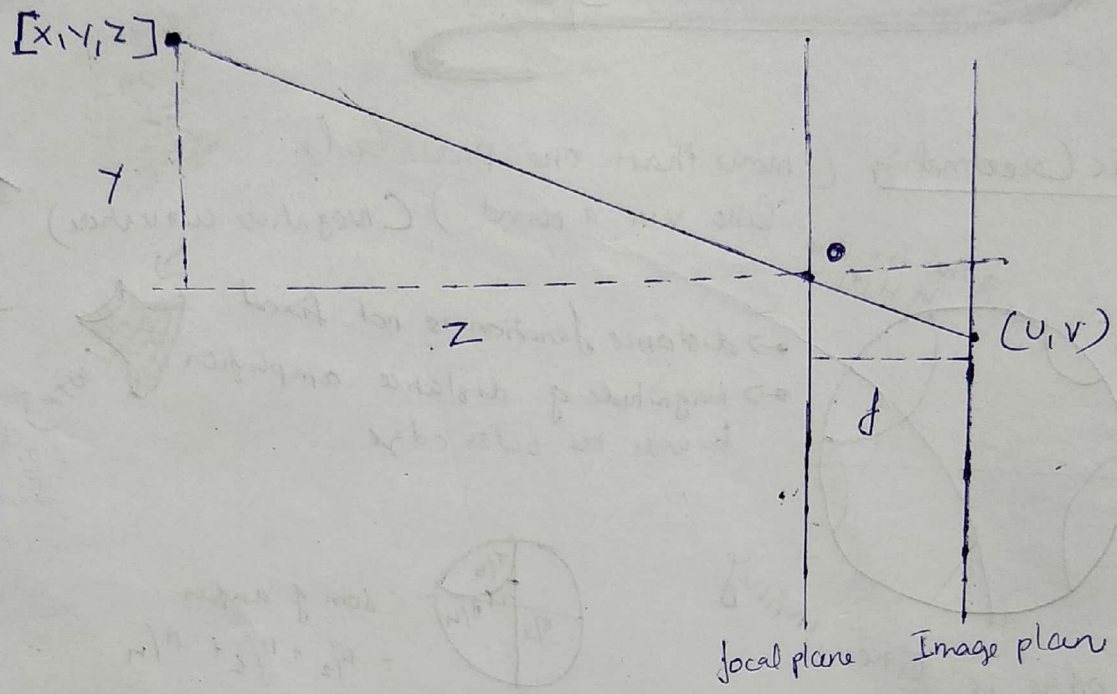
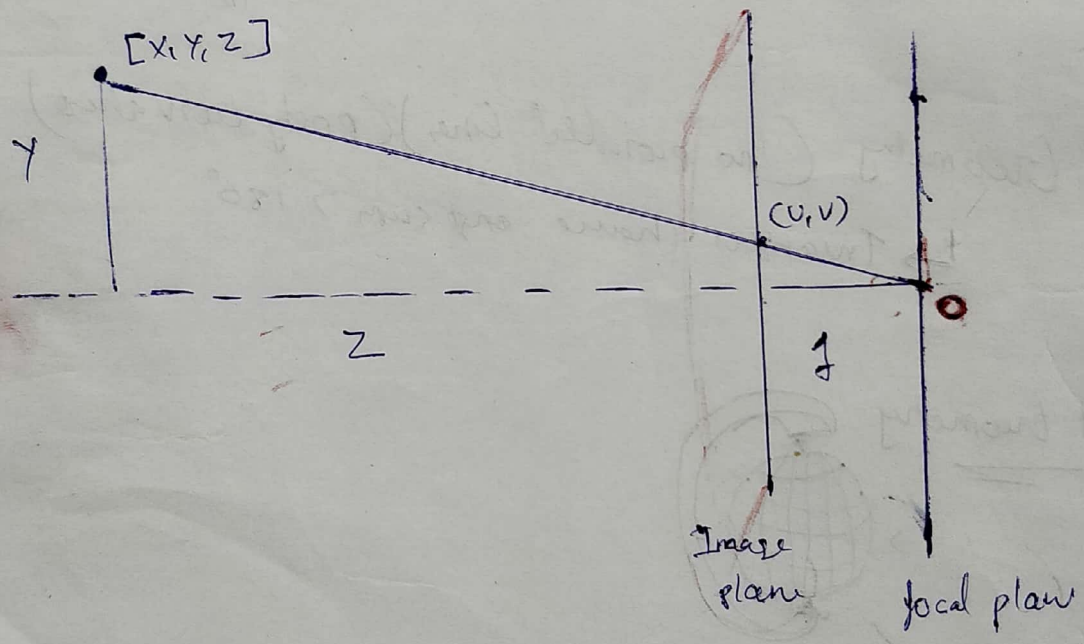
Pinhole camera model (source: ksimek, cs.toronto (cam params))





$$\frac{Z}{f} = \frac{Y}{v} \quad \text{(similar triangles)}$$

$$v = Y\frac{f}{Z} \qquad u = X f/_Z$$

$$\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} f & 0 & 0 \\ 0 & f & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

intrinsic param (K)

Extrinsic param = $(I|t) \times \begin{pmatrix} R & 0 \\ 0 & 1 \end{pmatrix}$ (t: translation)

$P = K \times [R|t]$

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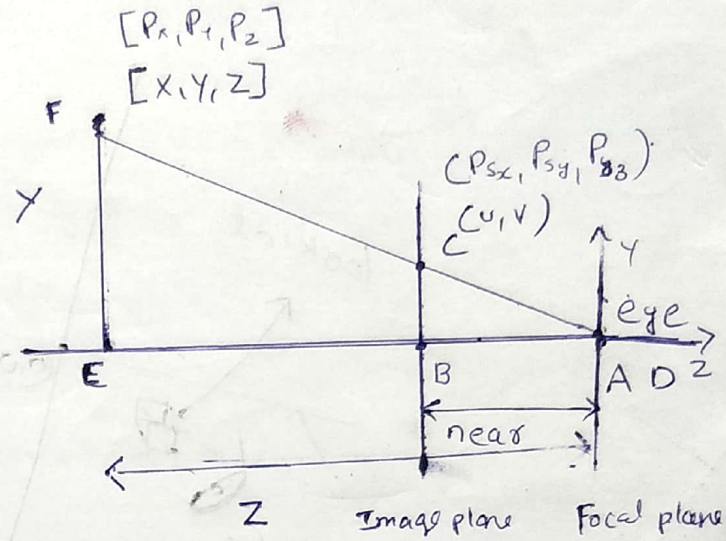
Opengl Camera model

Source: Scratch Pixel.

$$\frac{AB}{DE} = \frac{BC}{EF}$$

$$= \frac{n}{-P_z} = \frac{BC}{P_y} \Rightarrow BC = P_{sy} = \frac{n * P_y}{-P_z}$$

$$P_{sx} = \frac{n * P_x}{-P_z}$$



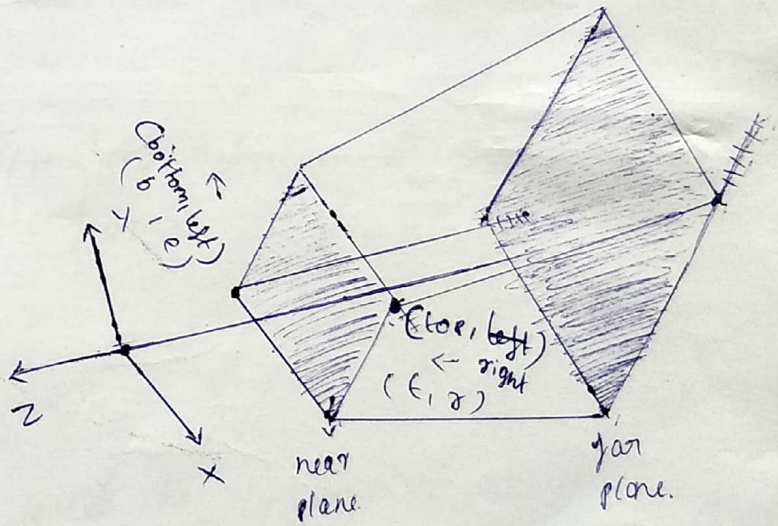
$$l \le P_{sx} \le r$$

$$0 \le P_{sx} \le r - l$$

$$0 \le \frac{P_s - l}{r - l} \le 1$$

$$\vdots$$

$$-1 \le \frac{2nP_x}{-P_z(r-l)} - \frac{r+l}{r-l} \le 1$$



$$\begin{bmatrix} \frac{2n}{r-l} & 0 & \frac{r+l}{r-l} & 0 \\ 0 & \frac{2n}{t-b} & \frac{t+b}{t-b} & 0 \\ 0 & 0 & -\frac{f+n}{f-n} & -\frac{2fn}{f-n} \\ 0 & 0 & -1 & 0 \end{bmatrix}$$

= projection matrix

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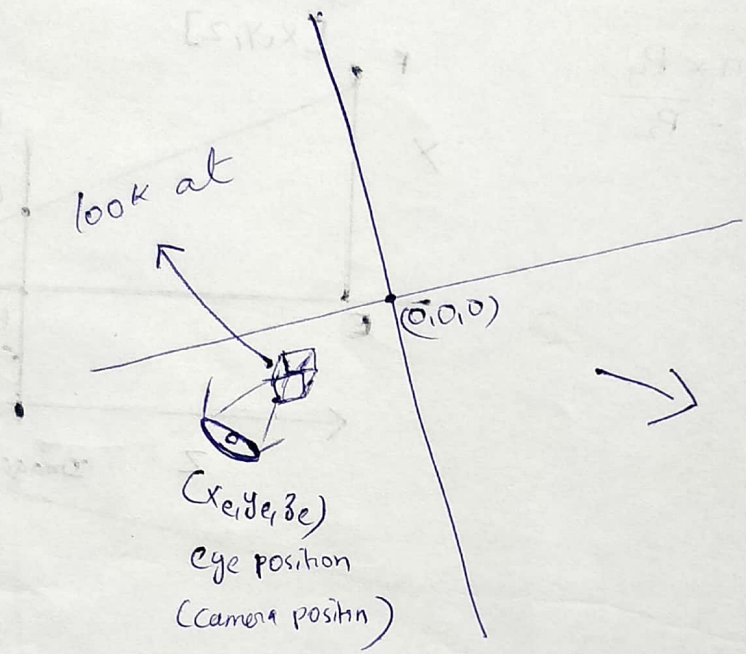
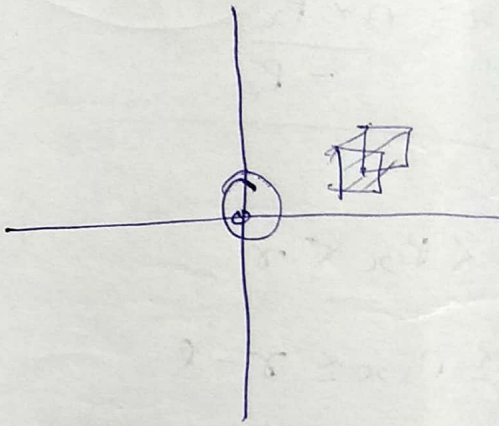
Eye-space ⇒ Transform entire space (including camera) inversely to a space where a fixed camera is at the origin (0, 0, 0), looking at Z.





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