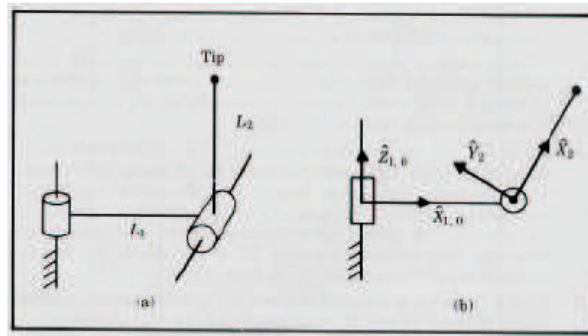


Homework 2

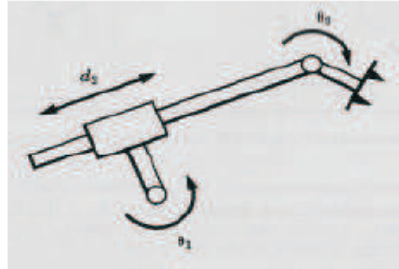
- For the 2-link manipulator shown, the link transformations 0_1T and 1_2T were determined. Their product is

$${}^0_2T = \begin{bmatrix} c_1 c_2 & -c_1 s_2 & s_1 & l_1 c_1 \\ s_1 c_2 & -s_1 s_2 & -c_1 & l_1 s_1 \\ s_2 & c_2 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}.$$

The frame assignments used are indicated below in the figure. Note that frame 0 is coincident with frame 1 when θ_1 is 0. The length of the second link is l_2 . Find an expression for the vector ${}^0P_{tip}$ which locates the tip of the arm relative to the 0 frame. (Courtesy of J. Craig)



- Consider the following RPR manipulator.



- Assign link frames $\{0\}$ through $\{3\}$ for the manipulator – that is, sketch the coordinate axes of each frame.
- Find the Denavit-Hartenberg parameters for this manipulator – that is, fill in the entries for the following table:

i	a_{i-1}	α_{i-1}	d_i	θ_i
1				
2				
3				

- Derive the forward kinematics for this manipulator – that is, find the matrix 0_3T .