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Subspace Projection Methods for Large Scale Image Data Analysis

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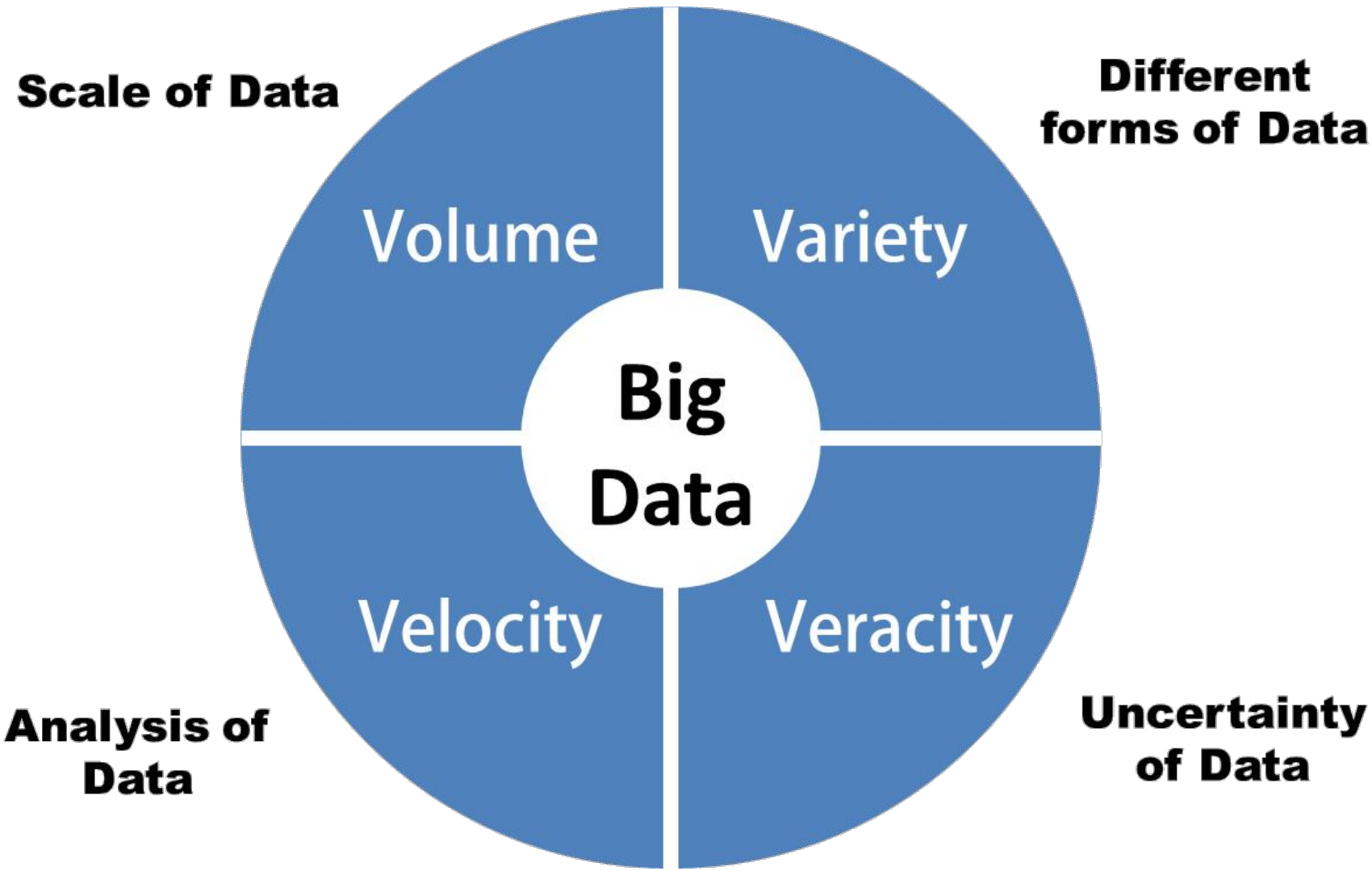
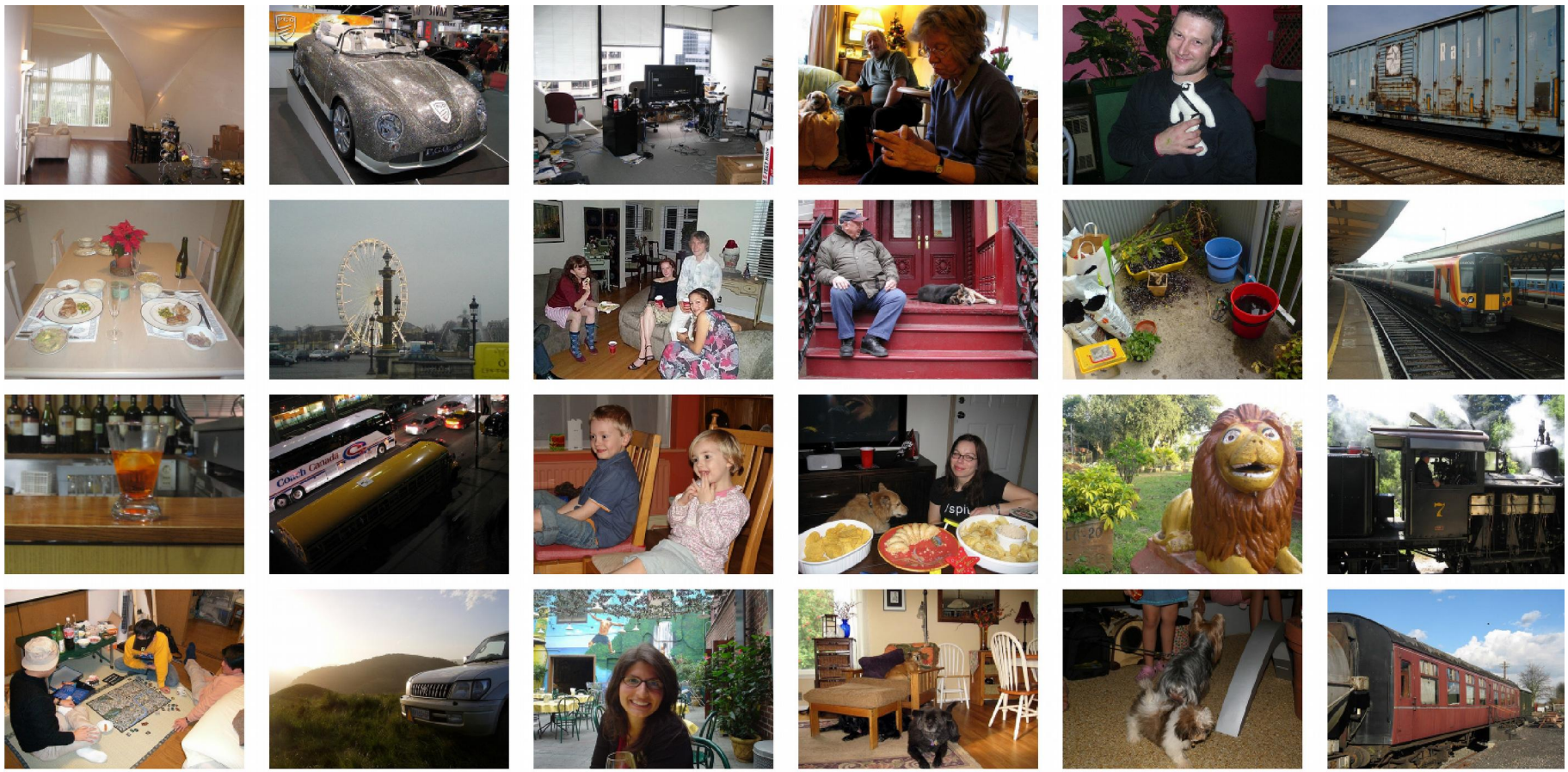
Outline

- Introduction
- Big Data & Sub-space analysis
- Visual data
- Semantic analysis & attributes
- Intrinsic dimensionality estimation
- Information theoretic measure of projection
- Sub-space projection methods
- Analysis and Conclusions

Big Data


Scale of Data
Different forms of Data
Volume
Variety
Big Data
Velocity
Veracity
Analysis of Data
Uncertainty of Data

Visual Data

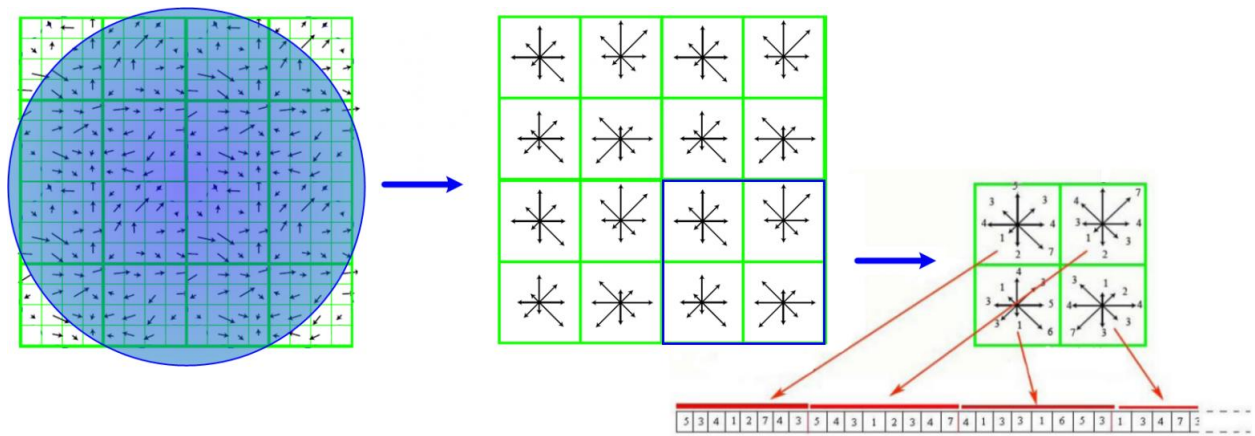


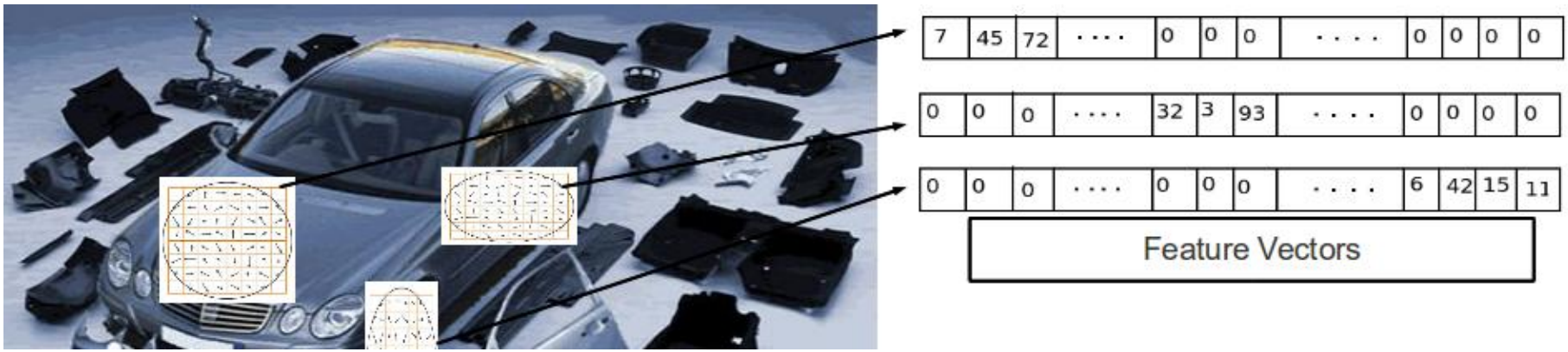
PASCAL Visual Object Classification challenge dataset

Caltech101 Dataset

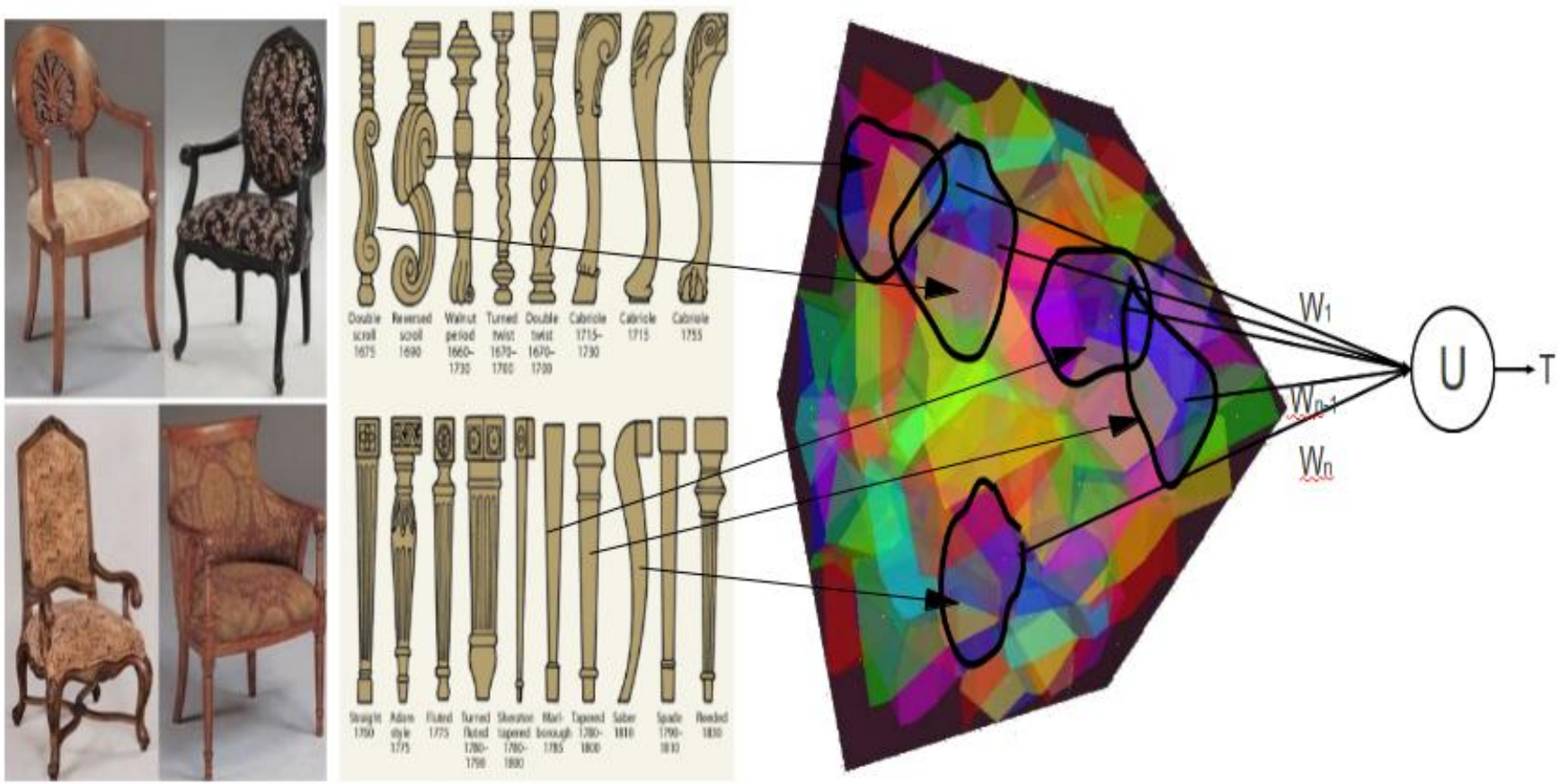
Intra-category appearance variation

Visual Feature & Category parts

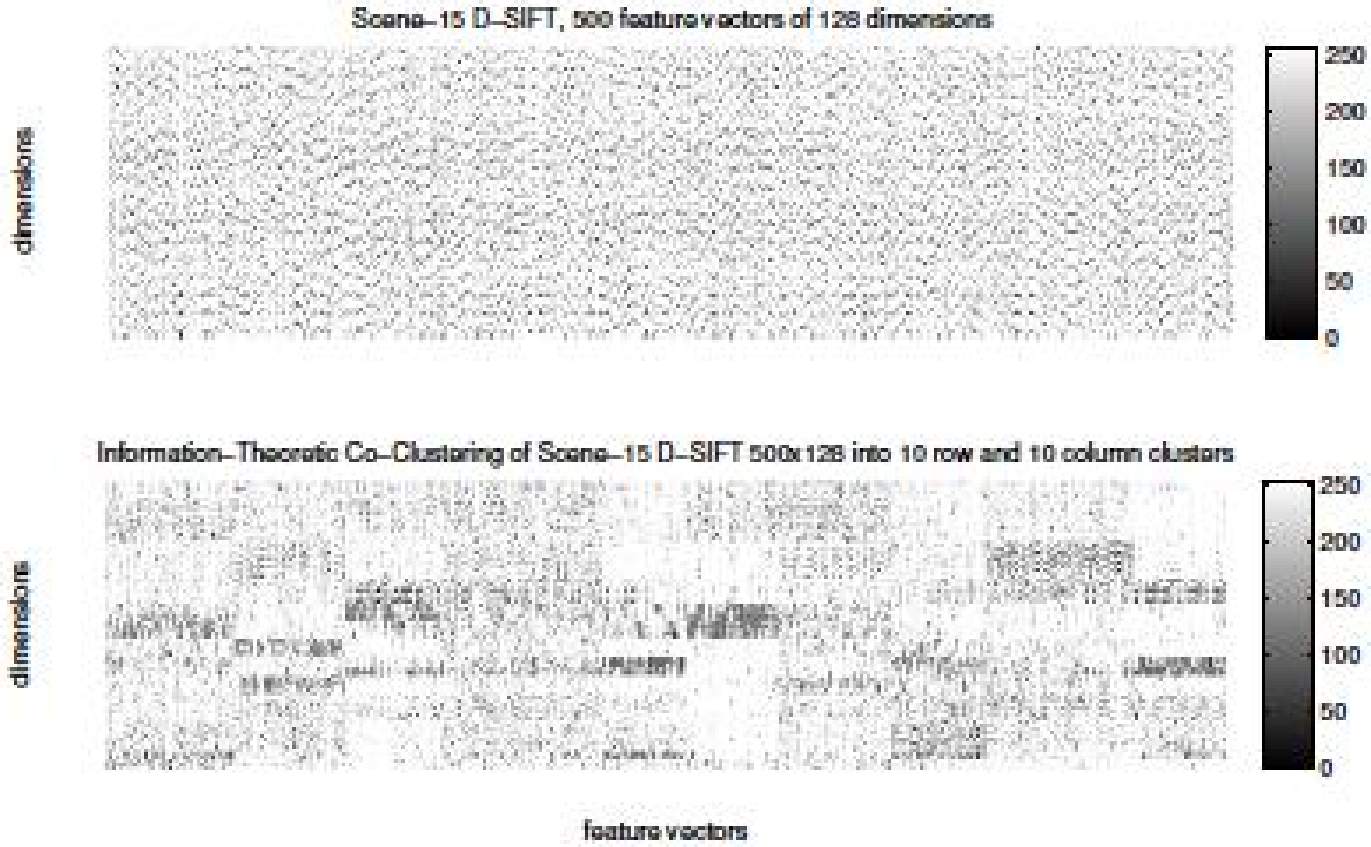




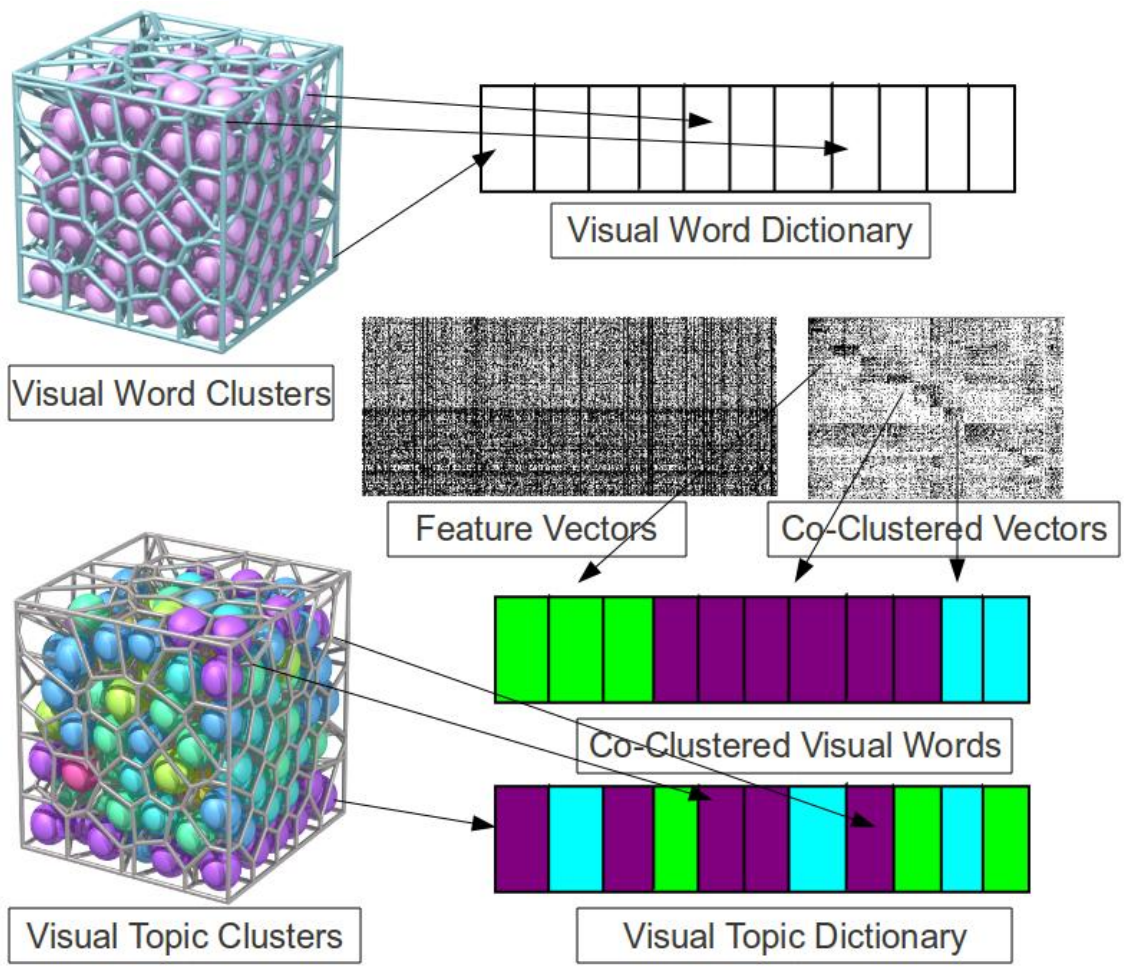
Project semantically equivalent parts



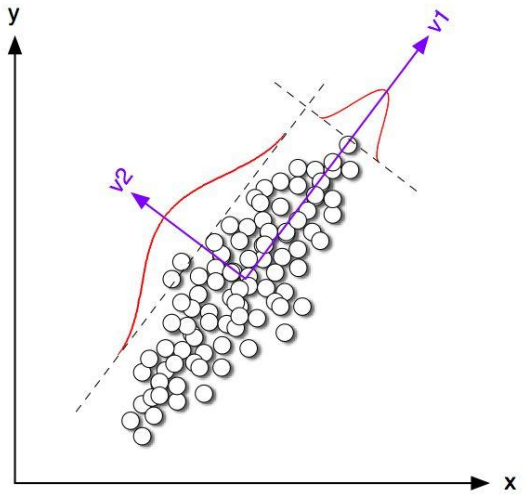
Co-clustering feature descriptors

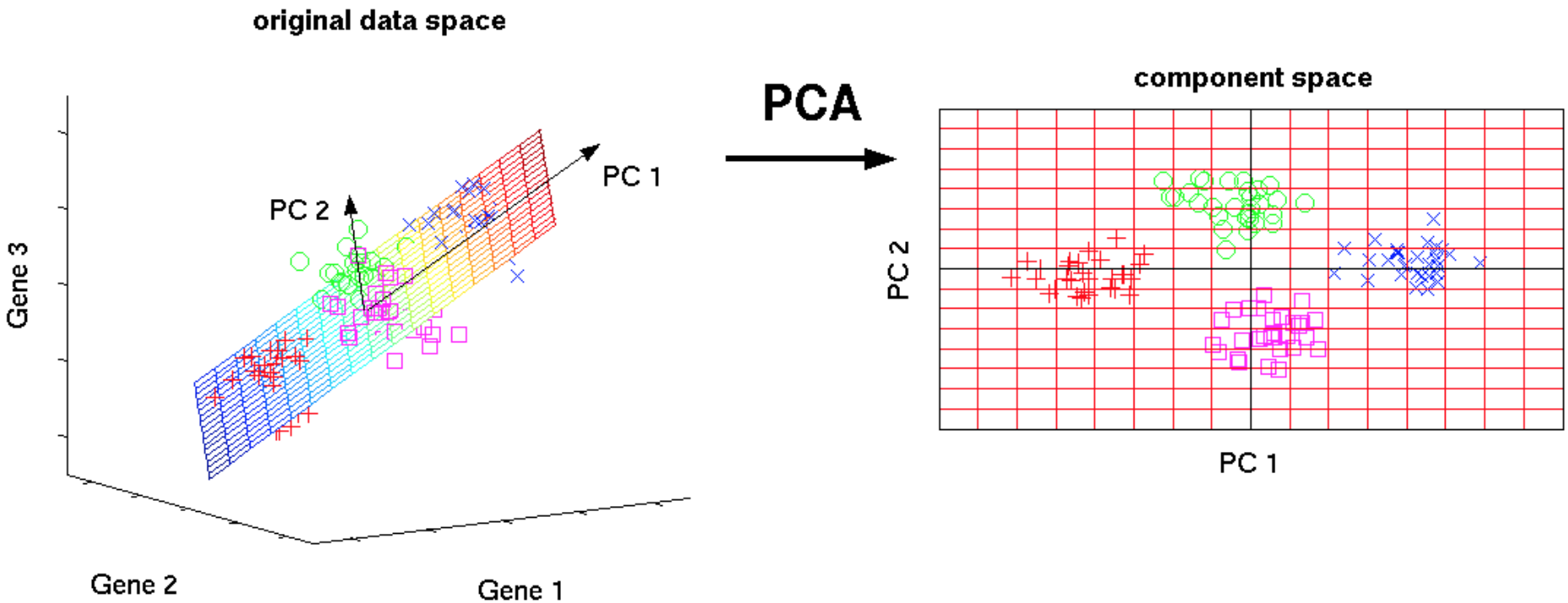


Group semantically equivalent feature space regions

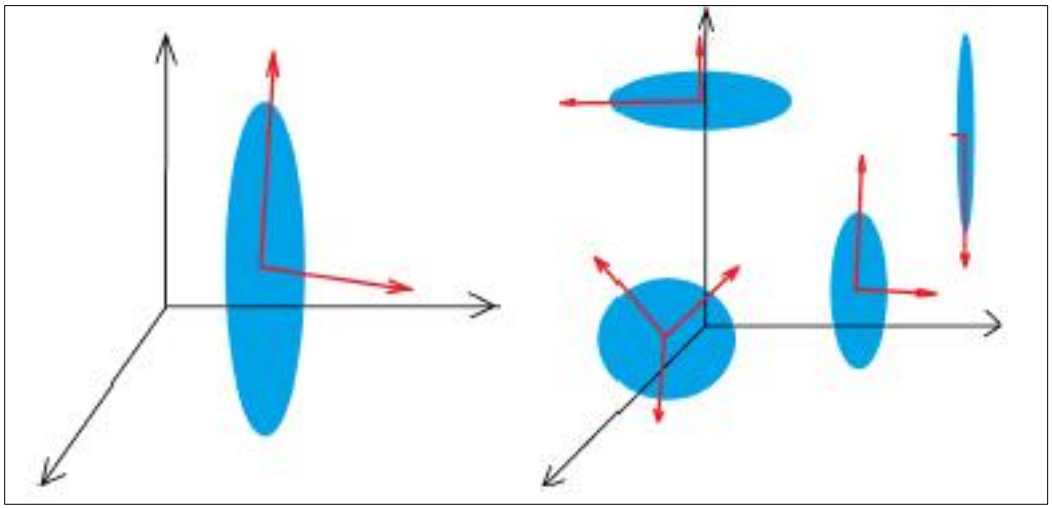


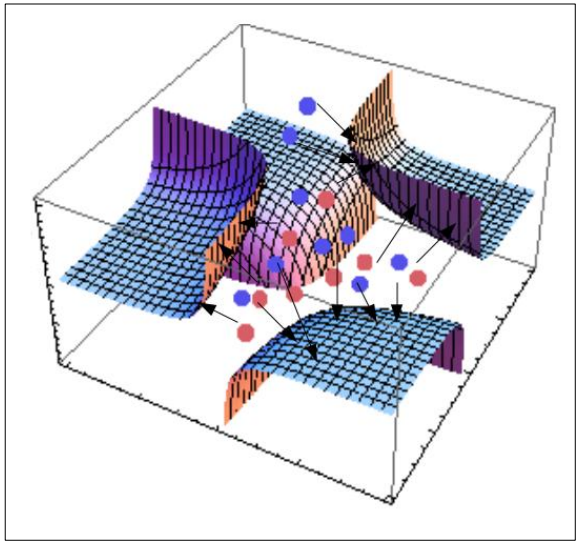
Principal Component Analysis



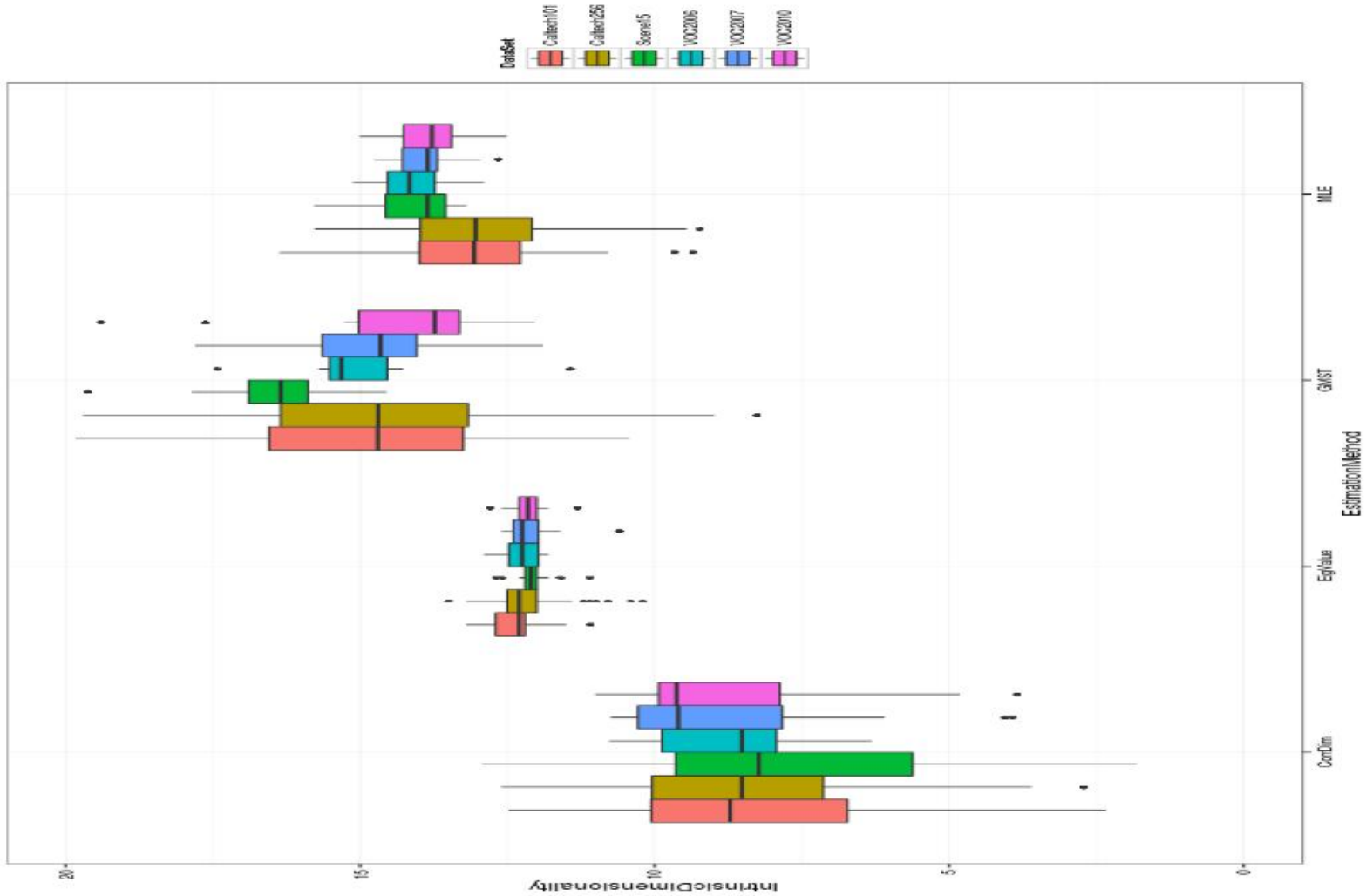


Project onto multiple sub-spaces



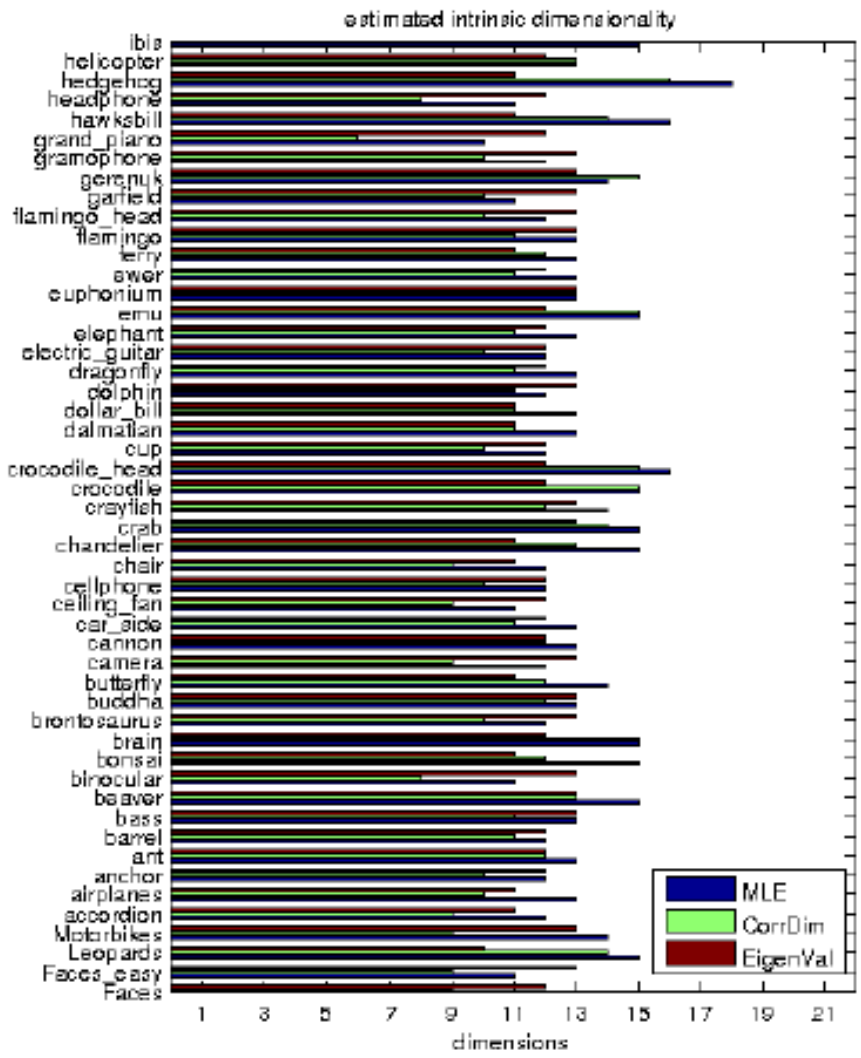


Intrinsic Dimensionality

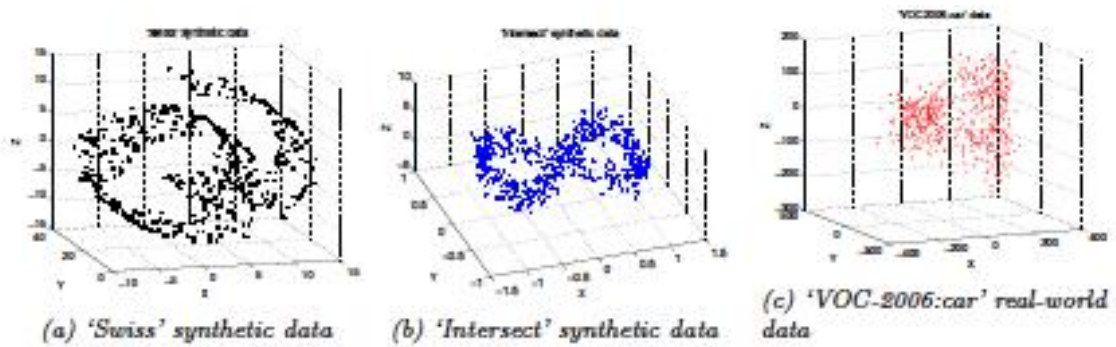


Intrinsic dimensionality was much lower than typically assumed in literature

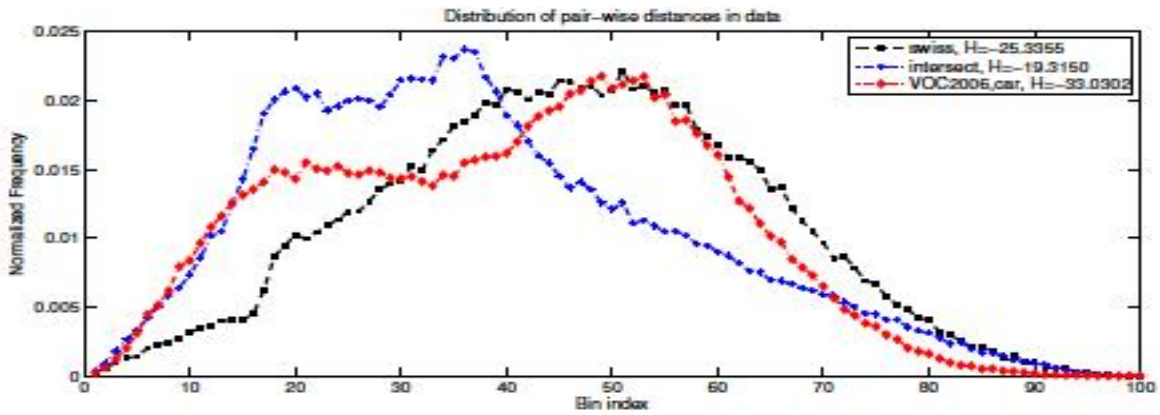
Intrinsic dimensionality of different visual categories



Measure information in embedded space



(a) 'Swiss' synthetic data (b) 'Intersect' synthetic data (c) 'VOC-2006:car' real-world data



Sub-space projection methods

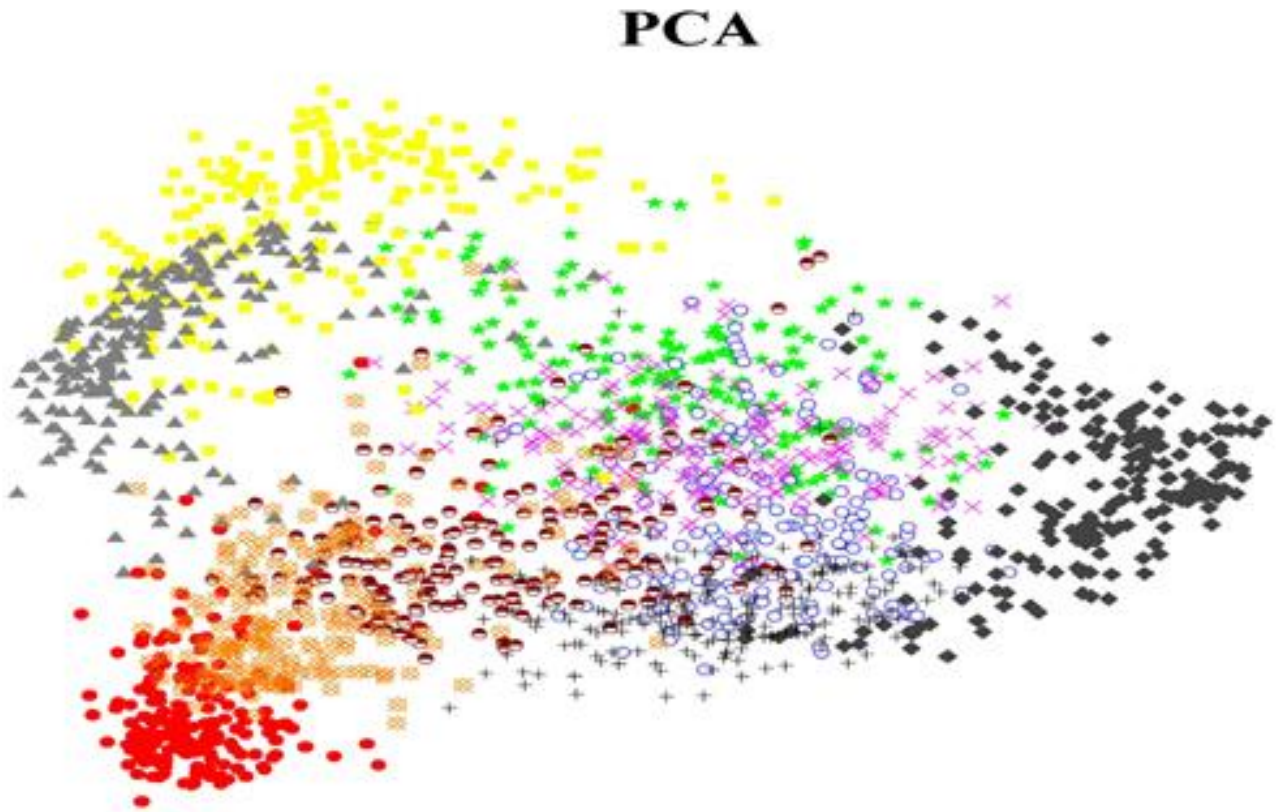
Global Methods

- Principal Components
- Multi-Dimensional Scaling
- Stochastic Proximity Embedding
- Isomap
- Diffusion Maps

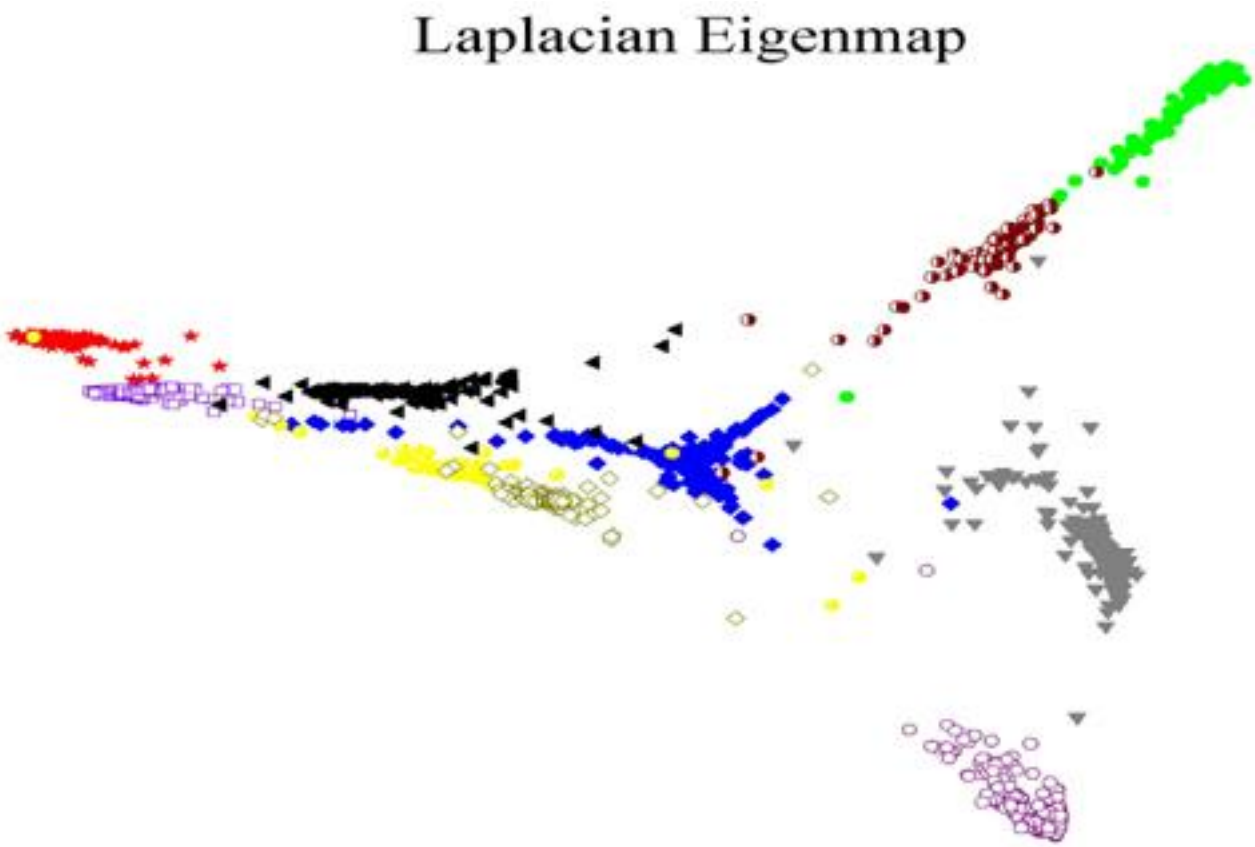
Local Methods

- Locally Linear Embedding
- Locality Preserving Projection
- Neighbourhood Preserving Projection
- Landmark Isomap
- t-Stochastic Neighbourhood Embedding

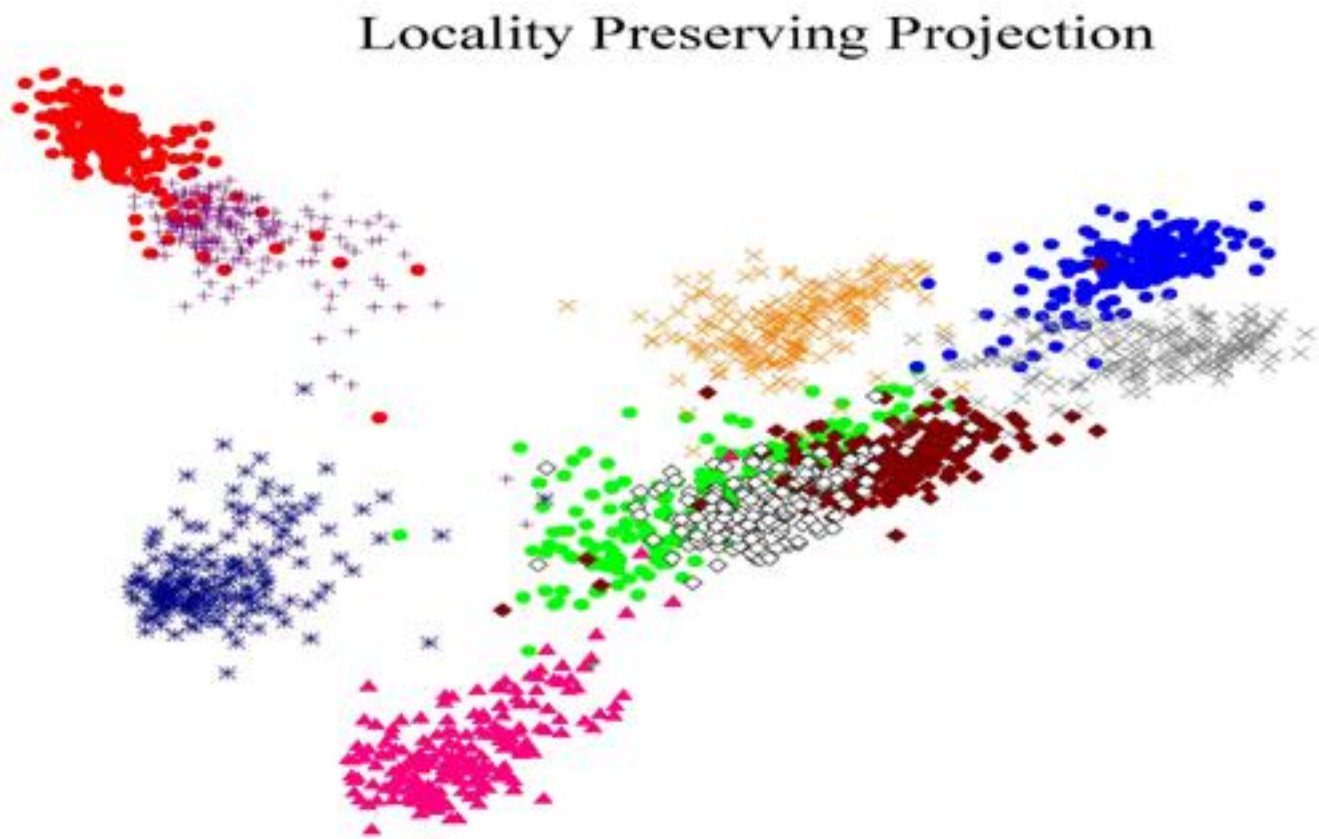
Visual Comparison 1 of 3



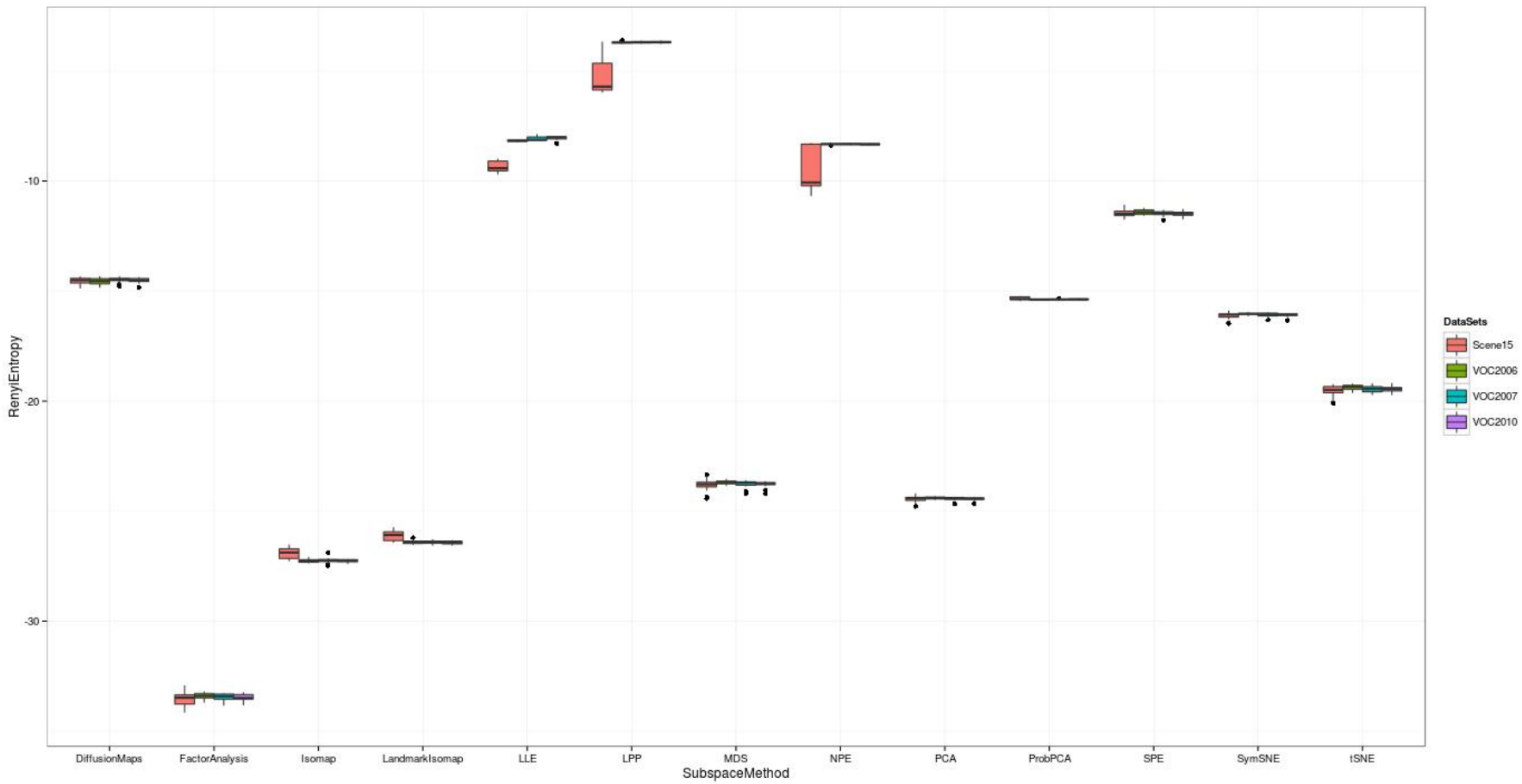
Visual Comparison 2 of 3



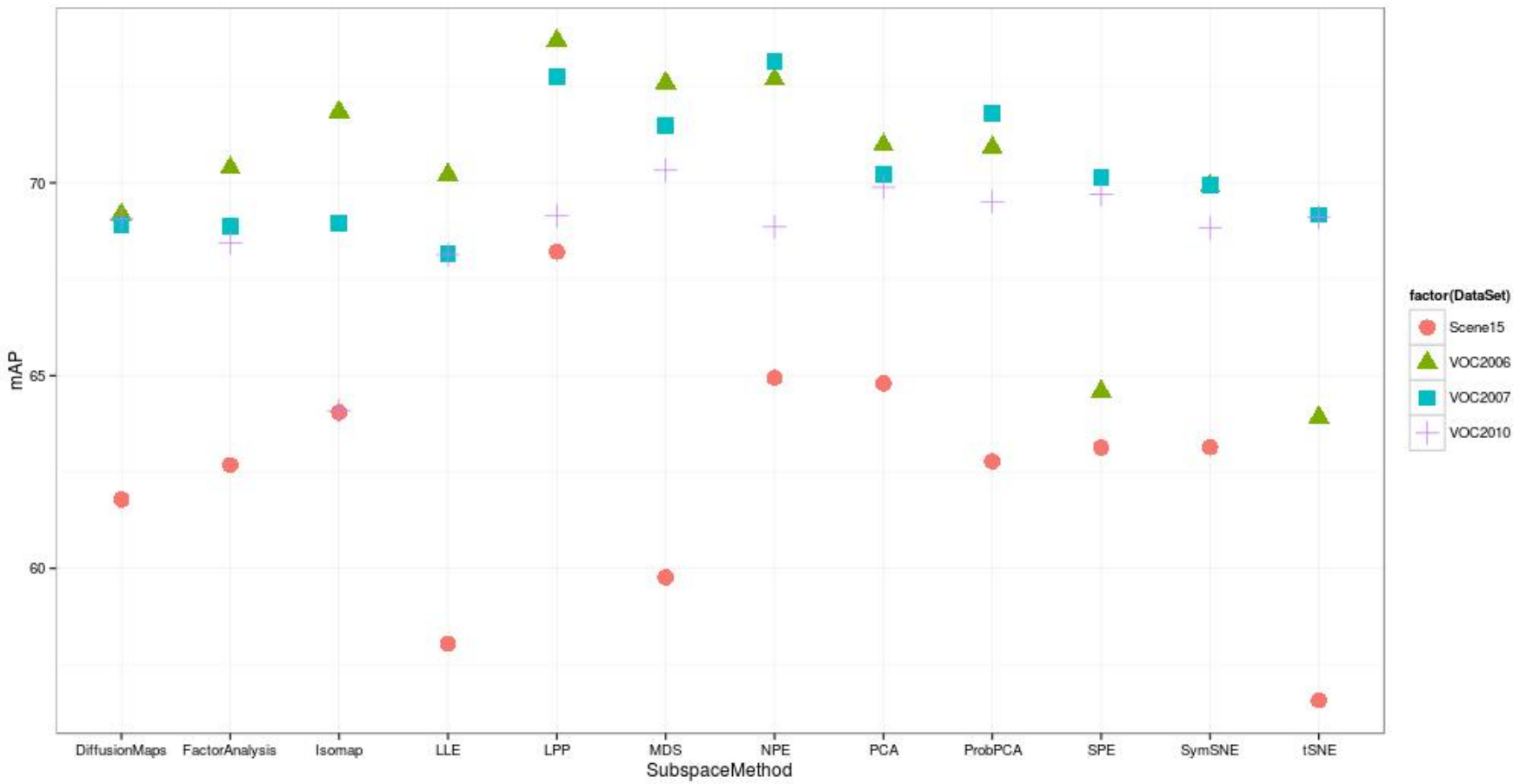
Visual Comparison 3 of 3



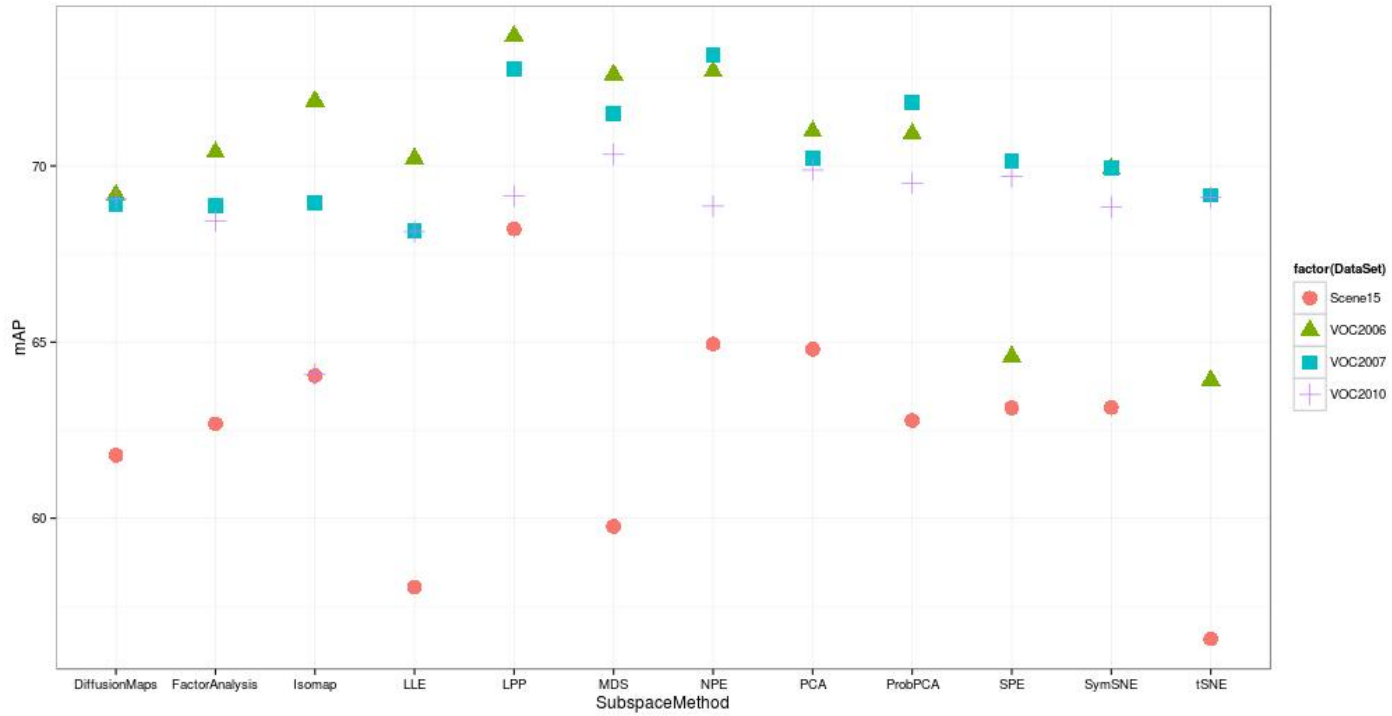
Renyi entropy based comparison

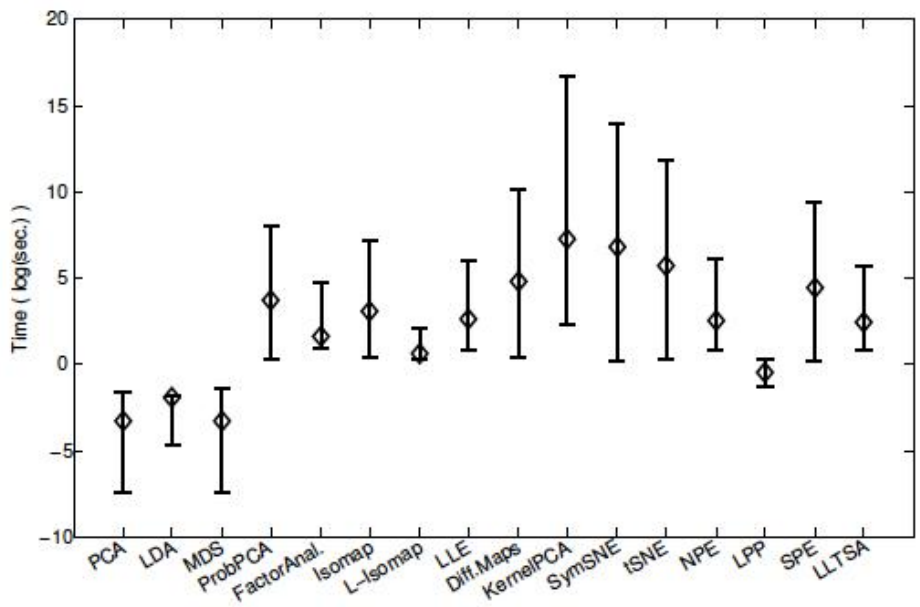


Classification performance based comparison



Processing time based com





Summary

- Estimated intrinsic dimensionality was in the neighborhood of 14 of the 128-dimensional descriptor.
- The performance of Locality Preserving Projection in comparison to other embedding methods accentuates the importance of modelling structure in local distributions.

Future Work

- Extend work on images to multi-media data
- Implement sub-space projection on Map-Reduce