

# Computer Vision - 1

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## ① Image Formation

(\*) Capturing a 3D scene into 2-D image

Most commonly used model:-

Pinhole Camera model

(\*) used to describe a 3D scene onto a 2-D image plane.

Math:-

$$\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \frac{1}{z} \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

$X, Y, Z$ : 3-D world coordinates

$u, v$ : 2-D image coordinates

$f_x, f_y$ : focal length in pixels (along  $x$  &  $y$ )

$c_x, c_y$ : Principal point (center of the image)

$Z$ : Depth of the point in scene

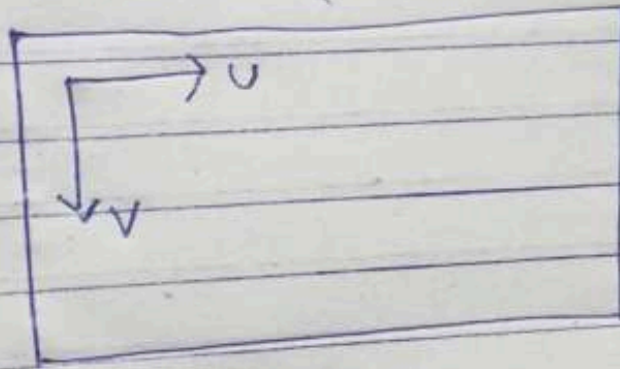


⊗  $X, Y, Z$  are measured w.r.t. an arbitrary origin. in world coordinate, (unit: m or cm)

⊗  $u, v$ : 2-D pixel coordinates.

→ origin generally at top-left-corner of image

$u, v \equiv$  (unit = Pixels)



2-D image

⊗ ~~Units~~ Units (SI)

$X, Y, Z, \text{ } \cancel{\text{units}}$	$\rightarrow$	m (metre)
$f_x, f_y, C_x, C_y, u, v$	$\rightarrow$	Pixels