ShipNet: Creating and Understanding a New Data Set

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Background

How can we police the Open Seas?

- **Challenges:** The scale of the world's ocean makes it difficult to know what and where people are fishing.
- **Opportunities:** Autonomous drones can fly long distances and potentially identify and report malicious fishing behavior in the open ocean.
- We have unprecendented access to what types of gear that ships are using.
- A critical task for a potential is getting images of these ships.

Methods

Transfer Learning

Approach 1

- **Vanilla:** Use pretrained Resnet weights as a feature extractor for images, train last layer
- **Accuracy:**
- **Pitfalls:** (Empirically)Training does not converge ~50% of time

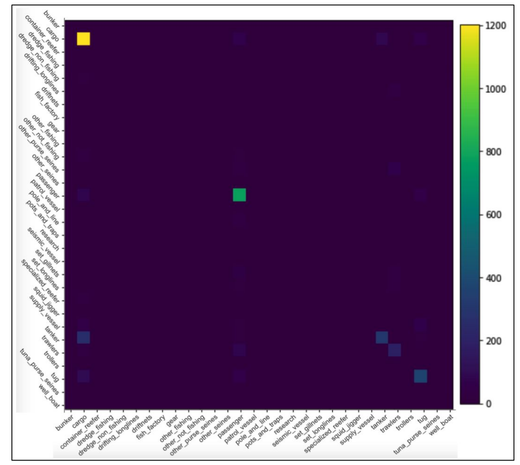
Approach 2

- **Pretrain:** Use ship samples from Marvel dataset, which has grainy classes of ships
- **Accuracy:** silhouette score.
- **Pitfalls:** Class imbalance has a tougher time getting less-seen classes using C.E.

Results

(3) Network is biased towards overrepresented classes

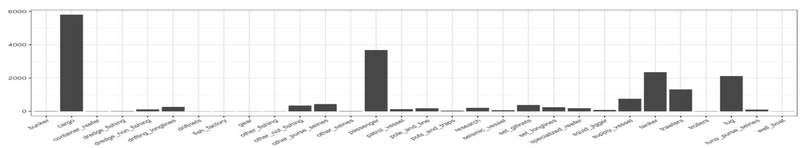
$$w_y = \frac{1-\beta}{1-\beta^{n_y}}$$



Since cargo ships make up the majority of ships on the ocean, the data set is biased towards these vessels

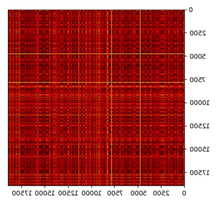
Methods

- **Initial data:** n = 1.5 million ship ids from satellite-intercepted signals.
- **Scraping:** Create web scraper that captures ship images from MarineTraffic.com
- **Labels:** Use labels from database, courtesy of Global Fish Watch, alongside images to create labeled data set for sup. learning
- **Final dataset:** ~25k images surfaced after scraping, 30 classes.

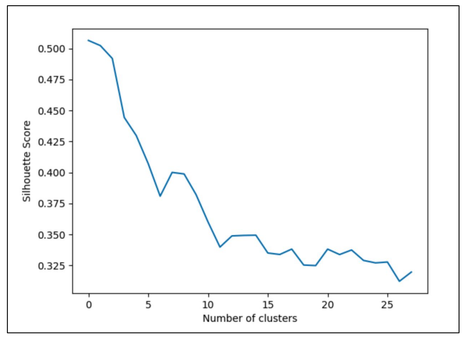


Results - Geometry

(1) Class Labels provide structure to data set - Euclidean



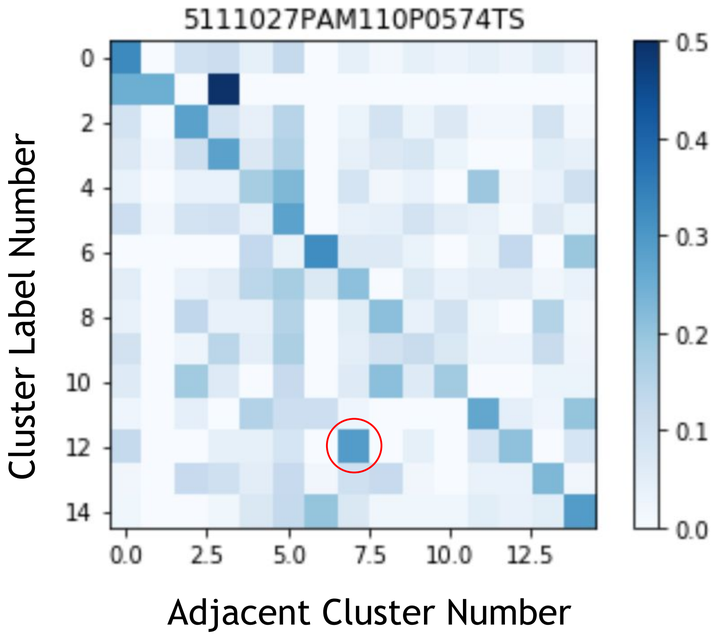
(2) Number of ships that the network is picking out is less than 30



Conclusions/Acknowledgements

- **Error Analysis:** Use weighted cross entropy for loss function
- **Future approach (1):** Use t-sne to understand the distribution of classes in latent space
- **Future approach (2):** utilize results from various clustering methods to better inform what features of ships this neural network is extracting from the images
- Networks also need more gpu time, it is possible that accuracy could be as high as .85

Acknowledgments: Class distribution and confusion matrix courtesy of Emma Gee.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Cluster Label Number
Adjacent Cluster Number
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4
6
8
10
12
14
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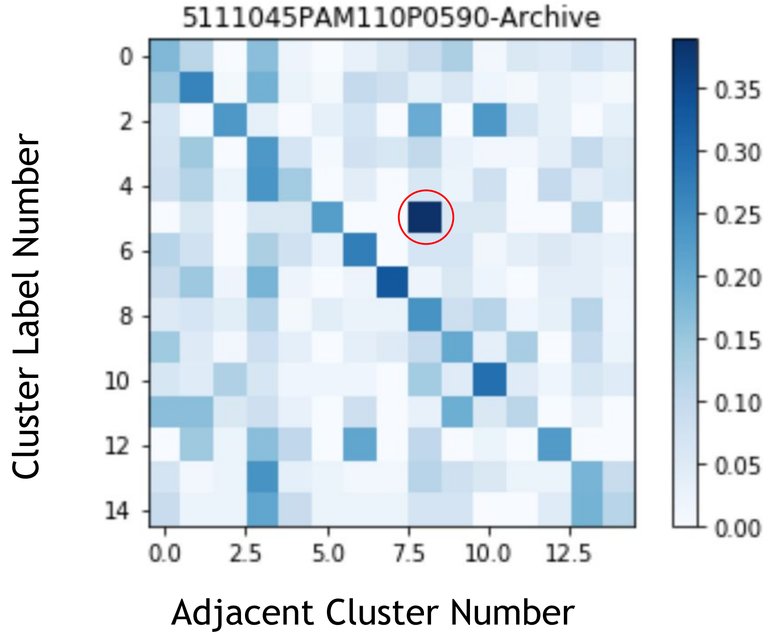
2.5
5.0
7.5
10.0
12.5
0.5
0.4
0.3
0.2
0.1
0.0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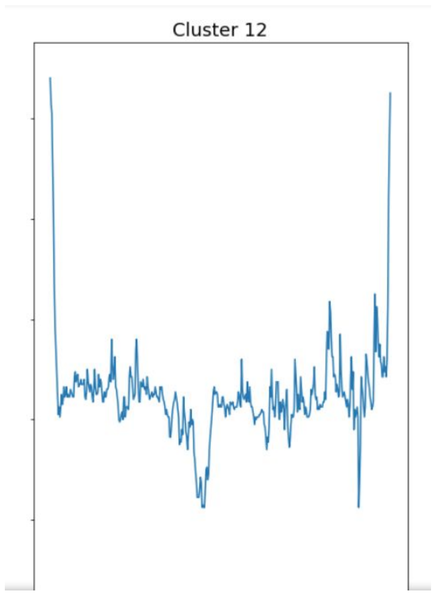
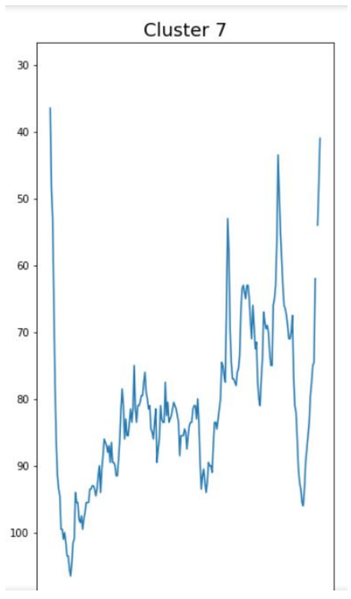

Cluster 12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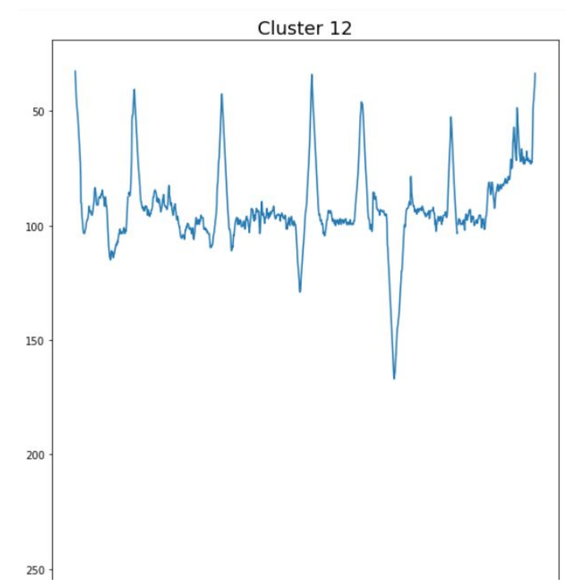
40
50
60
70
80
90
100


Cluster 12
50
100
150
200
250