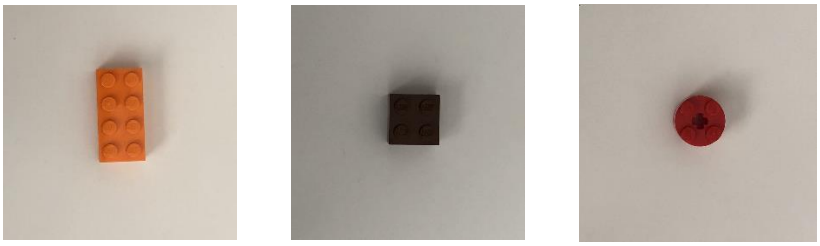
ENGR 418

Project – Stage 2

Sorting using engineered features

You have been hired by a company to develop machine learning algorithms for a sorting facility. The requirement is that the sorting device takes images of items on a conveyor belt, and then uses and machine learning algorithm to classify the items into classes. Then, the items get routed through different routes on the conveyor belt depending on their class.

For the sake of this project, you are given RGB images, and your focus will be on developing the classification algorithms. Also, for simplicity, it is assumed that items are Lego pieces of three different types with the following shapes (top view): Rectangles (2x4), squares (2x2), and circles (2x2). Examples are shown below.



The company tested your solution from stage 1, and requested an update. Namely, the company realized they have given you an idealized data set where the images are centered and oriented in a given direction. However, the items may appear in the image off-centre, and may have various orientations as shown below.

Your algorithm should be able to classify these three classes with different centering and orientations. To realize this, you need to extract/engineer features from the images, and to use these features to train and test a machine learning algorithm. The company requested that you use these features as the input of a 3-class classifier (Logistic regression, as in Lecture 5), and to use a maximum of 64 features per image.

You are given two new datasets to achieve this goal, each containing multiple images of each class. Use the dataset in the folder ‘training’ for training, and the one in the folder ‘testing’ for testing. Do not change the names of the folders or files.

Your tasks are as follows:

1. Apply your code from stage 1 on the new dataset to train and test the programmed classifier that uses raw images, and report the resulting confusion matrix and accuracy on the training set and also on the testing set.
2. Develop new code in Python and submit it through Canvas. The code must use feature extraction/engineering to obtain features that you use to train and test a machine learning algorithm.
    a. Your submission must be a python notebook named ENGR418_project_group_x_stage_2.ipynb, where x is your group number.
    b. Each cell in your python notebook must have a clear header comment box indicating what this cell does.
    c. The first cell in your notebook must contain the group number, group member names and student ID numbers.
    d. Training and testing must be done in separate cells.
    e. Your code must be well commented.
    f. Your code must be able to read all files in the training and testing folders, without any assumption on the number of files. During marking, your code may be run on folders with a different number of files.
    g. Your training cell must display the performance of the algorithm on the training set, displayed in the form of a confusion matrix as well as accuracy (no. of correctly classified samples divided by the total no. of samples)
    h. Your testing cell must display the performance of the algorithm on the testing set, displayed in the form of a confusion matrix as well as accuracy (no. of correctly classified samples divided by the total no. of samples)
        - Include your testing code in a callable function. The callable function must be called "test_function(path,arg1,arg2,…)" where a path will be passed (like "C:/Folder1/Folder2/") in addition to any other inputs that are necessary for your implementation (you can change the names arg1, arg2, etc.. This path will be replaced with the path of a testing set that will be used to test your classifier for grading.
3. Write a report explaining your work, and submit it through Canvas.
    a. Submit your report in PDF format.
    b. The report template is given on Canvas. Use the same template.
    c. The maximum page length is 5 pages (excluding references) with 1 inch margins, and the minimum font size is 12pt, and you must use the Time New Roman font.
    d. Do not include code in your report (code snippets are acceptable). Instead, you can explain your code using a flowchart or a pseudocode if needed.
    e. Your report must explain clearly how your algorithm work, and must comment clearly on its performance. Be sure to explain why your algorithm works and where it does not work why it does not. Also, remember to report the performance of the code from stage 1 on the new dataset and to comment on its performance.

All group members are expected to contribute to the projects. Failure to contribute to a project may lead to a deducted mark or a mark of zero on this stage of the project.

Any questions about the project must be directed to the instructor. The instructor will explain unclear issues and may amend this description to answer students' questions.

This stage of the project is worth 35% of your overall course grade, divided equally between the report and the code.