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Assumed Risk vs Actual Risk: Behavior-based Risk Modeling

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Agenda

1. Problem: Money laundering.

2. Risk modeling: assumed vs actual risk.

3. Approach: TDA Segmentation.

Money Laundering

The laundering of dirty money occurs when the perpetrators steer the ill-gotten cash through legitimate businesses or financial institutions to legitimize the money.

Running dirty money through the wash allows the criminals to spend that money without fear of reprisal.

Money Laundering

Between $500 billion and $1.5 trillion cash is laundered internationally per year.

If a financial institution processes funds from criminal activity, the institution could be drawn into active complicity with criminals and become part of the criminal network itself. Even if it is unintentional.

Money Laundering rewards corruption and crime, it damages the integrity of the entire society.

Anti-Money Laundering (AML)

Procedures, laws and regulations intended to prevent criminals from Money Laundering.

In case of robbery, extortion or fraud, money laundering investigation is frequently the only way to locate the stolen funds and restore them to the victims.

Anti-Money Laundering (AML)

Criminals are using more sophisticated means to remain undetected, AML actions need to be at the same level.

In the last five years, there has been an explosion of companies with proposals on how to address regulatory requirements using technology.

AML process

Transactions

Client Profiles
(CDD, KYC, etc.)

Sanctions/
PEP/Watch
Lists

Risk breakdown based on assumed risk, profiles captured during onboarding (Country, Line of business, products, …).

Transaction Monitoring System

Event Creation with filtering. Some priority/ranking. High rate of false positive.

Alert investigation are lengthy and expensive because of limited context.

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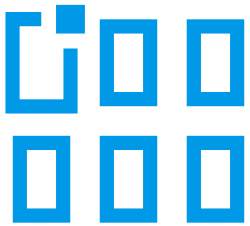
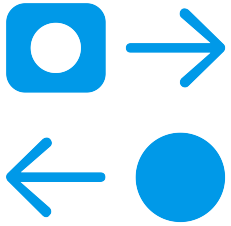
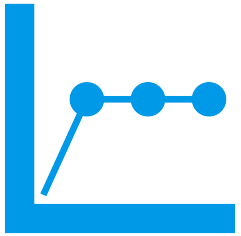
Assumed Risk



Standard KYC data
- Customer
- Products & Services
- Geographies

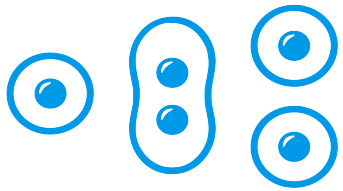


Risk scoring

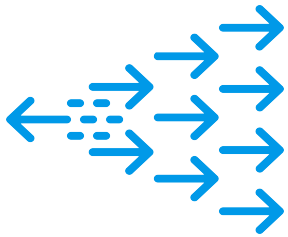


Relatively static in nature

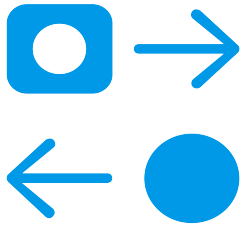
Actual Risk



Based on behavior



Augmented by changes to that behavior and/or environment over time



Dynamic in nature

AML process

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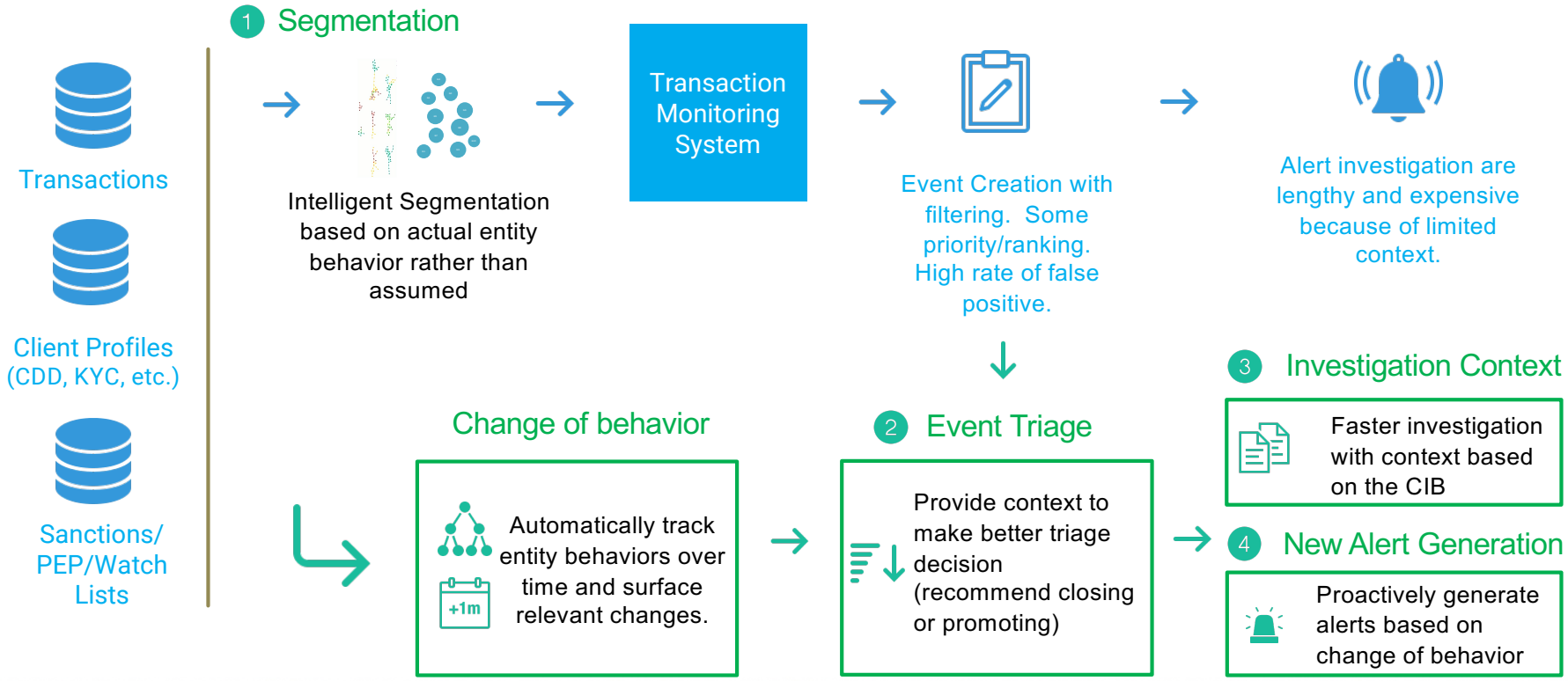
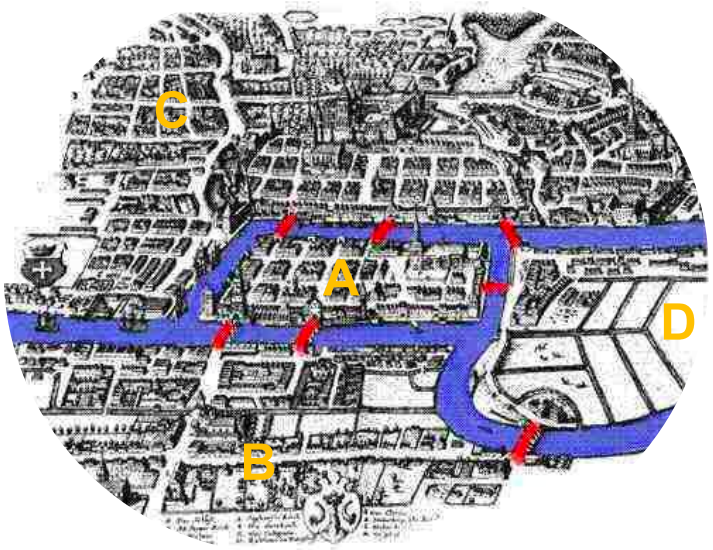
AML process with Segmentation



TDA Segments

- The challenge facing enterprises today is not data size, but data complexity.
- We are able to define meaningful segments using Topological Data Analysis (TDA).
- TDA is the use of topology to data analysis.

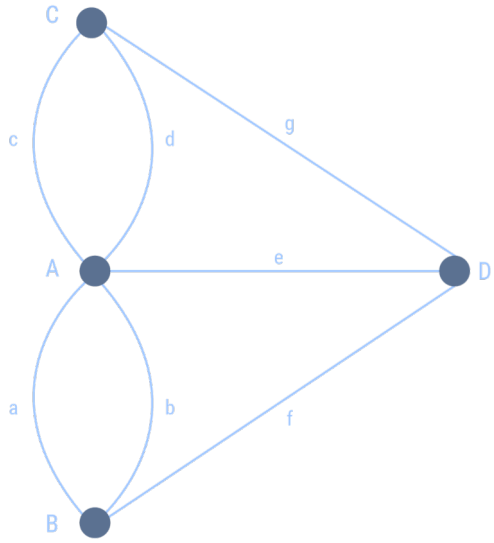
Topology



City of Königsberg in Prussia set on both sides of Pregel river

Challenge: design a walk through the city that would cross each of those bridges once and only once.

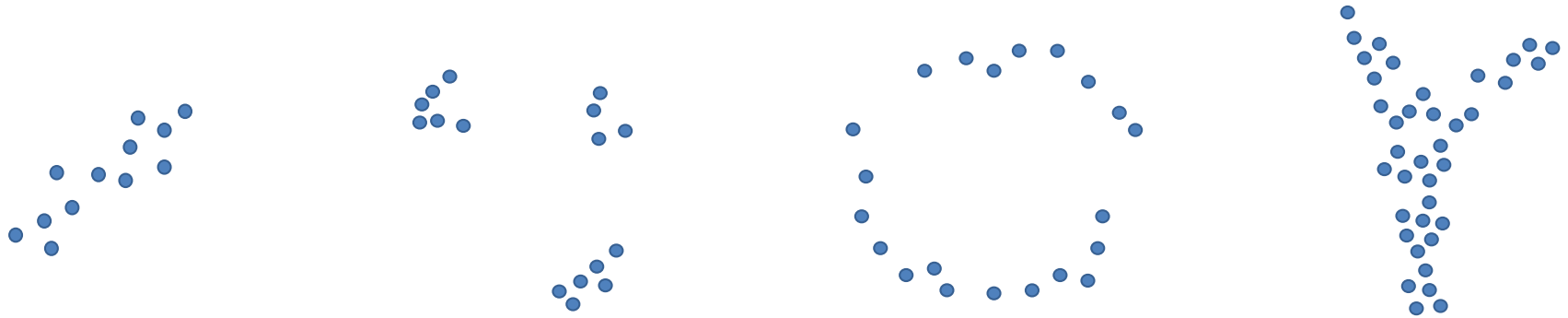
Euler's thinking: the only important feature of a route is the sequence of bridges crossed. Replace each land mass with a node and each bridge with an edge.



Topology studies the properties of spaces that are preserved under stretching and bending (not tearing or gluing).

Topological Data Analysis

- TDA is the approach that uses the “shape” of the data to extract information on complex datasets to create segments.

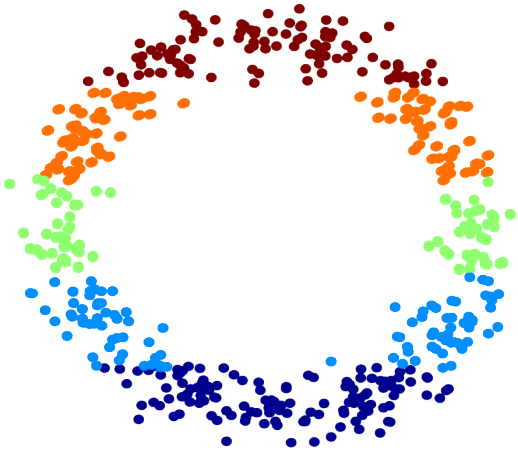


Line Clusters Loop Flares

Topological Data Analysis

- TDA is the approach that uses the “shape” of the data to extract information on complex datasets to create segments.
- The core idea behind TDA is the Mapper algorithm.
- The Mapper is a method created by *Gurjeet Singh, Facundo Memoli and Gunnar Carlsson* and published in 2007.
- We used AyasiAI’s approach of TDA, which offers a simple way of interrogating data to understand the underlying properties that characterize the segments and sub-segments that lie within data.

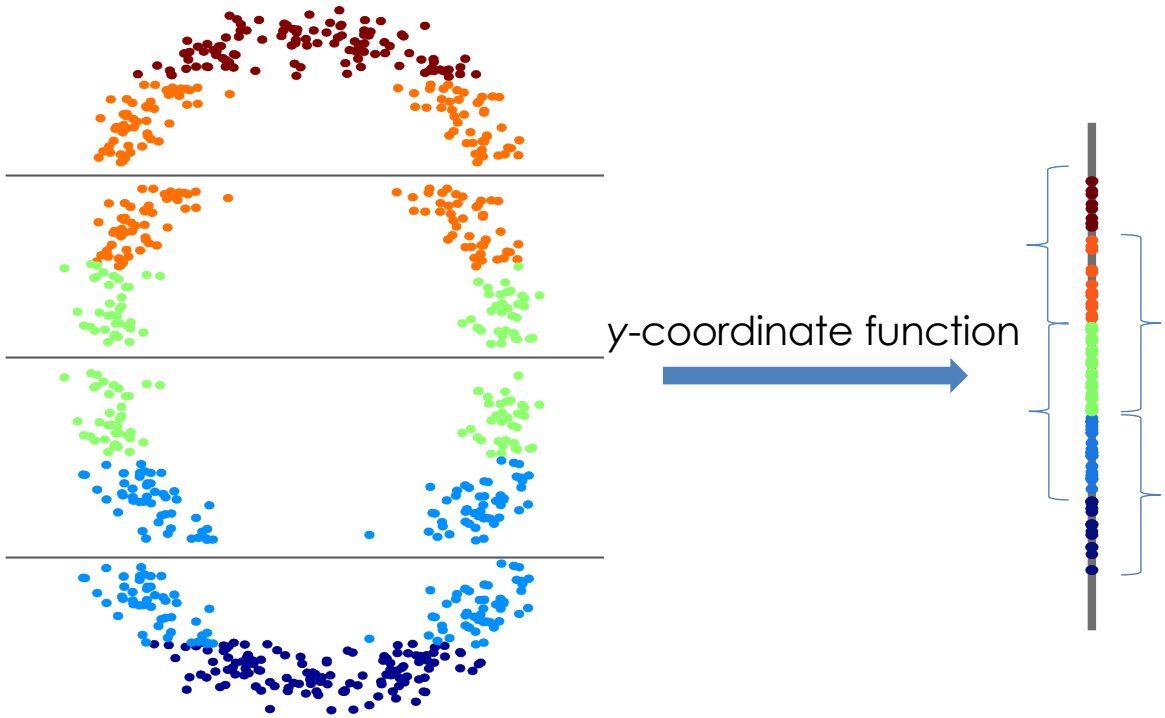
Creating Topological Networks



y-coordinate function

- TDA applies a function (lens) to the data set
- In this example, data points are mapped to their *y*-coordinate value

Creating Topological Networks

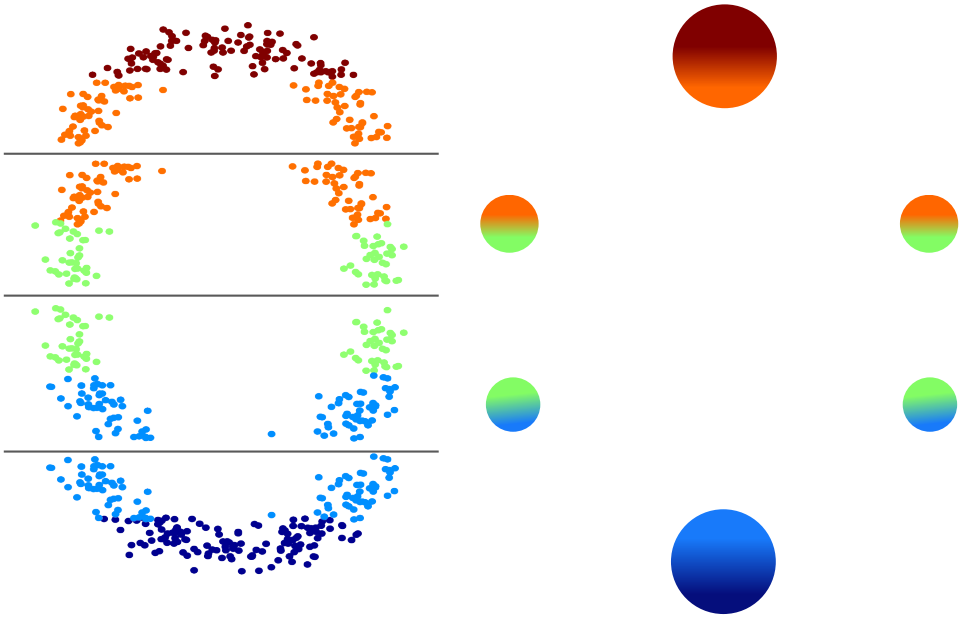


The algorithm subdivides the image of the function into overlapping bins of data points

Points within bins have similar function values

Because of the overlap, data points can fall into multiple bins

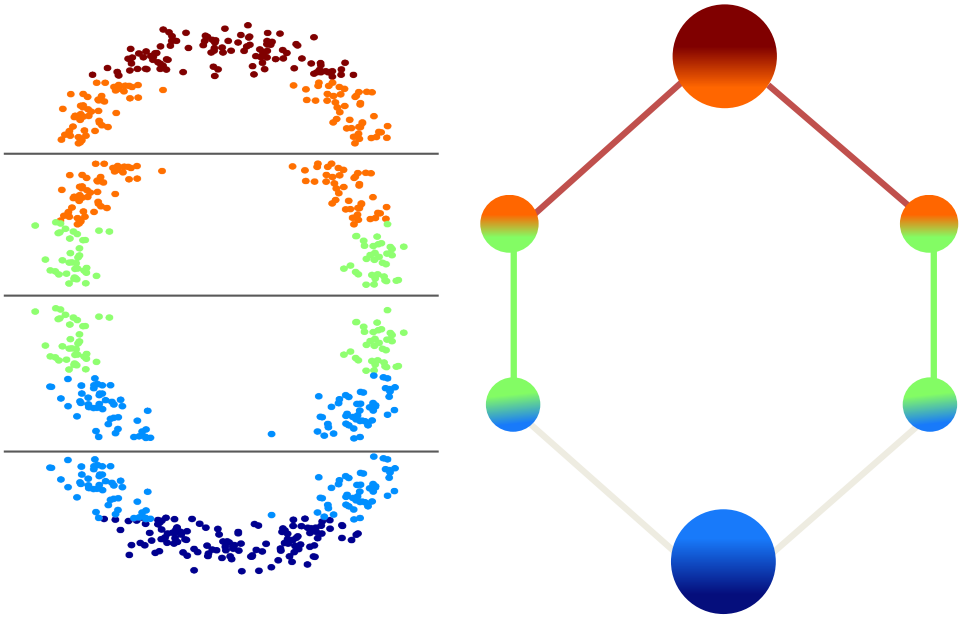
Creating Topological Networks



The algorithm clusters each of these sets of data points independently using a measure of similarity on the data points

A node represents a set of data points that are similar with respect to the measure of similarity

Creating Topological Networks

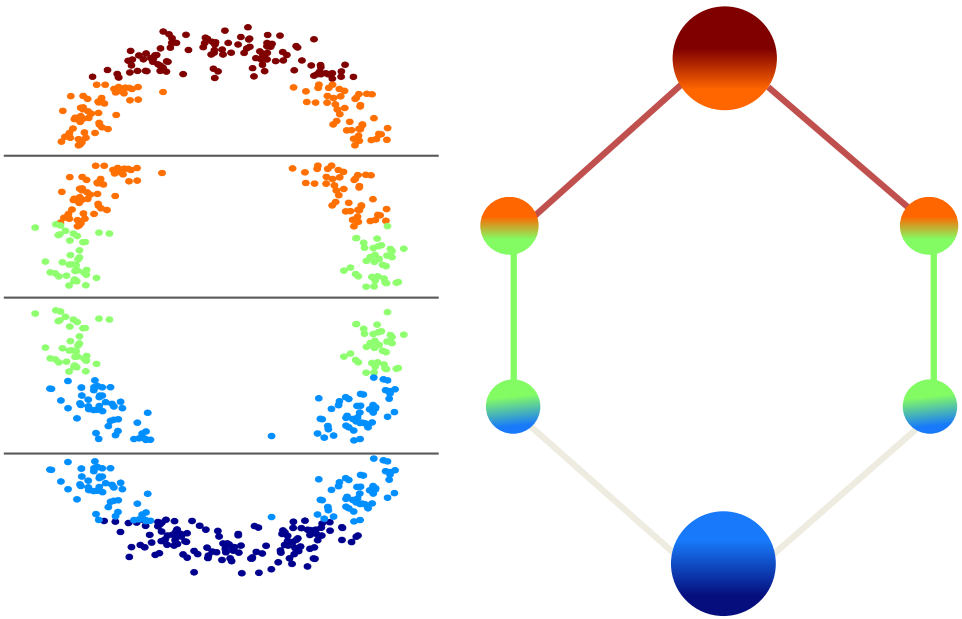


Nodes with data points in common are connected by edges to create a network

As the data was divided into overlapping data sets, a data point can be in multiple nodes

The network captures the underlying shape and behavior of the data

Creating Topological Networks



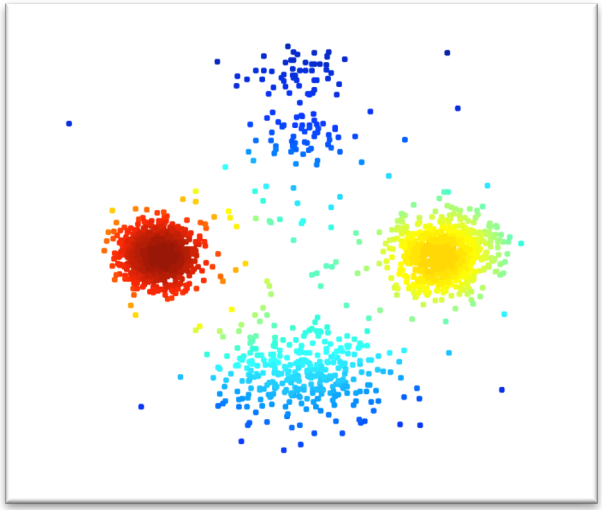
1. Apply a function (lens) to a data set

2. Create a visual network of nodes connected by edges using a measure of similarity.

Result:

A compressed summary of the data.

Creating Topological Networks



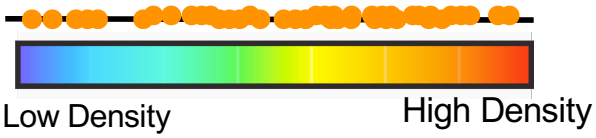
d : metric on data

f

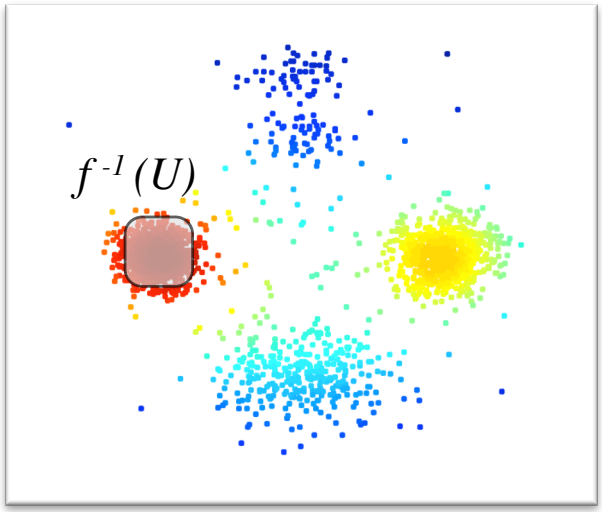
f is a function from the data to some other space (e.g. the real line)

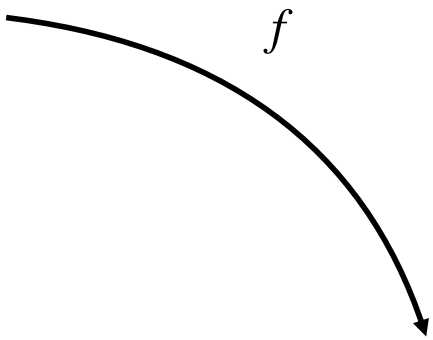
In this example, f is a density estimator at each point

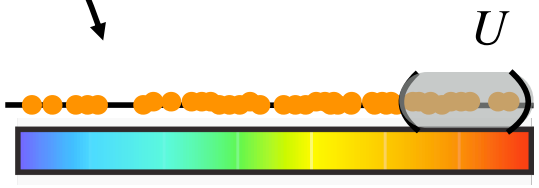
Data points are colored by a density estimator function



Creating Topological Networks



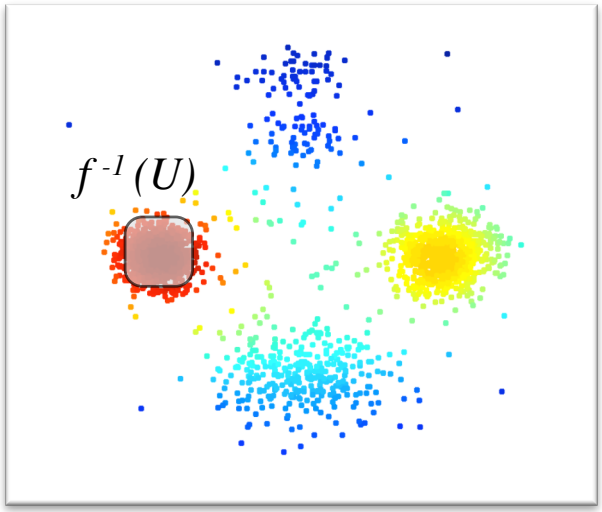




U defines a set of similar points in the image of f

$f^{-1}(U)$ is a set of data points that are similar in the image of f

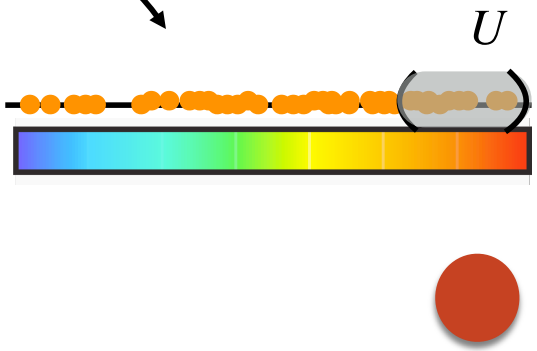
Creating Topological Networks



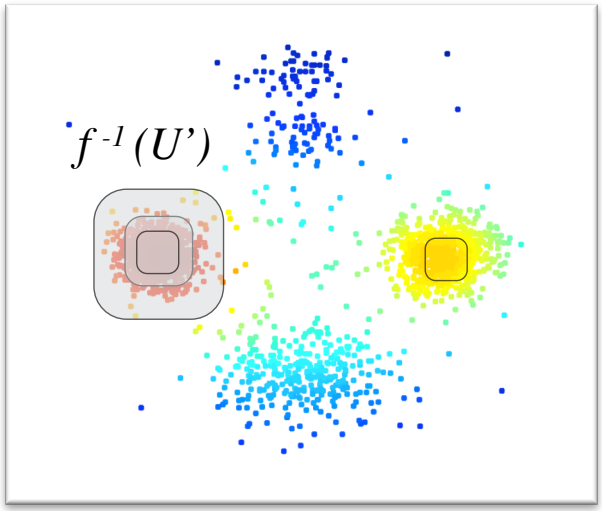
f

Using the metric, perform clustering to determine the sets of similar points in $f^{-1}(U)$

Represent each set of points similar in both function and metric as node



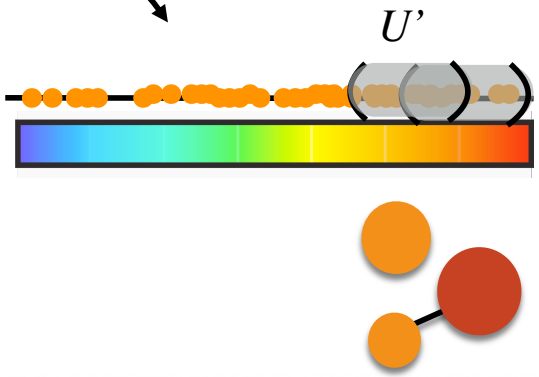
Creating Topological Networks



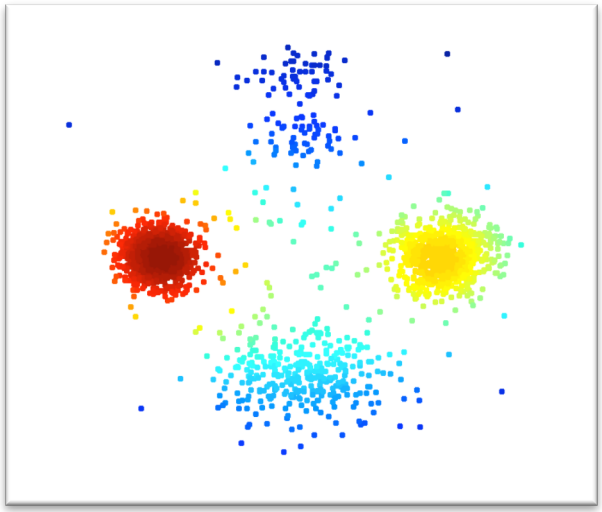
f

Repeat process with a different set of similar points in the image of the function

Edges between nodes indicate overlapping points. They capture the continuous nature of the data when viewed through the function

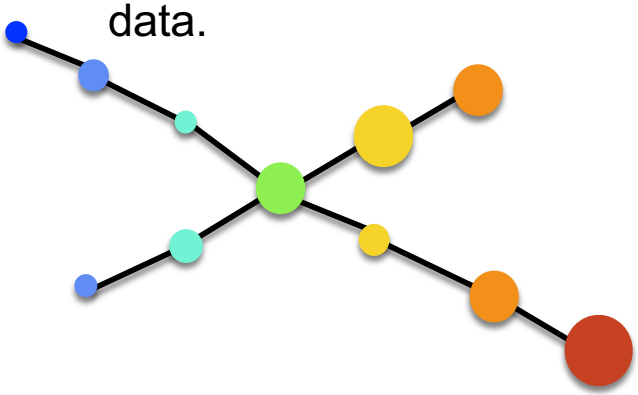


Creating Topological Networks



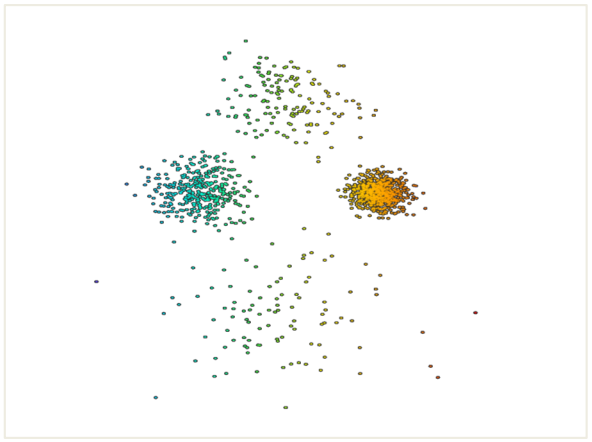
Nodes represent a set of points similar in both function and metric

The resulting graph is a geometric summary of the data.



Edges between nodes indicate overlapping points.

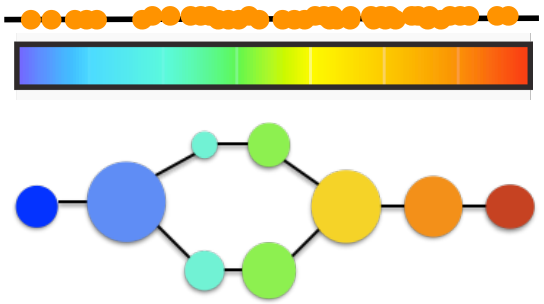
Creating Topological Networks



f

Different functions produce different summaries of the data.

In this example, f is now the projection of each point on the x-axis

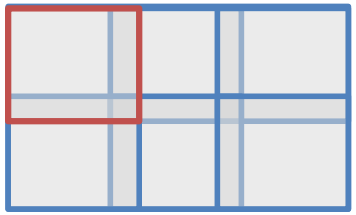


TDA Mapper Overview

1. Use the **Lens** to perform dimensionality reduction on the data

E.g. PCA, MDS, Neighborhood Lens, Entropy etc…

2. Use the **resolution** and **gain** to create an open cover (overlapping sections) on that low dimensional space

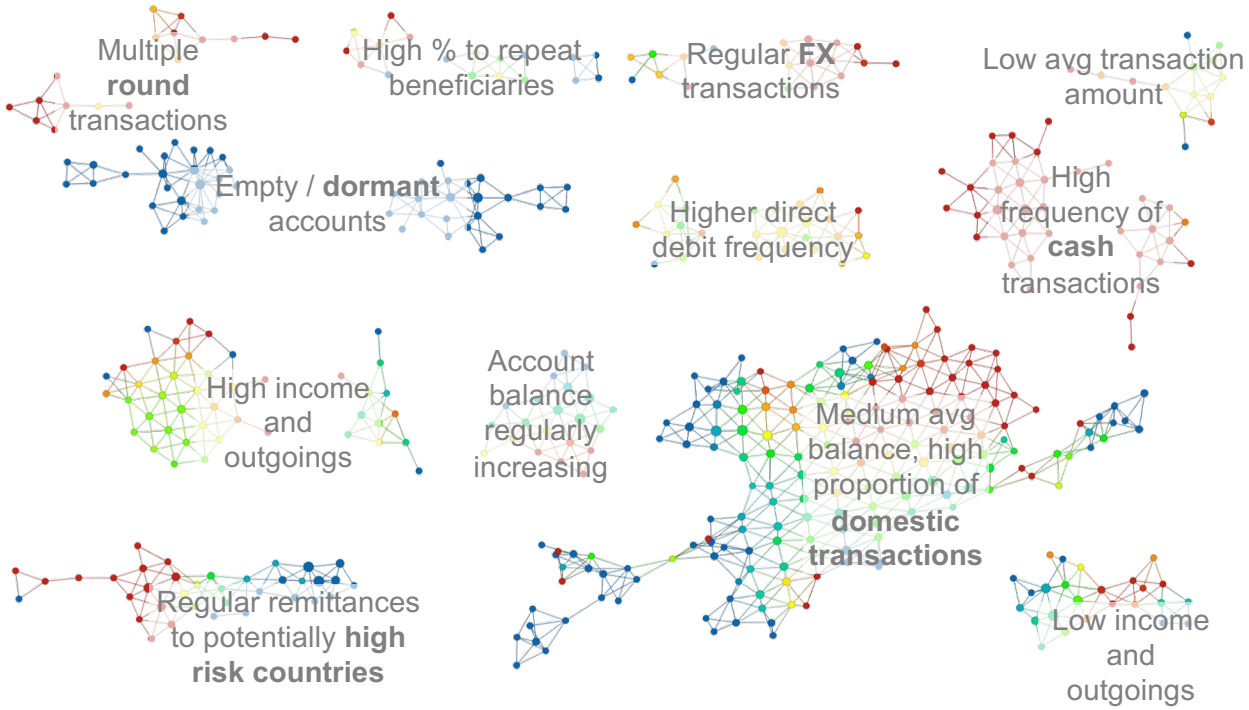


3. Use the **metric** (the measure of similarity) to cluster in the high dimensional space within each low dimensional section

E.g. haversine distance, Euclidean distance, Hamming distance etc..

4. Create a **network of similarity** - the clusters become **nodes**, and any shared points add in an **edge**

Assumed vs Actual Risk



Network of customers based on similarity of transactional behaviours

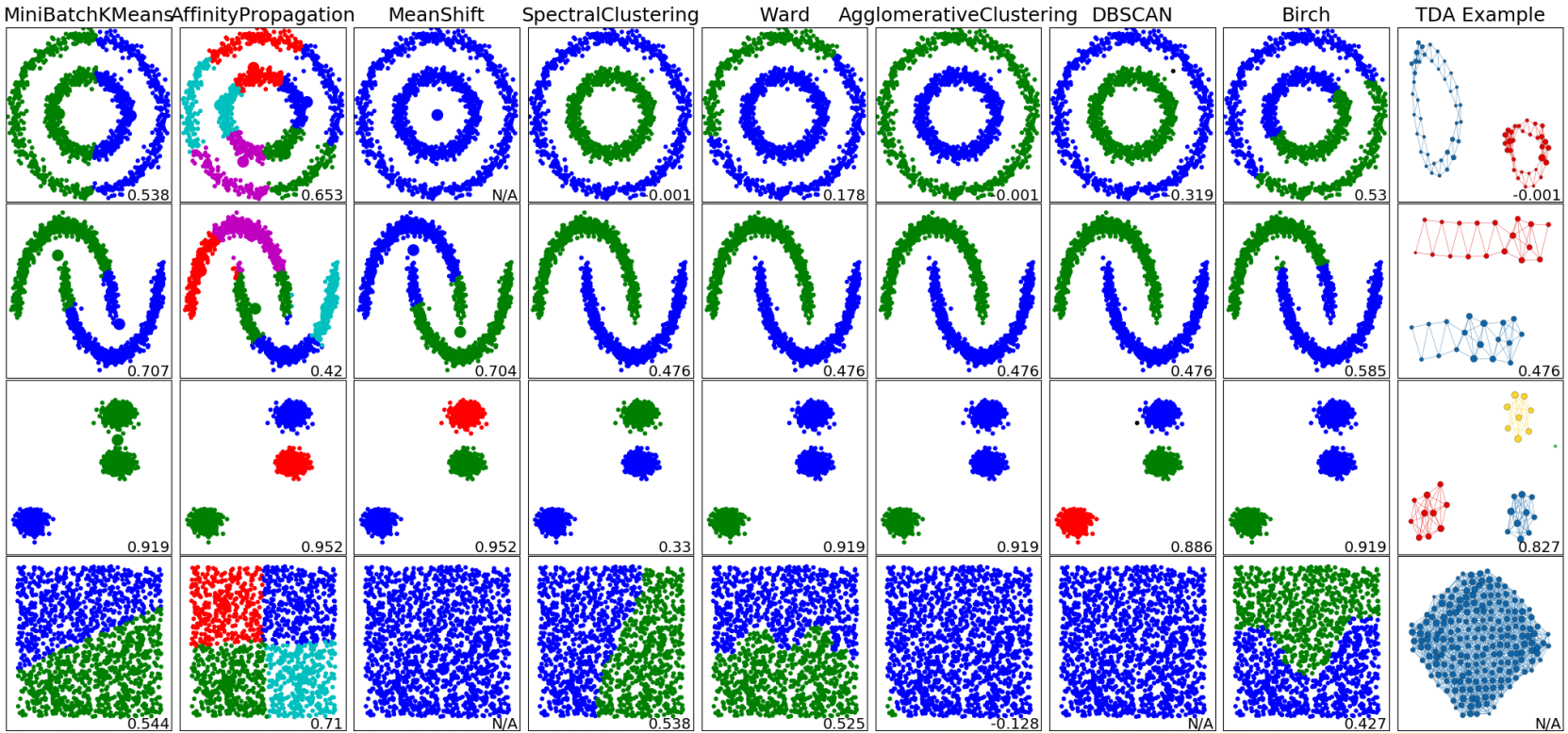
Node: Group of similar customers

Connection: Links two similar groups

Segments using TDA

- No need to specify the number of segments in advance.
- Represents continuous and cyclic phenomena much better than any form of clustering.
- No assumptions on the shape of the data.
- Label and unlabeled transaction information.
- TDA segments can be used with other models to improve performance.

TDA Benefits - Segmentation



Key Takeaways

1. Segmentation is the foundational element to improve **actual risk** modeling.

2. Segmentation can be integrated with existing systems to enhance the performance and operational efficiency of AML.

3. Data has shape and shape has meaning.

References

1. Gurjeet Singh, Facundo Memoli and Gunnar Carlsson (2007). *Topological Methods for the Analysis of High Dimensional Data Sets and 3D Object Recognition.* Eurographics Symposium on Point Based Graphics, European Association for Computer Graphics.
2. Gunnar Carlson (2009). *Topology and Data*. Amer. Math. Soc. 46

AyasdiAI was founded in 2008 by Gurjeet Sigh, Gunnar Carlsson and Harlan Sexton.

Thank you!

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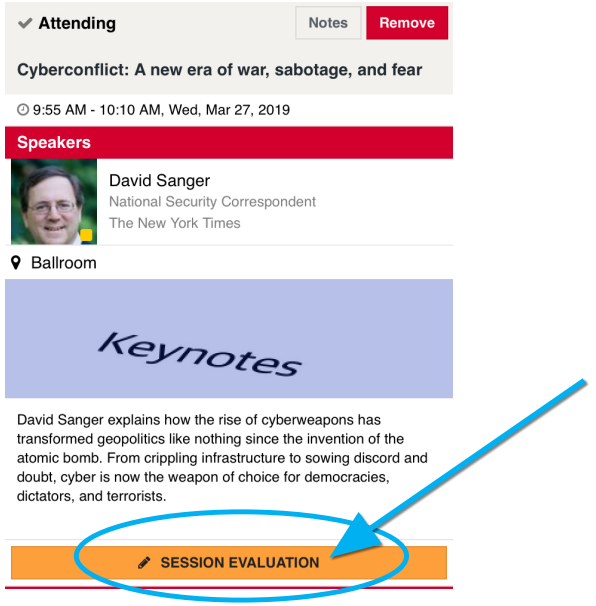

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