

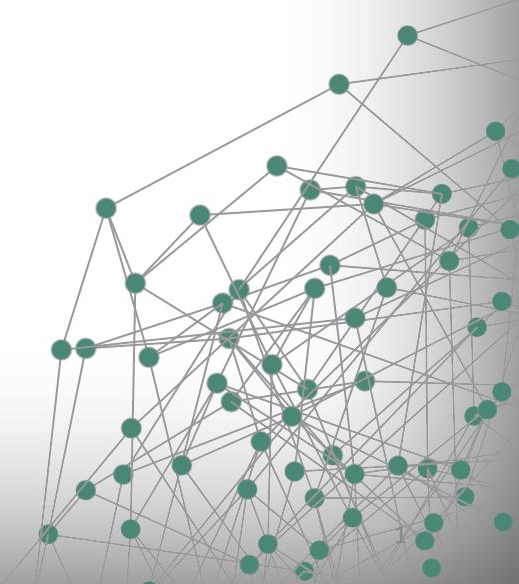


# Multidimensional Scaling

another method for dimension reduction

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# Multidimensional Scaling

- Graph encodes nominal relationships
  - Length of edge irrelevant
- How to embed quantitative relationships?
  - Length of edge indicates strength of relationship
- Metric MDS
  - Dimensionality reduction projection of data points from high dimensional space that tries to preserve distances

main idea



# Distances Between US Cities (mi.)

	Boston	NYC	DC	Miami	Chicago	Seattle	SF	LA	Denver
Boston									
NYC	206								
DC	429	244							
Miami	1,504	1,308	1,075						
Chicago	963	803	671	1,329					
Seattle	2,976	2,815	2,684	3,273	2,013				
SF	3,095	2,934	2,799	3,053	2,142	808			
LA	2,979	2,786	2,631	2,687	2,054	1,131	379		
Denver	1,949	1,771	1,616	2,037	996	1,307	1,235	1,059	



# Multidimensional Scaling

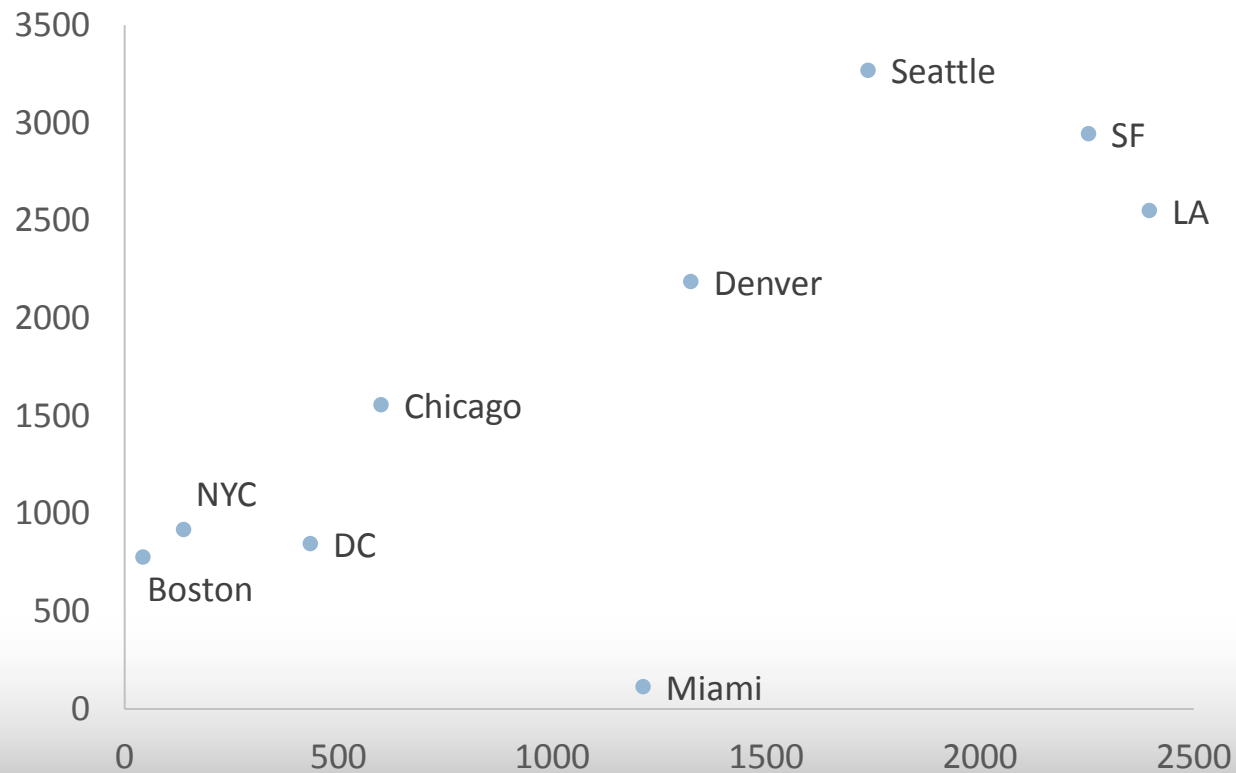
- Given distances  $d_{ij}$  between datapoints  $i$  and  $j$
- Find positions  $(x_i, y_i)$
- That minimize a stress function

$$\sum_{j=1..N-1} \sum_{i=i+1..j} (\|(x_i, y_i) - (x_j, y_j)\| - d_{ij})^2$$

- Can solve with any number of non-linear optimization methods



# Results





# MDS Uses

- Visualization of affinities
  - areas of collaboration based on co-authorship
  - number of attributes in common
- HCI
  - layouts based on task affinities
- Marketing
  - perceptual maps provide a landscape of products based on attributes

