Image Processing

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MESA

Introduction

- We started with a table of data - and told there was an image hidden inside of the data
- We found that if we processed the data, and mark all prime numbers with 0 and highlight them, it formed the shape of a pi symbol
- It was the fundamental introduction to image processing that helped us realize that while it is very easy for us humans to recognize the image
- But we wanted to know - how we could teach the computer to recognize objects and what type of technology is this applied to?

25	0	18	48	42	12	32		72	20	12
16	33	0	0	0	0	0		0	32	14
81	27	88	0	98	72	0		32	0	54
99	51	56	0	68	58	0		42	64	55
45	62	42	0	54	44	0		54	81	56
12	74	20	0	42	38	0		68	49	74
24	84	30	0	15	21	0		14	25	76
44	92	32	0	25	27	0		30	36	77
64	38	14	15	26	35	49		75	76	100

Design

- First, we had the computer generate random point in a plane
- Then we took those points and categorized them by number of sides, angles, and other aspects
- More specifically it consisted of randomly generating triangles, quadrilaterals, and to help us connect the points
- This type of pattern recognition are used for many key aspects of industry such as self-driving cars, AI, Smart X, to translate image to recognizable objects
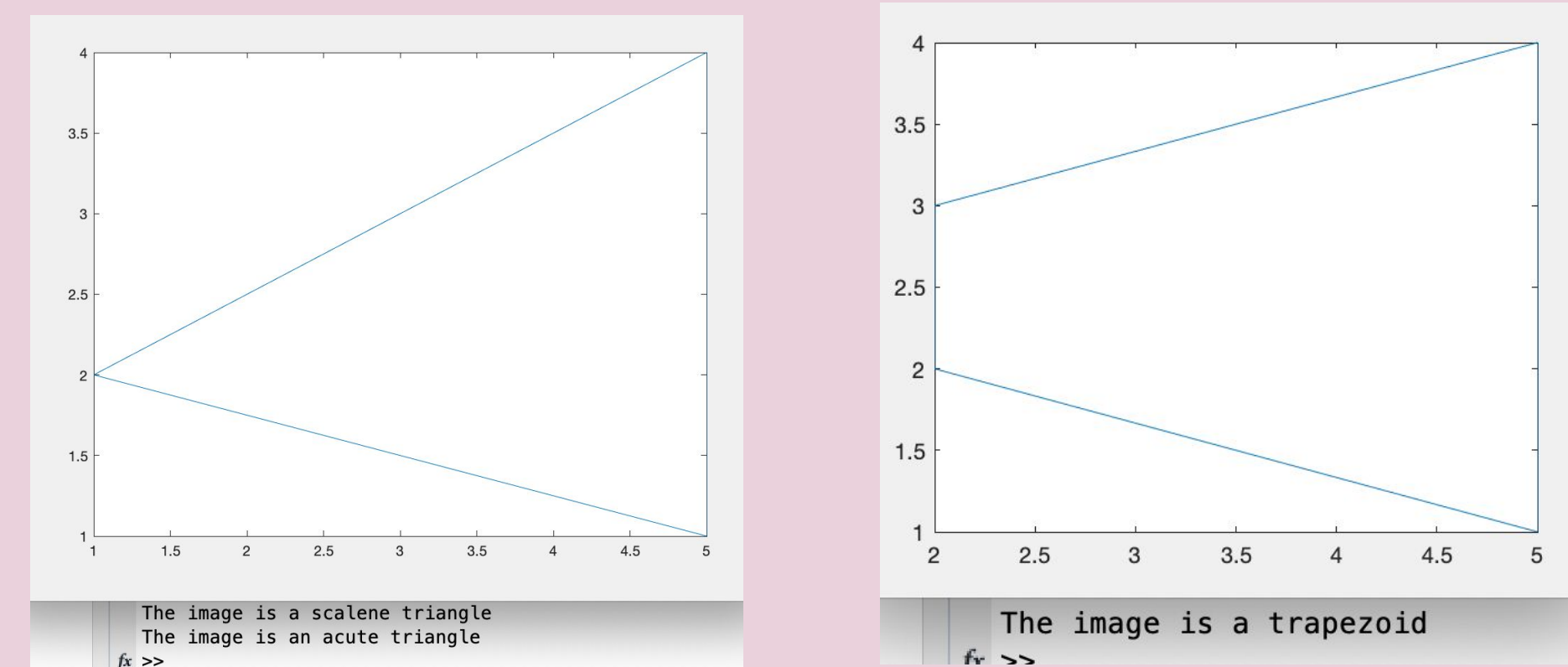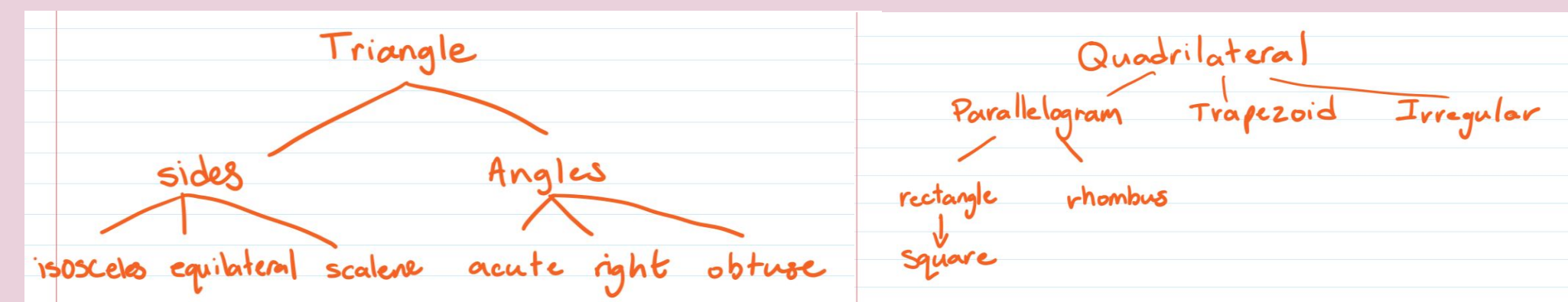
Materials Used

- We used MATLAB to do all of our coding
- We met once a week with Professor Antonio Castro to discuss our progress as well as future assignments
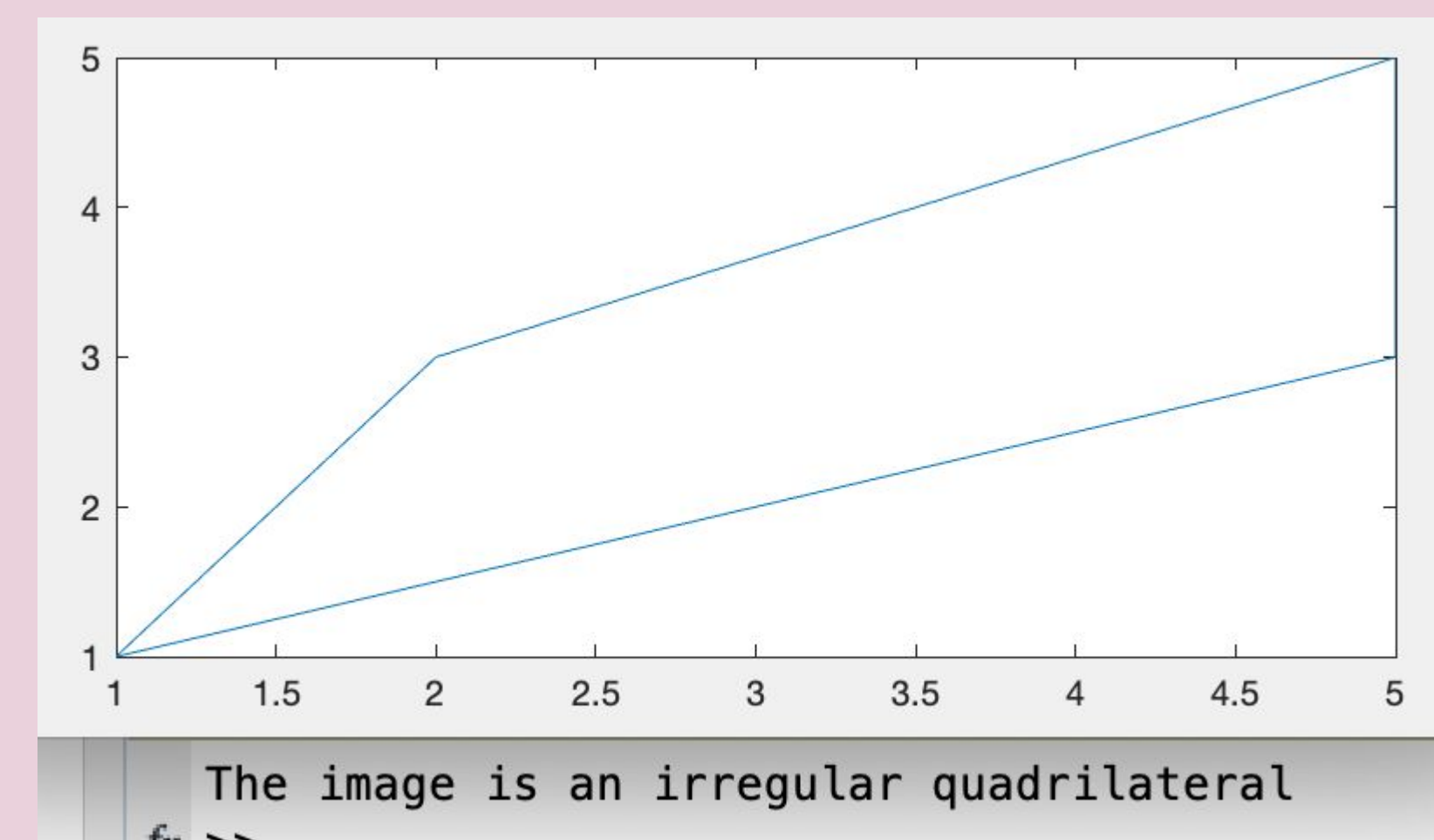- MATLAB also created the images that we processed
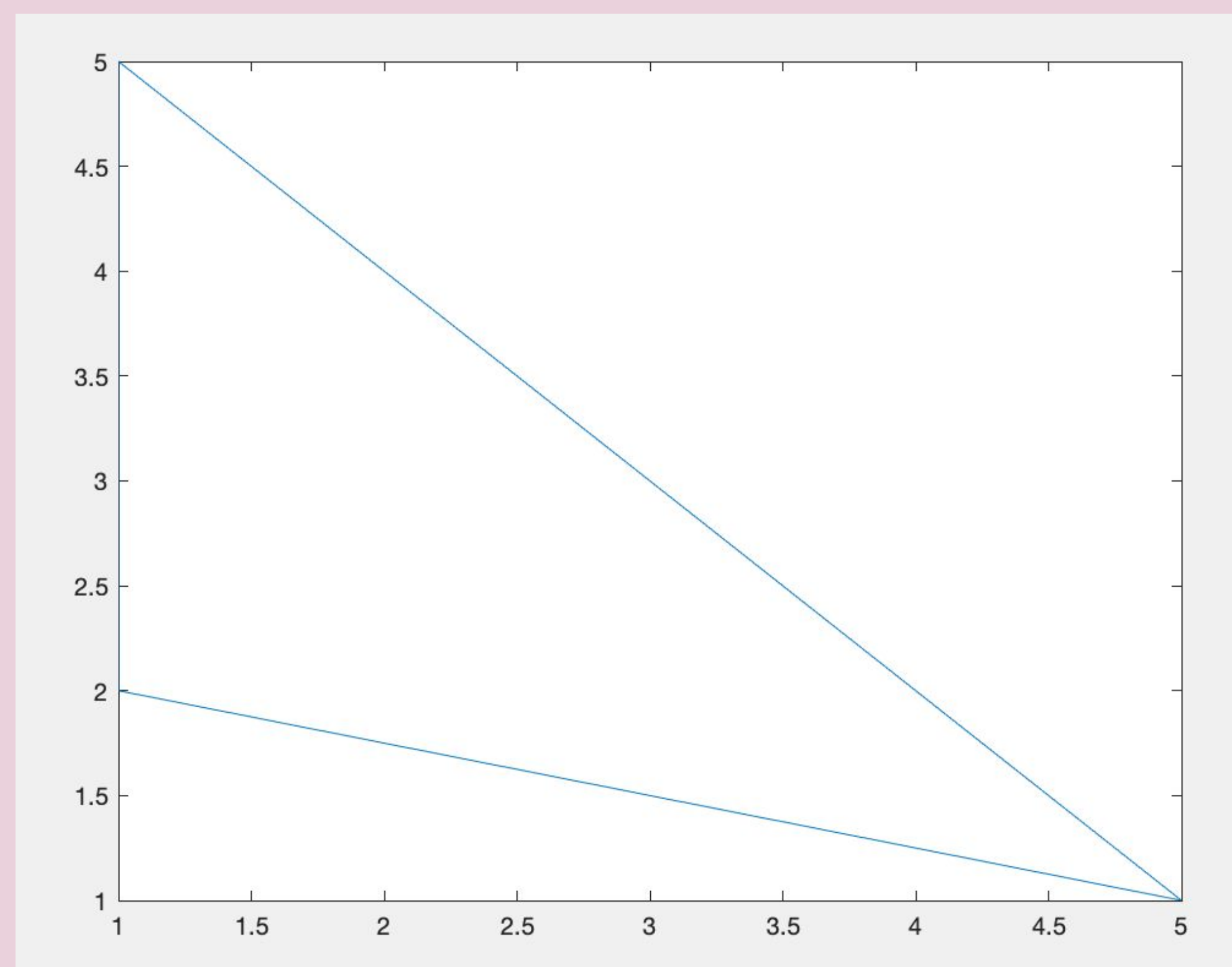
Example of the image that MATLAB would create using the convhull() function

Procedure

1. Our code directs MATLAB to create our image using randomly generate points, and having MATLAB connect them automatically using the convhull() function. We would get an array of the order of the points. Based on the points, we would categorize our images into different shapes.
   2. Check if it is a triangle
      a. If so, what type of triangle
3. Check if it is a quadrilateral

The image is a scalene triangle
The image is an acute triangle

The image is a trapezoid

4. If none - its an irregular quadrilateral

The image is an irregular quadrilateral

- In addition, there was sometimes that when creating the image with randomly created points, there is the possibility that you create and image with stacked points on one another in which the program returns an error.
- In addition, we had to create a function to receive all the information about the point and make sure that the points were not coplanar
- Coplanar point resulted in triangles being categorized as "quadrilaterals" while they were triangles - so we had to create a function names "preventCoplanar" to relieve of us that issue

```
function [x2,y2,k2,slopes2] = preventCoplanar(x,y,k);

slopes=zeros(1,(numel(x)+1));

sizeOfK=numel(k)-1;

for index=1:sizeOfK

    yOne = y(k(index));
    yTwo = y(k(index+1));

    xOne = x(k(index));
    xTwo = x(k(index+1));

    slopes(index) = (yOne-yTwo)/(xOne-xTwo);

end

    yOne = y(1);
    yTwo = y(end);

    xOne = x(1);
    xTwo = x(end);

    slopes(end) = (yOne-yTwo)/(xOne-xTwo);
```

The prevent Coplanar function in MATLAB

AI and Self Driving Cars

- Just like our project was to identify figures, AI uses pattern recognition to help with the mobility of how the self driving car moves and directs
- Self driving cars and AI go hand-in-hand
- Without AI self driving cars would be a close to impossible task
- This is used through the pattern recognition of commonly known shapes such as triangles, equilaterals, and circles to help the AI understand the motion of which it is going
- AI and pattern recognition isn't just limited to autonomous cars
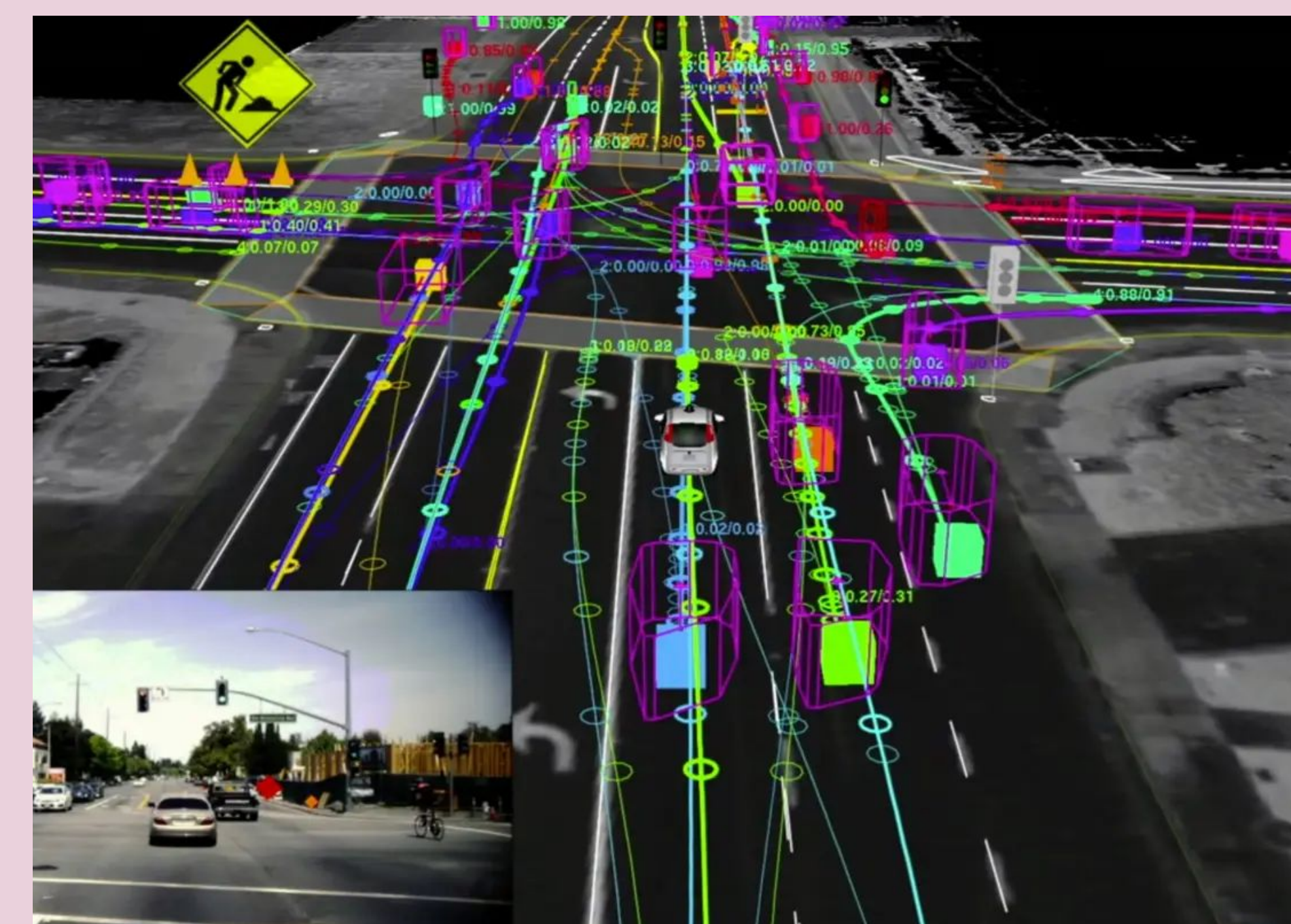- It's used in out everyday devices such as our phones, laptops, computers, etc.

Image Processing

- Image processing backed up by pattern recognition algorithms can create more technology for "smart homes" with more automated home security features.
- As a scholarly article points out "Intelligent home security control equipment has become indispensable in daily life".
- Someday there can be a cheaper means of acquiring facial recognition and or thumb and hand print software in homes that confirm identity and give permission to enter the home.
- Such software can even be used in automatically opening doors!
- We already have small steps in the right direction with more technology seen in homes such as Ring with cameras in doorbells that are synced to notify your smart phone of anyone or thing within a certain range approaching the foot of your door.
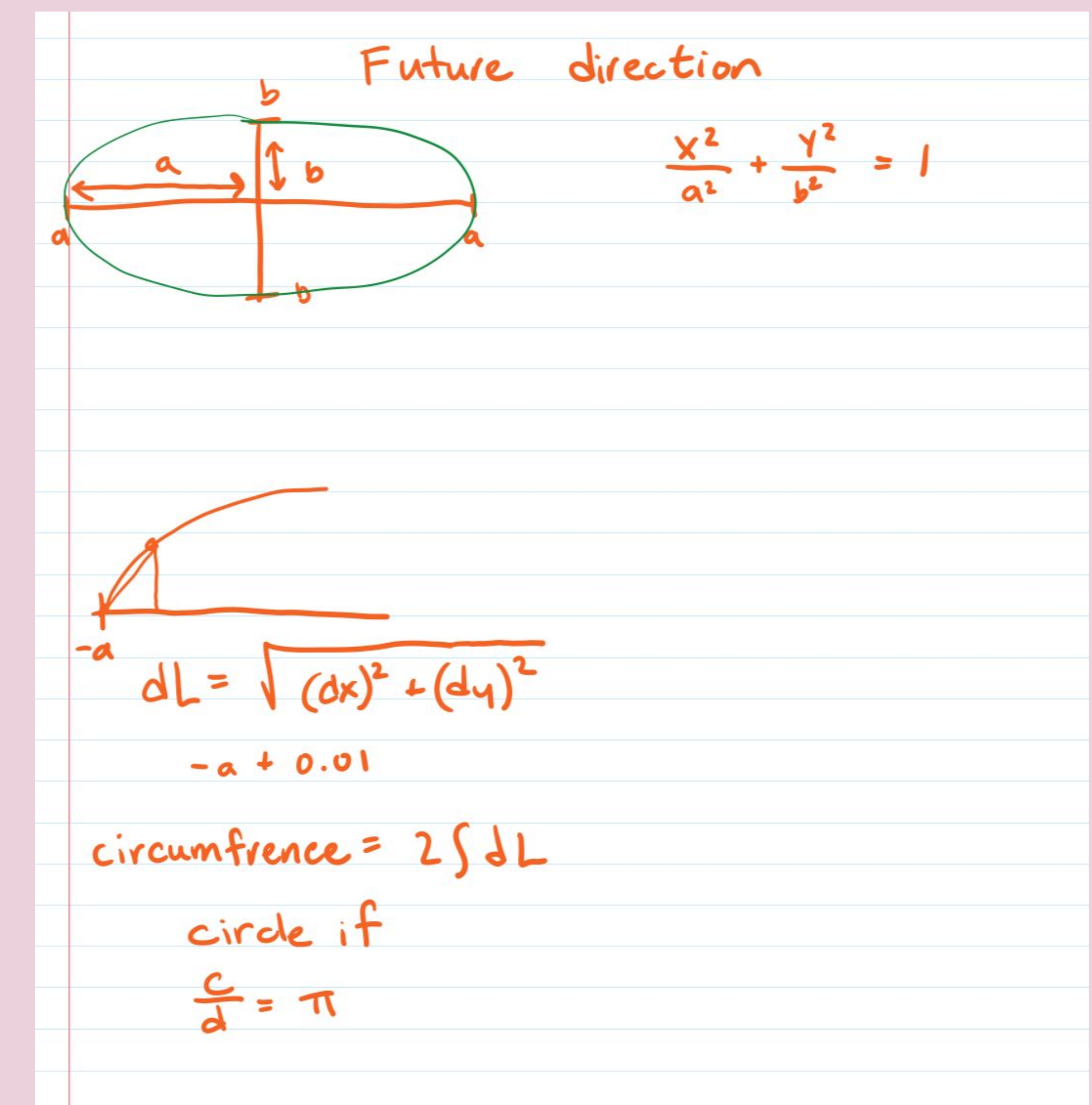
Results

- Through the utilization of MATLAB we were able to conjure up graphs from coding which helped with pattern recognition in differentiating different shapes and specifically what their angles and lengths told us about their identities
- This helped us understand the commands and details of what goes into AI and its role with image processing and pattern recognition

Conclusion

- While we learned the very basics of image and shape processing, we were able to get more insight about how this is being applied in the world day
- Research continues today to create self driving technology to lead for a more safer environment on the road and in our daily lives

Limitations / Future Direction

- Professor Antonio Castro taught us the next direction we wanted to go to which was learning to randomly make ovals and check if they were circles
- We knew that if had a randomly generated a and b, we would check the circumference of the oval and put it over the diameter and checking if the approximation is equal to pi
- Our images were created from points that were generated by MATLAB and not images as in photographs - something that we would like to try in the future

Future direction

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$$dL = \sqrt{(dx)^2 + (dy)^2}$$

$-a + 0.01$

$circumfrence = 2\int dL$

circle if

$$\frac{c}{d} = \pi$$

References

- Upgrad.com
- Geeksforgeeks.org
- MATLAB
- Antonio Castro, Professor, Napa Valley College