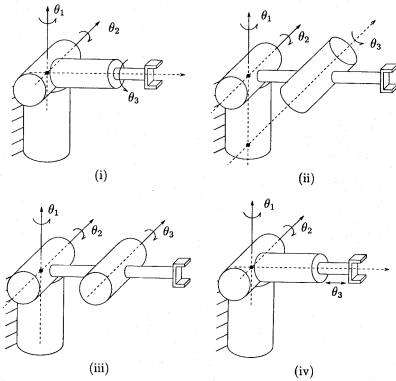


### Homework # 3

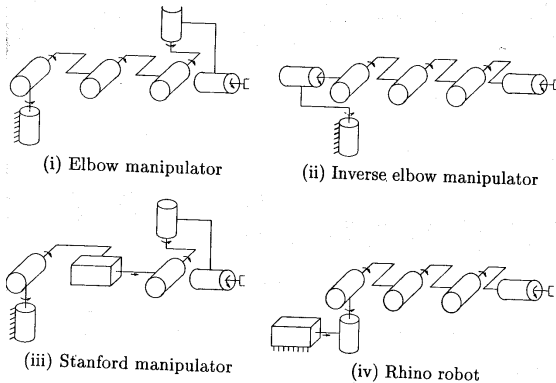
Due: February 7, 2007

The following problems are from Chapter 3 in Murray, Li, & Sastry (the chapter is available from the course webpage, under **lectures**).

1. Consider the 4 3-DOF manipulators below. Find the forward kinematics map (i.e.,  $R_{0T}$  and  $p_{0T}$  in terms of  $\theta_1, \theta_2, \theta_3$ ). Feel free to use the MATLAB symbolic toolbox.



2. Consider the 4 6-DOF manipulators below. Find the forward kinematics map (i.e.,  $R_{0T}$  and  $p_{0T}$  in terms of  $\theta_1, \theta_2, \theta_3, \theta_4, \theta_5, \theta_6$ ). Feel free to use the MATLAB symbolic toolbox.



3. Write a MATLAB function `fwdkin.m` that computes  $R_{0T}$  and  $p_{0T}$  for a given joint vector  $\theta$ . The function should have the following input and output arguments:

`function [R,p]=fwdkin(theta,type,H,P,n)`

where `theta` is the input joint vector, `type` is the vector indicating the joint type (0 for rotational, 1 for prismatic, others may be added later), `H` is a  $3 \times n$  matrix denoting the axis of rotation in the zero configuration, `P` is a  $3 \times n$  vector denoting the link vectors in the zero configuration, and `n` is the number joints.

The function should be able to accept either symbolic or numerical vectors `theta`. Verify your result in Problems 1 and 2.