Explanation to Hexapod Project

1. COXA Angle: $\alpha=\tan^{-1}(y/x)$
2. Horizontal distance from femur Joint $X'=\sqrt{x^2+y^2}-L_1$

   Vertical distance $Z'=z$
3. Distance from femur base to End Effector D

   $D=\sqrt{x'^2+z'^2}$
4. Tibia angle :$\cos(\Upsilon)=\frac{D^2-L_2^2+L_3^2}{2L_2L_3}$, $\Upsilon=\cos^{-1}\left(\frac{D^2-L_2^2+L_3^2}{2L_2L_3}\right)$
5. femur Angle(β): θ-φ

   θ (angle between the line connecting femur to foot and the horizontal)= $\tan^{-1}(Z'/X')$

   φ(angle between femur and that line)=$\cos^{-1}\{(L_2^2-D^2-L_3^2)/2DL_2\}$

Testing and Validation

Test 1: Enter end-effector's X position: 10

Enter end-effector's Y position: 15

Enter end-effector's Z position: 18

Calculated Joint Angles (in degrees):

Coxa (α) = 56.31°

Femur (β) = 20.17°

Tibia (Υ) = 55.78°

Test 2. Enter end-effector's X position: 1

Enter end-effector's Y position: 0.5

Enter end-effector's Z position: 0.3

ERROR!

Traceback (most recent call last):

File "<main.py>", line 49, in <module>

File "<main.py>", line 36, in end_effector_pos_user_input

File "<main.py>", line 19, in test_inverse_kinematics

ValueError: math domain error

Test 3. Enter end-effector's X position: 5

Enter end-effector's Y position: 10

Enter end-effector's Z position: 14.5

Calculated Joint Angles (in degrees):

Coxa (α) = 63.43°

Femur (β) = -0.03°

Tibia (ϒ) = 104.78°

Test 4. Enter end-effector's X position: 10

Enter end-effector's Y position: 20

Enter end-effector's Z position: 30

Unreachable position

Test 5. Enter end-effector's X position: 10

Enter end-effector's Y position: 5

Enter end-effector's Z position: -35

Unreachable position