**Title:** Image Recognition Based on Linear Algebra with Matlab Program

**Team members:** Xinlei Cai, Yulin Chen, Yunqi Zhang.

**Introduction:**

The program combines Canny edge detection algorithm and picture rotation, which is implemented in Matlab from the bottom up without using any library method. It would be able to estimate the probability that the shape of the color lump on a 2-D image is a circle, triangle, square and pentagon, and choose which shape the color lump most looks like.

**Expected results:**

The final choice and the probabilities of other shapes of the Matlab program is consistent with human decision.

**Applications of linear algebra:**

In computer graphic processing, one picture is often transformed into n\*n\*3 matrix. So our project is matrix based processing. To be more specific, steps are listed and applications of linear algebra are marked below.

1. Converting the image into gray scale
2. Adapt Guass blur kernel to convolve the image, estimating noise points

(We use kernel matrix to convolve the image)

1. Convolving the gray image with Sobel-x filter and Sobel-y filter

(We use kernel matrix to convolve the image, realizing the matrix transformation.)

4. Calculating the gradient magnitude and direction

5. Non-maxima suppression

6. Double Threshold

7. Rotate the matrix and calculate L2 loss function

(We use linear tansformation to get some rotation matrices and get their index (height, width). After normalization, we comparing them with ideal data)

1. Calculate probability based on the loss function

**Work distribution:**

**Idea**: Chen Yulin came up with the initial idea of combining Canny edge detection algorithm and picture rotation to determine the shape of the color lump in the given picture.

**Investigation**: Cai Xinlei and Zhang Yunqi investigated into the proposal and found that currently there is little research about the combination of the two famous algorithms to detect shapes. So we decided to do a project about it.

**Implementation**: Chen Yulin implemented the algorithms in Matlab step by step and tested it with many pictures. He has also optimized the program several times to produce a better performance.

**Demonstration**: Cai Xinlei was responsible for writing the research proposal and Zhang Yunqi prepared some interesting presentation material like videos to help demonstrate our group’s project clearly and vividly.

**Sources:**

<https://en.wikipedia.org/wiki/Sobel_operator>

<https://en.wikipedia.org/wiki/Canny_edge_detector>

<https://afteracademy.com/blog/what-are-l1-and-l2-loss-functions>

https://www.mathworks.com/help/matlab/