Visualization of the Trade History between China and US States

Dong Liang and Li Ai

Table of Contents

- Introduction
- Data & Methods
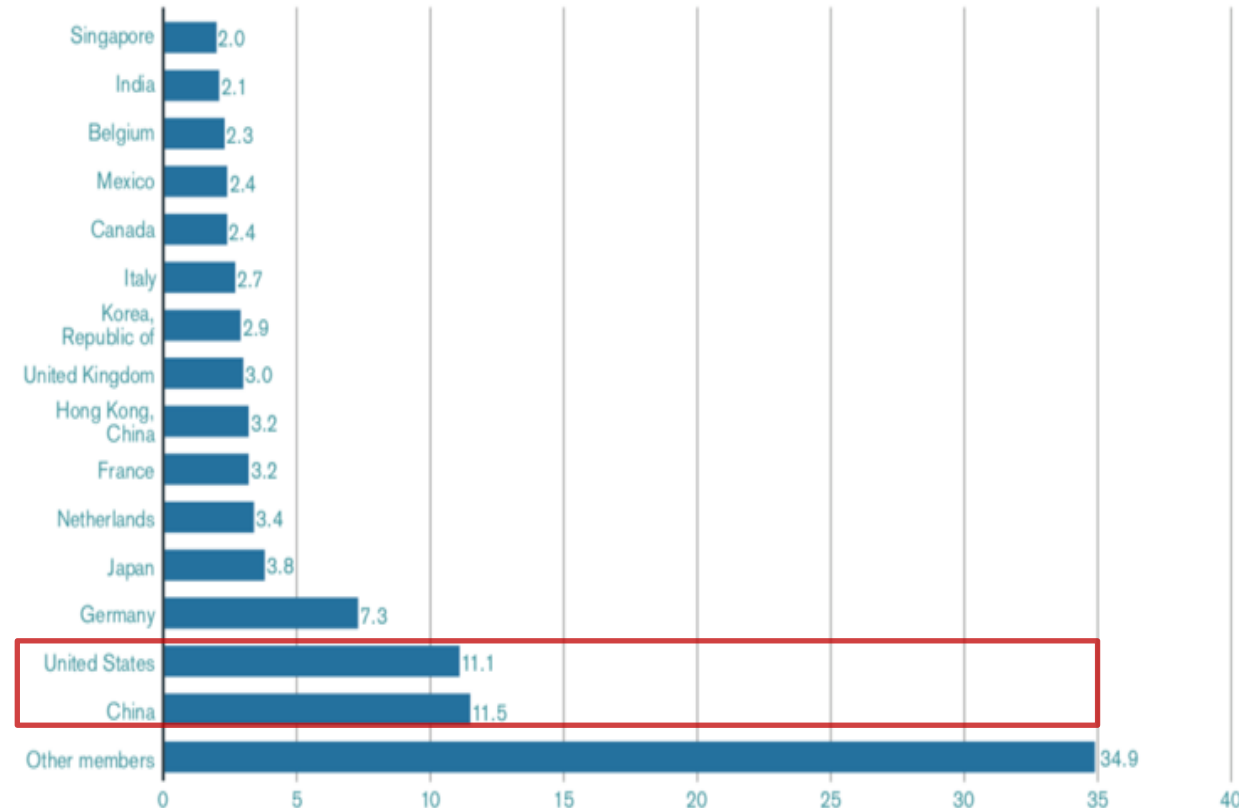- Results and Conclusions
- Team Members

Dong Liang

Li Ai

Introduction

- US-China: the largest bilateral trade in the world
  - Top 2 economies
  - >20% world merchandize trade
  - ~$33B in 1992 to ~$634B in 2018

- Trade war started against China in 2018
  - Tariff raised from 10% to 25% on $250B import
  - Huge impact on the economies of both countries and the rest of the world

- The project will focus on the visualization of the trade between China and individual US states
  - Visualizations of the import, export and surplus/deficit over time
  - Visualizations for manifold-learning-based clustering analysis
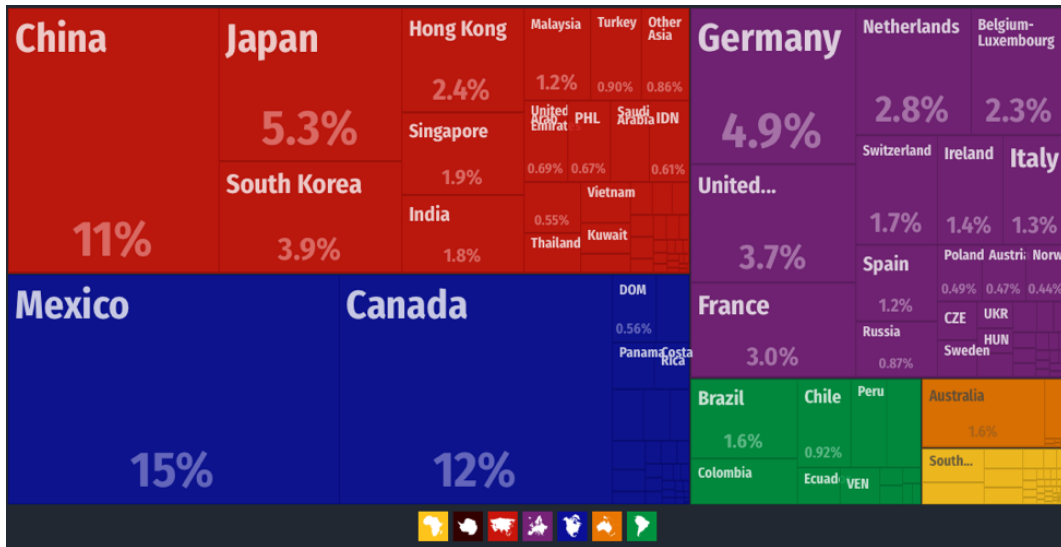
(Percentage)

Country	Percentage
Singapore	2.0
India	2.1
Belgium	2.3
Mexico	2.4
Canada	2.4
Italy	2.7
Korea, Republic of	2.9
United Kingdom	3.0
Hong Kong, China	3.2
France	3.2
Netherlands	3.4
Japan	3.8
Germany	7.3
United States	11.1
China	11.5
Other members	34.9

Note: Merchandise trade calculated as an average of exports and imports.
Source: WTO-UNCTAD estimates.

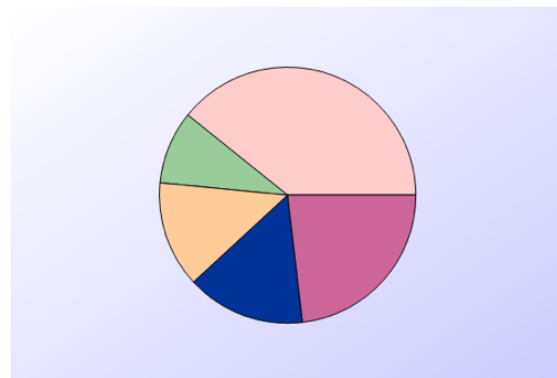# Existing Visualizations: Tree Map, Pie Chart and Time Series
(They normally focus on the whole US instead of individual states)

Export destinations of the U.S. foreign trade

(Source: the Observatory of Economic complexity)

(Source: International Trade Administration)
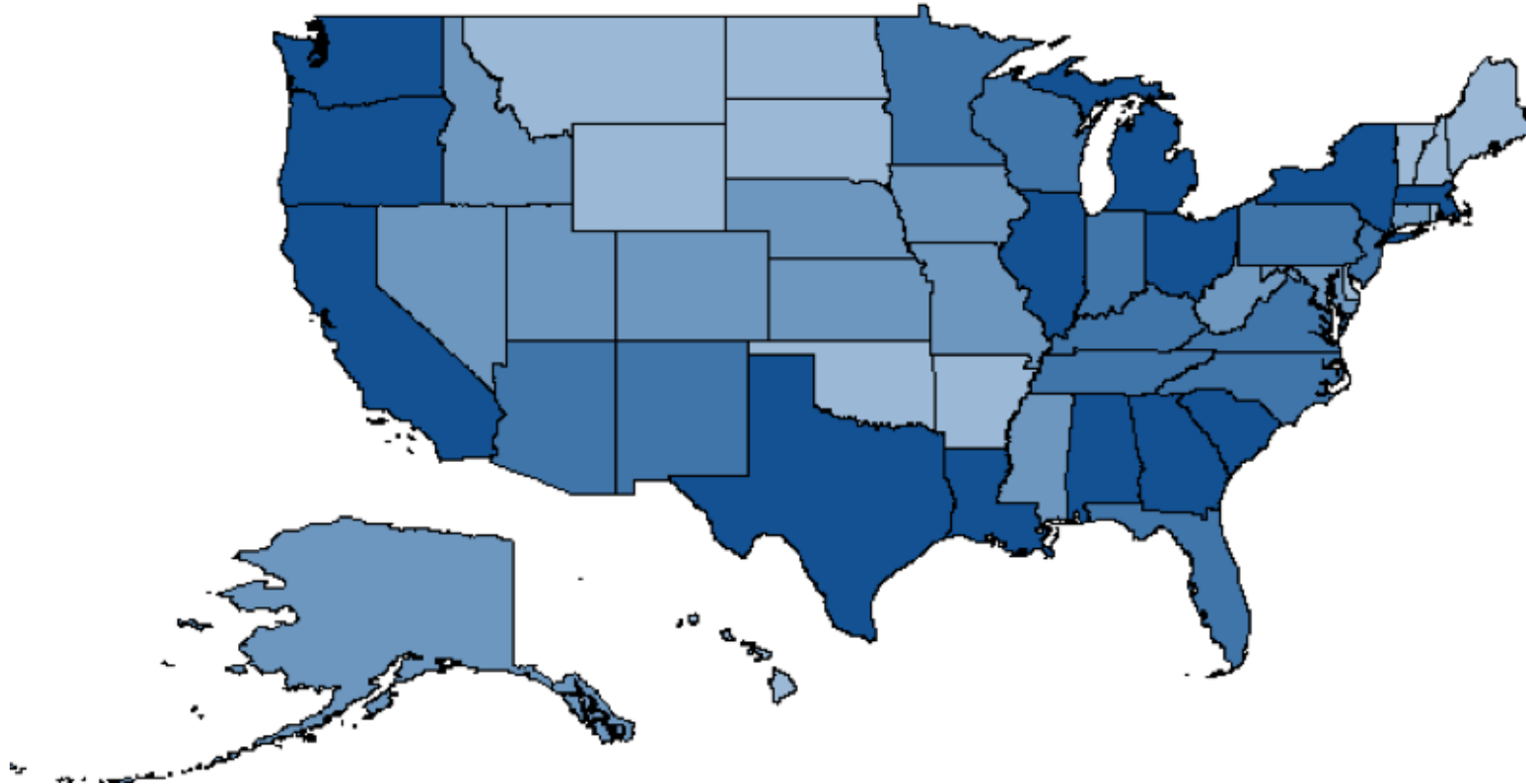

(Source: Bloomberg)

Existing Visualizations: Choropleth Map
(They are for individual states but often suffer problems...)

2018 NAICS Total All Merchandise exports to China

*(Source: International Trade Administration)*

Data

- International Trade Administration's official website for export and import data. Their database has both the export (1999-2008) and import data (2009-2008) between US states and individual foreign countries and economic entities (China, EU, etc.);
- US Census Bureau's official website for export and import data between US and China (1985-2018);
- St Louis Federal Reserve's official website for producer price index data to adjust trade numbers;
- US Federal Election Commission's official website for 2016 presidential election result data;
- US Department of Commerce Bureau of Economic Analysis' official website for GDP by state data.

Methods

- Part I: Visualize the Import and Export Over Time for Individual States
  - Pyramid bar chart
  - Choropleth
  - Time-series

- Part II: Visualization of Clustering Analysis by Manifold Learning
  - Uniform Manifold Approximation and Projection (UMAP) for clustering analysis
  - Choropleth of clusters
  - Bar chart to compare the political orientation of the clusters
  - Box plot to compare the economic and trade characteristics of clusters
  - Waffle chart to compare the export to different trade partners (China, EU, NAFTA and Japan) for the clusters

Part I: Visualizations of Trade between China and Individual US States

Pyramid Bar Chart
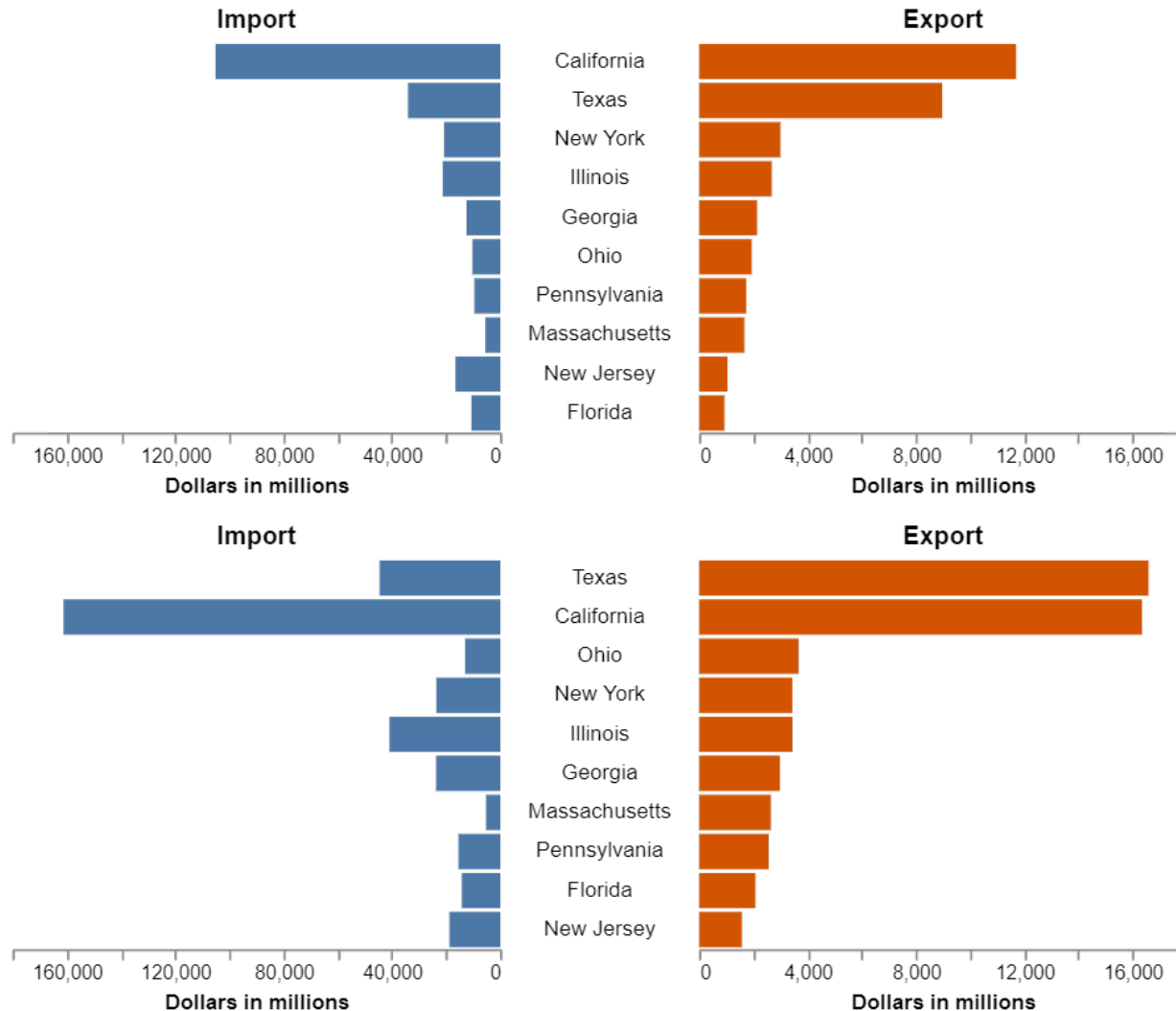
2018 (top 10 states by GDP)
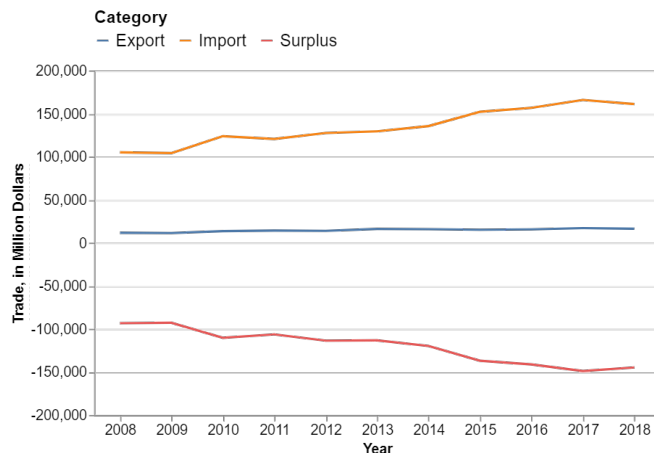
Interactive Plots

- Export and import both grew over time but in different rate
  - Import grew similarly for all states
  - Export grew differently for different states
- Import one magnitude larger than export for most states
- Plus and cons of bar chart
  - Compare multi-dimensions
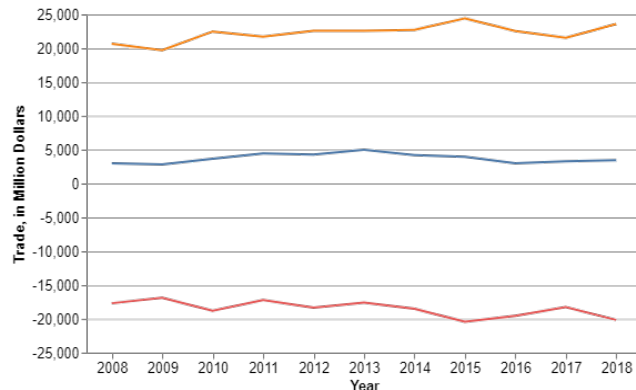 - Plot gets too busy for 50 states

Choropleth Map

Export 2008 · Import 2008 · Export 2018 · Import 2018
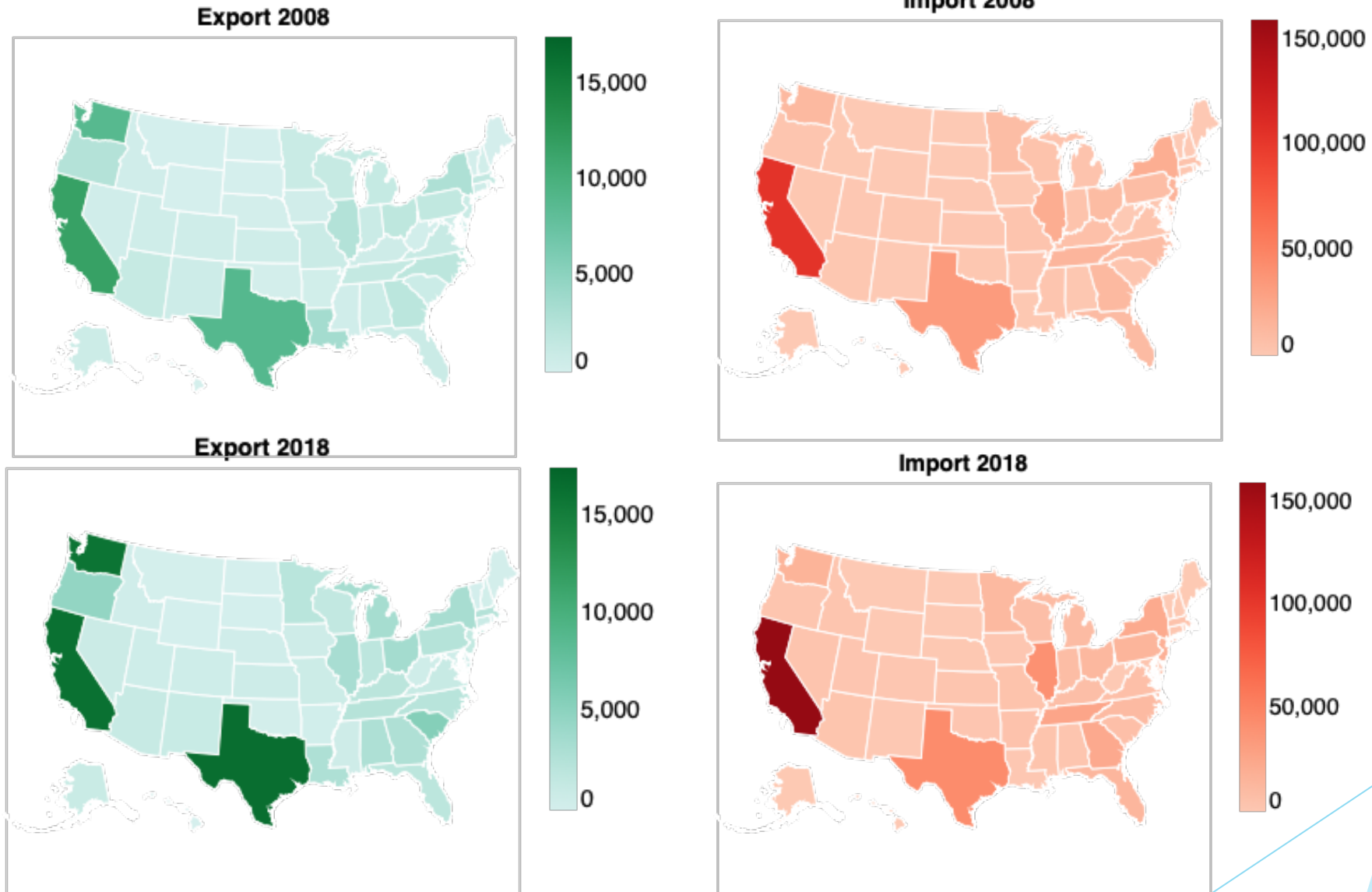
- Effectively and intuitively show 50 states together
- Choropleth illustrates quantitative information less accurately
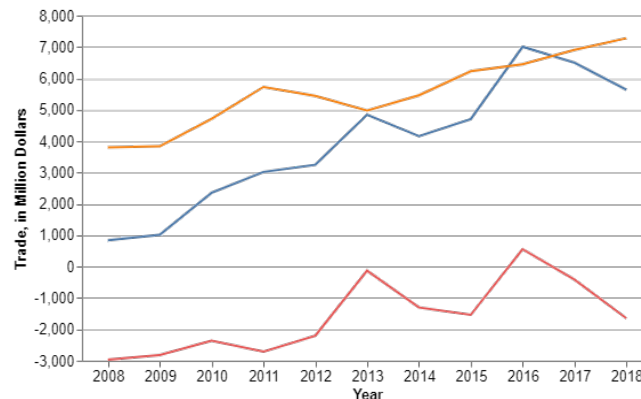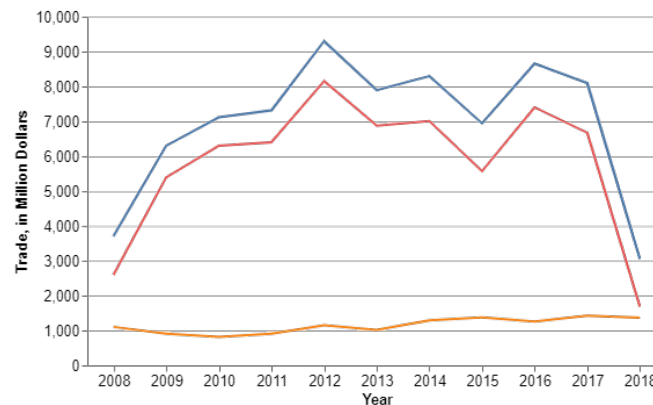
Time-Series

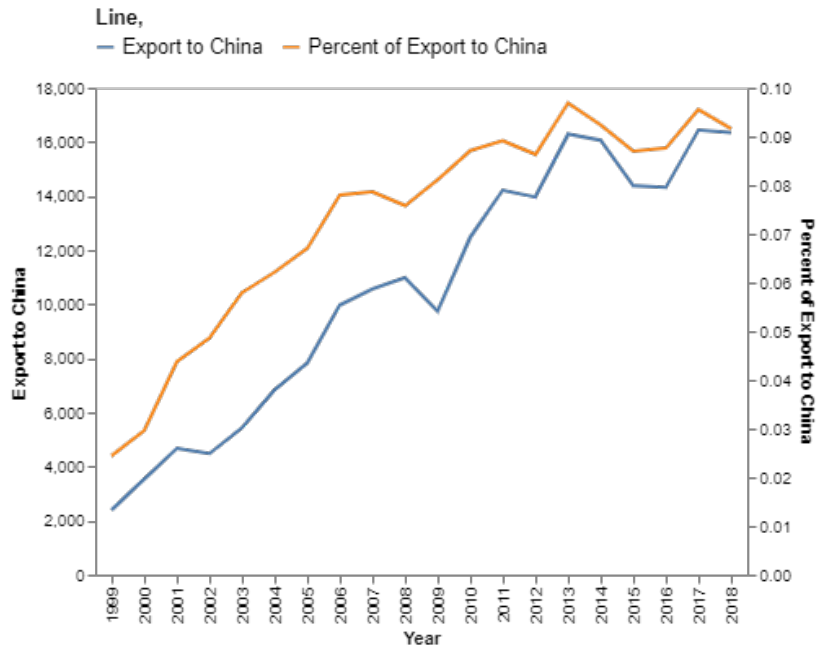California

South Carolina

New York

Louisiana

- Illustrates the trend over time for each state
- Allows us to study more details
  - Different states show different patterns
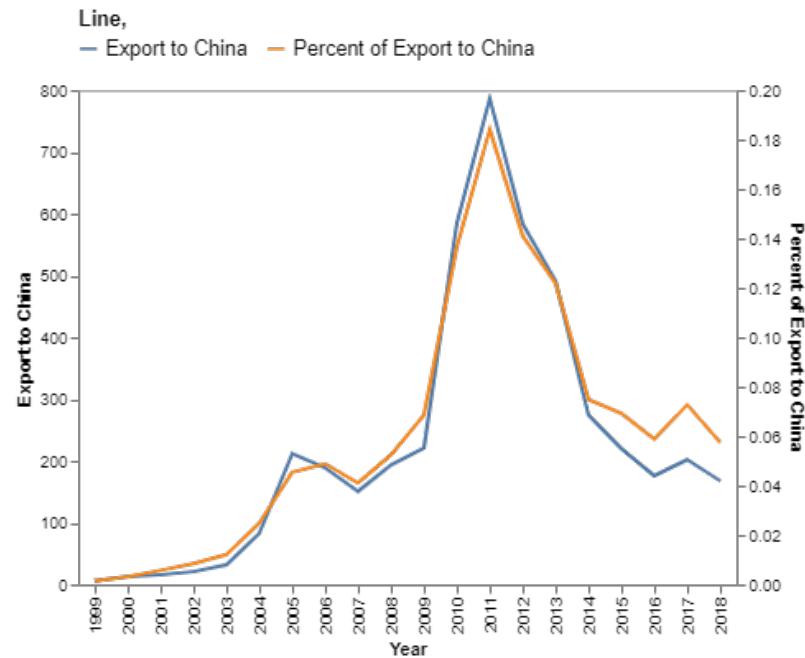- Need to plot each state separately

Interactive Plots

Time-Series (Total Export vs. Percent of Export to China)

Interactive Plots

California

Vermont

- Absolute and percent of export has similar trend, implying relatively consistent share of export to China
- Export grew over time for most states, with a few exceptions, e.g. Vermont

Part II: Visualizations of Manifold-Learning-Based Clustering Analysis

# Uniform Manifold Approximation and Projection

- ▶ The latest, weighted k-neighbor graph-based learning algorithm for general purpose dimension reduction
  - ➤ Preserve fine detailed local manifold structure in the low dimensional embedding space
  - ➤ Successfully applied in clustering task on datasets with homogenous data types
- ▶ Manifold-learning model based on:
  - ➤ US foreign trade
  - ➤ Geographic distribution
  - ➤ Political orientation

UMAP embedding of random colours

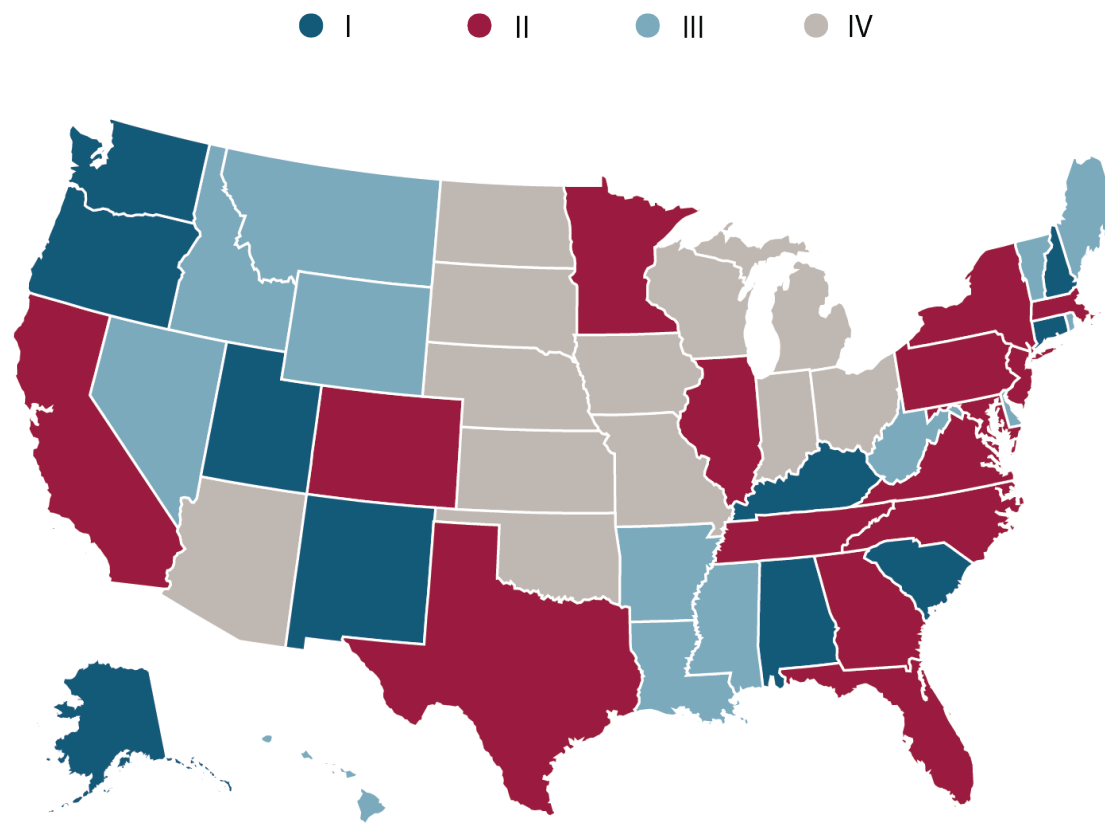*https://umap.scikit-tda.org/parameters.html*
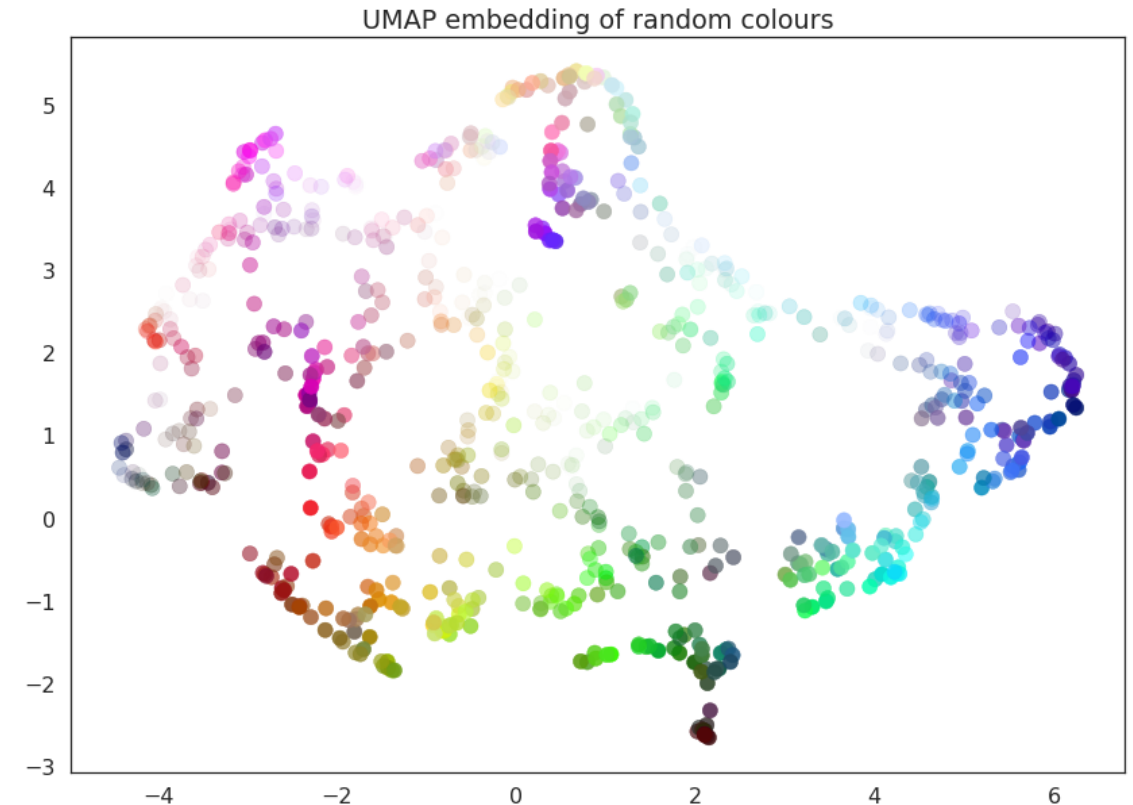
UMAP embeddings of U.S. states

Manifold
Leaning
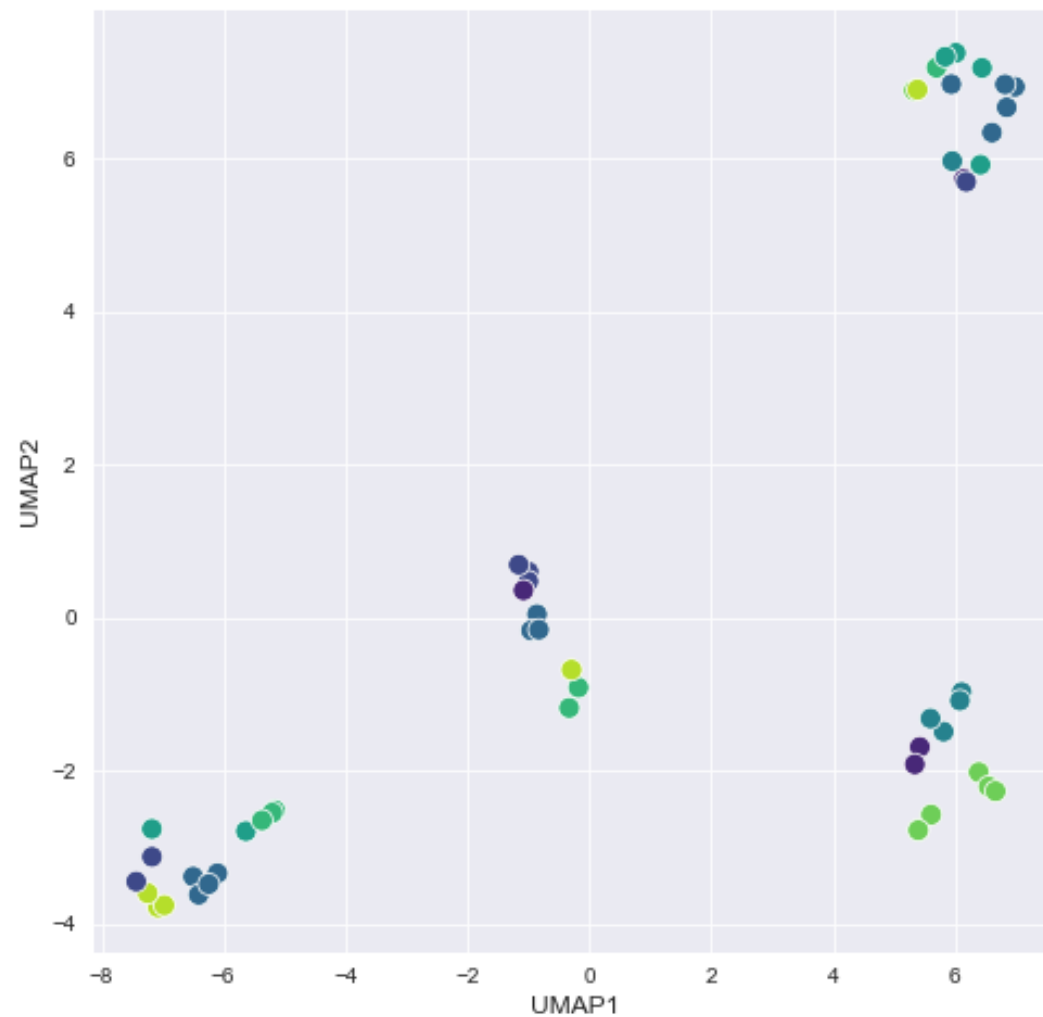
# Geographic Distribution of Clusters

● I   ● II   ● III   ● IV

▶ Category I has a wide geographical span and presents a sporadic distribution.

▶ Category II is heavily concentrated on the East and West coasts of the U.S., the Great Lakes region, and some of the economic centers in the southern U.S..

▶ States of categories III and IV are predominantly located in the Midwestern U.S. that includes some traditional agricultural states

Political Orientation of Clusters
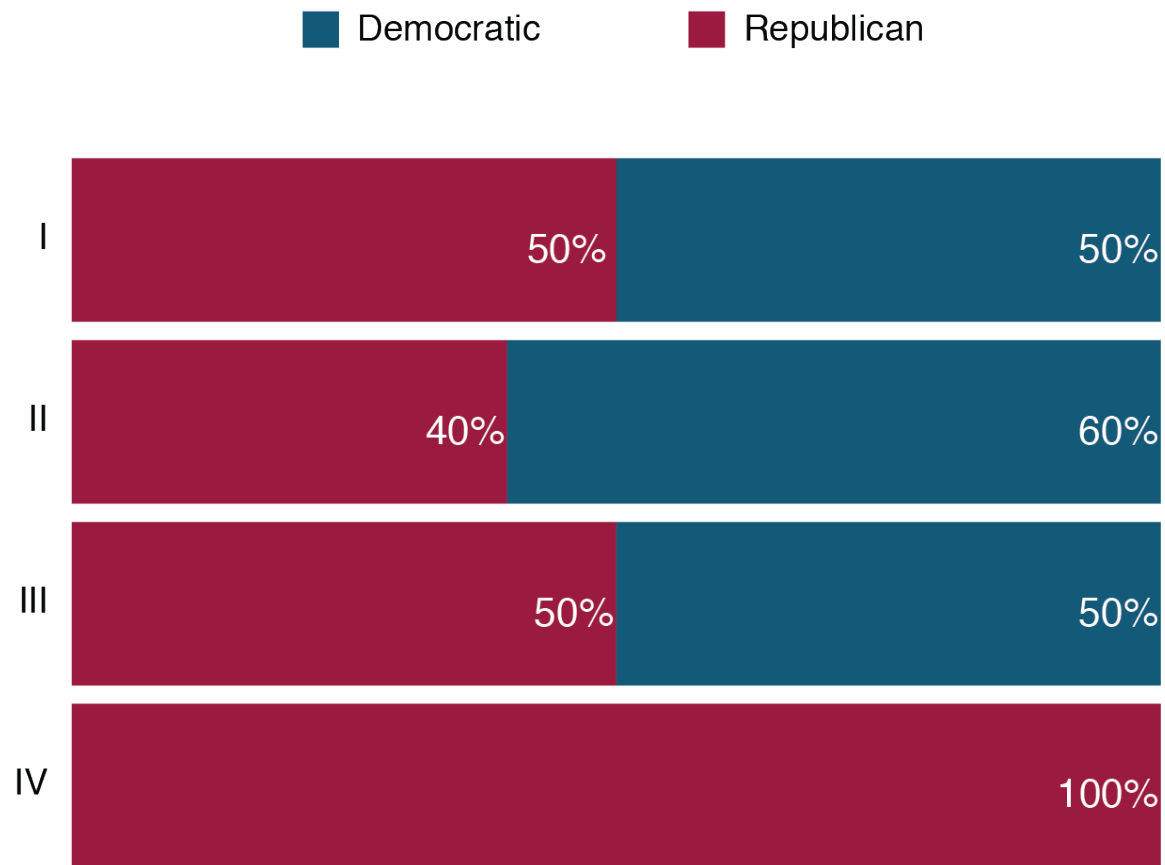
Economic and Trade Characteristics of Clusters
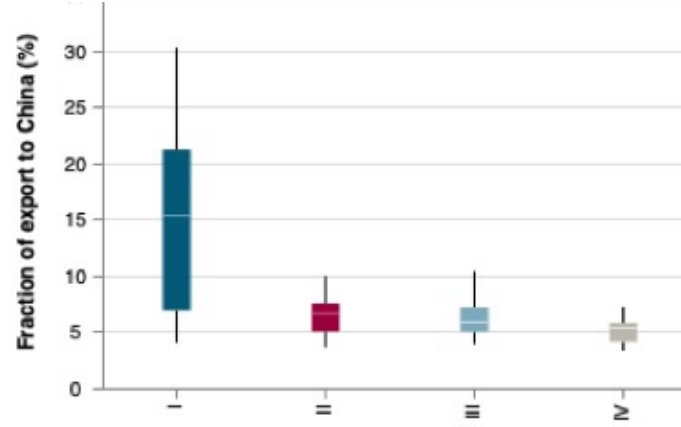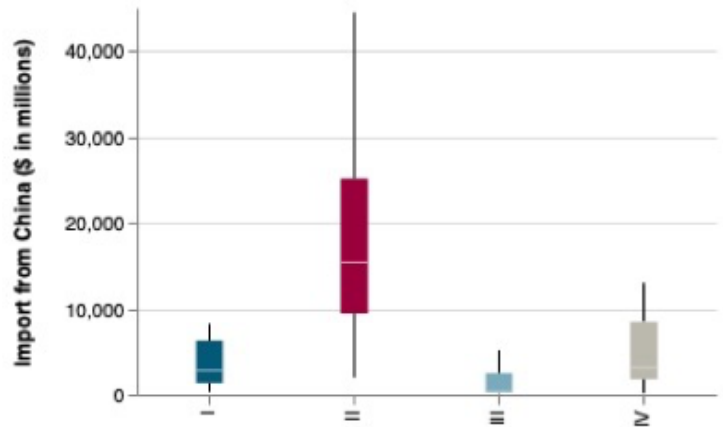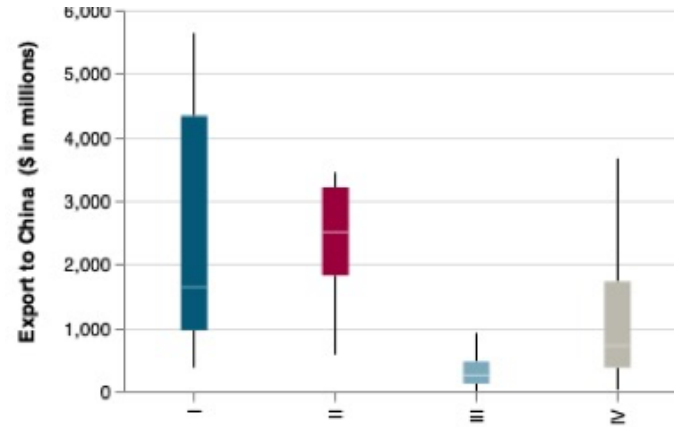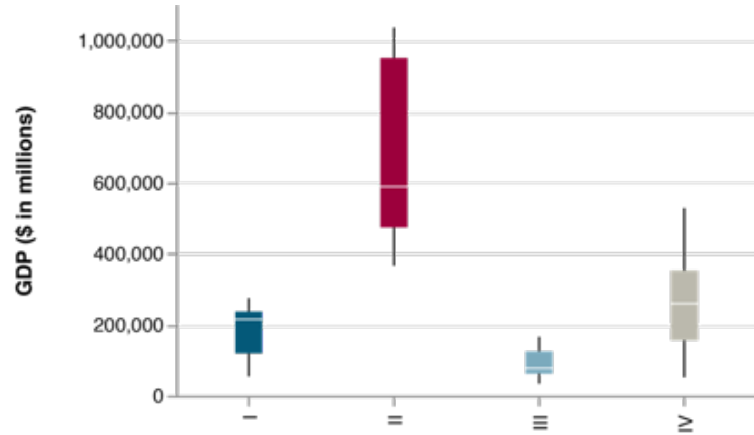
- Category II states have the largest GDP and imports from China.

- Category I states on average have a much higher percent of export to China, while the absolute export is about the same for Category I and Category II states.

- Category III is characterized by low statistics across the data spectrum.

Export Characteristics of Clusters

- Category I has the highest percent of export to China, doubling that of the other three categories

- Category IV states' export is dominated by export to NAFTA

- Category III states have more export to the other parts of the world than the total export to the four economic entities

- We expect that, Category I states would be impacted by the trade war the most, while Category III would be impacted the least.
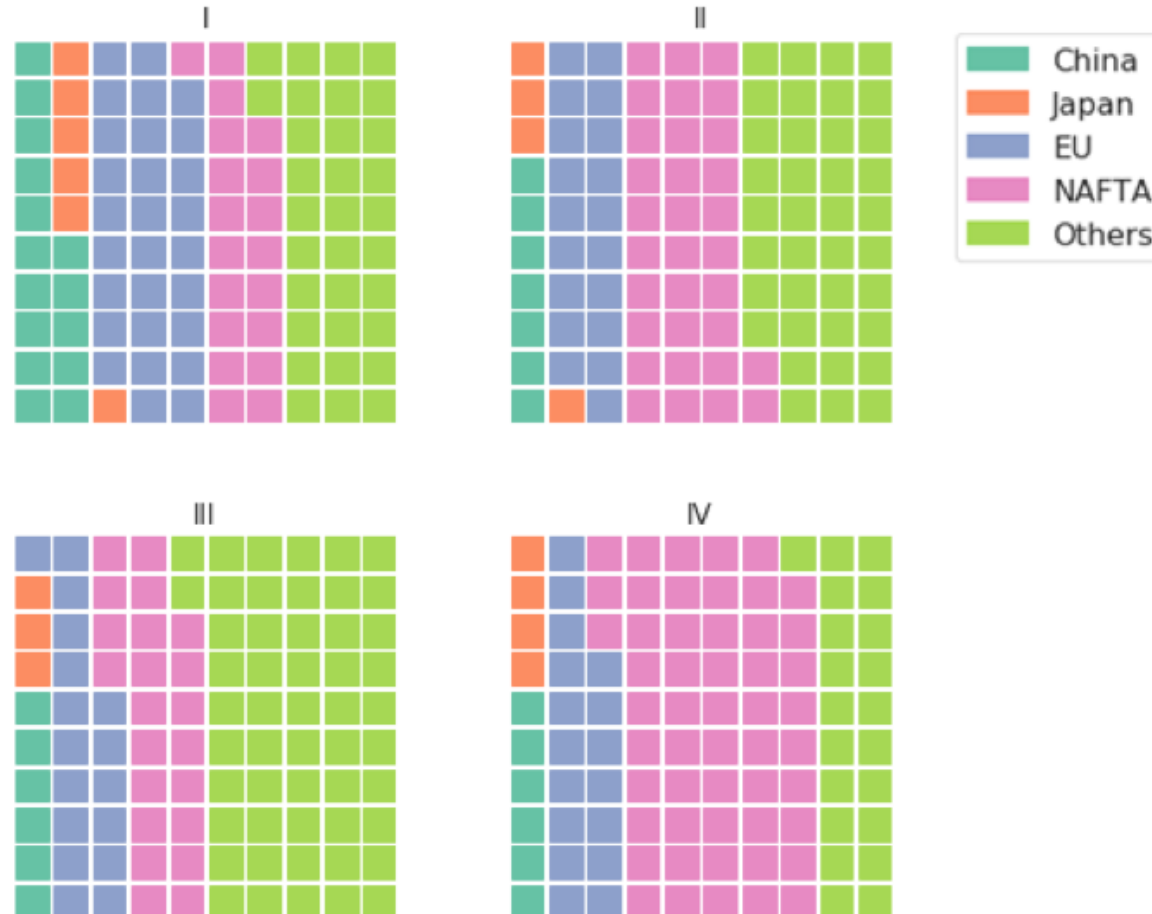
Summary and Conclusions

- Various visualization techniques were used to illustrate the trade history between China and individual US states
  - Each technique has their own strength and weakness
  - The most appropriate visualization should be chosen based on the nature of the data and the information to be delivered

- Manifold learning-based model gave interesting insights on the clustering of different states
  - Four clusters of US states were identified
  - The analysis of various characteristics (political orientation, geographic distribution, economic strength, etc.) of the clusters provides insights into how different U.S. states would be impacted by the trade war.

Future Work

- Investigate the underlying reasons for the different trends observed for different states

- Study the details of export and import portfolios by different states, e.g. what kinds of goods each state imports and how they change over time

- Modeling the trade data, e.g. ARIMA models, and perform forecasting based on different scenarios

- Compare the results from the modeling work with manifold learning results