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/************************************************
* HeeChan Kang
* CSC 431 - AI Robotics
* Assignment One - Inverse Kinematics
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#include <stdio.h>
#include <stdlib.h>
#include <math.h>

void main() {
      double x, y, alpha, beta, radius;
      double base = 100.0, l1 = 80.0, l2 = 80.0;
      double limit = 7*M_PI/8;

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

      /* Check if the distance of input is out of reach or not */
      radius = sqrt(pow(x,2) + pow((y-base),2));
      if (y > 0 && radius <= (l1 + l2)) {
            /* 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))));
            /* Make sure arm doesn't crossover itself */
            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 (cm): 100
Enter y-coordinate (cm): 100
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 (cm): 0
Enter y-coordinate (cm): 260
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 (cm): 180
Enter y-coordinate (cm): 80
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 (cm): 80
Enter y-coordinate (cm): 180
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 (cm): 100
Enter y-coordinate (cm): 100
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 (cm): 60
Enter y-coordinate (cm): 120
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 (cm): -40
Enter y-coordinate (cm): 150
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 (cm): 30
Enter y-coordinate (cm): 160
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 (cm): 200
Enter y-coordinate (cm): 200
Invalid input! Either the coordinate is out of reach or the coordinate is below the ground.
```