Program Assignment 2 (Due 2/24/15)

1. Write a procedure to calculate the inverse kinematics for the 3-D planar manipulator of Fig3.6a on P70 (or P78 of 2nd Ed.) of the textbook. You can make $l_1 = l_2 = 1$. The procedure should pass arguments as shown below:

   Procedure INVKIN(VAR grelb: frame; VAR current,near,far: vec3; VAR sol:boolean);

   where "grelb" and "current" are input parameters: "grelb" is the desired gripper frame specified relative to the base frame (note that the type "frame" is a 3x3 homogeneous transformation matrix), and "current" is the current configuration of the robot (given as a vector of JOINT angles); the output includes two solutions (i.e., joint angle vectors) "near" and "far" and a flag "sol": "near" is the nearest solution to "current", "far" is the second solution, and "sol" is FALSE if no solution exists.

2. Write the following procedure to compute the forward kinematics for the 3-D planar manipulator based on your program assignment 1:

   Procedure KIN(VAR theta: vec3; VAR grelb: frame);

   where "theta" is the input joint vector and "grelb" is the output gripper frame (a 3x3 matrix).

3. Write the following procedure to convert the joint space representation of the gripper location to the vector representation $gvec = (x, y, \phi)$, where ϕ is the Euler angle, based on your program assignment 1:

   Procedure WHERE(VAR theta: vec3; VAR gvec: vec3).

   This procedure may call KIN.

4. Write the following procedure to convert the gripper location (x, y, ϕ) to matrix representation:

   Procedure WHATFRAME(VAR gvec: vec3; VAR grelb: frame).

5. Write a main program to test the correctness of INVKIN and KIN. Basically, the program accepts a desired gripper location in terms of (x, y, ϕ), call WHAT-FRAME, INVKIN, WHERE, and then print out the result. The result should be the same as the input.

Turn in the source code of your program and the above procedures and the file of the execution of your program for the following input gripper locations (assuming that the robot initially is at configuration $theta_1 = theta_2 = theta_3 = 0$: $(x, y, \phi) = (0, 0, -90)$, $(0.6, -0.3, 45)$, $(-0.4, 0.3, 120)$, and $(0.8, 1.4, 30)$.