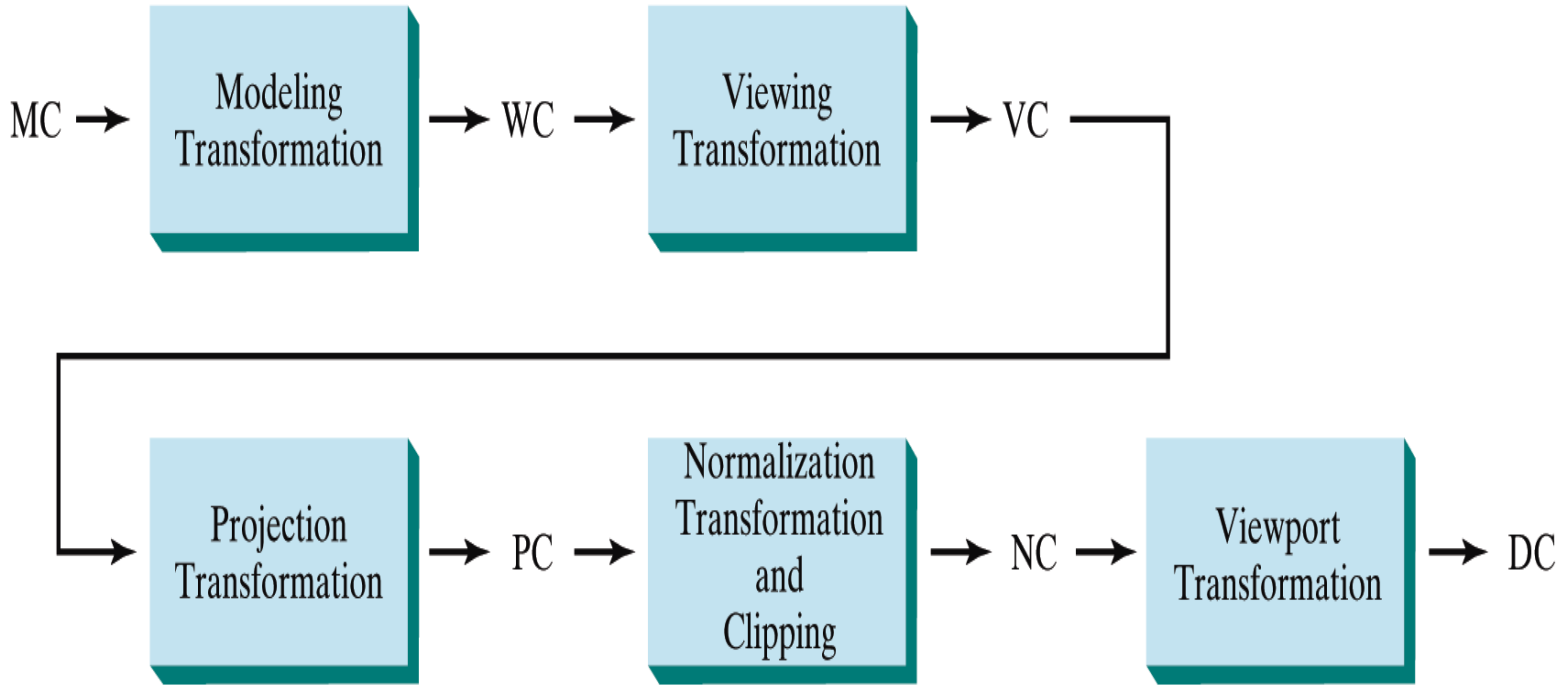
Camera Analogy

1. Viewing position
2. Camera orientation
3. Size of clipping window



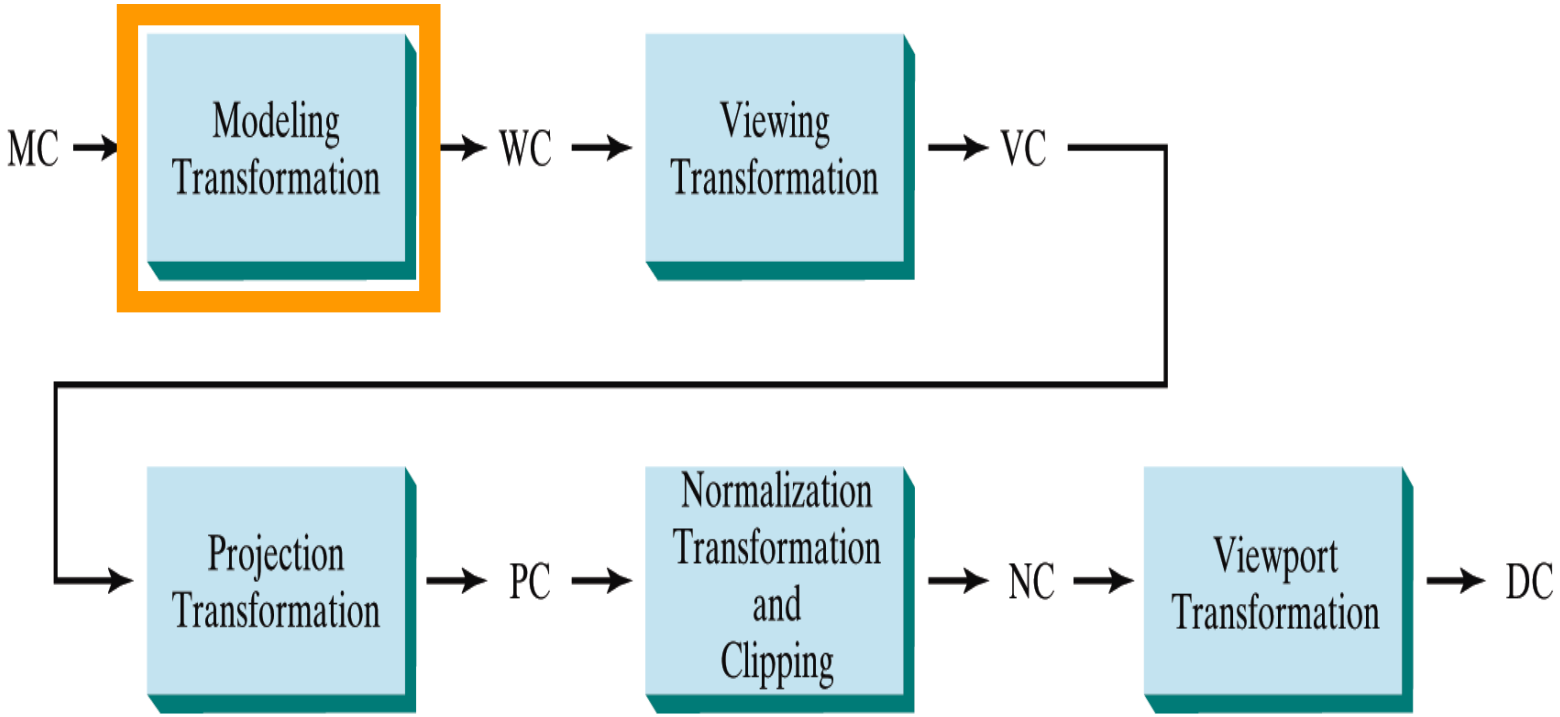
Viewing Pipeline

- The general processing steps for modeling and converting a world coordinate description of a scene to device coordinates:



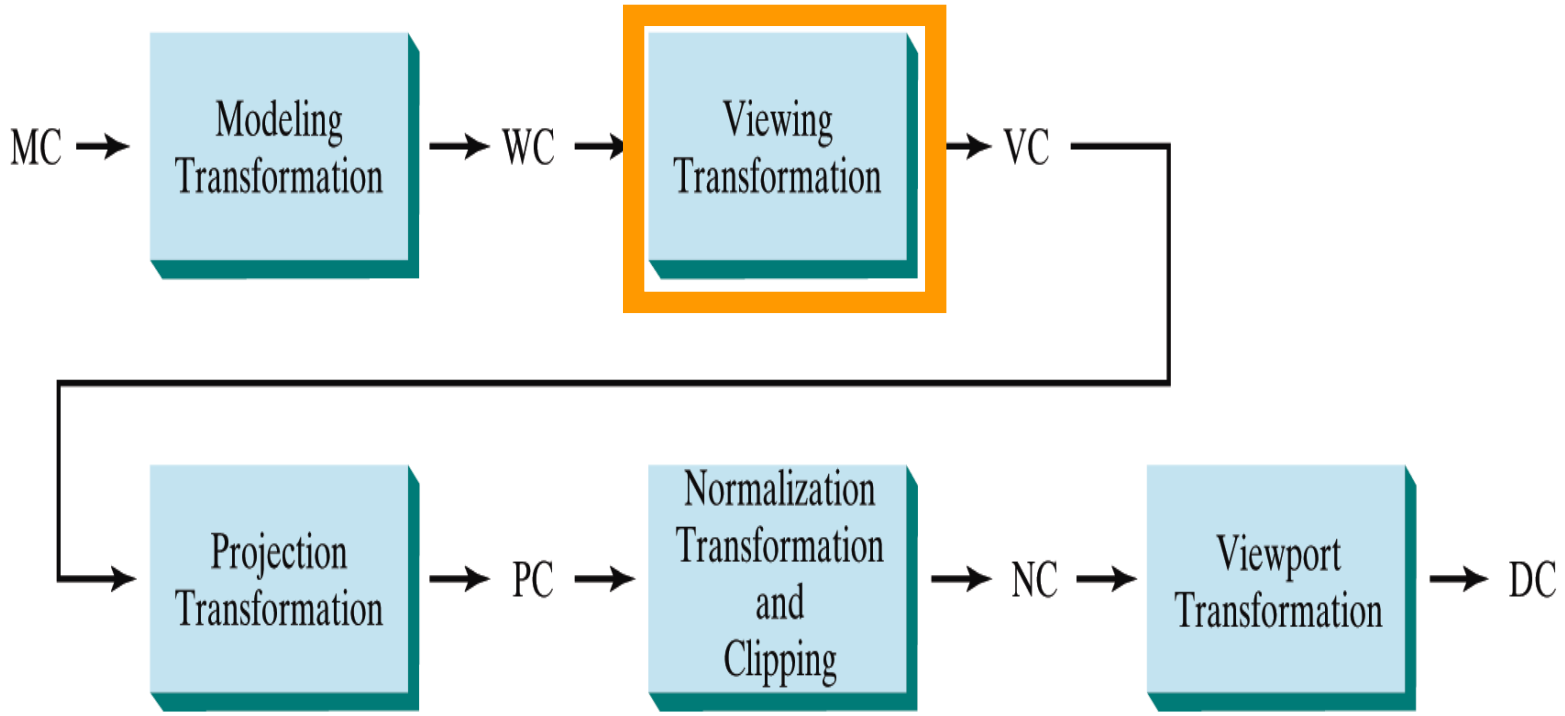
Viewing Pipeline

1. Construct the shape of individual objects in a scene within modeling coordinate, and place the objects into appropriate positions within the scene (world coordinate).



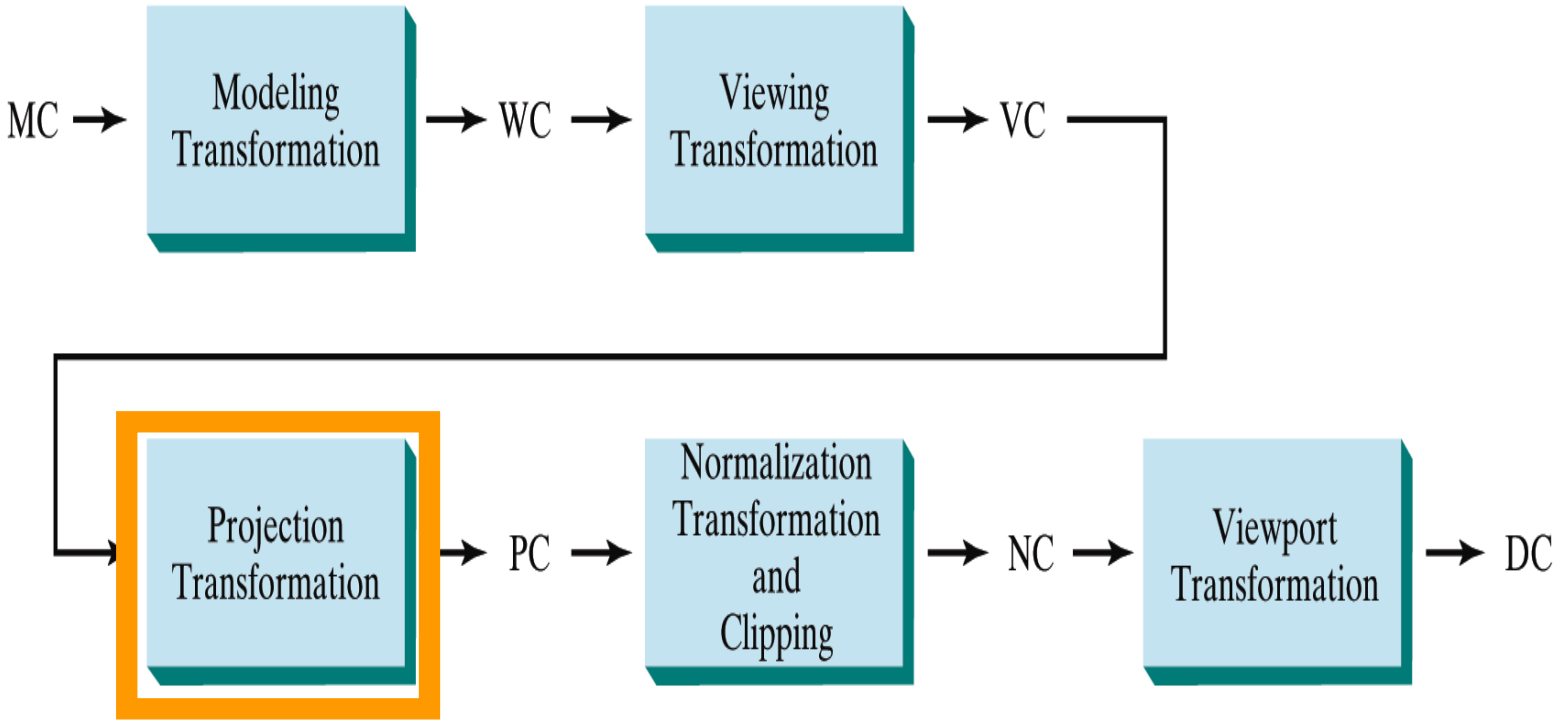
Viewing Pipeline

2. World coordinate positions are converted to viewing coordinates.



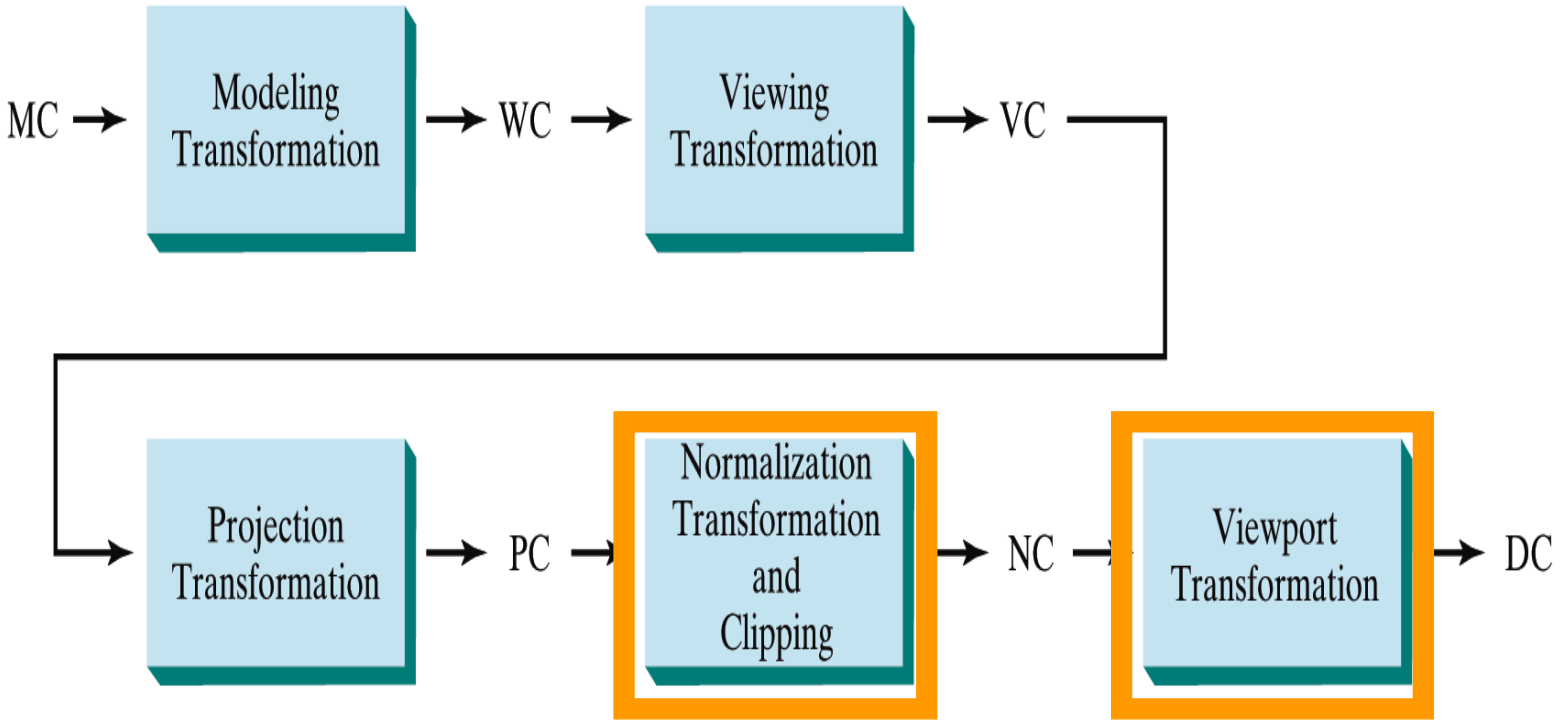
Viewing Pipeline

3. Convert the viewing coordinate description of the scene to coordinate positions on the projection plane.

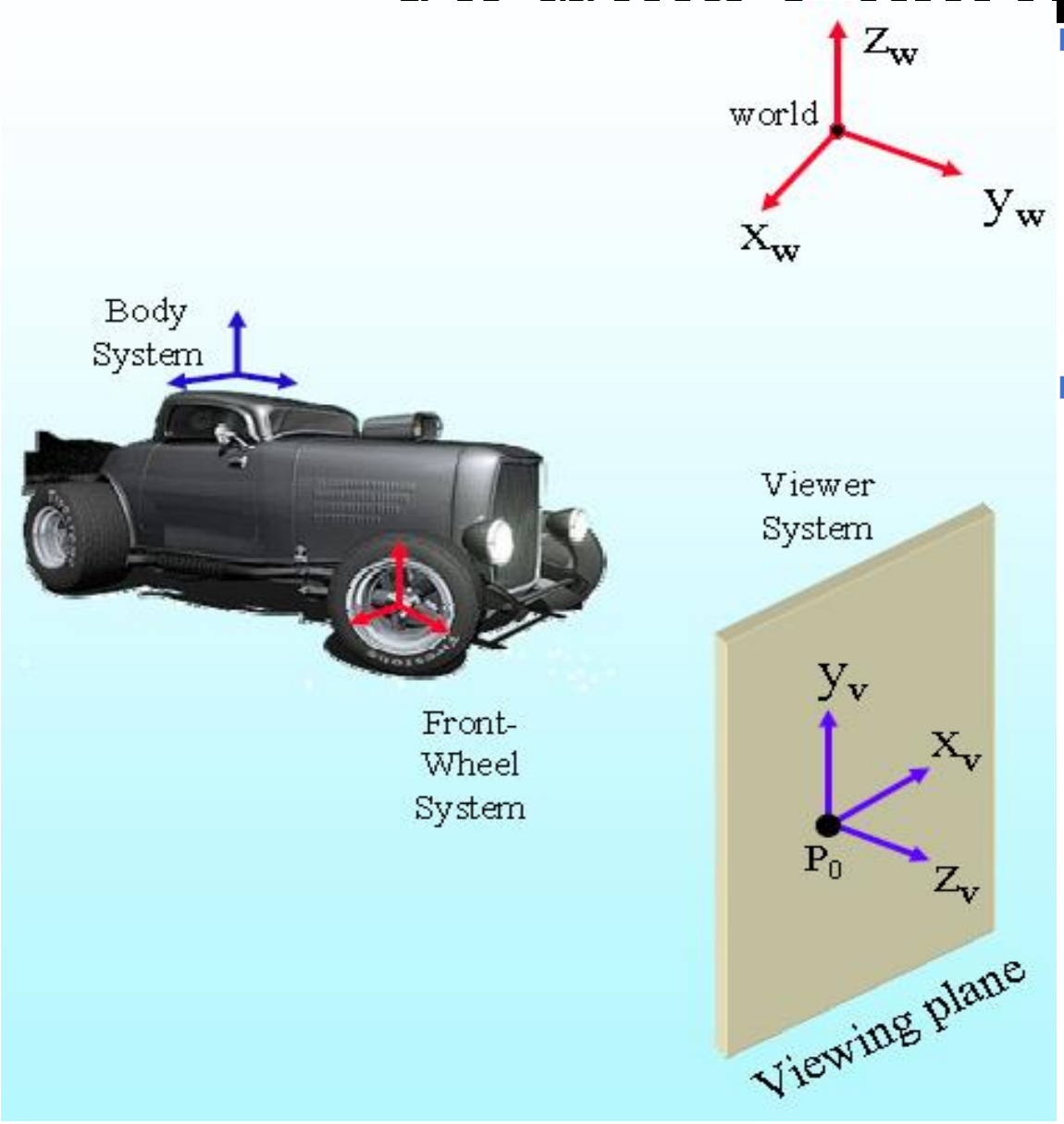


Viewing Pipeline

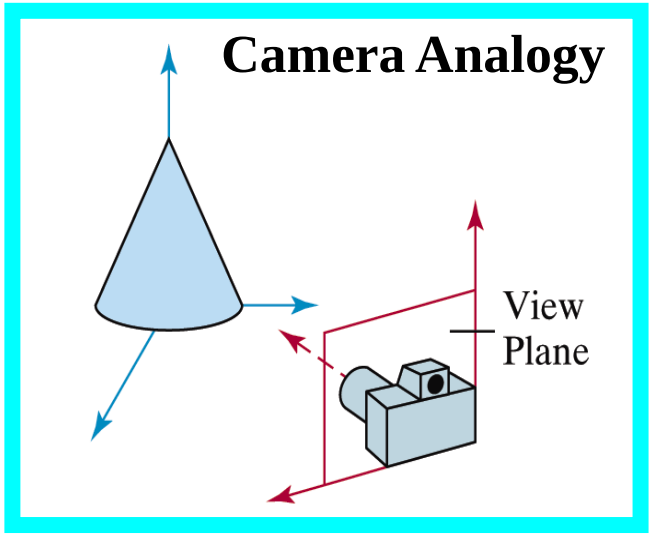
4. Positions on the projection plane, will then mapped to the Normalized coordinate and output device.



Viewing Coordinates

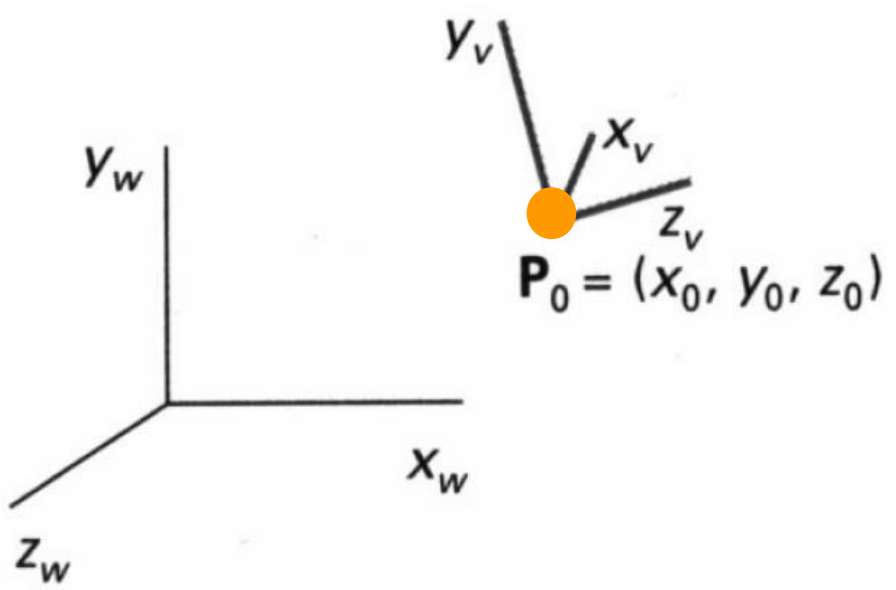


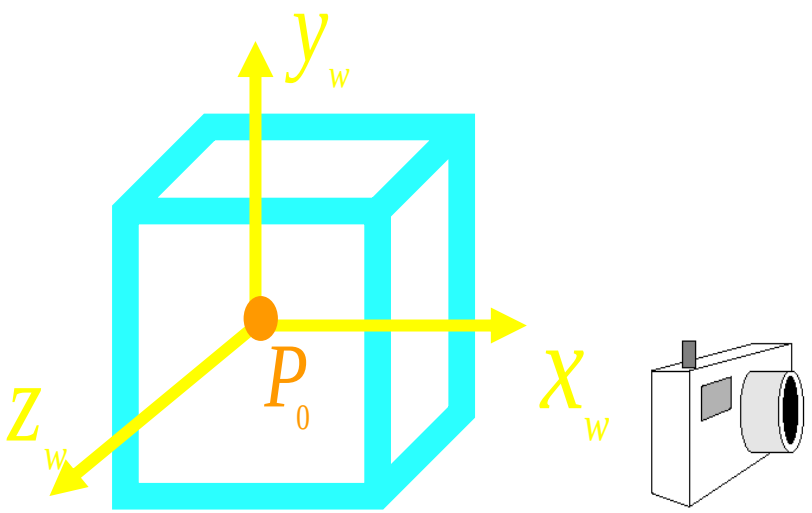
- Viewing coordinates system described 3D objects with respect to a viewer.
- A Viewing (Projector) plane is set up perpendicular to z_v and aligned with (x_v,y_v).



Specifying the Viewing Coordinate System (View Reference Point)

- We first pick a world coordinate position called **view reference point** (origin of our viewing coordinate system).
- P_0 is a point where a camera is located.
- The view reference point is often chosen to be close to or on the surface of some object, or at the center of a group of objects.

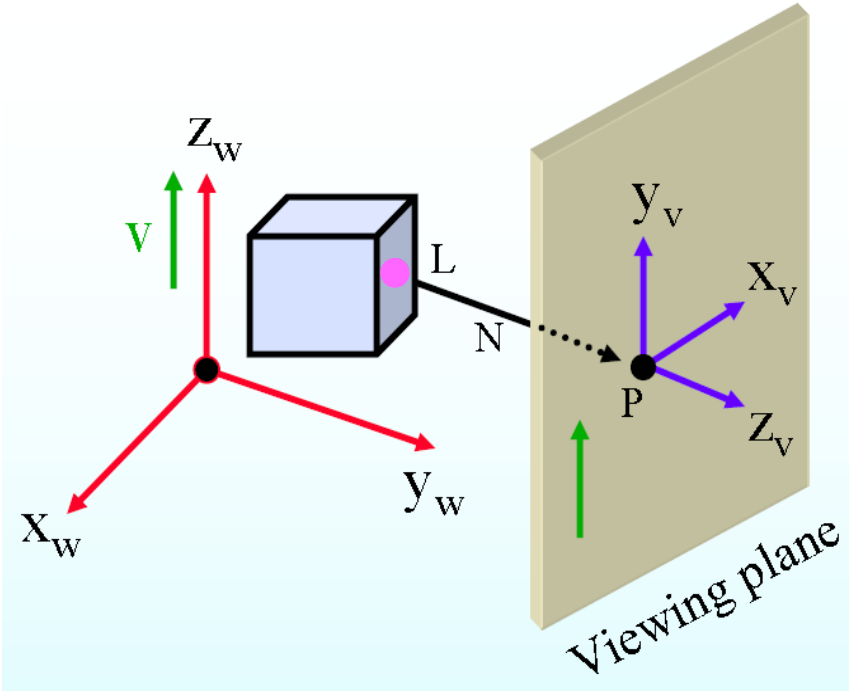


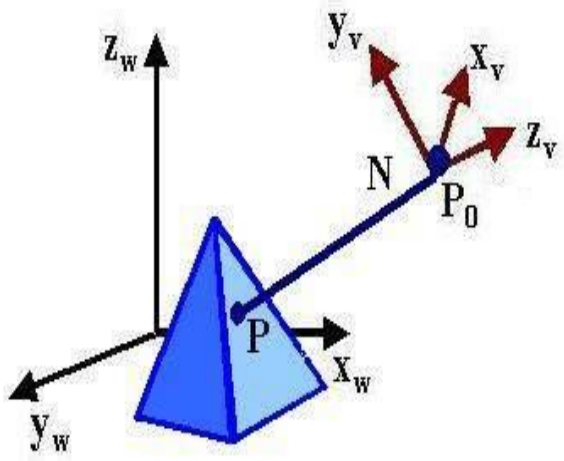


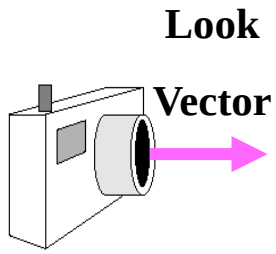
Position

Specifying the Viewing Coordinate System (Z_v Axis)

- Next, we select the positive direction for the viewing $\mathbf{z_v}$ axis, by specifying the **view plane normal vector**, **N**.
- The direction of **N**, is from the **look at point** (L) to the view reference point.

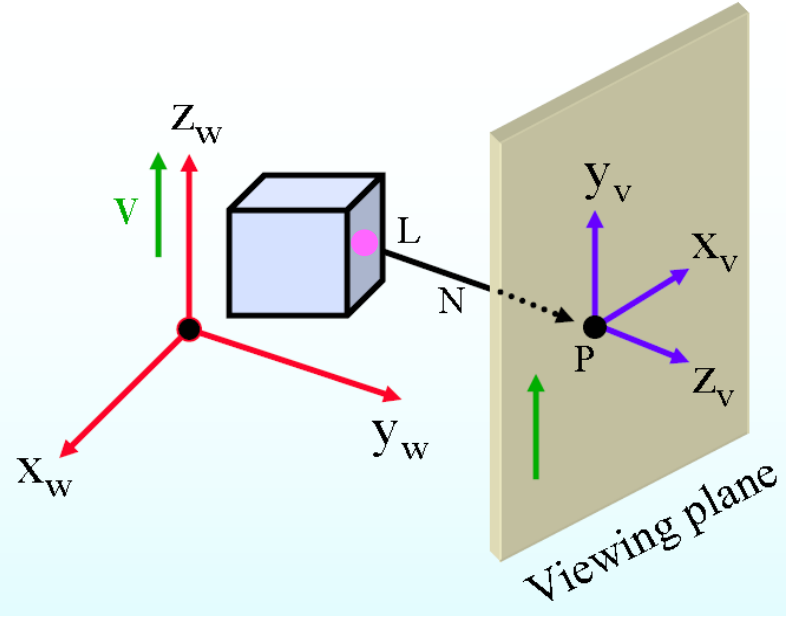


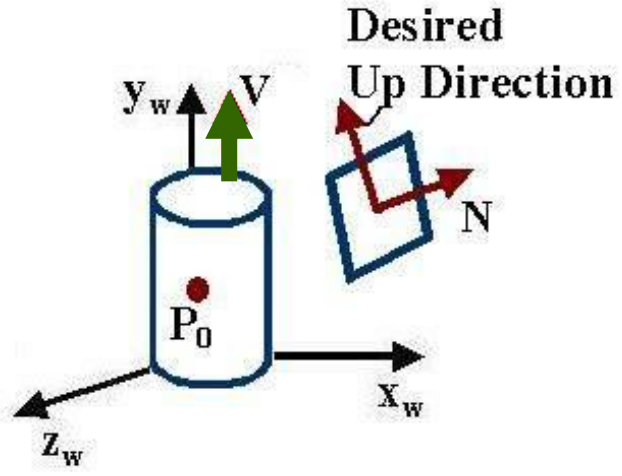


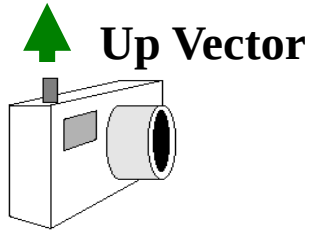


Specifying the Viewing Coordinate System (y_v Axis)

- Finally, we choose the ***up direction*** for the view by specifying a vector ***V***, called the ***view up vector***.
- This vector is used to establish the positive direction for the y_v axis.
- ***V*** is projected into a plane that is perpendicular to the normal vector.

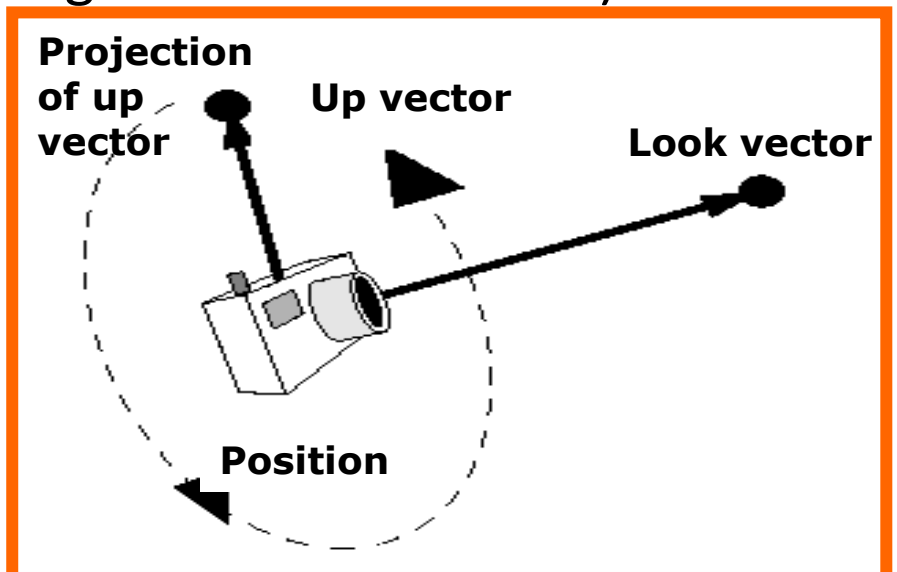






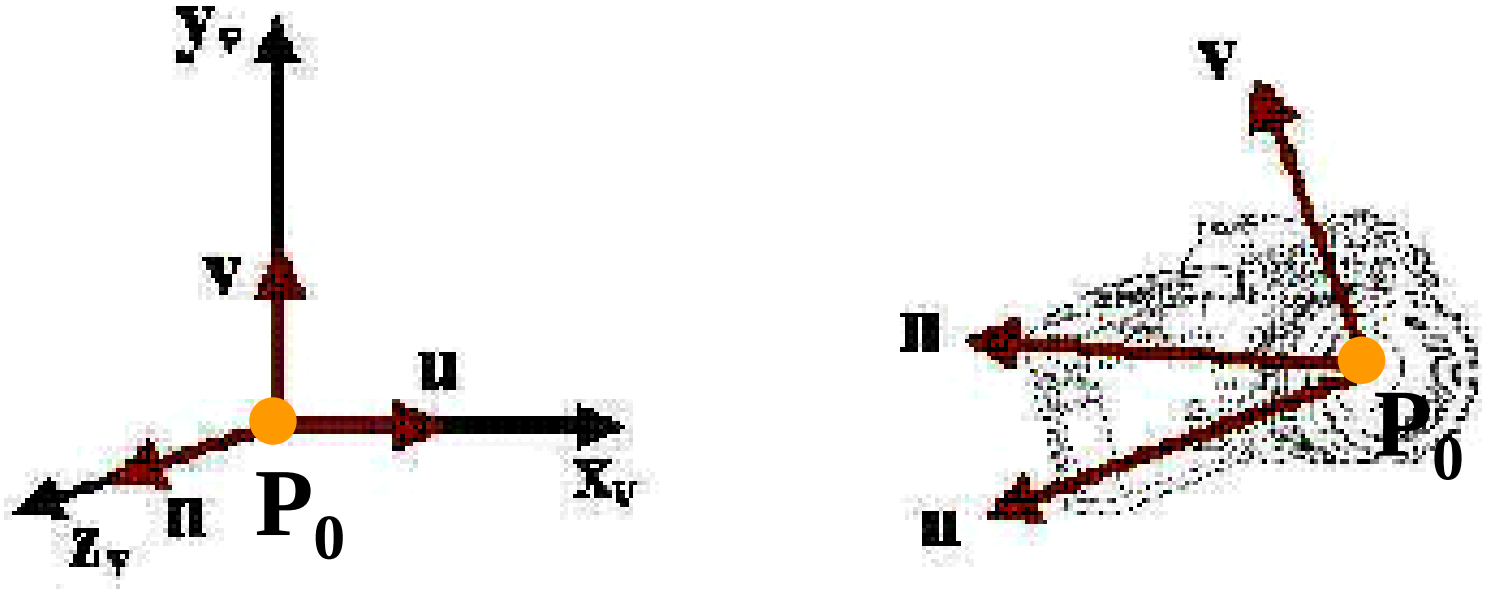
Look and Up Vectors

- ***Look Vector***
  - the direction the camera is pointing
  - three degrees of freedom; can be any vector in 3-space
- ***Up Vector***
  - determines how the camera is rotated around the *Look vector*
  - for example, whether you're holding the camera horizontally or vertically (or in between)
  - projection of *Up vector* must be in the plane perpendicular to the look vector (this allows *Up vector* to be specified at an arbitrary angle to its *Look vector*)



Specifying the Viewing Coordinate System (x_v Axis)

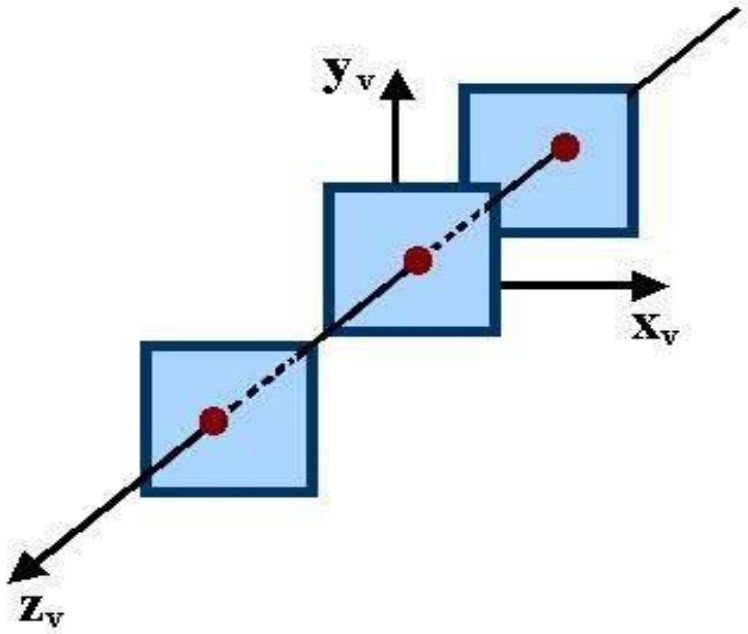
- Using vectors **N** and **V**, the graphics package computer can compute a third vector **U**, perpendicular to both **N** and **V**, to define the direction for the $\mathbf{x}_v$ axis.



The View Plane

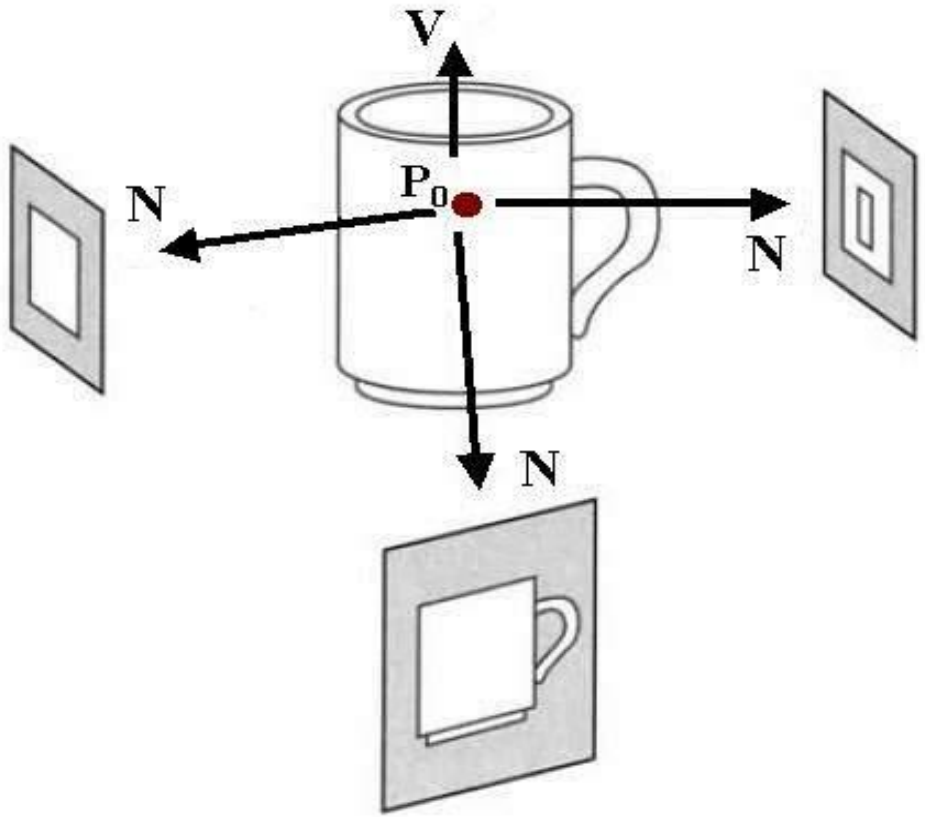
- Graphics package allow users to choose the position of the view plane along the z_v axis by specifying the **view plane distance** from the viewing origin.

- The view plane is always parallel to the $x_v y_v$ plane.



Obtain a Series of View

- To obtain a series of view of a scene, we can keep the view reference point fixed and **change** the direction of **N**.



Simulate Camera Motion

- To simulate camera motion through a scene, we can keep **N fixed** and **move** the view reference **point** around.