

This homework may be completed in groups of two.

Name 1: \_\_\_\_\_

(opt) Name 2: \_\_\_\_\_

## Part I

Given the Matlab code AutoThreshold.m, fill in the 5 TODOs to implement image thresholding. Copy the text for these TODOs below.

1. TODO #1
2. TODO #2
3. TODO #3
4. TODO #4
5. TODO #5
6. Run your code on the file Duplo.png. Copy Figure 1 below

## Part II

Using the same image, label the connected components using the two-pass algorithm from section 11.4. Call your file ConnectedComponents.m with function call `cc = ConnectedComponents( binary_img )`, where `binary_img` is a binary image and `cc` is a matrix the size of `binary_img` with 0 assigned to background pixels and integers to different connected components.

Show a screenshot of the connected components applied to the thresholded Duplo.png

Attach your code

## Part III

Compute and label the centroids and orientation of each connected component. Call your code CentroidAndOrientation.m, with function call `[centroids, orientations] = CentroidAndOrientation(cc)`, where `cc` is the output from part II. Show an image applied to the output from Part II. Draw the centroids and orientation lines in white.

1. Calculate the manipulator Jacobian of the cylindrical robot with spherical wrist manipulator at the position  $z_6$ .
  - a. Write out the J matrix in terms of  $z_i$  and  $o_i$ .
  - b. Write out the J values. Calculate the cross products. You may use your previous calculations for the A and T matrices.

