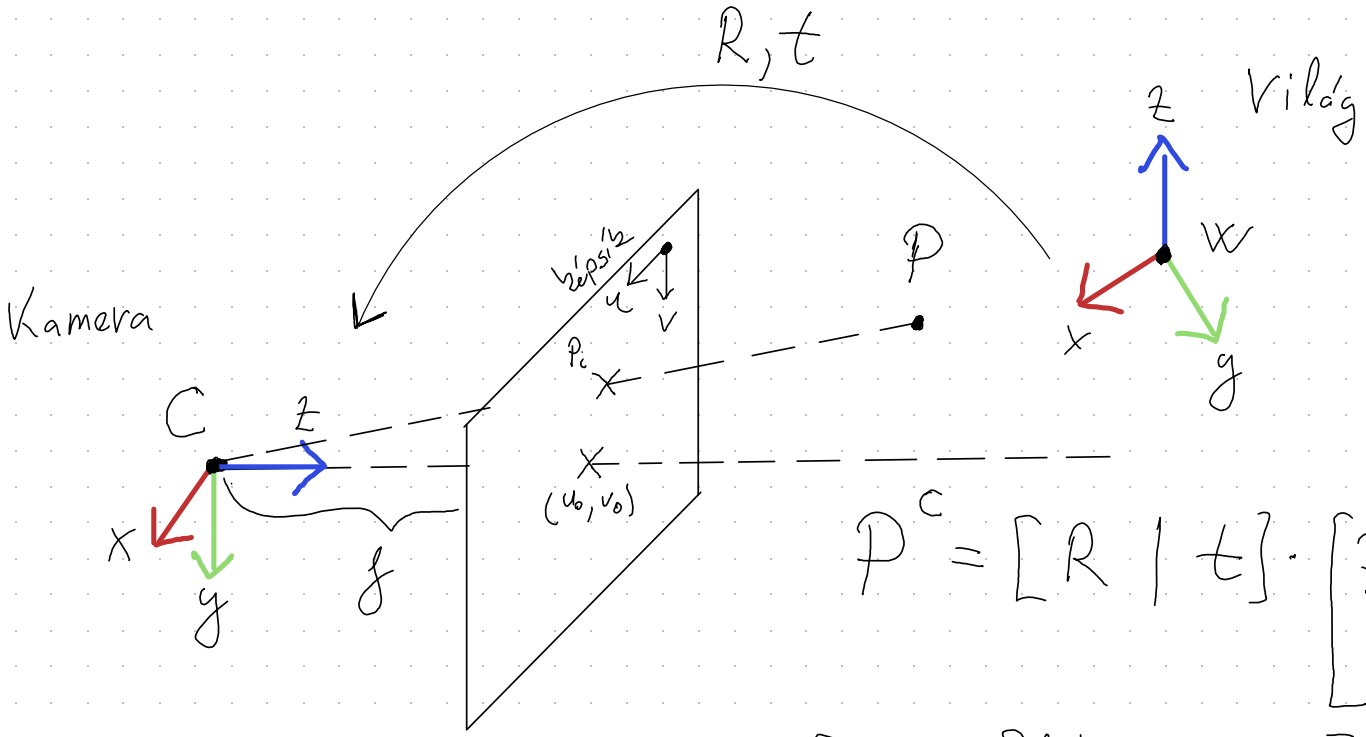
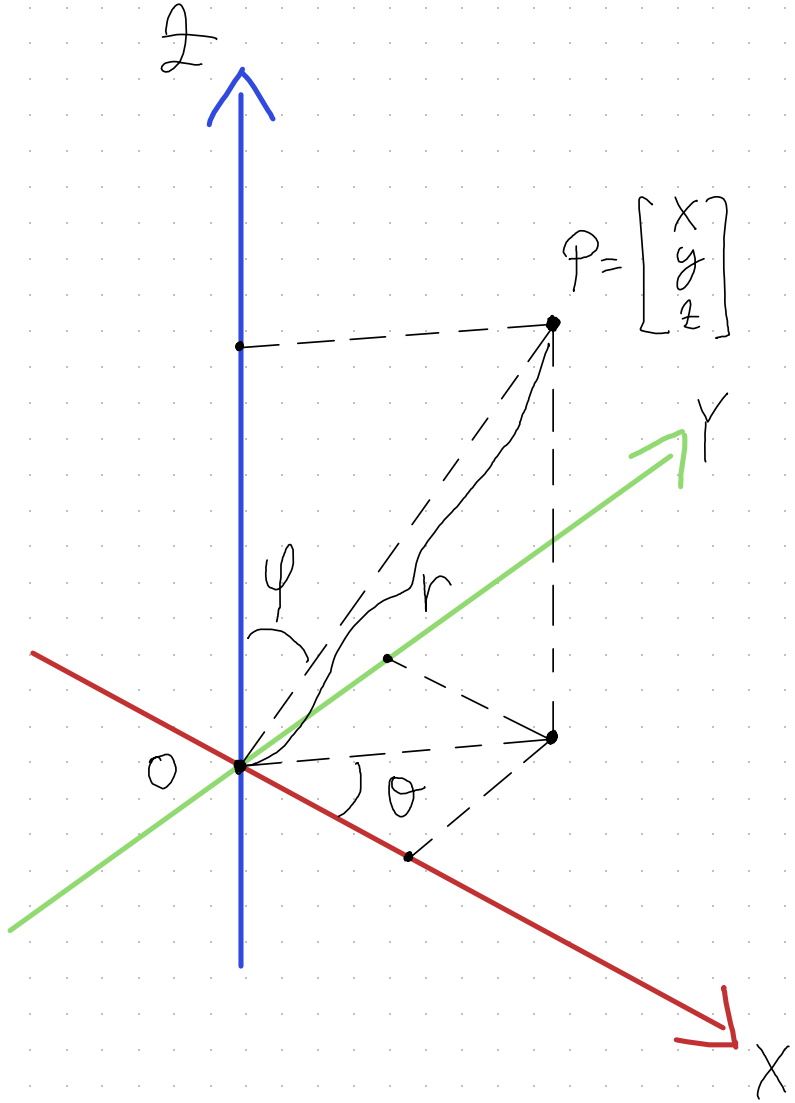
Kamera modell (OpenCV)



$$P^C = [R \mid t] \cdot \begin{bmatrix} P^W \\ 1 \end{bmatrix}$$

$$P_i = \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} \simeq \underbrace{\begin{bmatrix} f \cdot k_u & 0 & u_0 \\ 0 & f \cdot k_v & v_0 \\ 0 & 0 & 1 \end{bmatrix}}_{K} \cdot P^C$$

Gömbi koordináták



$$x = r \cdot \cos\theta \cdot \sin\varphi$$

$$y = r \cdot \sin\theta \cdot \sin\varphi$$

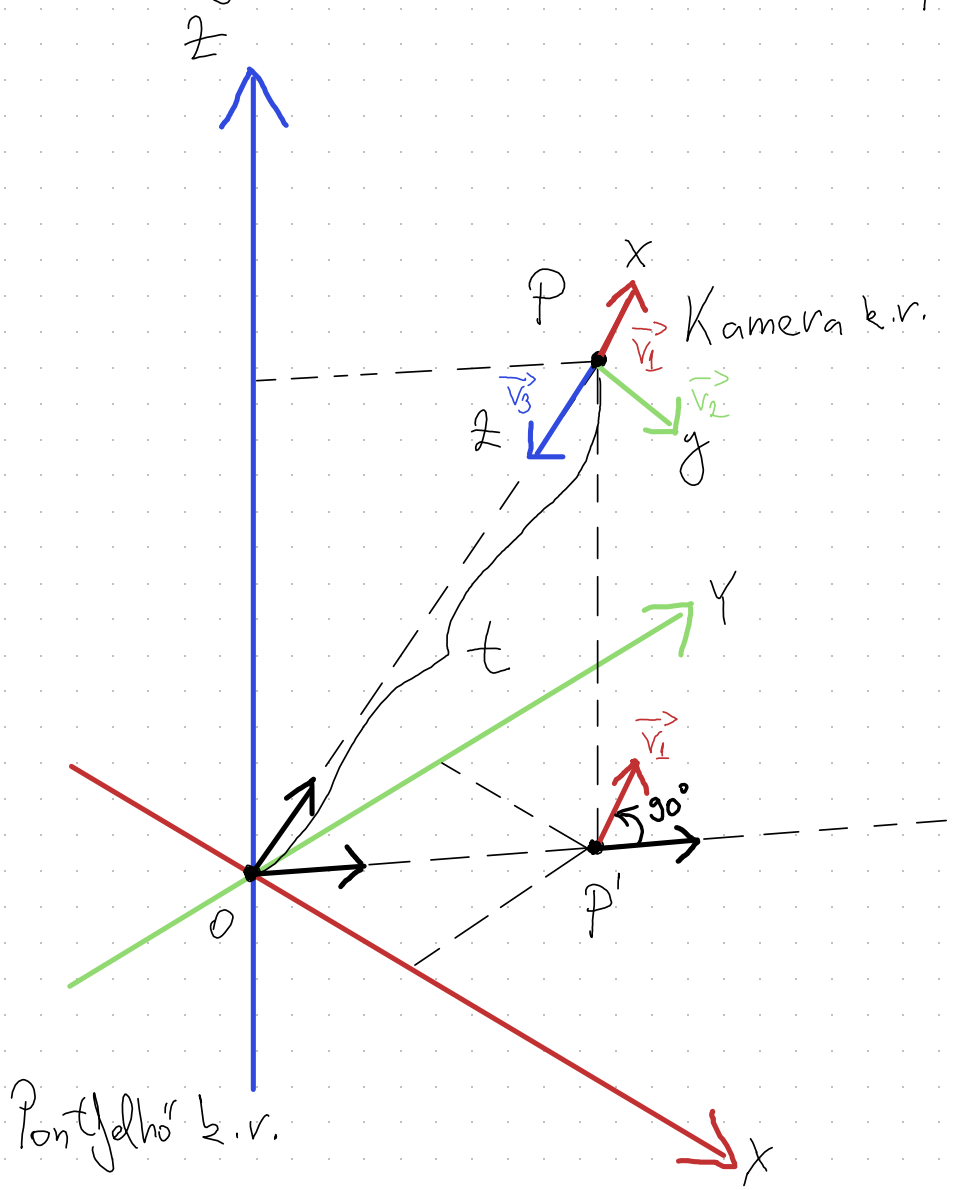
$$z = r \cdot \cos\varphi$$

$r \in \mathbb{R}^+$

$\theta \in [0, 2\pi)$

$\varphi \in [0, \pi]$

Pontfelhő vizualizáció – Külső paraméterek



$$P = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \xrightarrow{\text{z}\uparrow \quad \text{y}\rightarrow \text{x}} P' = \begin{bmatrix} x \\ y \\ 0 \end{bmatrix}$$

Eltolás

$$t = \begin{bmatrix} -x \\ -y \\ -z \end{bmatrix}$$

$$P^{\text{Felhő}} + t = P^{\text{Kamera}} = 0$$

Forgatás

$$R = \begin{bmatrix} v_1^T \\ v_2^T \\ v_3^T \end{bmatrix}$$

$$\vec{v_3} = \frac{-\vec{P}}{\|\vec{P}\|_2}$$

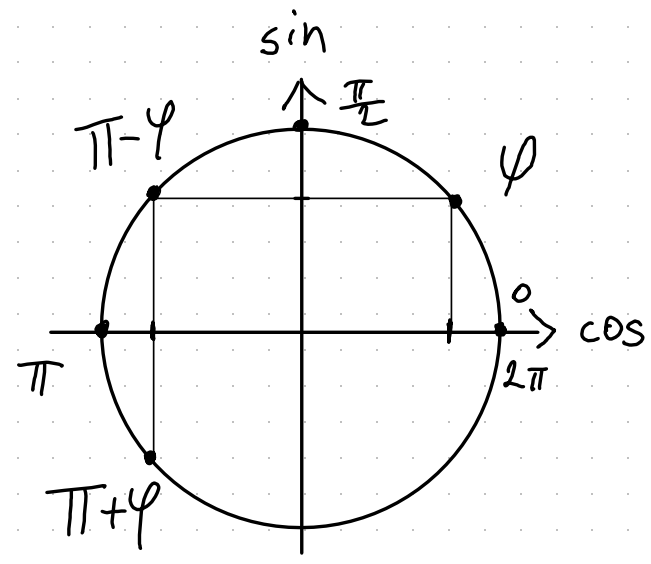
↳ az origóba néz

$$\vec{v_1} = \frac{R^{90^\circ} \cdot \vec{P'}}{\|\vec{P'}\|_2} = \begin{bmatrix} -y \\ x \\ 0 \end{bmatrix}$$

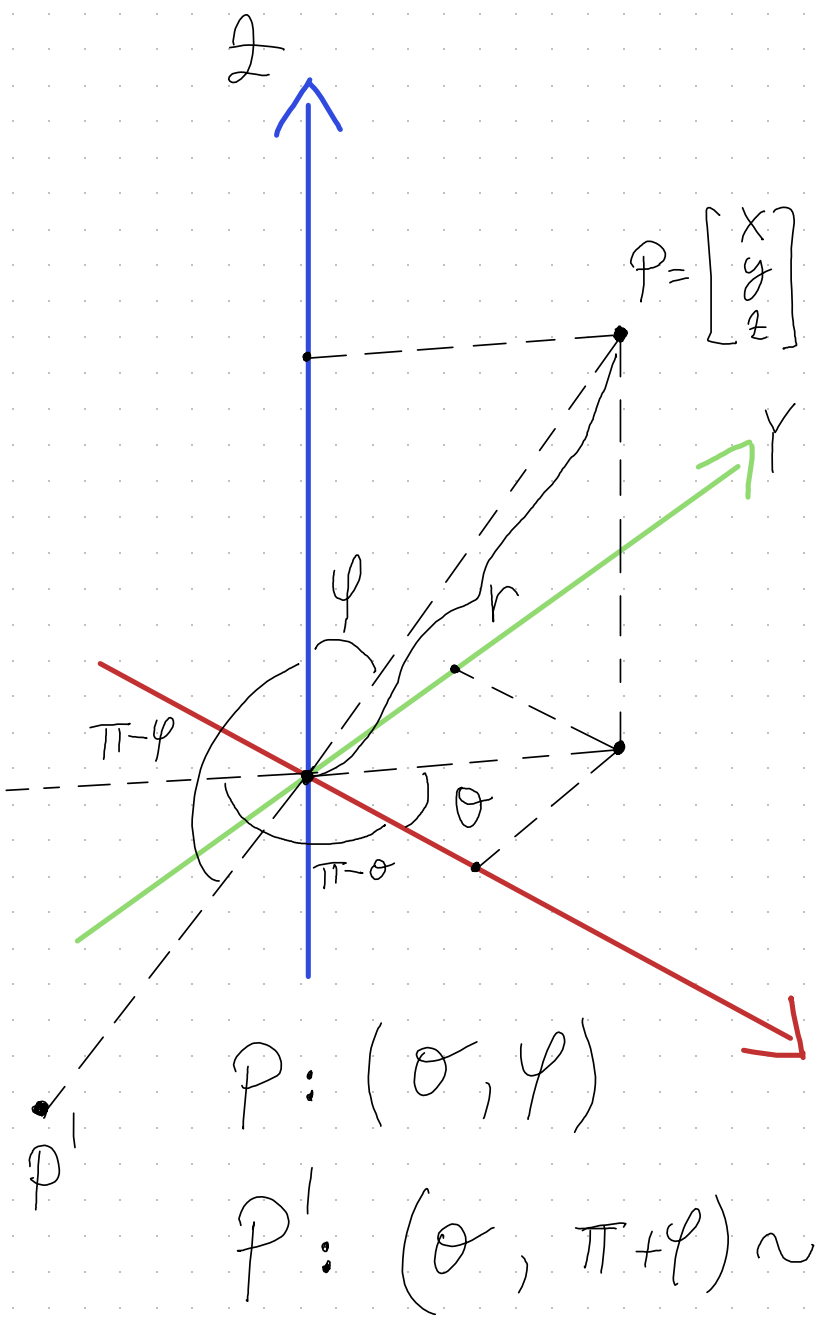
↳ X-tengely mindig jobbra

$$\vec{v_2} = \vec{v_3} \times \vec{v_2}$$

↳ tengelyek mind merőlegesek



$$\sin(\pi+\varphi) = -\sin\varphi$$
$$\sin(\pi-\varphi) = \sin\varphi$$
$$\cos(\pi+\varphi) = -\cos\varphi$$
$$\cos(\pi-\varphi) = -\cos\varphi$$



$$x = r\cdot\cos\theta\cdot\sin\varphi$$
$$y = r\cdot\sin\theta\cdot\sin\varphi$$
$$z = r\cdot\cos\varphi$$

$r \in \mathbb{R}^+$

$\theta \in [0, 2\pi)$

$\varphi \in [0, \pi]$

$P: (\theta, \varphi)$

$P': (\theta, \pi+\varphi) \sim (\theta+\pi, \pi-\varphi)$

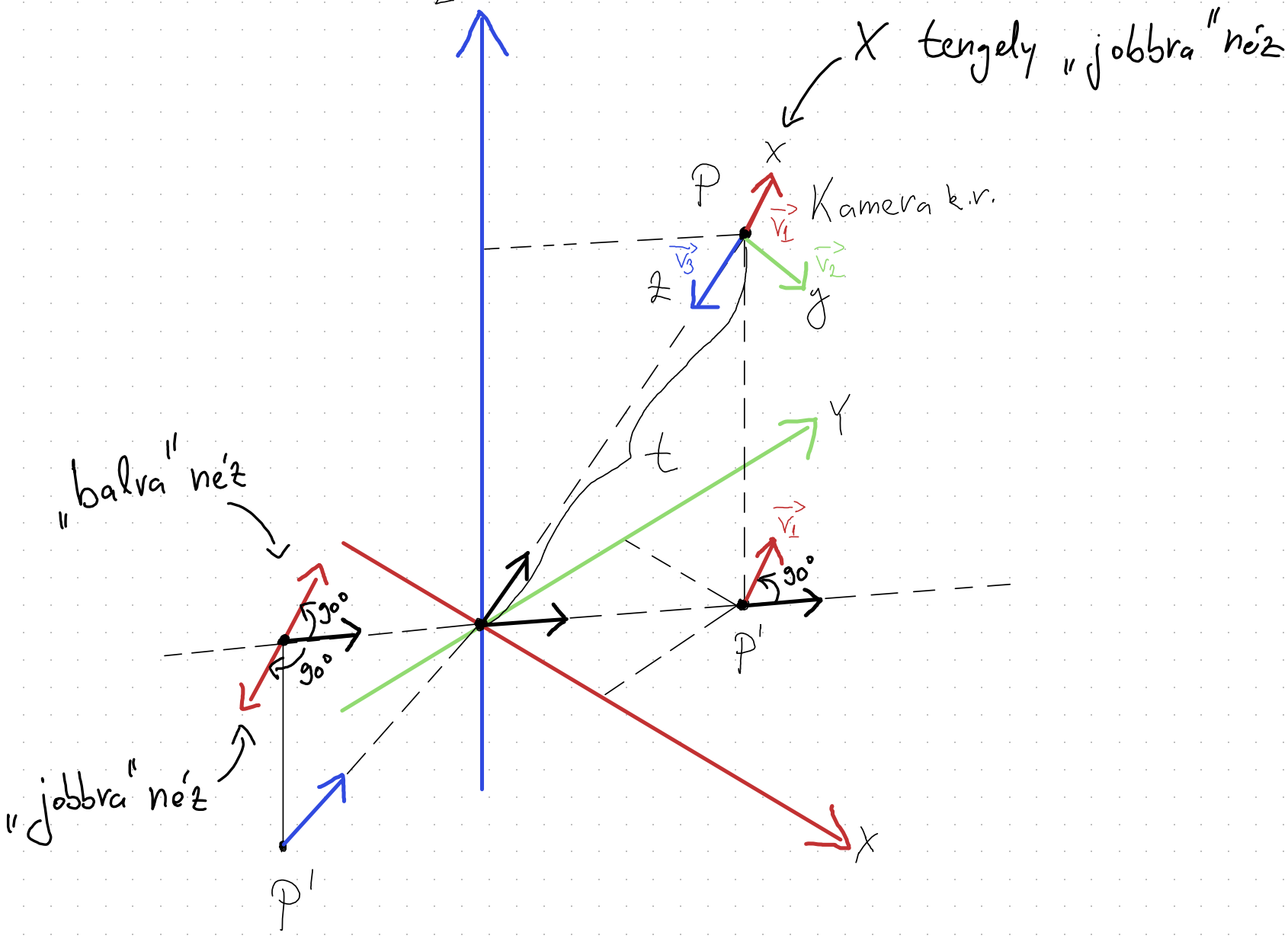
$$P = \begin{bmatrix}x\\y\\z\end{bmatrix} = \begin{bmatrix}\cos\theta\sin\varphi\\ \sin\theta\sin\varphi\\ \cos\varphi\end{bmatrix}$$

$\cdot(-1)$

$$P' = \begin{bmatrix}-x\\-y\\-z\end{bmatrix} = \begin{bmatrix}-\cos\theta\sin\varphi\\ -\sin\theta\sin\varphi\\ -\cos\varphi\end{bmatrix} = \begin{bmatrix}\cos\theta\sin(\pi+\varphi)\\ \sin\theta\sin(\pi+\varphi)\\ \cos(\pi+\varphi)\end{bmatrix} = \begin{bmatrix}\cos(\pi+\theta)\cdot\sin(\pi-\varphi)\\ \sin(\pi+\theta)\cdot\sin(\pi-\varphi)\\ \cos(\pi-\varphi)\end{bmatrix}$$

Ha $\varphi > \pi$-vel ki is megyünk az értelmezési tartományból, a képletek működnek

Hol jön képbe a tükrözés?



Amint Y-vel átlépjük $\pi - t$, az X-tengelyt más irányba kell forgatni.