

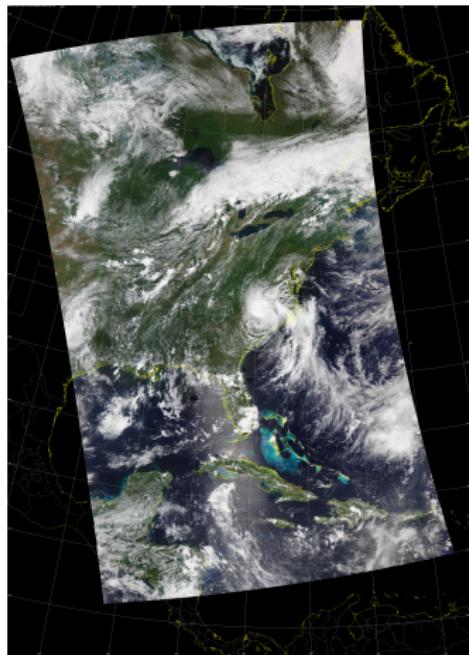
Neural Network Clustering Methods on VIIRS Data

Hampton University

Center for Atmospheric
Sciences: Research
Experience for
Undergraduates

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Outline

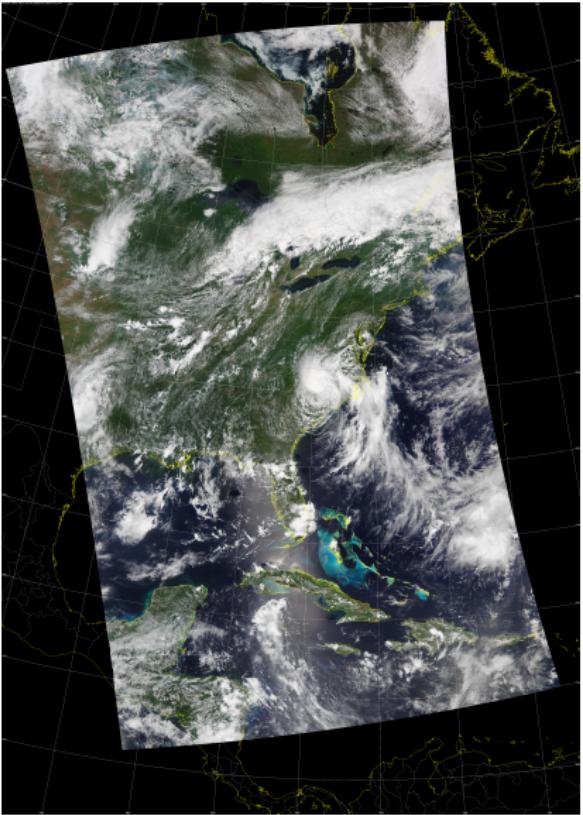
Outline

1. Motivations & Background

Introduction: Motivations

What does
this image show?

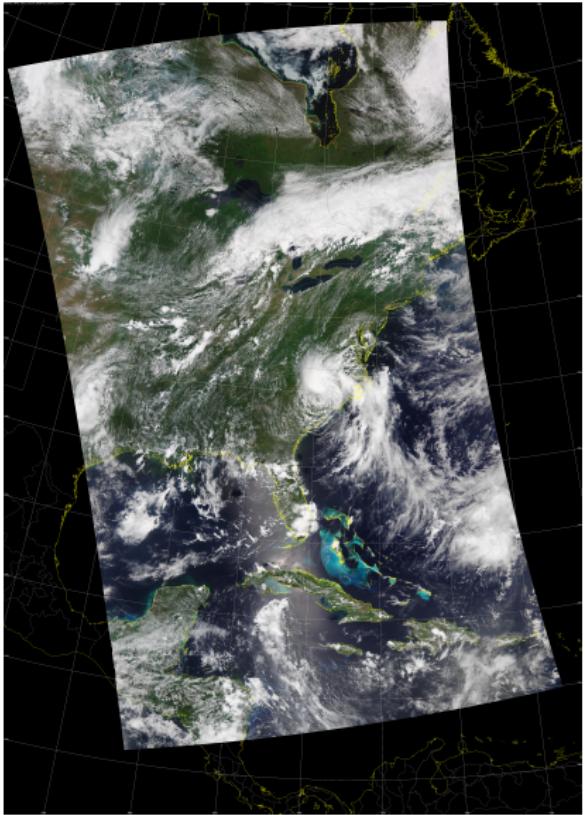
- Ocean
- Land
- Clouds



Introduction: Motivations

What if we focus
on the clouds?

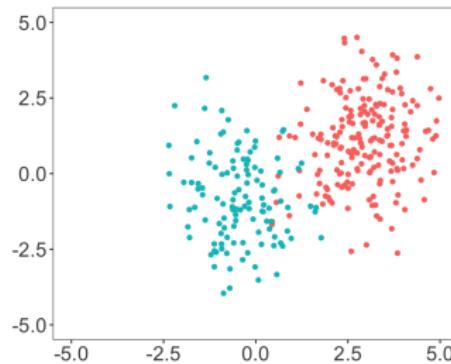
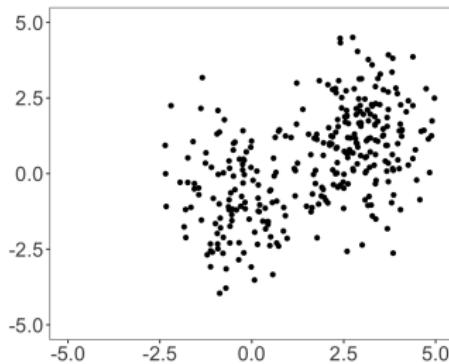
- Difficult to distinguish types
- Different Textures



Introduction: Clustering Algorithms

What is a clustering algorithm?

- A way to break data into distinct groups



- Can we compare clustering algorithms with a neural network based algorithm?

Introduction: Data Source

Data Source

- Visible Infrared Imaging Radiometer Suite (VIIRS)
- Data in 16 bands
 - $0.4 \mu\text{m} - 12.488 \mu\text{m}$
 - Visible spectrum is $0.4 \mu\text{m} - 0.8 \mu\text{m}$



Outline

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1. Motivations & Background
2. Methods & Clustering Algorithms

Methods: Data Overview

Data selection & Methods

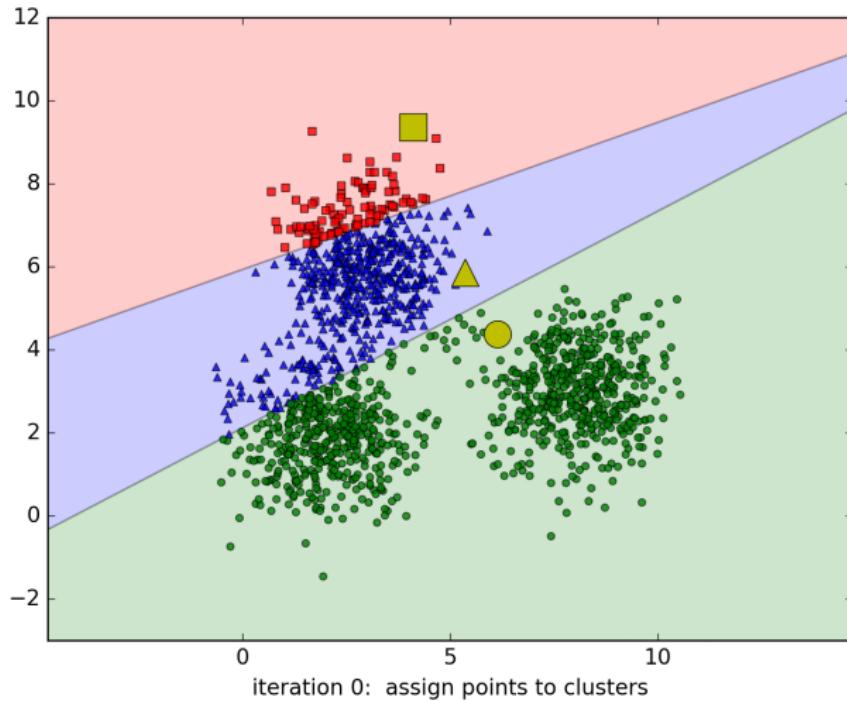
- There are many different types of clouds
- Group clouds into four different clusters
 - Jakob, Tselioudis, Hume, 2005
- Need to do something about the surface
 - Clouds from Advanced Very-High-Resolution Radiometer Extended (CLAVR-x)
- Compare k -means and Neural Networks

Clustering Algorithms: k -Means

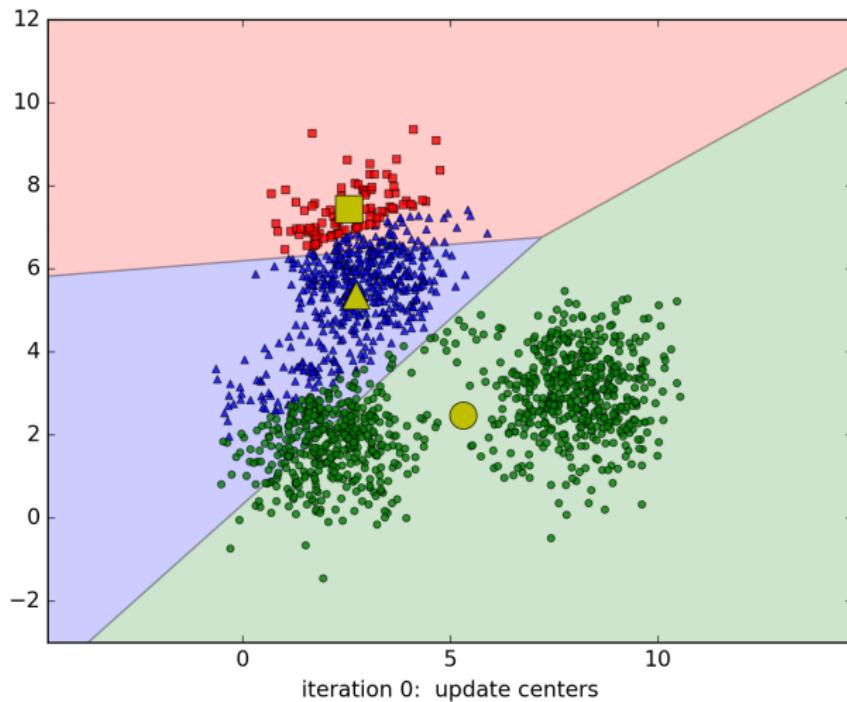
What is k -means?

- Partitions data into k distinct groups
- Each group has a cluster centroid
- Assigns observation to the nearest centroid
- Upcoming graphic from Tiep, 2017

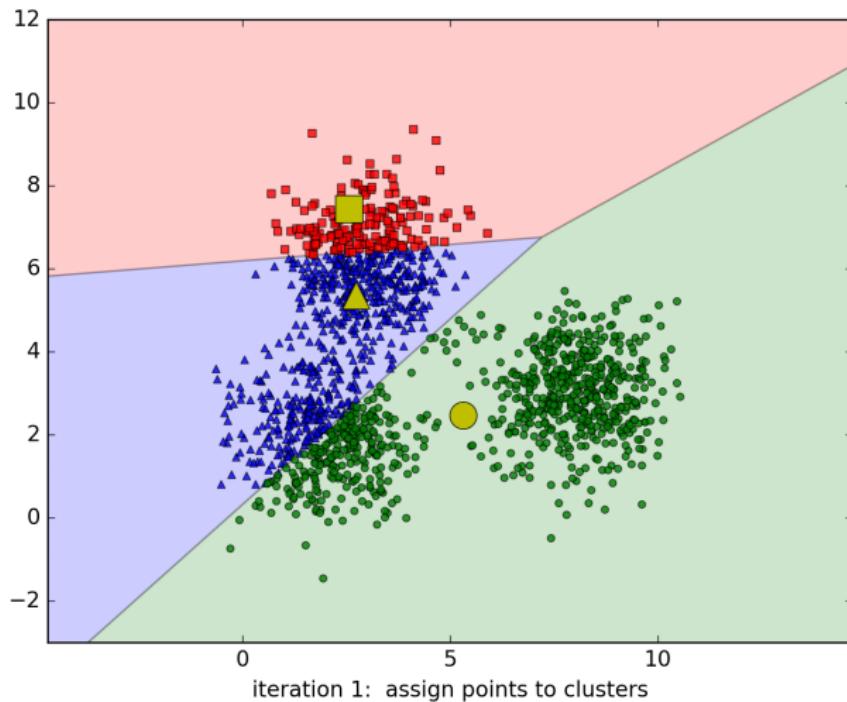
Clustering Algorithms: k -Means



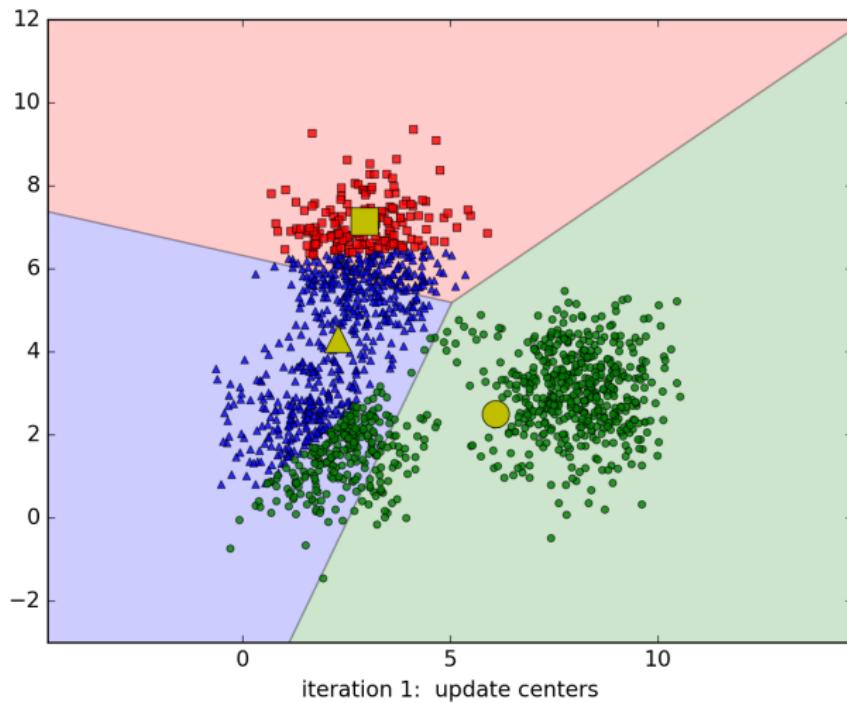
Clustering Algorithms: k -Means



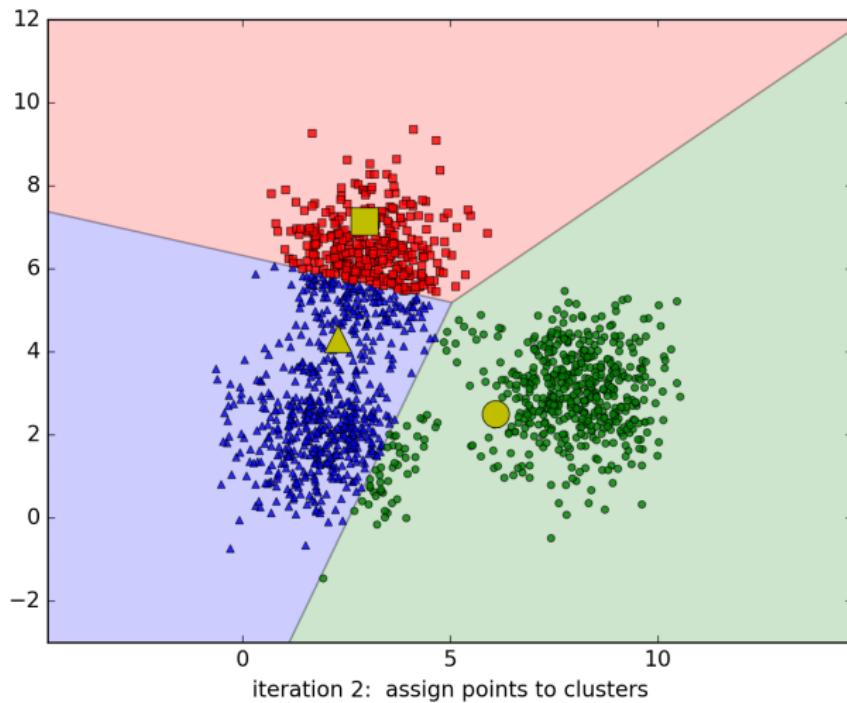
Clustering Algorithms: k -Means



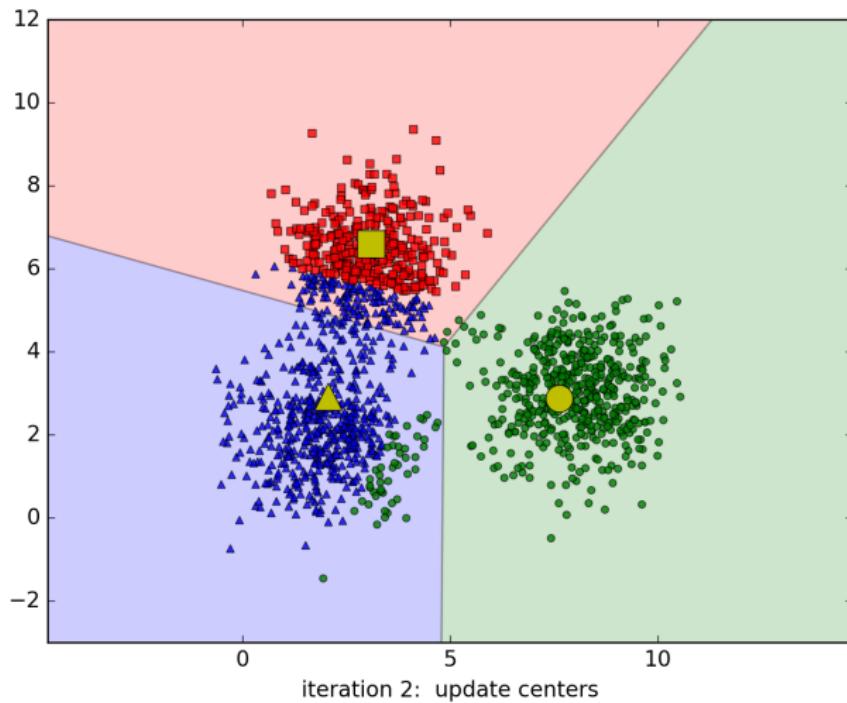
Clustering Algorithms: k -Means



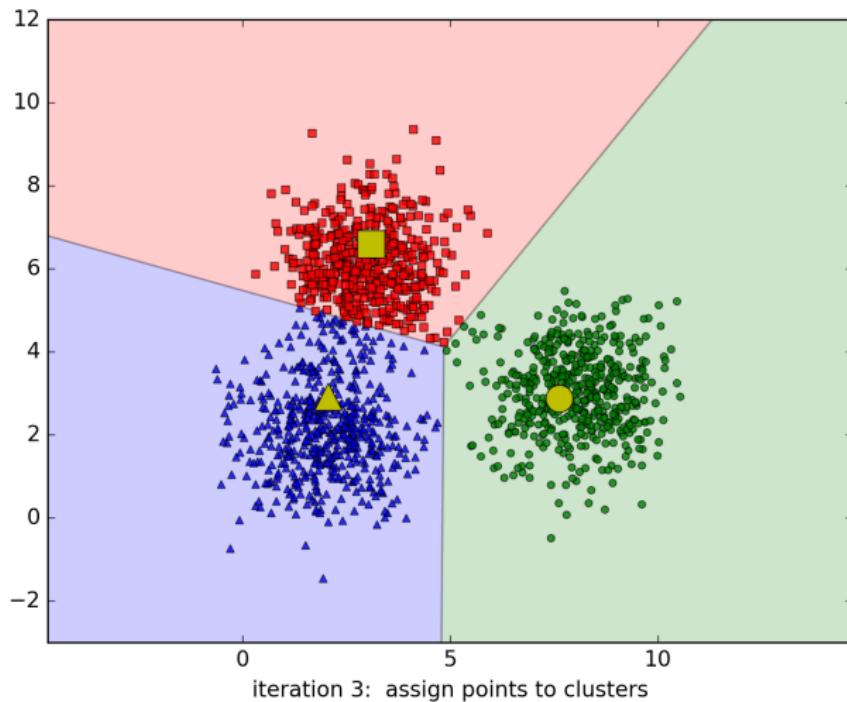
Clustering Algorithms: k -Means



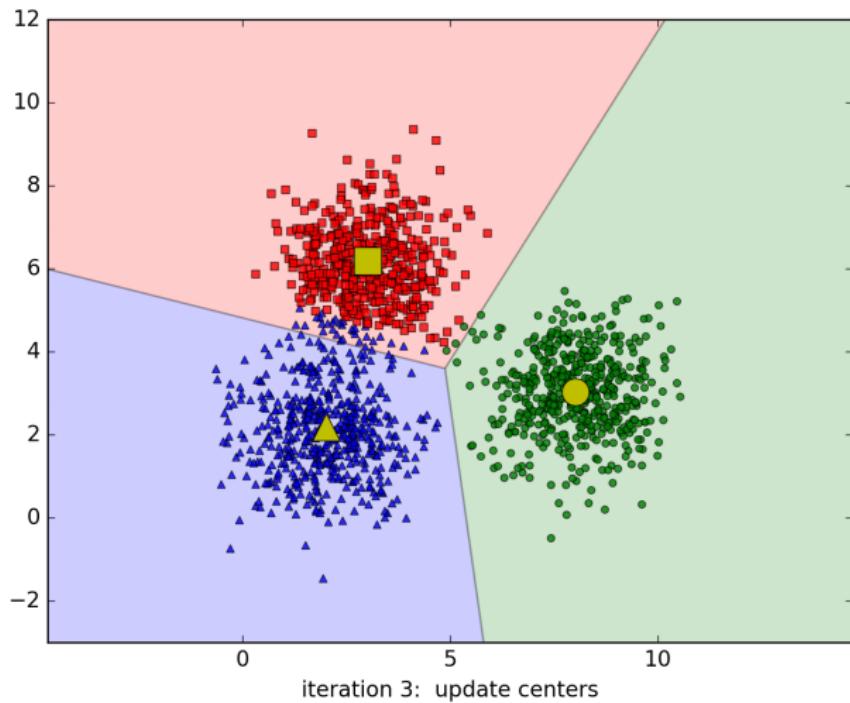
Clustering Algorithms: k -Means



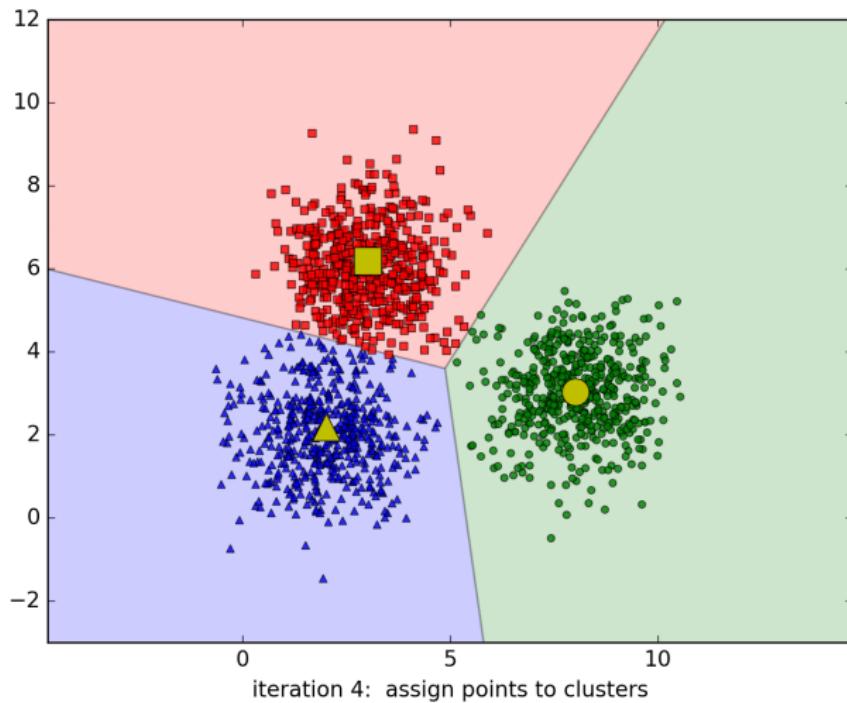
Clustering Algorithms: k -Means



Clustering Algorithms: k -Means



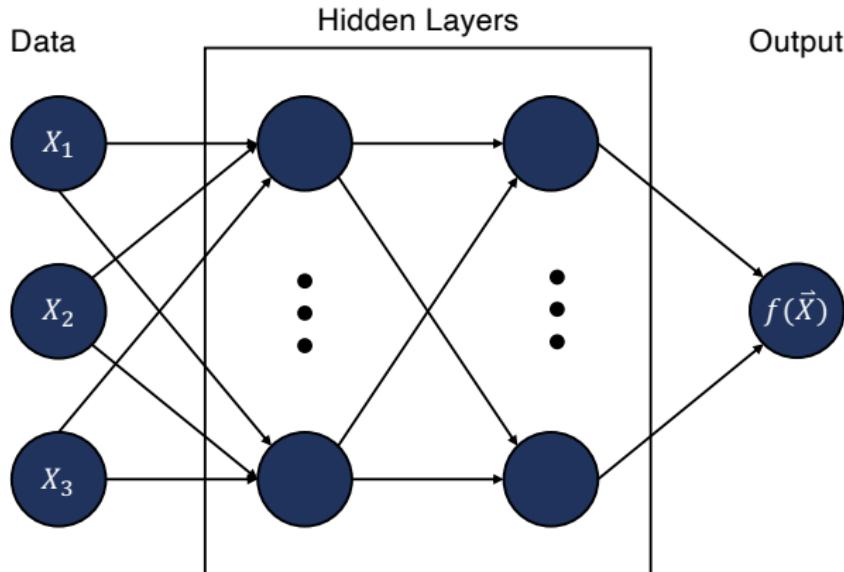
Clustering Algorithms: k -Means



Clustering Algorithms: Neural Networks

What is a Neural Network?

- We're treating them as black boxes



Clustering Algorithms: Neural Networks

A neural network also has ‘loss’

- We define a differentiable loss function
- Loss is a metric we try to minimize

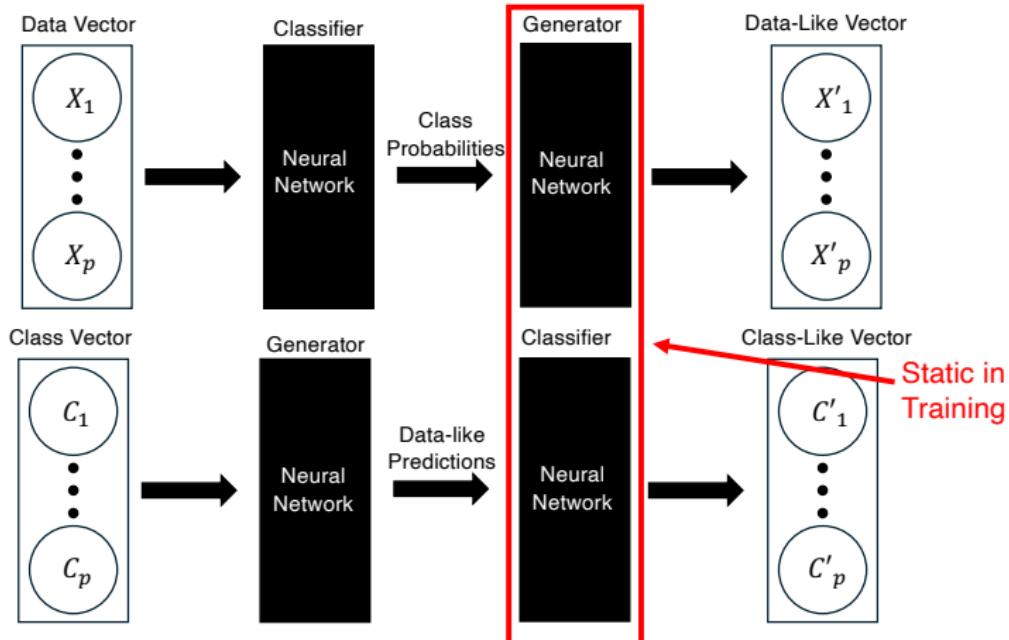
Clustering Algorithms: Neural Networks

How can Neural Networks cluster data?

- Not so clear
- Created a system of two Neural Networks

Clustering Algorithms: Neural Networks

How can Neural Networks cluster data?



Clustering Algorithms: Loss functions

What loss did we use

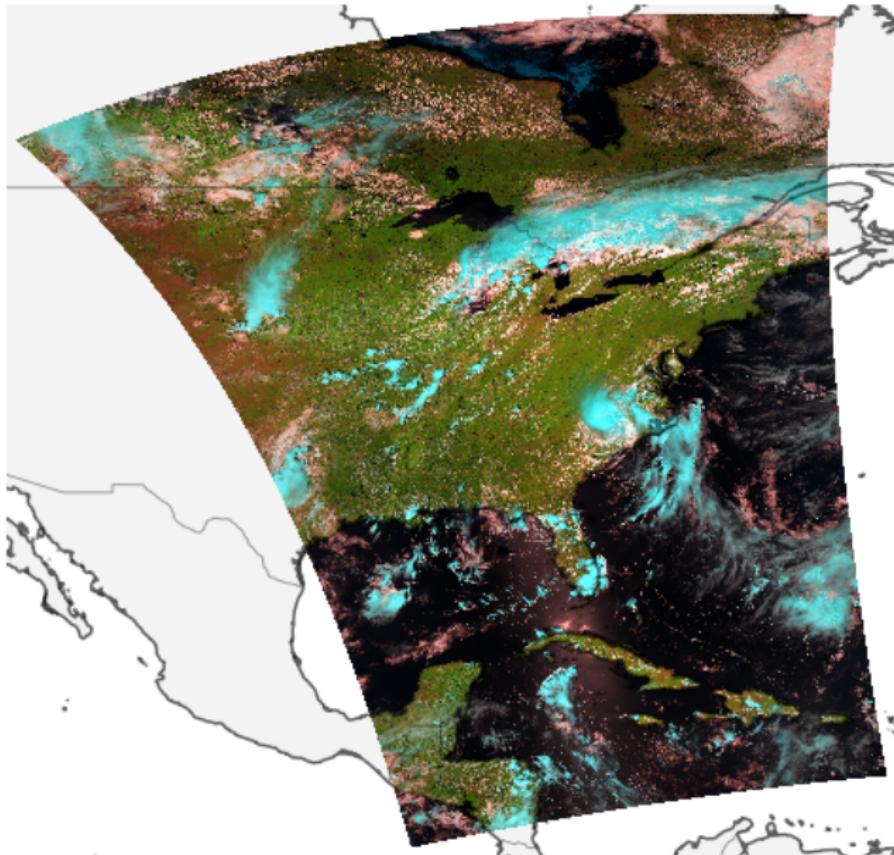
- We experimented with two loss functions for classifier training
 - Mean Squared Error
 - Negative Variance Ratio Criterion
- Used Cross-Entropy loss for the generator training

Outline

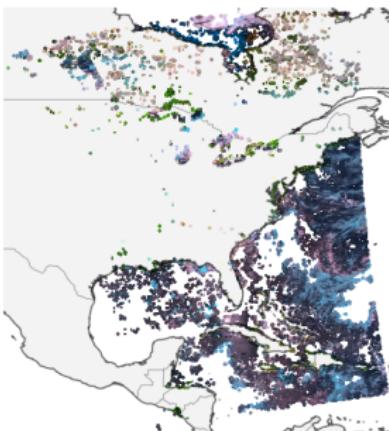
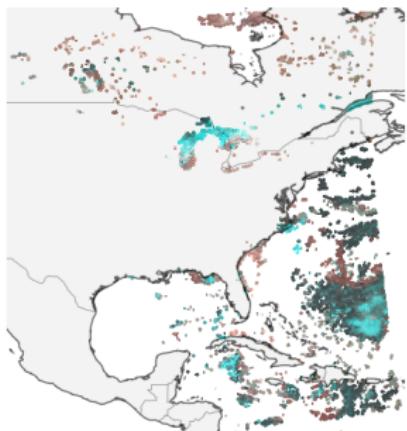
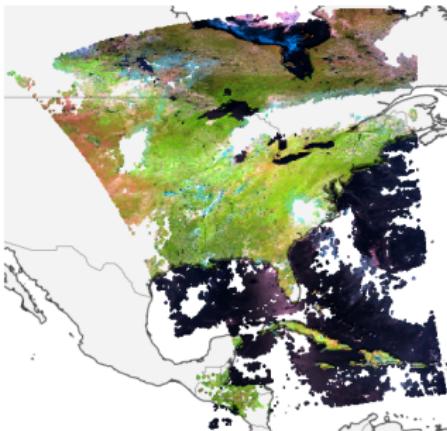
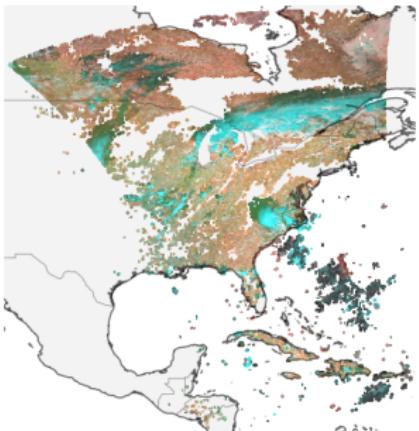
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1. Motivations & Background
2. Clustering Algorithms & Methods
3. Results

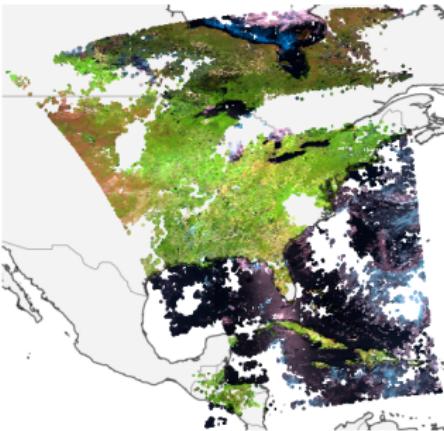
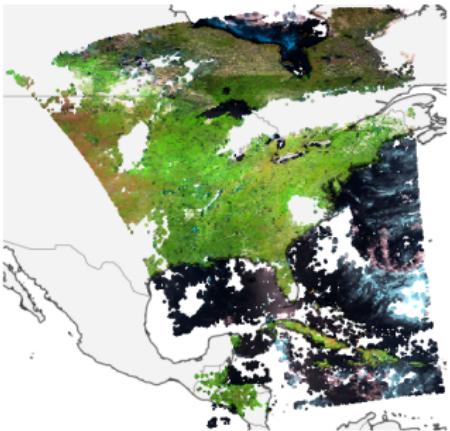
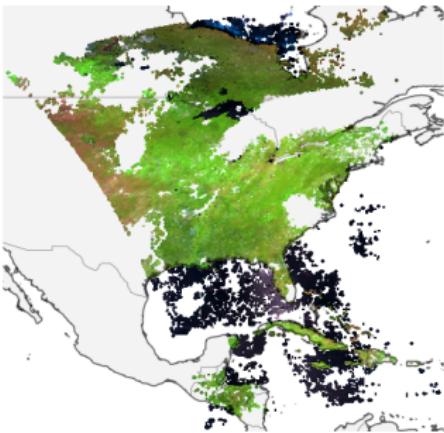
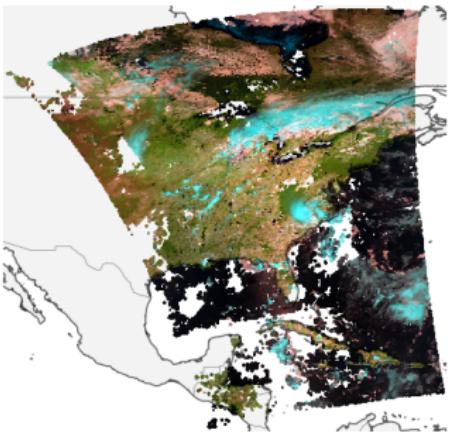
Results: Psuedo True-Color Image



Results: k -means plots



Results: Neural Network Classifier plots



Results: Conclusions

Conclusions

- Neural Networks are unable to distinguish points k -means recognizes
- We may need a higher powered model

Results: Future Directions

Future Directions

- Create more complex models
- Try different architectures
- More data processing

Thank you & Acknowledgements

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- Any Questions
- Thanks to Dr. Kelly Robbins and Dr. Jennifer Heath for writing me letters of recommendation
- Thanks to Dr. McNabb for supervising my project
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