Digit Detection Modeling Basic Search and Recognition Mechanisms

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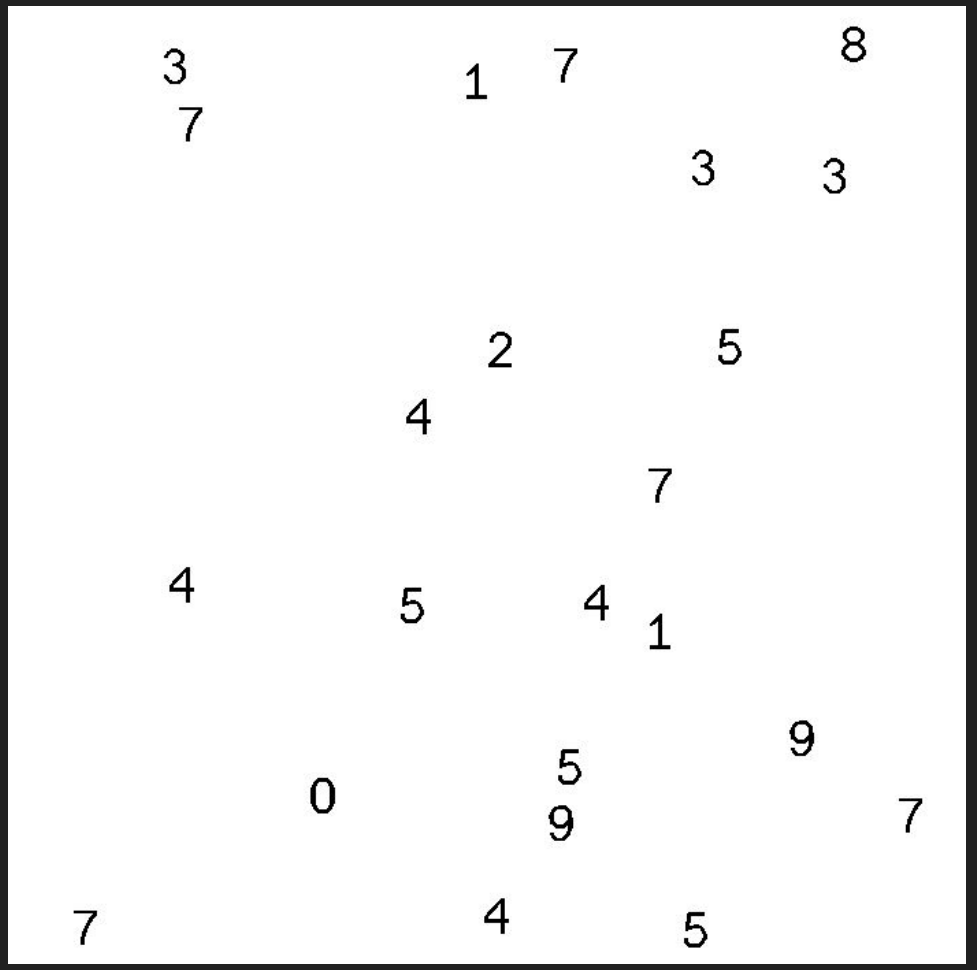
Overview

Goal:

Given an image such as this one, find and identify all digits

Motivation:

- Lab 1 - Detector
- Interest in images/vision



Overview

Approach

- 10 input patterns respond to a small window of a given image
- The window moves across the entire image until it has scanned it entirely

- The project resulted in a simple, slow-working model for digit detection with basic search and recognition mechanisms using ten detector units that respond to a series of given inputs, representing how neurons in the visual system respond to seeing and recognizing numbers.

Outline

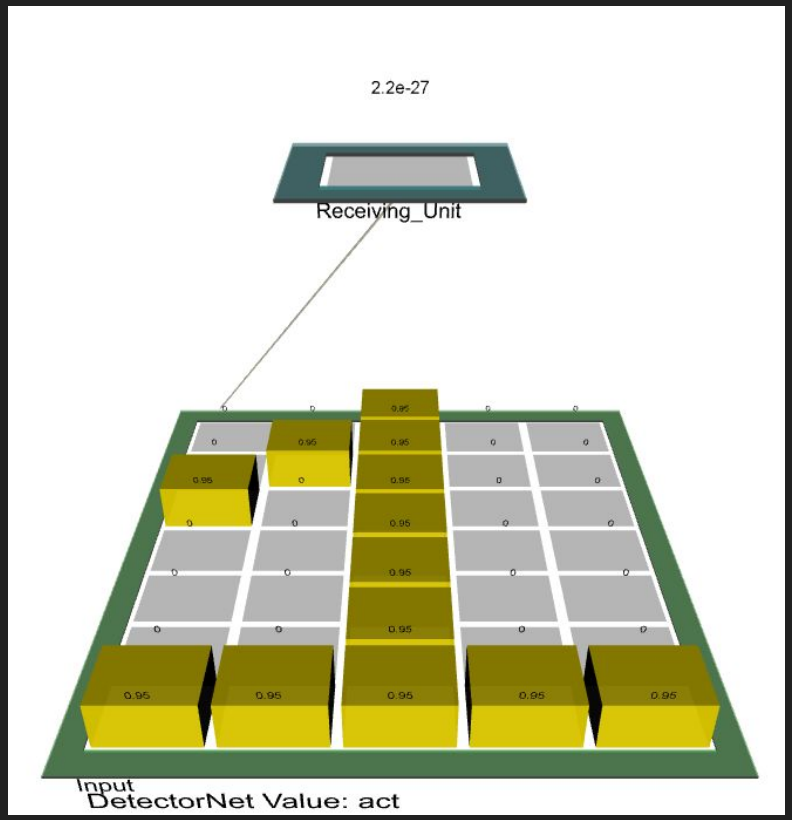
- Background on image processing
- Description of model
- Mechanisms used in model
- Results
- Work to be done

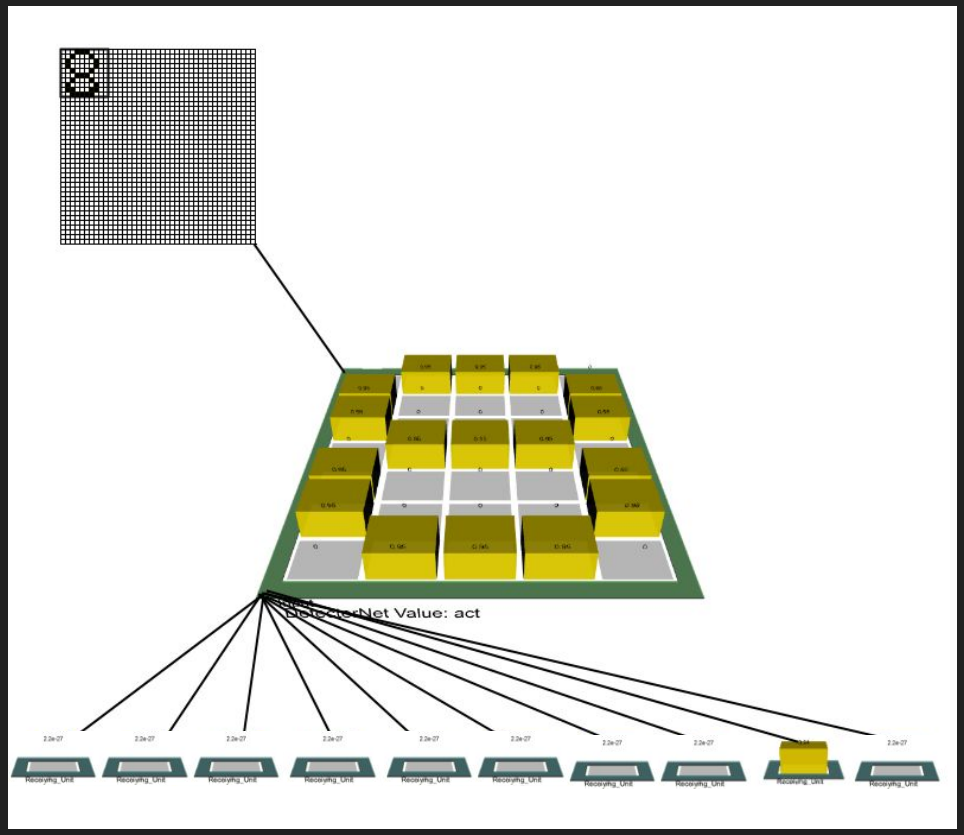
Background

- A bit about the images
  - Image is made up of pixels
  - Pixels can be black or white
- Black pixels indicate something is on the image
  - I.e. numbers/letters
- A window is a small subsection of an image

Methods

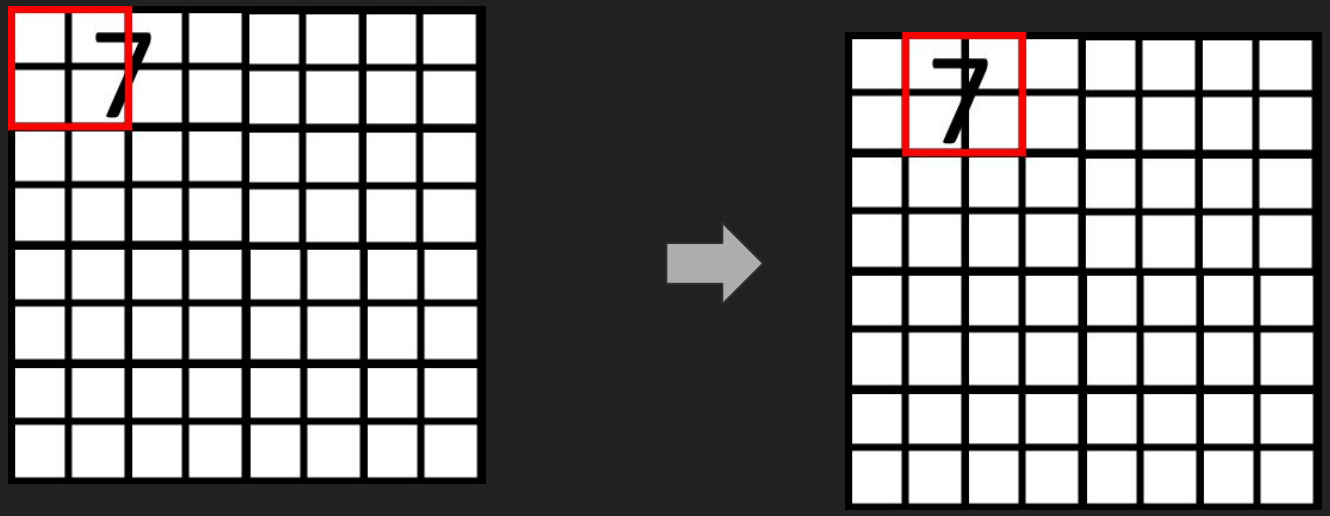
The model:





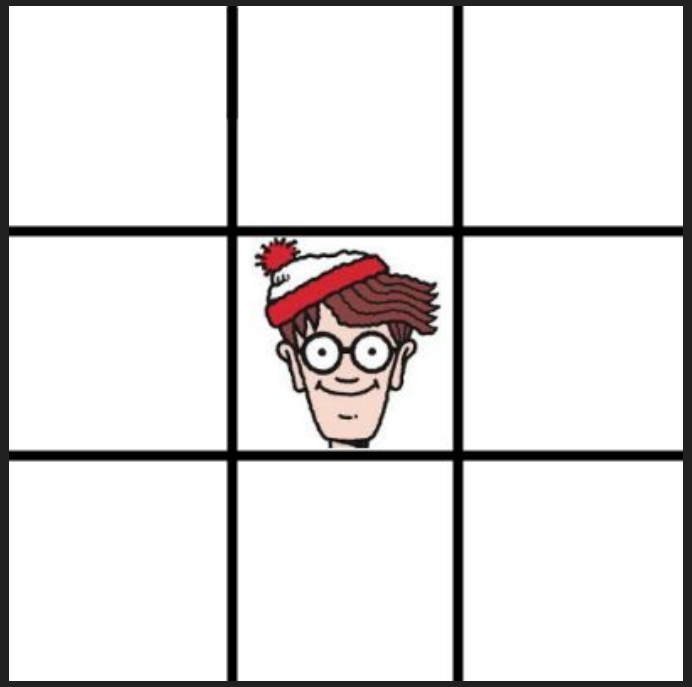
Methods

- Sweep the entire image with the window
- Send each window to the network as the input for detection



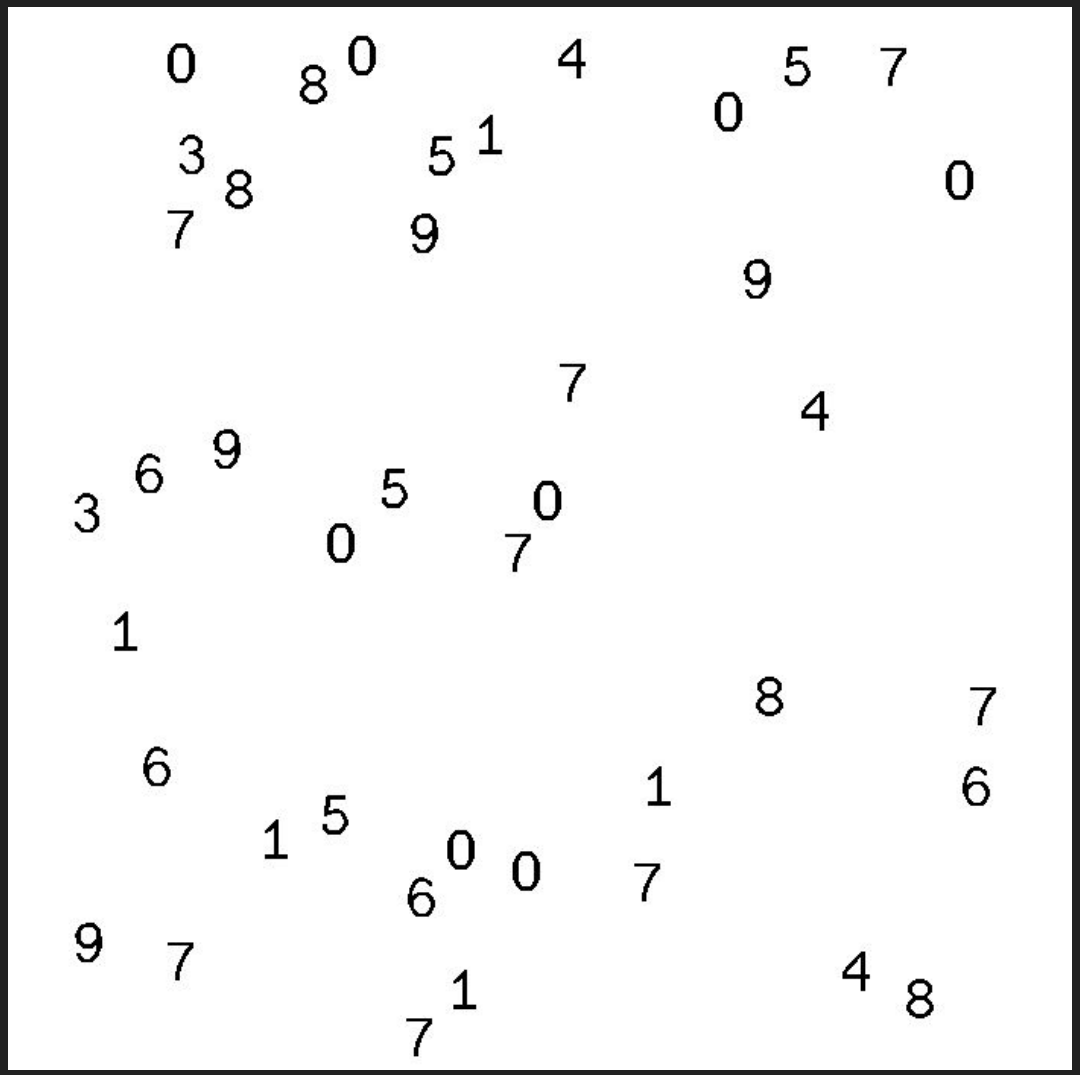
Methods

- Performance improvement - Region mask
  - Good for sparse images
  - Doesn’t help much with densely populated images



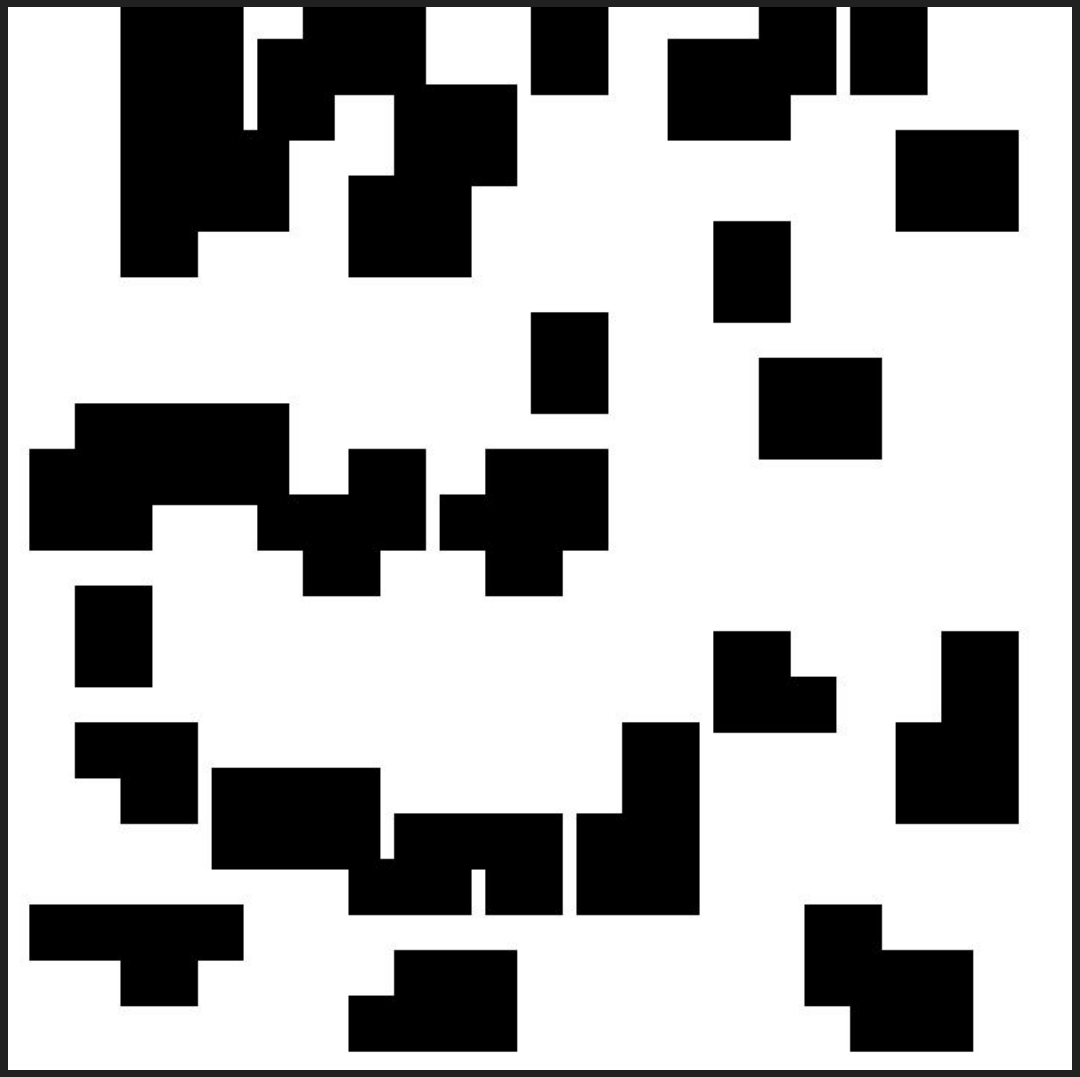
Results

- It works! (no surprise here)



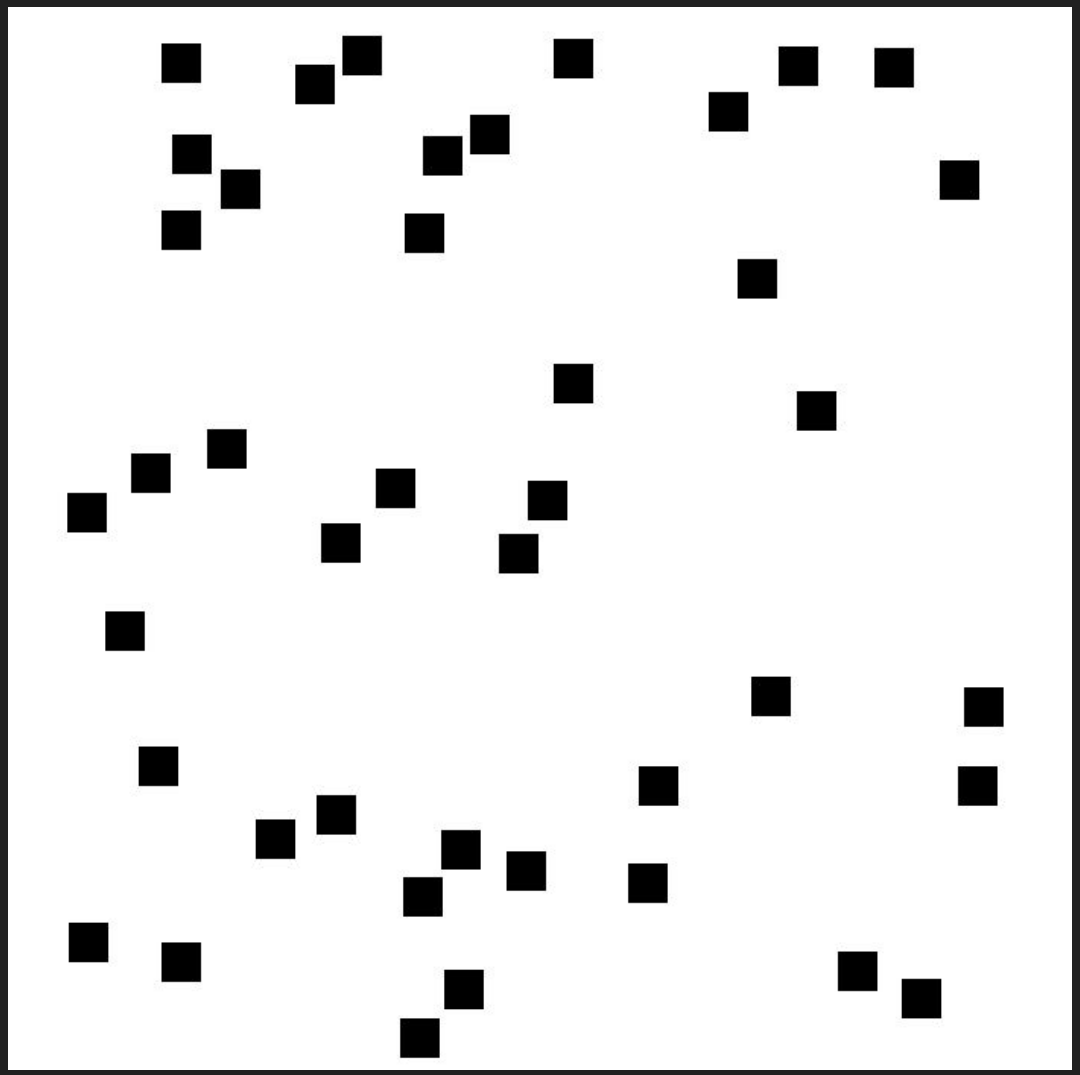
Results

- It works! (no surprise here)

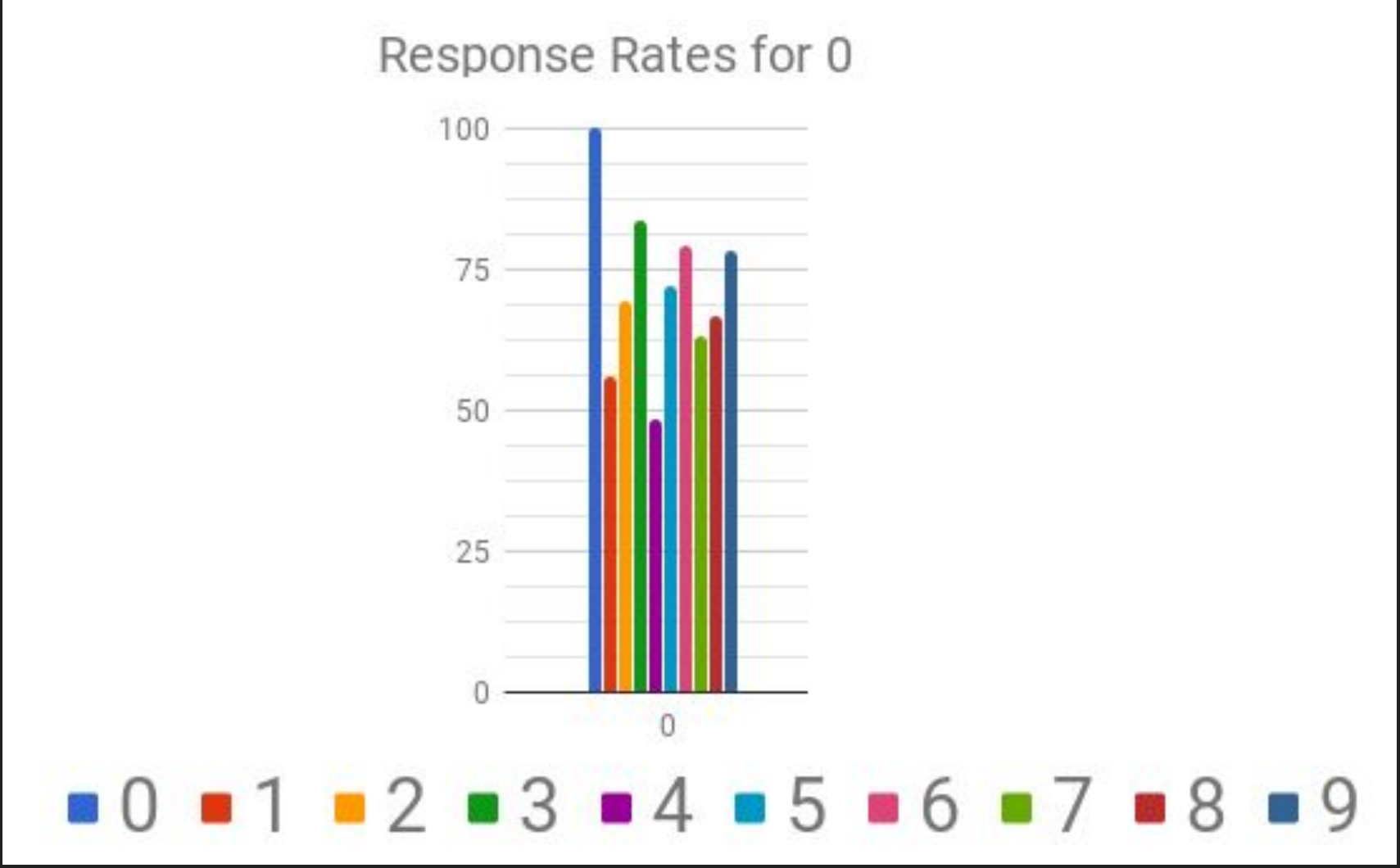


Results

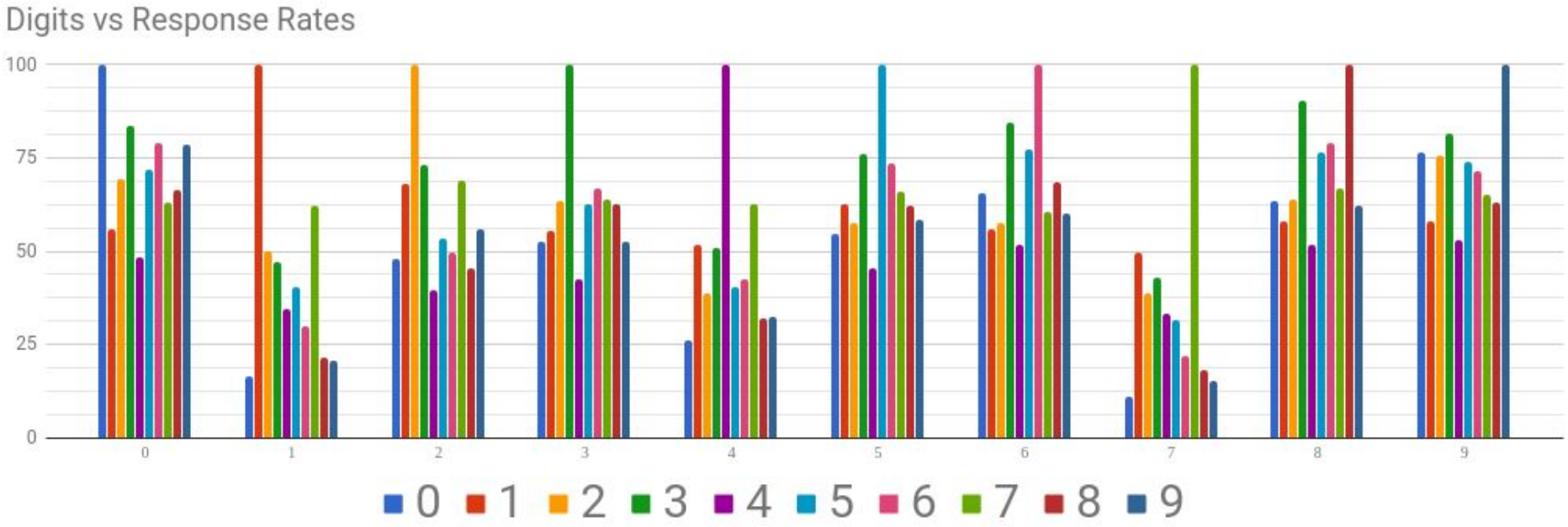
- It works! (no surprise here)



Results



Results


Digits vs Response Rates
100
75
50
25
0
0
1
2
3
4
5
6
7
8
9
0 1 2 3 4 5 6 7 8 9

Interpretation of Results

- The network successfully found and identified each digit
  - Not a surprise, since the templates for the receiving units were used to create the test images
- Using a region mask resulted in a 50-70% improvement in run time
  - Works better for sparse images

Conclusions

- Sweeping the image mimics how people search dense images
- Region Segmentation mimics how the visual system doesn’t need to search the *entire* image

- The project resulted in a simple, slow-working model for digit detection with basic search and recognition mechanisms using ten detector units that respond to a series of given inputs, representing how neurons in the visual system respond to seeing and recognizing numbers.

Future Work

- See how the network responds to variations
  - Different fonts
  - “Damaged” numbers
  - Noise
  - Rotated/resized fonts

Takeaway

- The project resulted in a simple, slow-working model for digit detection with basic search and recognition mechanisms using ten detector units that respond to a series of given inputs, representing how neurons in the visual system respond to seeing and recognizing numbers.

Acknowledgements/Contact

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