Task_5 code explanation

Created April 13, 2025

Class Summer Projects SnT

Code Run-through

Function imported - math function is used for the trigonometric functions in the code.

User Defined functions:

check_triangle_existence(a,b,c):

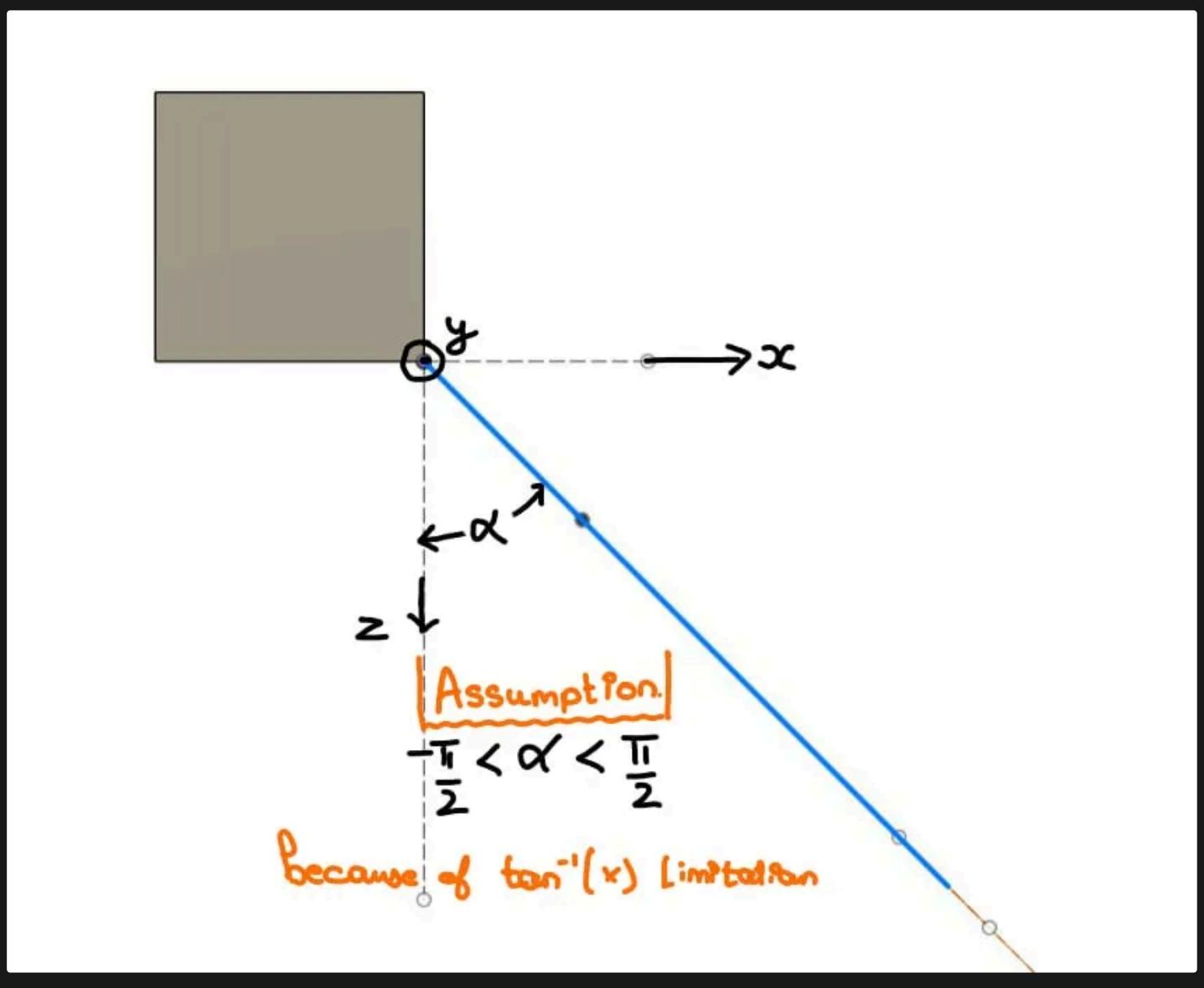
To check the triangle if it is possible to reach or not by using basic properties returning 1 if not possible and 0 if it is possible to reach.

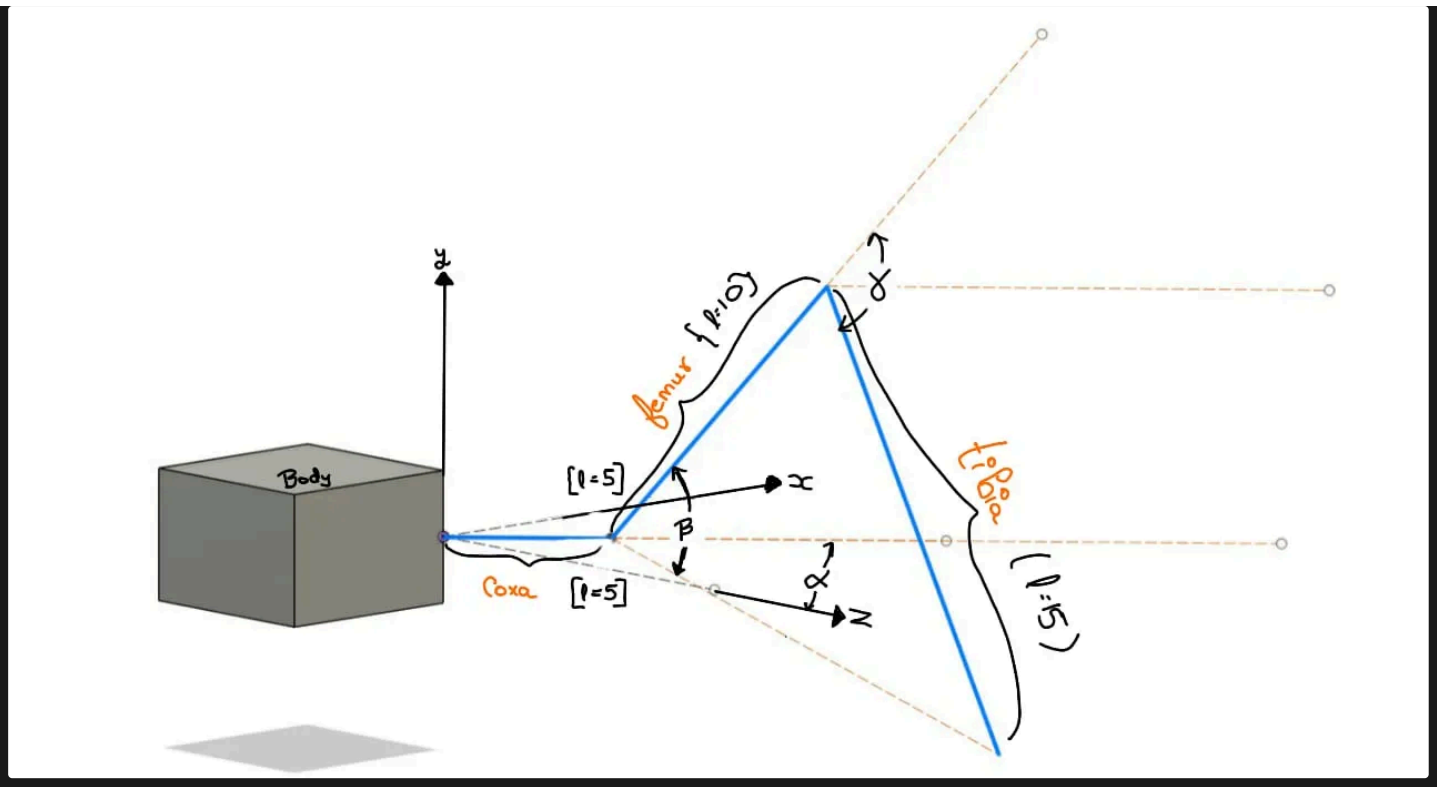
inverse_kinematics(x,y,z)

takes the input of the point to be reached, and prints out the alpha, beta and gamma angles that are specified in the below images with the assumptions.

I have considered 3 DOF's

`Coxa = 5 units` , `Femur = 10 units` , `Tibia = 15 units`





To find the angle (alpha) we use the tan inverse function. If z==0; it goes out of bounds of the tan inverse function, so we specifically use an if function to output ±(π/2).

we use the round(x,z) function to round x to z decimal points, and round is an inbuilt function in python.

then we find the coordinates of the end of the coxa, to find one side of the triangle that is formed by the femur, tibia and dist.

and beta and gamma is found out using the following formulas:

$$\frac{\cos A}{2} = \left(\frac{s(s-a)}{bc}\right)^{\frac{1}{2}}$$

and if it is possible to reach the output is printed and if it not possible "Sorry not possible to reach" is printed.

test_inverse_kinematics()

tests the cases for 5 tests

TEST 1

typical reachable point {(10.0, 5.0, -10.0)} (since distance to the point is < 25)

TEST 2

very close to base {(1.0, 1.0, -1.0)} (since the distance to this point is <<25)

TEST 3

Near max extension {(5.0, -24.0, 0.0)} (since the distance to this point is ~25)

TEST 4

Unreachable (distance > 25 units) {(20.0, 20.0, -10.0)} (since the distance to this point is >25)

TEST 5

Foot deeply below base {(5.0, -10.0, 0.0)}

OUTPUT

```
PS C:\Users\adith\OneDrive\Desktop> & C:/Users/adith/AppData/Local/Programs/Python/Python313/python.exe c:/Users/adith/OneDrive/Desktop/TASK_5/hexapod_ik_solution.py
TEST 1 - Typical Reachable Point (10.0,5.0,-10.0)

α (alpha) = -45.0 °   β (beta) = 47.68 °    γ (gamma)= 77.21 °


TEST 2 - Very Close To Base (1.0,1.0,-1.0)

α (alpha) = -45.0 °   β (beta) = 129.66 °    γ (gamma)= 160.54 °


TEST 3 - Near max extension (5.0, -24.0, 0.0)

α (alpha) = 90.0 °   β (beta) = 20.02 °    γ (gamma)= 33.21 °


TEST 4 - Unreachable (20.0, 20.0, -10.0)

Sorry not possible to reach


TEST 5 - Foot deeply below base (5.0, -10.0, 0.0)

α (alpha) = 90.0 °   β (beta) = 97.18 °    γ (gamma)= 138.59 °
```