

Machine Learning Algorithms to Correct Images to Help the Color Blind

Jimmy Hickey

Winona State University

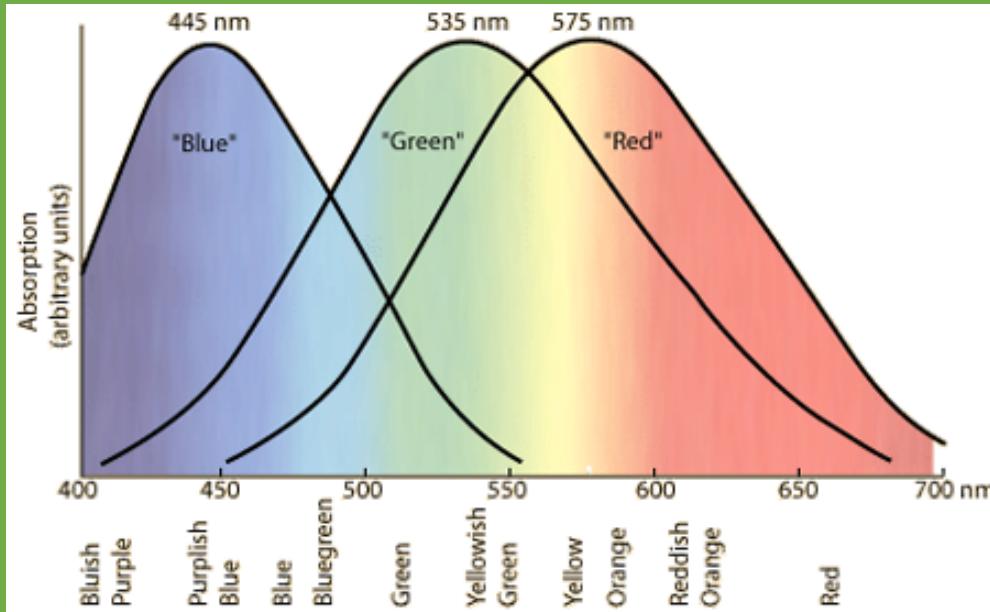
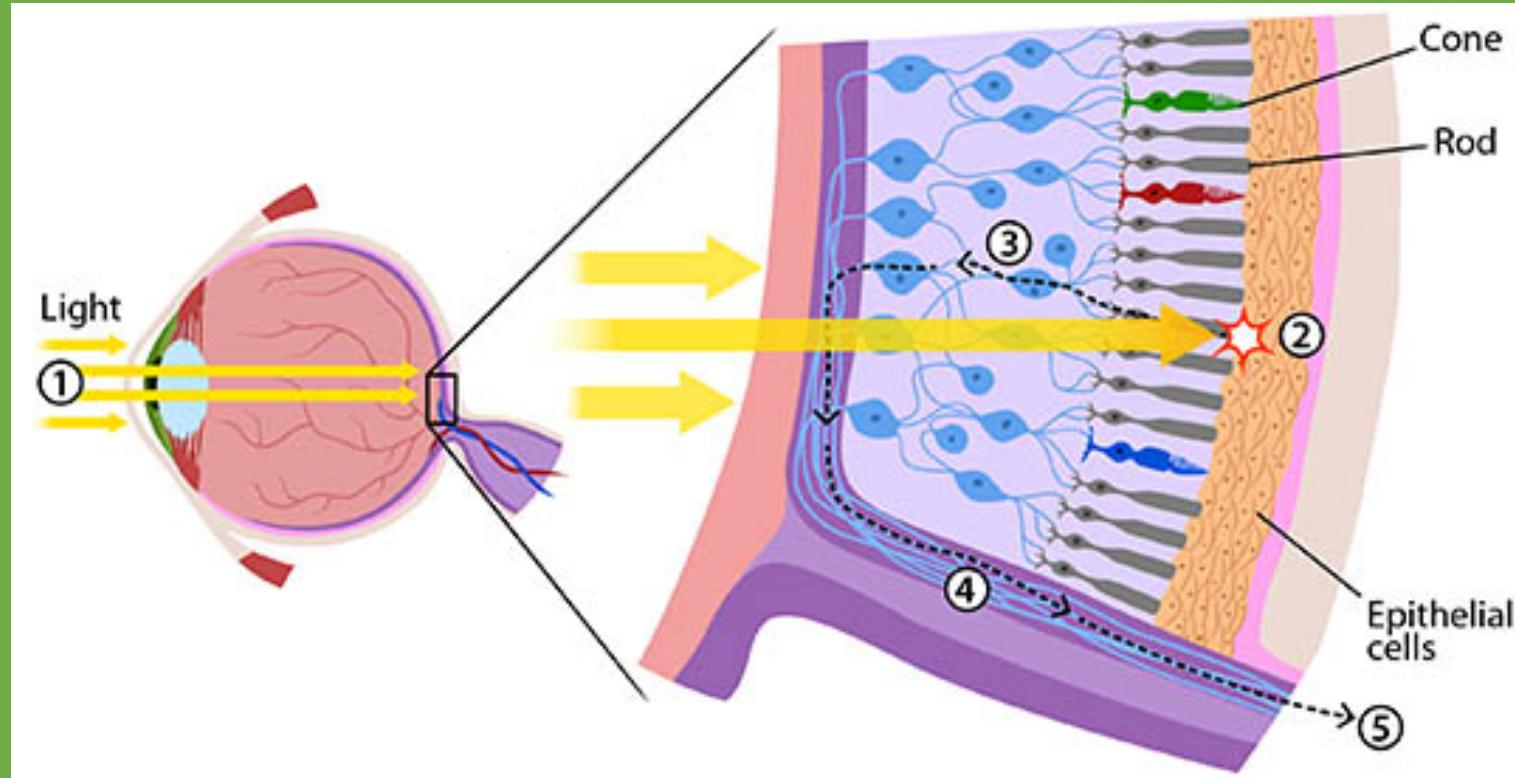
April 25th 2018



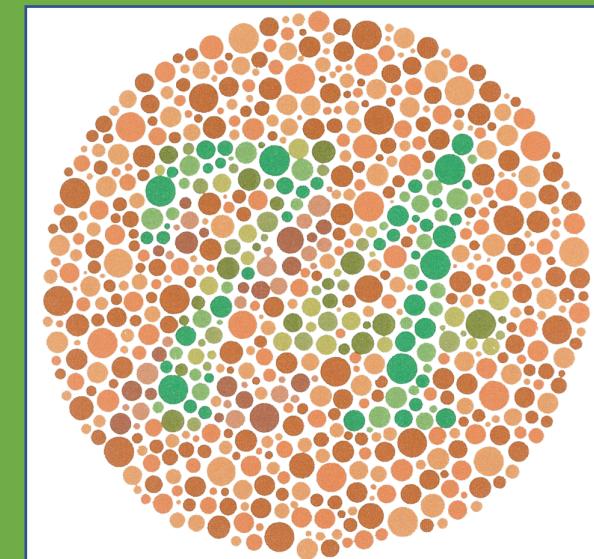
Color Blindness

We can still see colors!

<https://askabiologist.asu.edu/rods-and-cones>



<http://hyperphysics.phy-astr.gsu.edu/hbase/vision/colcon.html>



https://en.wikipedia.org/wiki/Ishihara_test

Current Solutions

- Glasses
- Gene Therapy?



enchroma.

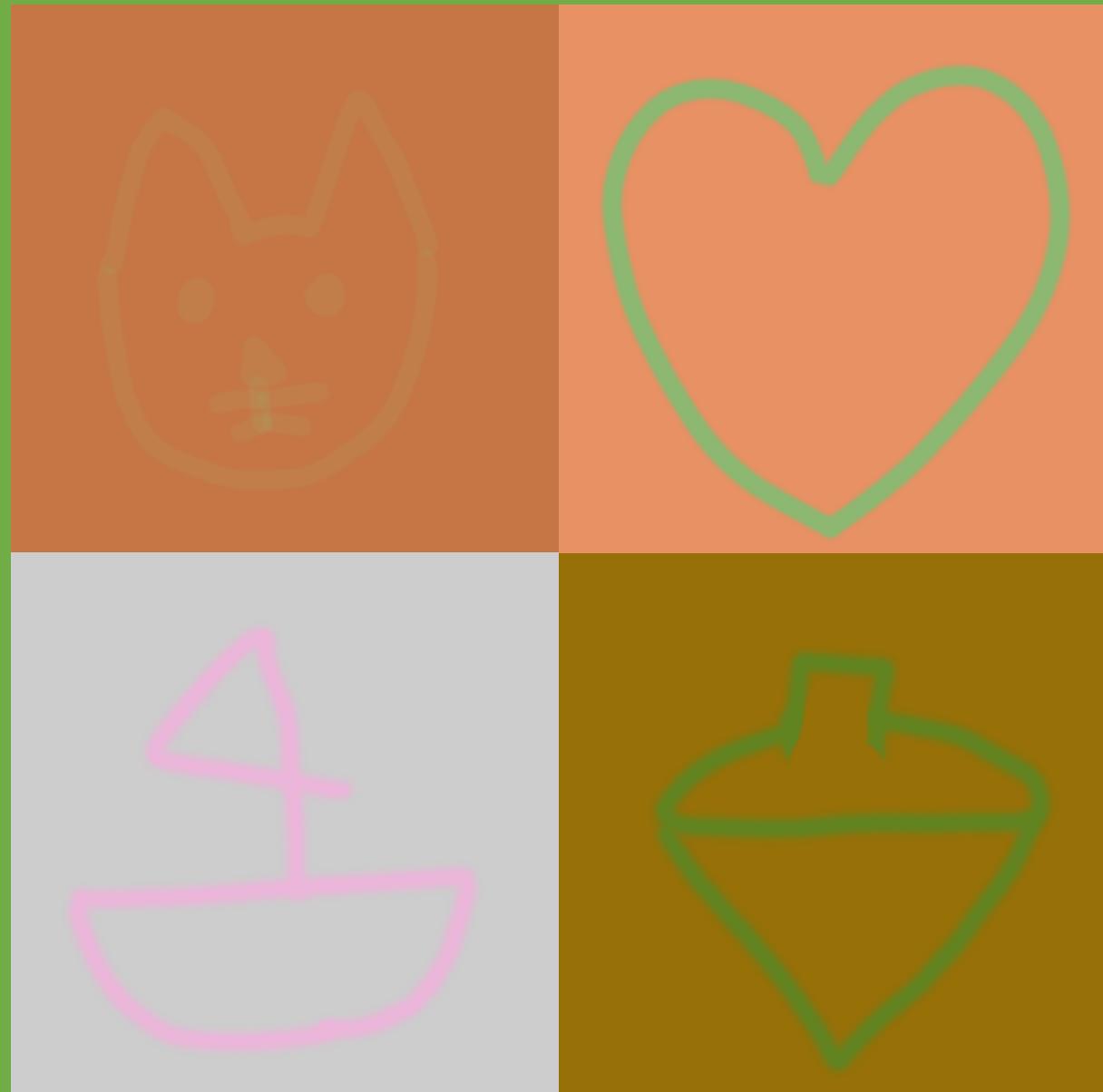


Goals

- Identify colorblind problem areas
- Correct these issues without losing much information

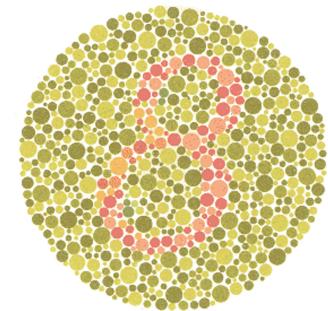
Data Creation

- Data created rather than using Ishihara test
- Drawn using Adobe Photoshop
- Images with many color combinations

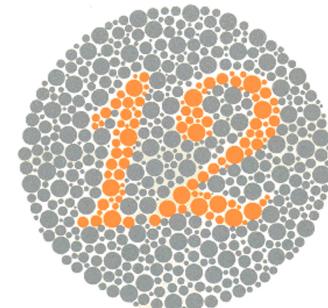


Color Detection

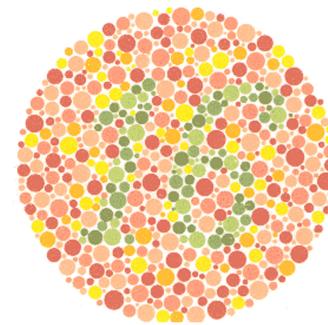
- Unsupervised learning pattern recognition
- Examine RGB value of each pixel in an image



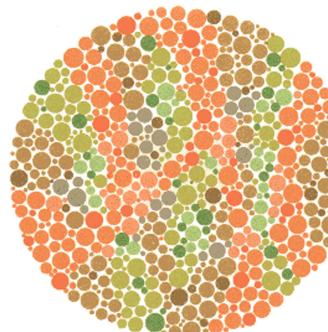
8



12



16

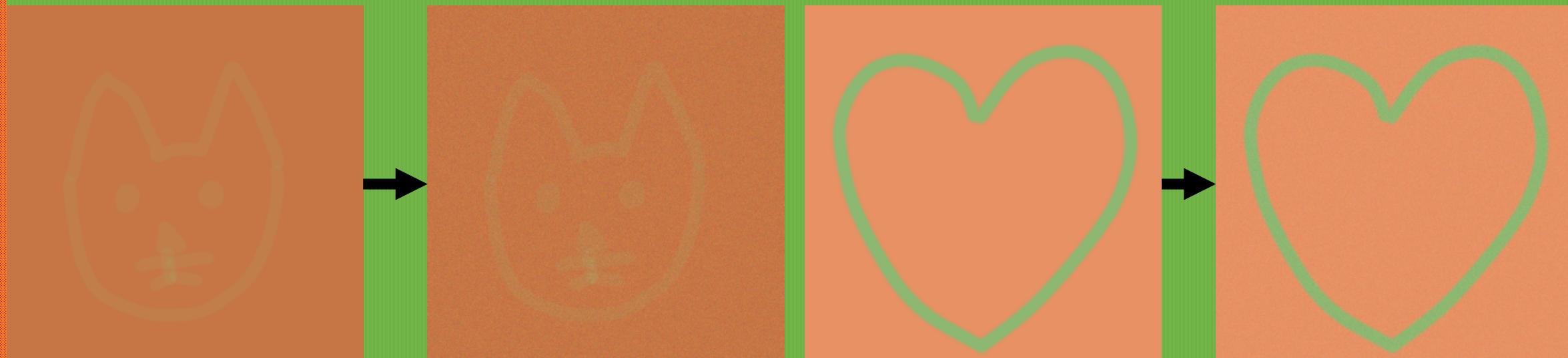


Adding Noise

```
mean = 0
```

```
sd = 3
```

```
np.ceil(np.random.normal(mean, sd))
```

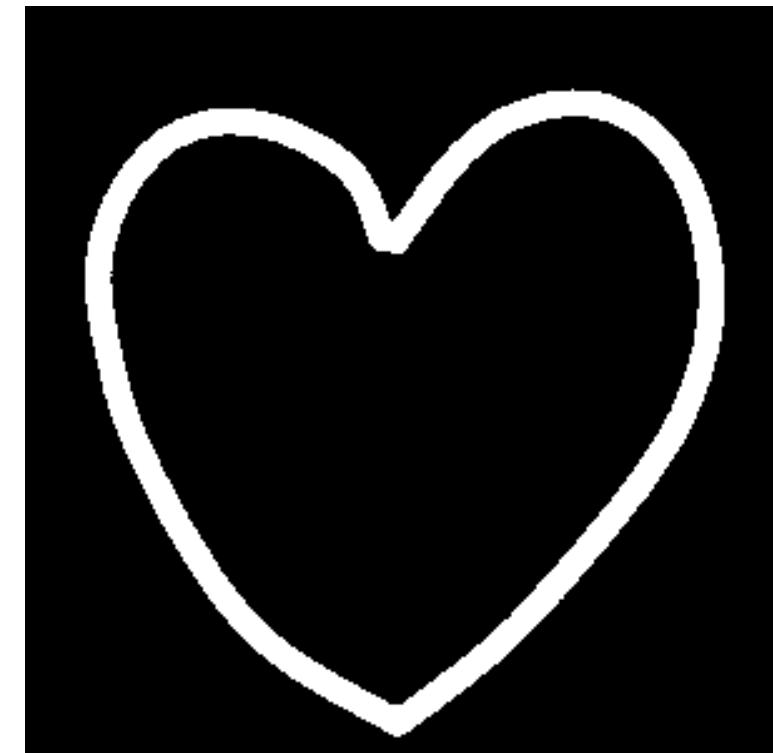
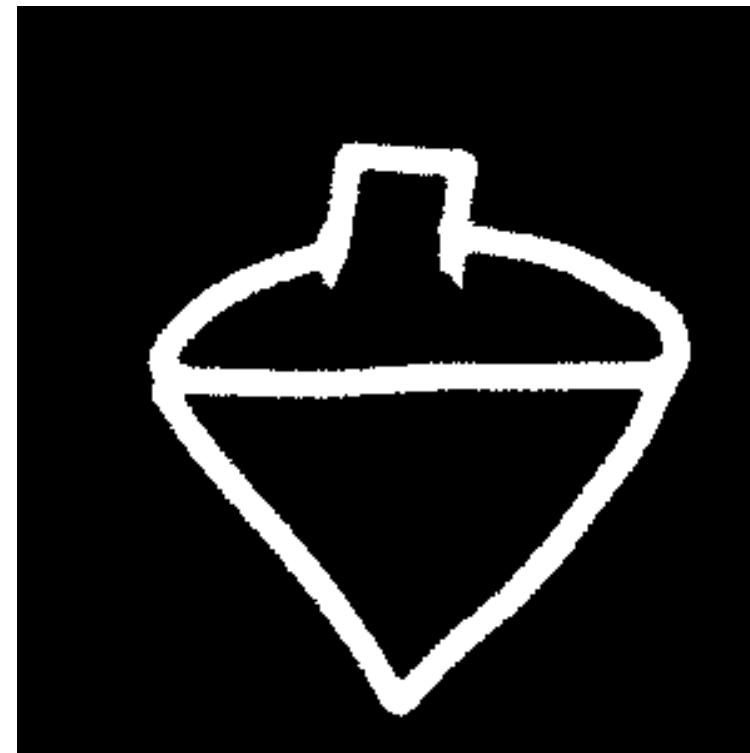
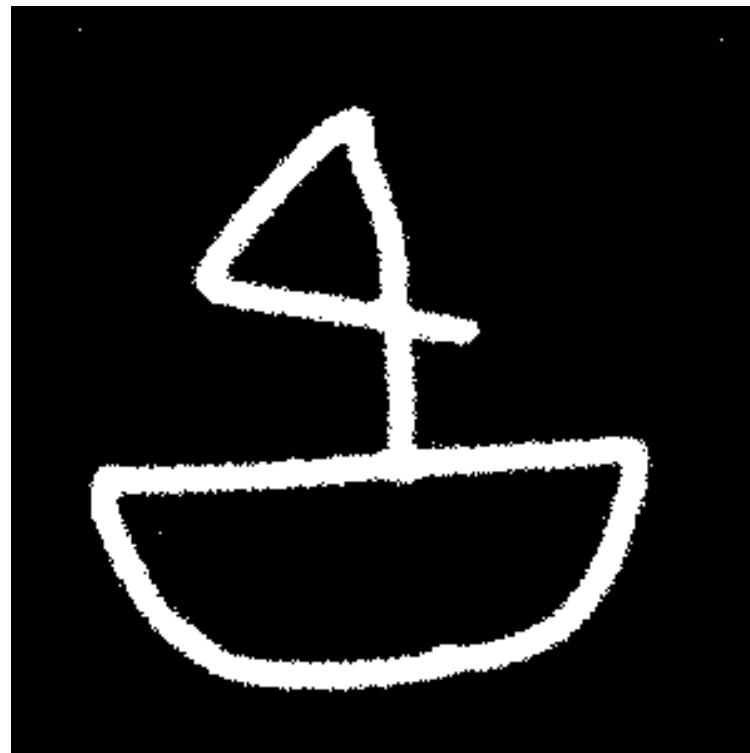


K-Means Clustering

1. Randomly select a mean for each cluster.
2. Classify each piece of data according to each mean.
3. Use these new classifications to recompute the mean of each cluster.
4. Repeat 2 & 3 until the clusters converge.

K-Means Clustering

- Clusters changed to black and white



Color Correction

- Color reassignment
- Edge detection

<http://www.gamersexperience.com/colorblind-accessibility-in-video-games-is-the-industry-heading-in-the-right-direction/>



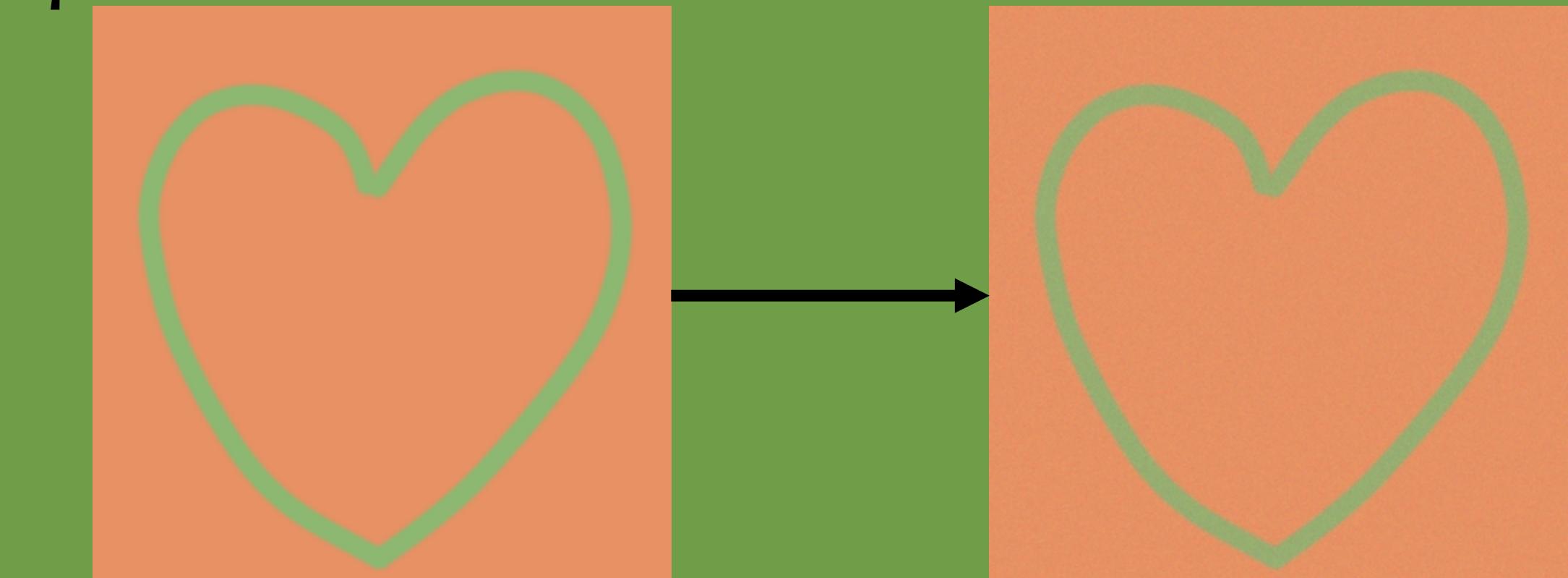
A different implementation of color reassignment.



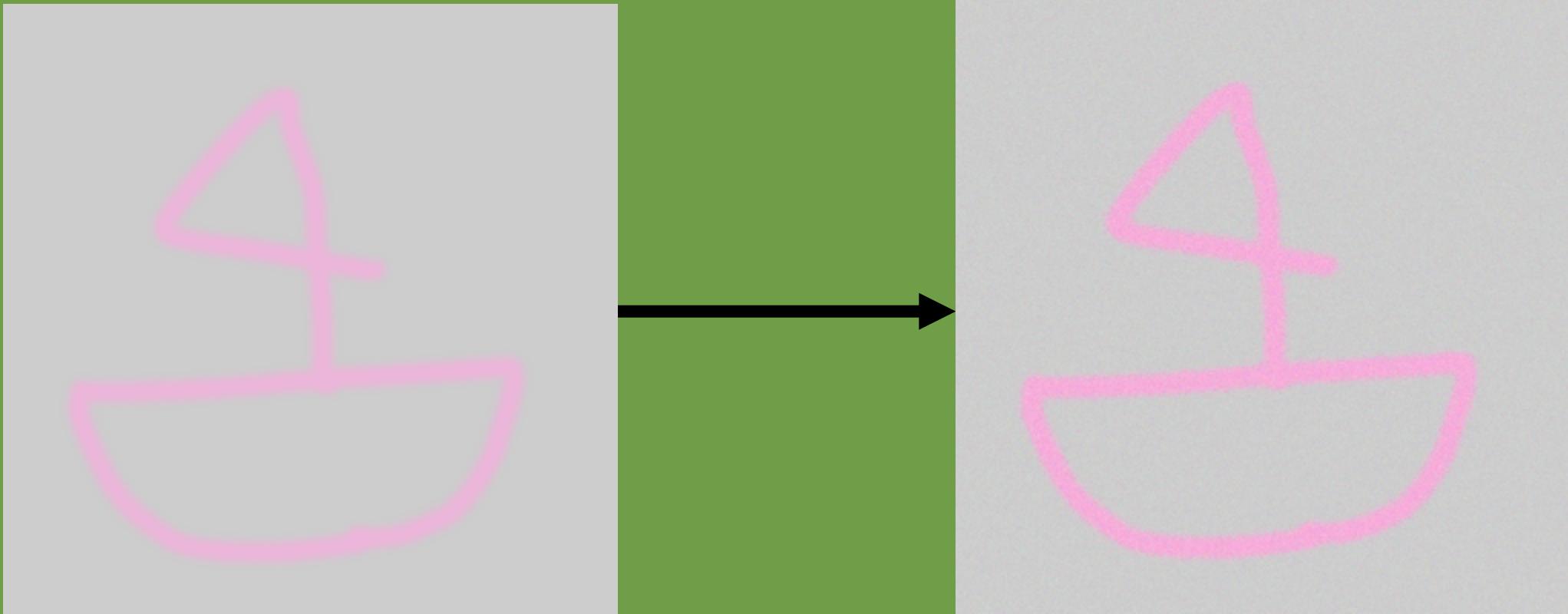
<https://www.mathworks.com/discovery/edge-detection.html>

Color Reassignment

- Slightly adjust the colors of the pixels in each cluster

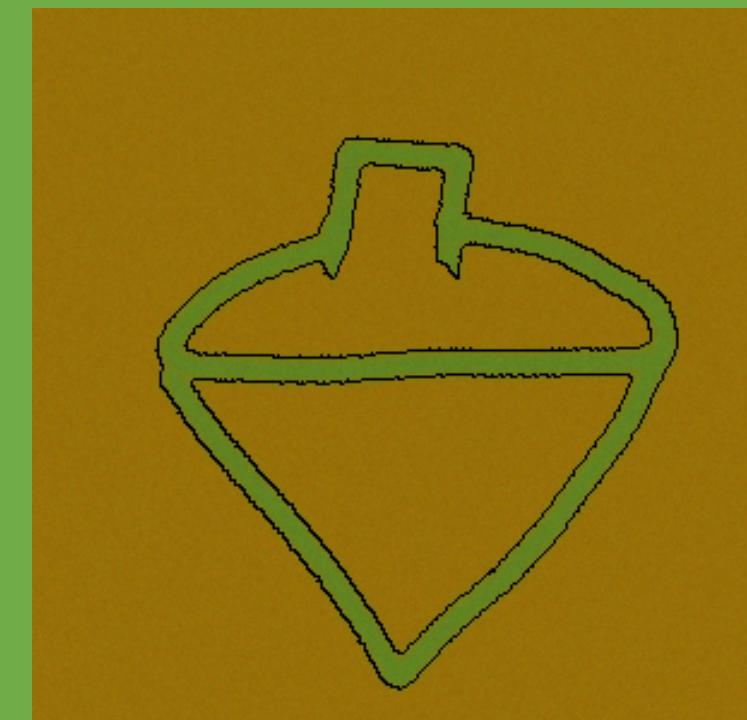
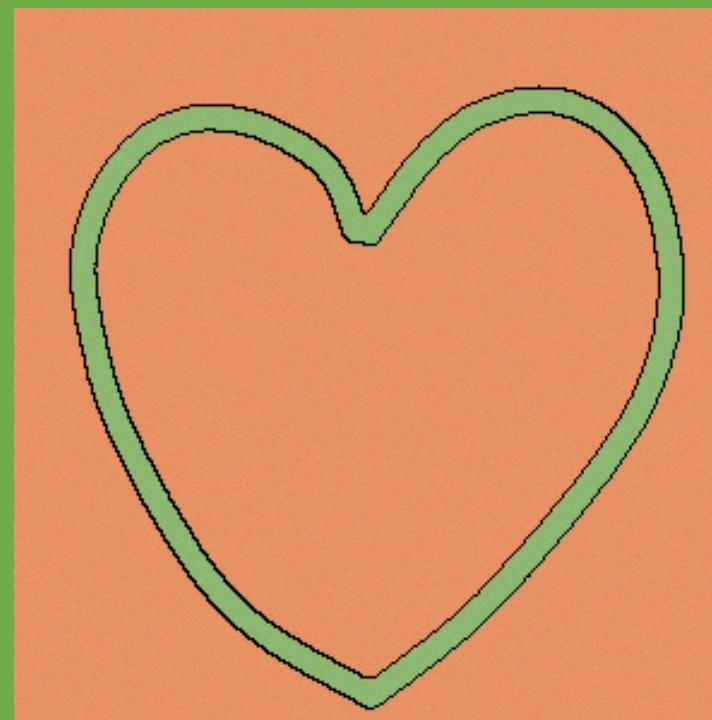
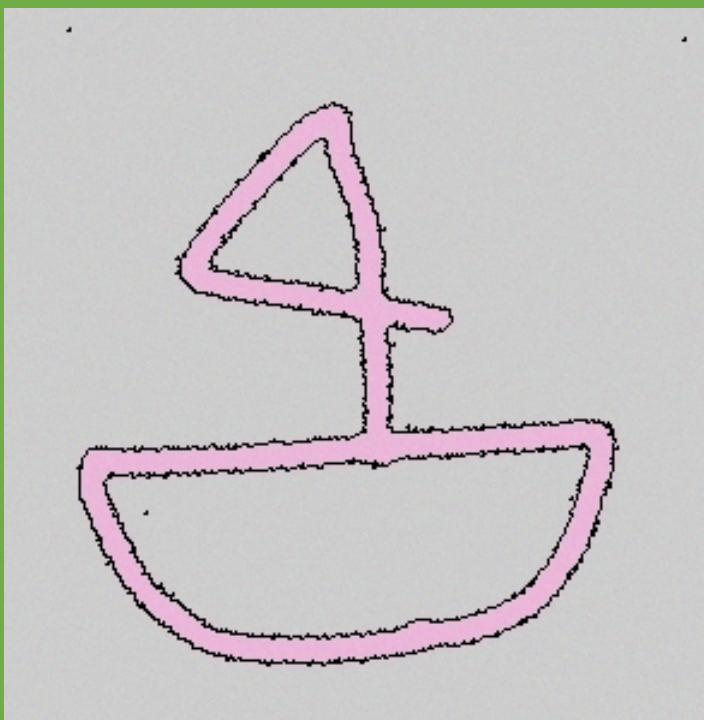


Color Reassignment



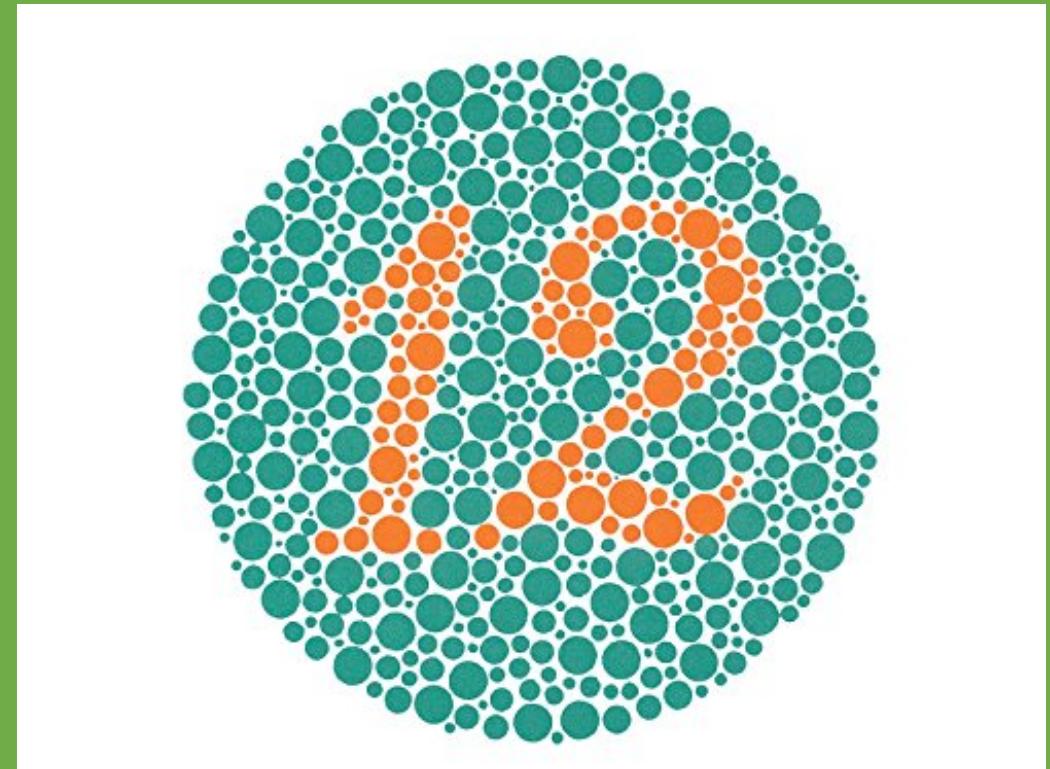
Edge Detection

- Draw thin edges between clusters



Limitations and Improvements

- Non-representative data
- No expert opinions
- No user feedback
- Supervised learning



<https://www.amazon.com/KANEHARA-Ishihara-Chart-Deficiency-Plates/dp/B00MAVIR3Y>

References

- [1] Ryan Cross. 2016. How EnChroma's Glasses Correct Color-Blindness. (June 2016). <https://www.technologyreview.com/s/601782/how-enchromas-glasses-correct-color-blindness>
- [2] enchroma. [n. d.]. Frequently Asked Questions. ([n. d.]). <http://enchroma.com/contact-us/>
- [3] National Eye Institute. 2015. Facts About Color Blindness. (February 2015). https://nei.nih.gov/health/color_blindness/facts_about
- [4] Thales Sehn K.űrting. 2013. How K-Means algorithm works. (July 2013). <https://www.youtube.com/watch?v=luRb3y8qKX4>
- [5] Emily Singer. 2009. Color-Blind Monkeys Get Full Color Vision. (September 2009). <https://www.technologyreview.com/s/415339/color-blind-monkeys-get-full-color-vision/>
- <https://opendyslexic.org/>

Acknowledgements

- Dr. Zhang & Dr. Iyengar
- Dr. Deppa

Thank you!

[https://github.com/Jimmy
JHickey/Computer-Color-
Blind-Correction](https://github.com/JimmyJHickey/Computer-Color-Blind-Correction)

