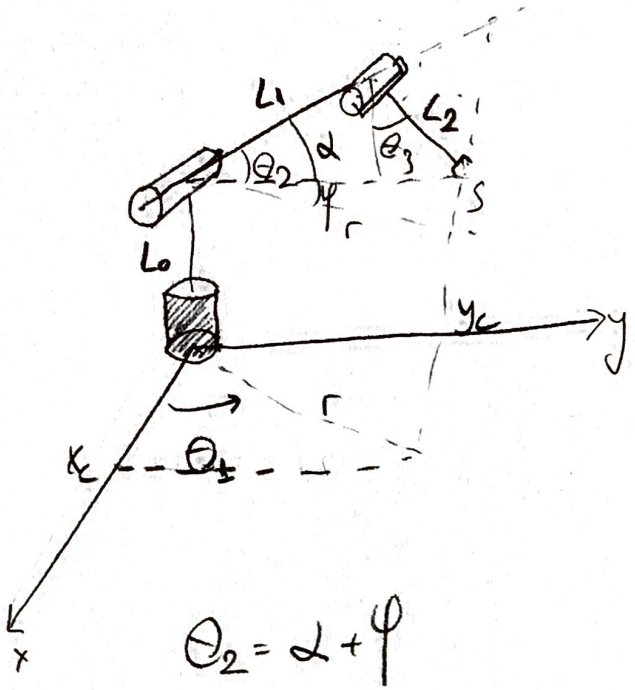

$$\theta_1 = \operatorname{atan2}(y_c, x_c)$$

$$r = \sqrt{x_c^2 + y_c^2}$$

$$s = z_c - L_0$$

$$r^2 + s^2 = L_1^2 + L_2^2 + 2 L_1 L_2 \cos(90 - \theta_3)$$

$$\sin\theta_3 = \frac{r^2 + s^2 - L_1^2 - L_2^2}{2 L_1 L_2} = D$$

$$\cos\theta_3 = -\sqrt{1 - D^2}$$

↳ this only valid for elbow up solution since the limitations of joints

$$\theta_3 = \operatorname{atan2}(D, -\sqrt{1 - D^2})$$

$$\theta_2 = \alpha + \varphi$$

$$\varphi = \operatorname{atan2}(s, r)$$

$$\alpha = \operatorname{atan2}(L_2 \cos\theta_3, L_1 + L_2 \sin\theta_3)$$

$$\theta_2 = \operatorname{atan2}(s, r) + \operatorname{atan2}(L_2 \cos\theta_3, L_1 + L_2 \sin\theta_3)$$