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/*****
* HeeChan Kang
* CSC 431 - AI Robotics
* Assignment One - Inverse Kinematics
*****/

#include <stdio.h>
#include <stdlib.h>
#include <math.h>

void main() {
    double x, y, alpha, beta, radius;
    double base = 1.0, l1 = 0.8, l2 = 0.8;
    double limit = 7*M_PI/8;

    /* Take user input for x and y coordinates. */
    printf("Enter x-coordinate: ");
    scanf("%lf", &x);
    printf("Enter y-coordinate: ");
    scanf("%lf", &y);

    /* Check if the distance of input is out of reach or not */
    radius = sqrt(pow(x,2) + pow((y-1),2));

    if (y > 0 && radius <= 1.6) {
        /* Inverse Kinematics equation derived from class for beta and use
           beta to find alpha */
        beta = acos( (pow(x,2) + pow(y,2) - (2 * base * y) + pow(base,2) -
            pow(l1,2) - pow(l2,2)) / (2 * l1 * l2) );
        alpha = atan( -x / sqrt(pow(l1,2) + pow(l2,2) + (2 * l1 * l2 *
            cos(beta) - pow(x,2))) ) - atan( (l2 * sin(beta)) / (l1 + (l2
            * cos(beta))) );
        if (alpha > -limit && alpha < limit && beta > -limit && beta <
            limit) {
            printf("Alpha is: %6.4lf radians or %6.4lf degrees.\n", alpha,
                alpha * 180/M_PI);
            printf( "Beta is: %6.4lf radians or %6.4lf degrees.\n", beta,
                beta * 180/M_PI);
        } else {
            printf("The coordinates entered are unreachable due to the
                arm's physical limitations.\n");
        }
    } else {
        printf("Invalid input! Either the coordinate is out of reach or the
            coordinate is below the ground.\n");
    }
}

```

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heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ gcc inverseKinematics.c -o iK -lm
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: 0
Enter y-coordinate: 2.6
Alpha is: -0.0000 radians or -0.0000 degrees.
Beta is: 0.0000 radians or 0.0000 degrees.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: 1.8
Enter y-coordinate: .8
Invalid input! Either the coordinate is out of reach or the coordinate is below the ground.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: .8
Enter y-coordinate: 1.8
Alpha is: -1.5708 radians or -90.0000 degrees.
Beta is: 1.5708 radians or 90.0000 degrees.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: 1
Enter y-coordinate: 1
Alpha is: -2.4665 radians or -141.3178 degrees.
Beta is: 1.7913 radians or 102.6356 degrees.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: -0.8
Enter y-coordinate: 1.8
Alpha is: 0.0000 radians or 0.0000 degrees.
Beta is: 1.5708 radians or 90.0000 degrees.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: .6
Enter y-coordinate: 1.2
Alpha is: -2.4135 radians or -138.2813 degrees.
Beta is: 2.3288 radians or 133.4325 degrees.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: -.4
Enter y-coordinate: 1.5
Alpha is: -0.4843 radians or -27.7498 degrees.
Beta is: 2.3181 radians or 132.8192 degrees.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: .3
Enter y-coordinate: 1.6
Alpha is: -1.6018 radians or -91.7770 degrees.
Beta is: 2.2763 radians or 130.4239 degrees.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$ ./iK
Enter x-coordinate: 20
Enter y-coordinate: 20
Invalid input! Either the coordinate is out of reach or the coordinate is below the ground.
heechan@heech-laptop:~/Documents/Git/airobotics/ArmLocalization/AssignmentOne$
```