

Test Cases:

1. Input 1 I-shaped PVC into the center of the bucket. Put in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I,L and T-shaped PVC needed to meet the order requirement. Then put 1 for I-shaped, 0 for L shaped and 0 for T-shaped PVC. The result should print "Entire order is here, move to the staging area" and then it will perform image processing again to make sure the parts are actually there and if it is there then it will print out again "Entire order is here, move to the staging area" and if a part is detected missing or in excess then it will print out the error and then a solution to fix those errors.
2. Input 1 L-shaped PVC into the center of the bucket. Put in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I,L and T-shaped PVC needed to meet the order requirement. Then put 0 for I-shaped, 1 for L shaped and 0 for T-shaped PVC. The result should print "Entire order is here, move to the staging area" and then it will perform image processing again to make sure the parts are actually there and if it is there then it will print out again "Entire order is here, move to the staging area" and if a part is detected missing or in excess then it will print out the error and then a solution to fix those errors.
3. Input 1 T-shaped PVC into the center of the bucket. Put in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I,L and T-shaped PVC needed to meet the order requirement. Then put 0 for I-shaped, 0 for L shaped and 1 for T-shaped PVC. The result should print "Entire order is here, move to the staging area" and then it will perform image processing again to make sure the parts are actually there and if it is there then it will print out again "Entire order is here, move to the staging area" and if a part is detected missing or in excess then it will print out the error and then a solution to fix those errors.
4. Input 1 I-shaped PVC into the center of the bucket. Put in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I, L and T-shaped PVC needed to meet the order requirement. Then the user puts 0 for I-shaped, 1 for L shaped and 0 for T-shaped PVC. The result should print 1 L-shaped is missing and 1 I-shaped is in excess. Then it will print out statements telling the system to add 1 L-shaped PVC from the "PARTS BIN" to the "CURRENT BIN" and then remove 1 I-shaped PVC from the "CURRENT BIN" to the "PARTS BIN".
5. Input 1 L-shaped PVC into the center of the bucket. Put in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I, L and T-shaped PVC needed to meet the order requirement. Then the user puts 1 for I-shaped, 0 for L shaped and 0 for T-shaped PVC. The result should print 1 I-shaped is missing, 1 L-shaped is in excess. Then it will print out statements telling the system to add 1 I-shaped PVC from the "PARTS BIN" to the "CURRENT BIN" and then remove 1 L-shaped PVC from the "CURRENT BIN" to the "PARTS BIN".
6. Input 1 T-shaped PVC into the center of the bucket. Put in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I, L and T-shaped PVC needed to meet the order requirement. Then the user puts 0 for I-shaped, 2 for

L shaped and 0 for T-shaped PVC. The result should print 2 L-shaped are missing, 1 T-shaped is in excess. Then it will print out statements telling the system to add 2 L-shaped PVC from the "PARTS BIN" to the "CURRENT BIN" and then remove 1 T-shaped PVC from the "CURRENT BIN" to the "PARTS BIN".

7. Input 2 I-shaped, 3 L-shaped and 5 T-shaped PVC into the center of the bucket laying flat and organized. Then in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I, L and T-shaped PVC needed to meet the order requirement. Then put 1 for I-shaped, 3 for L shaped and 7 for T-shaped PVC. The result should print 1 I-shaped is missing, 2 T-shaped is in excess. Then it will print out statements telling the system to add 1 I-shaped PVC from the "PARTS BIN" to the "CURRENT BIN" and then remove 2 T-shaped from the "CURRENT BIN" to the "PARTS BIN" to meet the order requirements.
8. Input 3 I-shaped, 4 L-shaped and 4 T-shaped PVC into the center of the bucket with some parts occluded. Then in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I, L and T-shaped PVC needed to meet the order requirement. Then put 3 for I-shaped, 4 for L shaped and 4 for T-shaped PVC. The result should say "Entire order is here, move to the staging area" but since this is a test case we expect it to fail. So instead if it prints out that 1 I-shaped is in excess and 1 L-shaped PVC is missing then maybe it is because a part of the L-shaped is hidden under other parts since it's occluded. Thus, the model is assuming the hidden L-shaped PVC is actually an I-shaped PVC and we are actually missing an L-shaped PVC. This error can be fixed by rearranging the parts of shaking the bucket.
9. Input 3 I-shaped, 4 L-shaped and 5 T-shaped PVC into random areas of the bucket . Then in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I, L and T-shaped PVC needed to meet the order requirement. Then put 3 for I-shaped, 4 for L shaped and 5 for T-shaped PVC. The result should print "Entire order is here, move to the staging area" but instead its printing out 1 I-shaped is missing. This is most likely because 1 of the I-shaped PVC is not under the camera frame. Thus, the model is not detecting that part at all. This error can be fixed by moving the camera angle to make sure all the parts are under the frame.
10. Input 1 T-shaped PVC into the center of the bucket. Put in the terminal run `final_code` to detect the object. Prompt asks users to enter the number of I, L and T-shaped PVC needed to meet the order requirement. Then put 0 for I-shaped, 0 for L shaped and 1 for T-shaped PVC. The result should print "Entire order is here, move to the staging area", but instead it detects 2 T-shaped PVC and prints out an error statement saying remove 1 T-shaped PVC from the "CURRENT BIN" to the "PARTS BIN". The reason behind this wrong detection could be the glare of the PVC pipes. Thus, this error could be fixed by dimming the light.

Validation:

- Accurately detected 1 I-shaped, 1 L-shaped and T-shaped PVC
- Accurately performs image processing twice if the order requirement has been met once to make sure the parts are actually there
- Accurately prints out the errors
- Accurately tells user to add missing parts from the parts bin to the current bin and then remove extra parts from the current to the parts bin in order to fulfill the order requirement
- Accurately works on most lighting environments
- Accurately detects the correct number of parts even when occluded parts are included by rearranging all the parts or shaking the bin
- Completed task successfully in under 2 minutes