Perspective Projection (원근투영)

far clip plane

viewing Frustum

near clip plane

camera

Frustum 안에서 물체만 볼 수 있다.

Near Plane / Far Plane

시점 / Projection window

$a/2$, d, n, f

$$d = \frac{1}{\tan\frac{a}{2}}$$

$a = \text{fov (시야축)}$

옆에서 볼 것

far Plane / f / $f-n$ / aspect ratio / r / n / $\beta/2$ / Near Plane / Projection window / 시점

위에서 볼 것
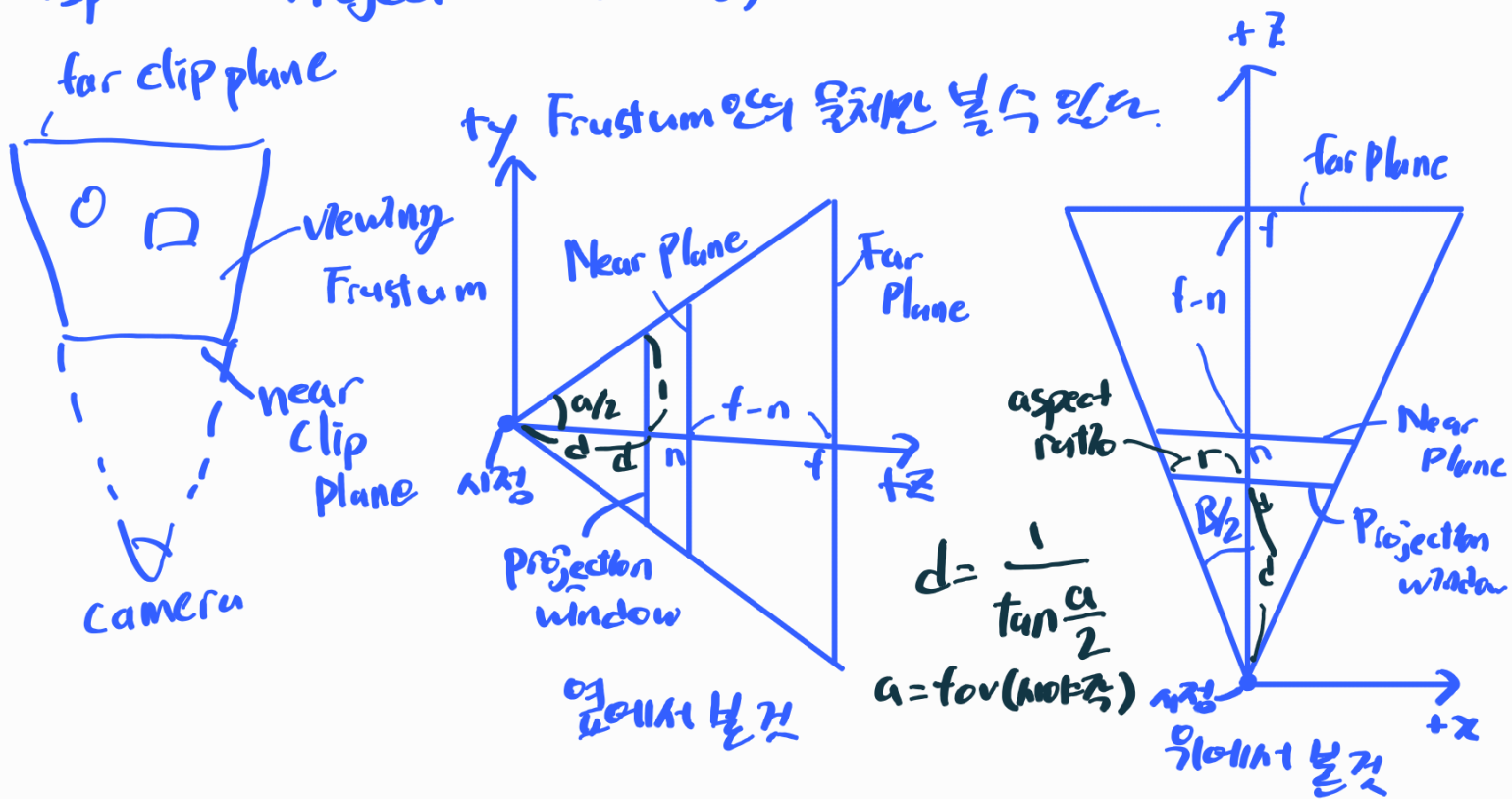
Projection 행렬

$$[x, Y, Z, 1]$$

(모인트)

$$
\begin{bmatrix}
\dfrac{1}{r\tan(\frac{a}{2})} & 0 & 0 & 0 \\
0 & \dfrac{1}{\tan(\frac{a}{2})} & 0 & 0 \\
0 & 0 & \dfrac{f}{f-n} & 1 \\
0 & 0 & \dfrac{-nf}{f-n} & 0
\end{bmatrix}
$$

$r = $ aspect ratio

$a = $ fov (시야축) (radian)

$n = $ 시점에서 Near Plane까지 거리

$f = $ 시점에서 Far Plane 까지 거리

$$= \left[\frac{x}{r\tan(\frac{a}{2})}, \frac{Y}{\tan(\frac{a}{2})}, \frac{f(Z-n)}{f-n}, Z \right]$$

↓↓ Homogeneous divide

$$\left[\frac{x}{r\tan(\frac{a}{2})Z}, \frac{Y}{\tan(\frac{a}{2})Z}, \frac{f(Z-n)}{(f-n)Z}, 1 \right]$$

$$\left[\frac{x}{r\tan(\frac{a}{2})z}, \frac{y}{\tan(\frac{a}{2})z}, \frac{f(z-n)}{(f-n)z}, 1 \right]$$

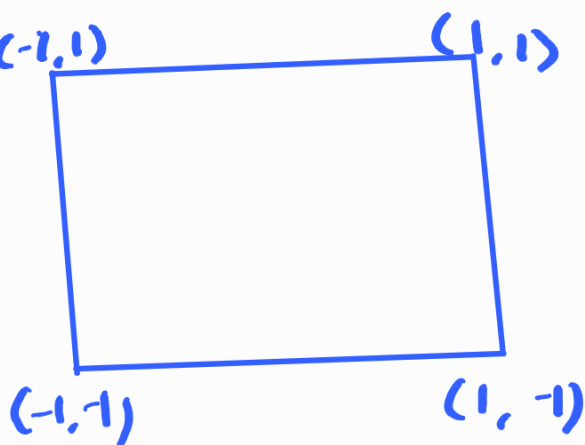$$= \left[\frac{d}{rz}x, \frac{d}{z}y, \frac{f(z-n)}{(f-n)z}, 1 \right] = [x', y', z', 1]$$

Normalized Device Coordinates $(-1,1)$ ⬚ $(1,1)$

- $-1 \le x' \le 1$
- $-1 \le y' \le 1$, $\quad \frac{d}{rz}x, \frac{d}{z}y$

$(-1,-1)$ $\quad\quad\quad$ $(1,-1)$

Normalized Depth Value

- $0 \le z' \le 1$ $\quad \frac{f(z-n)}{(f-n)z}$

(viewport의 Depth으로 정육체의 z 범위를 $[0,1]$로 만들어줄것이다
이 범위를 벗어나면 그리지 않는다.