P1

(1.1) homo. coord. $P = \{34, 56, 10\}$

Cartesian coord $P' = \{3.4, 5.6\}$ #

(1.2) ${}^{A}P_{2d} = [u \; v \; 1]$ * in homo. coord.

$$\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} 100 & 0 & 0 \\ 0 & 100 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} -2 \\ 3 \\ 5 \end{bmatrix} = \begin{bmatrix} -200 \\ 300 \\ 5 \end{bmatrix}$$

$\Rightarrow u = -200/5 = -40$

$v = 300/5 = 60$, ${}^{A}P_{2d} = [-40, 60, 1]^{T}$ # * homo. coord.

(1.3) $T_{cam\text{-}pose} = {}^{w}T_{c}$, ${}^{c}P = {}^{c}T_{w}\,{}^{w}P$

$${}^{c}T_{w} = {}^{w}T_{c}^{-1} = \begin{bmatrix} R^{T} & -R^{T}d \\ 0_{n} & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & -1 \\ 0 & 0 & 1 & -5 \\ 0 & -1 & 0 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$-\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 3 \\ 5 \end{bmatrix} = \begin{bmatrix} -1 \\ -5 \\ 3 \end{bmatrix}$$

$$\Rightarrow {}^{c}P = \begin{bmatrix} 1 & 0 & 0 & -1 \\ 0 & 0 & 1 & -5 \\ 0 & -1 & 0 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 3 \\ 1 \\ 5 \\ 1 \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ 2 \\ 1 \end{bmatrix}$$

${}^{c}P = [2, 0, 2]$ #

* Cartesian coord

(1.4)

A: -2 cm

B: 1 cm

C: 0 cm

(1.5)

1. depth (C) = 3 cm
2. depth (A) = 8 cm
3. $I_{depth}(u,v)$ = depth (C) = 3 cm
4. proj-sdf (A) = 3 − 8 = −5 cm
5. ① proj-tsdf (A) = max(−1, min(1, proj-sdf(A)/8))
   = max(−1, −5/8) = −0.625

   ② proj-tsdf (A) = max(−1, min(1, proj-sdf(A)/2))
   = max(−1, −5/2) = −1

(1.6)

1. -2 cm
2. A: ^{cam_0}proj-sdf(A) = −5

   ^{cam_1}proj-sdf(A) = −2

   abs(^{cam_1}proj-sdf(A)) < abs(^{cam_0}proj-sdf(A))

   ⇒ updated_proj-sdf (A) = −2

   C: ^{cam_0}proj-sdf(C) = 0

   ^{cam_1}proj-sdf(C) = −4

   abs(^{cam_1}proj-sdf(C)) > abs(^{cam_0}proj-sdf(C))

   ⇒ no update. updated_proj-sdf(C) = 0