1.2 Lab 1.5 Week Two, The Tower of Hanoi using the Teach Pendant

1.2.1 Important

Read the entire lab before starting and especially the “Grading” section as there are points you will receive by completing certain sections or checkpoints by the end of the lab session(s).

1.2.2 Objectives

This lab is numbered 1.5 because it continues the programming you learned in Lab 1 but also prepares you for Lab 2. In Lab 2 and forward you will be using the Robot Operating System (ROS) environment to program the UR3. For this lab you will continue to program the UR3 using its Teach Pendant pseudo code but perform a similar task that will be required in Lab 2, solving a three block Tower of Hanoi puzzle. In this lab, you will:

- Move three stacked blocks from one position to another position using the rules specified for the Tower of Hanoi puzzle. Blocks should be aligned on top of each other.
- Use high level “Move” commands to move the UR3’s Tool Center Point in linear and circular motions
- Time permitting play with other functionality of the teach pendant.

1.2.3 References

- https://www.universal-robots.com/academy/
- Since this is a robotics lab and not a course in computer science or discrete math, feel free to Google for solutions to the Tower of Hanoi problem.\(^1\) You are NOT required to implement a recursive solution.

1.2.4 Pre-Lab

Read in more detail the UR3 Software Manual chapters 13 and 14. Additionally if for some reason you have not completed the training videos, go through the training videos found at Universal Robots website https://www.  

\(^1\)http://www.cut-the-knot.org/recurrence/hanoi.shtml (an active site, as of this writing.)
universal-robots.com/academy/. These training sessions get into some areas that we will not be using in this class, but go through all of the assignments as they will help you get familiar with the UR3 and its teach pendant. You also may want to reference these sessions when you are in lab.

1.2.5 Task

The goal is to move a “tower” of three blocks from one of three locations on the table to another. An example is shown in Figure 1.1. The blocks are numbered with block 1 on the top and block 3 on the bottom. When moving the stack, two rules must be obeyed:

1. Blocks may touch the table in only three locations (the three “towers”).

2. You may not place a block on top of a lower-numbered block, as illustrated in Figure 1.2.
1.2.6 Procedure

1. Choose the three spots on the robot’s table where blocks can be placed when solving the Tower of Hanoi problem.

2. Choose a starting position and ending position for the tower of three blocks. Future note: In Lab 2 the user will enter the start and stop positions.

1.2.7 Report

You will submit a report that uses pseudo-code to describe how you would solve the task described in previous Section.

- Please organize your code using Python style indentation. If you are unfamiliar with Python, please discuss this with your TA.

- Try to use clear terminology similar to what you learned in the Academy e.g. Move, If... Else..., Set, etc.

- Your TA will inform you how and when they wish you to deliver the completed report (Gradescope/Email).

- There is no specified format for the report as long as it is typed and well organized. But you should explain you psuedo code format before using it. Please submit as a pdf.

We understand that this task is a bit abstract and may not be easy to visualize without the robot in front of you. Try your best and think about what you learned in the Academy.

1.2.8 Grading

- 50 points, report.