## 0.1 TODO List

### 0.1.1 Classic Dimensionality Reduction

1. Learn about the following:

    (a) PCA
    (b) MDS
    (c) isomap

2. Maybe need to implement some of them

3. Know the difference from a practical aspect

### 0.1.2 Clustering

1. Need to learn about the different approaches

    (a) Variational
    (b) Spectral
    (c) Hierarchical
    (d) Density thresholding
    (e) Mode seeking
    (f) Valley Seeking

2. Need to know the specific applications

3. Need to delve into one of them to see if possible for improvement

## 0.2 Clustering

Point cloud (with coordinates)

Distance / dissimilarity matrix

Note: this seems to be a different idea of the distance function used in TDA, which is called lens in that context.

Barcode →merge tree →dendrogram

### 0.2.1 Mode Seeking Paradigm

Problems:

1. Noisy estimator

2. Neighborhood graph

Solutions:

1. Be proactive: smooth

2. Be reactive: merge clusters after clustering
   This leads to "topological persistence"

Persistence for Model Seeking:
Probability density function $f$

- Nested family (filtration) of of inverse images, or superlevel-sets $f^{-1}([t, +\infty))$ for $t$ from $+\infty$ to $-\infty$

- Track evolution of "topology"

## 0.3   Topological Persistence

Persistence diagram shows the "persistence" of the topological features. Slight perturbation causes slight difference in persistence diagrams.

## 0.4   Mapper