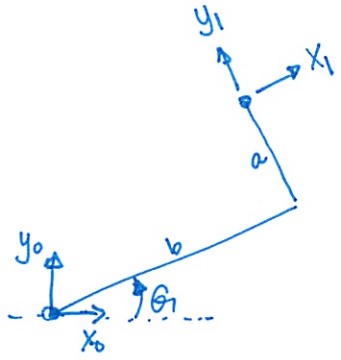
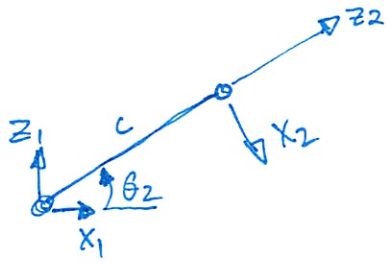
1.



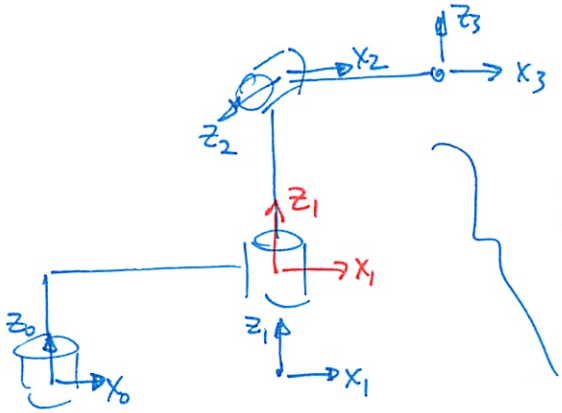
$$T_1^0 = R_z(\theta_1)\, T_x(b)\, T_y(a)$$



$$T_2^1 = R_y(-\theta_2)\, T_x(c)\, R_y(90^\circ)$$

---

2. a)

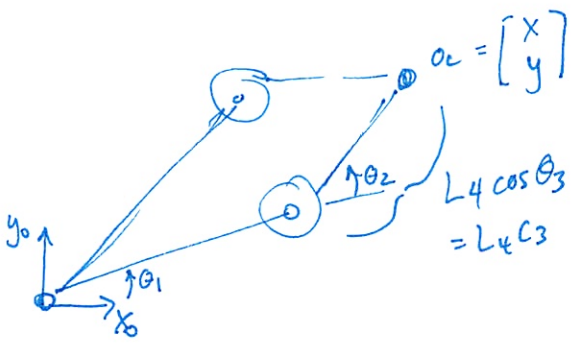


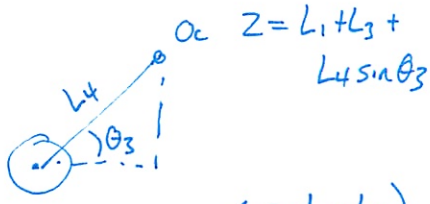
2 common cases for {1}

Link	a_i	α_i	d_i	θ_i
1	L_2	0	$0, L_1$	θ_1^*
2	0	90°	L_1+L_3, L_3	θ_2^*
3	L_4	-90°	0	θ_3^*

3. Ignore special cases for now:

From the top down, this is just the RR robot from the lectures:





$$\theta_3 = \operatorname{asin}\left(\frac{z - L_1 - L_3}{L_4}\right)$$

$$\cos\theta_2 = \frac{x^2 + y^2 - L_2^2 - (L_4 c_3)^2}{2 L_2 L_4 c_3} = c_2$$

$$\theta_2 = \operatorname{atan2}\left(\pm\sqrt{1 - c_2^2},\ c_2\right)$$

$$\theta_1 = \operatorname{atan2}(y, x) - \operatorname{atan2}(L_4 c_3 s_2,\ L_2 + L_4 c_3 c_2)$$

Special cases:

if $x = y = 0$

θ_1 indeterminate

$\theta_2 = \pm 180°$

if $x = L_2 \cos\theta_1$, $y = L_2 \sin\theta_1$ $\quad \theta_3 = \pm 90°$

θ_2 indeterminate