Projet 3A - Extracting Insights From NBA Data Using Topology

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Gustavo Castro
Henrique Gasparini Fiuza do Nascimento

March 16, 2017

École Polytechnique

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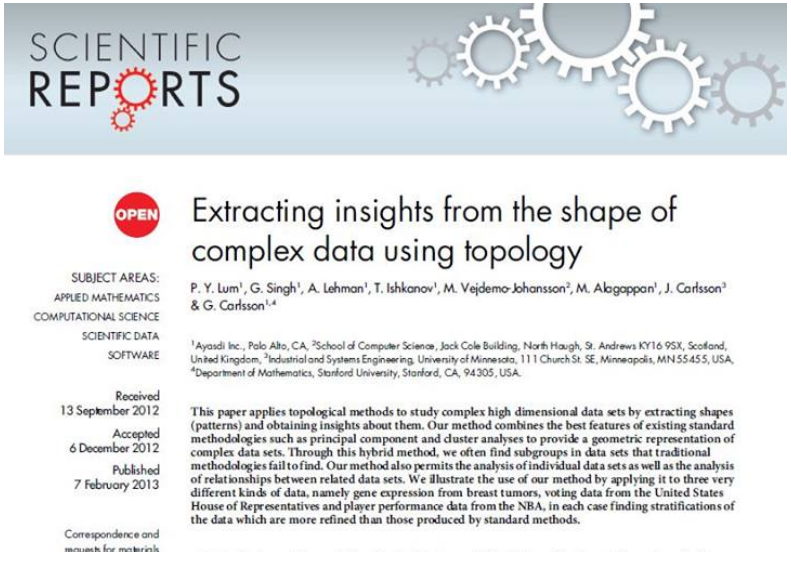
Contextualizing

- Paper published by M. Alagappan in 2013



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Extracting insights from the shape of complex data using topology

SUBJECT AREAS:
APPLIED MATHEMATICS
COMPUTATIONAL SCIENCE
SCIENTIFIC DATA
SOFTWARE

P. Y. Lum[1], G. Singh[1], A. Lehman[1], T. Ishkanov[1], M. Vejdemo-Johansson[2], M. Alagappan[1], J. Carlsson[3] & G. Carlsson[1,4]

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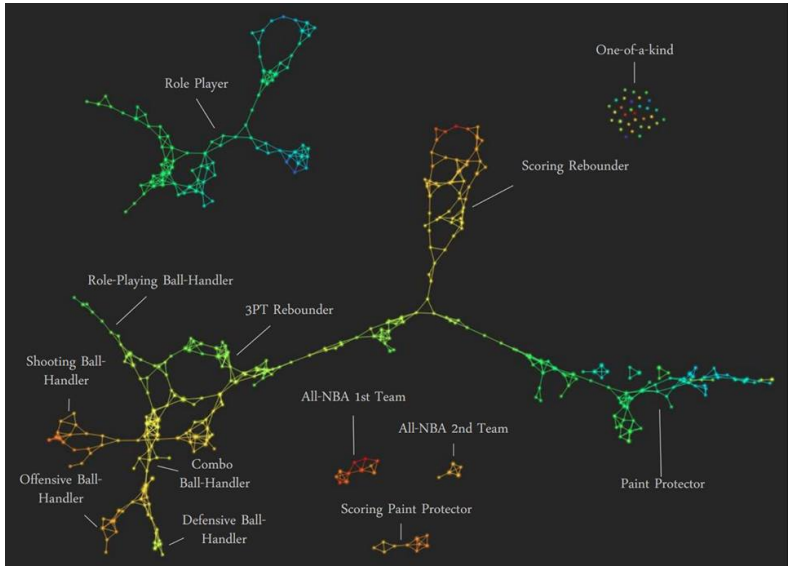

[M. Alagappan, 2012]

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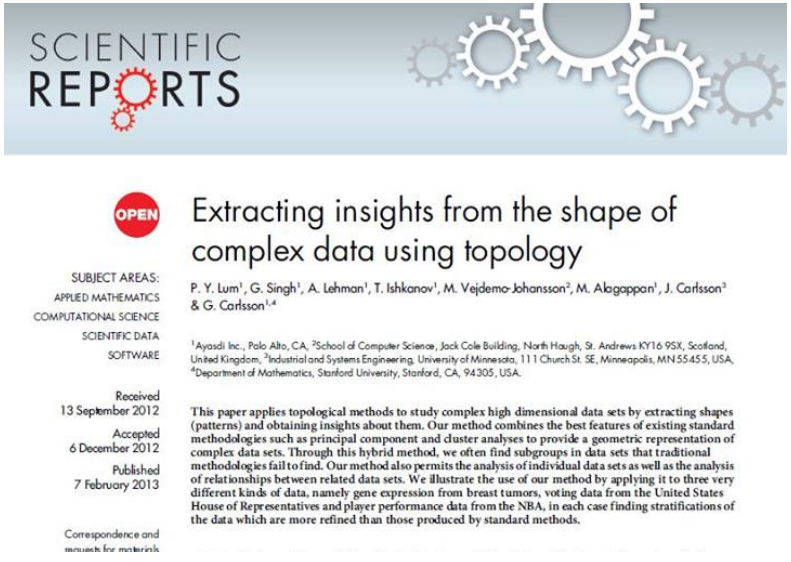
- Paper published by M. Alagappan in 2013
  - Method Mapper applied to NBA players of 2010-2011 season



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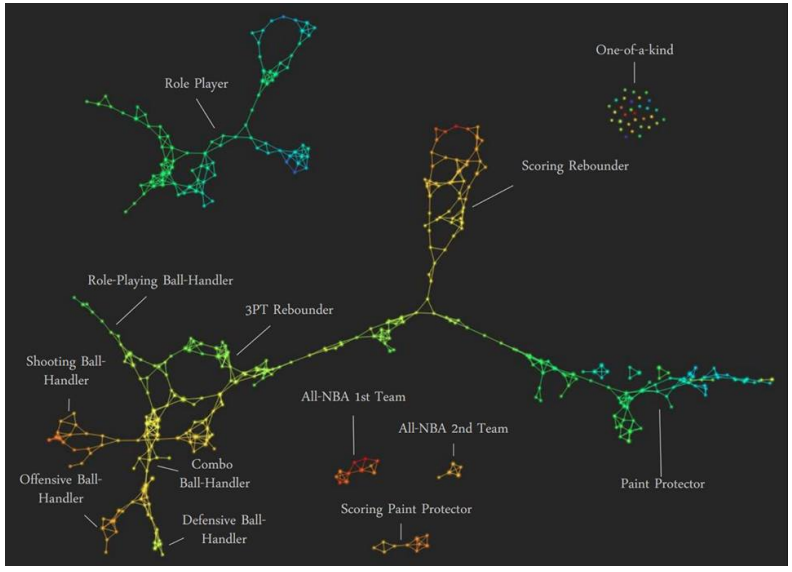
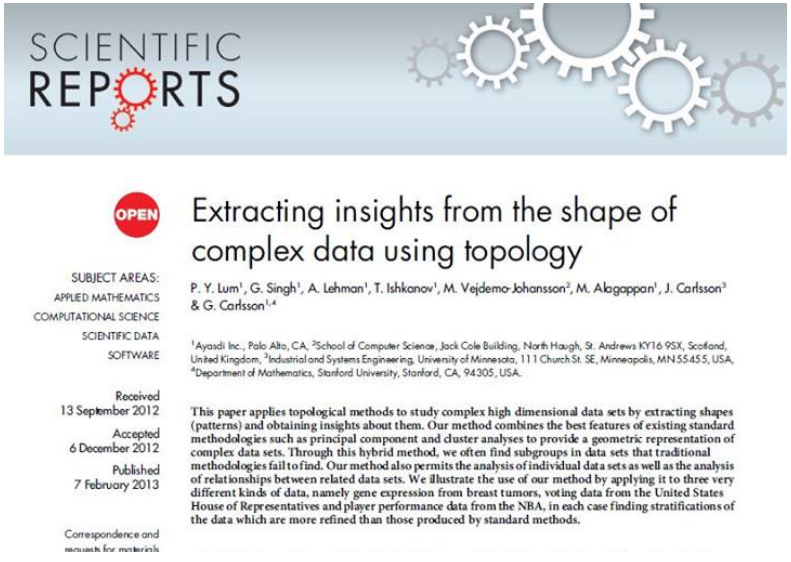


[M. Alagappan, 2012]

Contextualizing

- Paper published by M. Alagappan in 2013
  - Method Mapper applied to NBA players of 2010-2011 season
  - Lead to a different classification of playing styles



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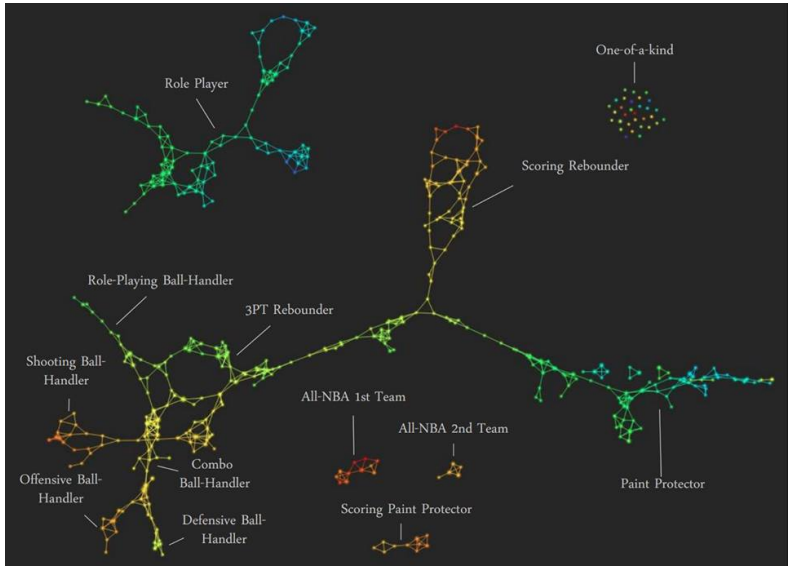
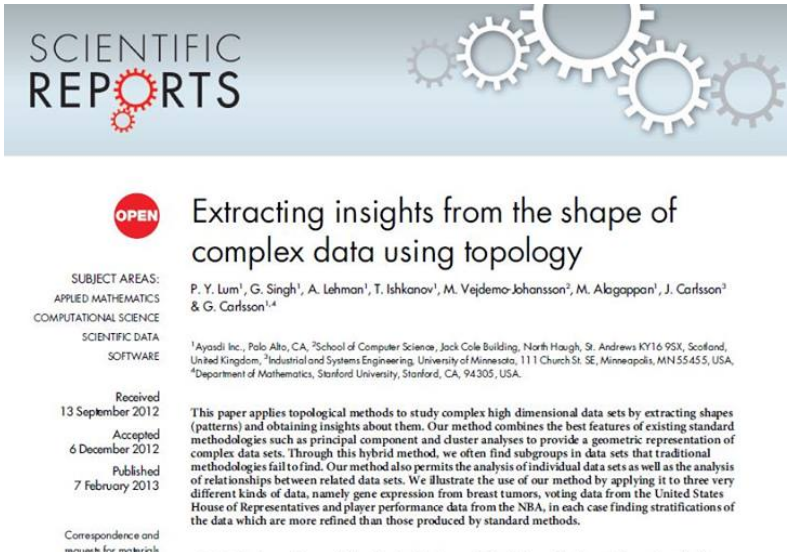


[M. Alagappan, 2012]

Our goals

- Analyse data using classical methods of clustering



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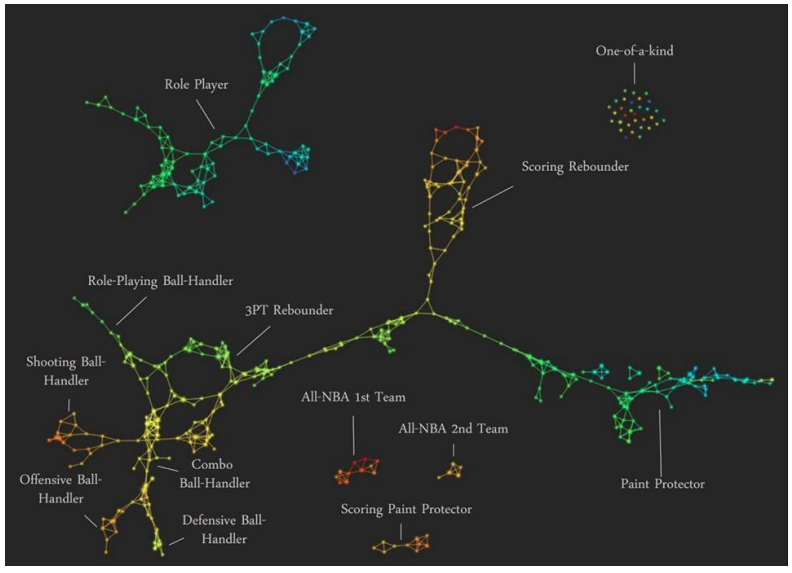

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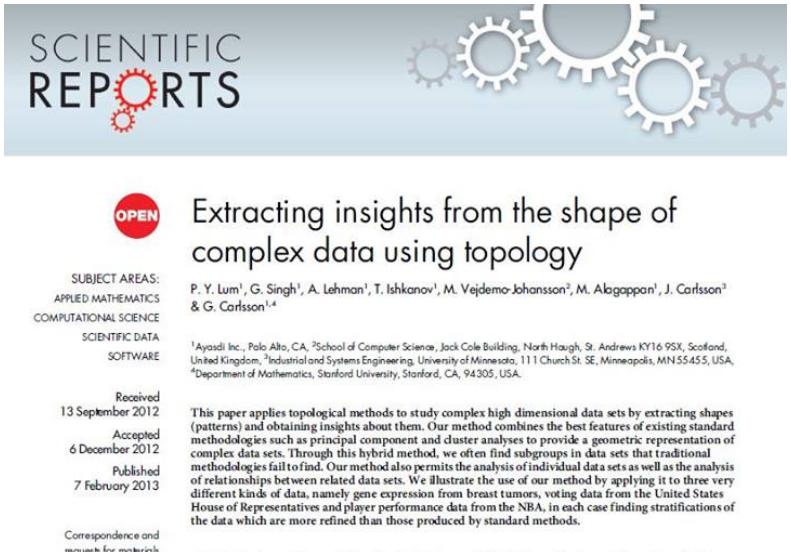
- Analyse data using classical methods of clustering
- Use Mapper algorithm to NBA's last season



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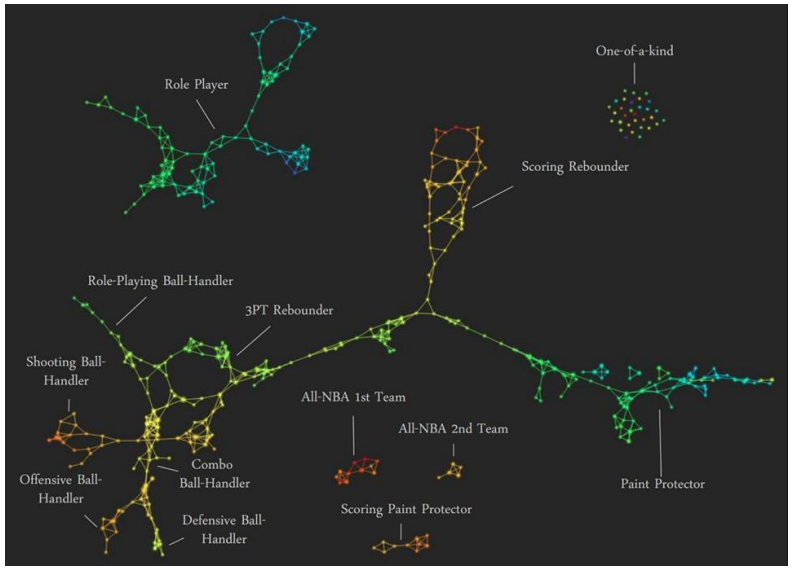
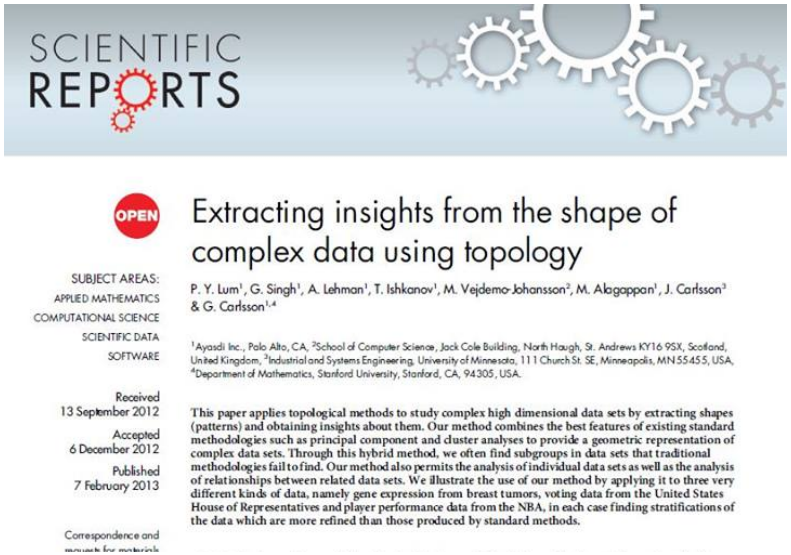


Our goals

- Analyse data using classical methods of clustering
- Use Mapper algorithm to NBA's last season
- Perform a similar analysis that Alagapan did



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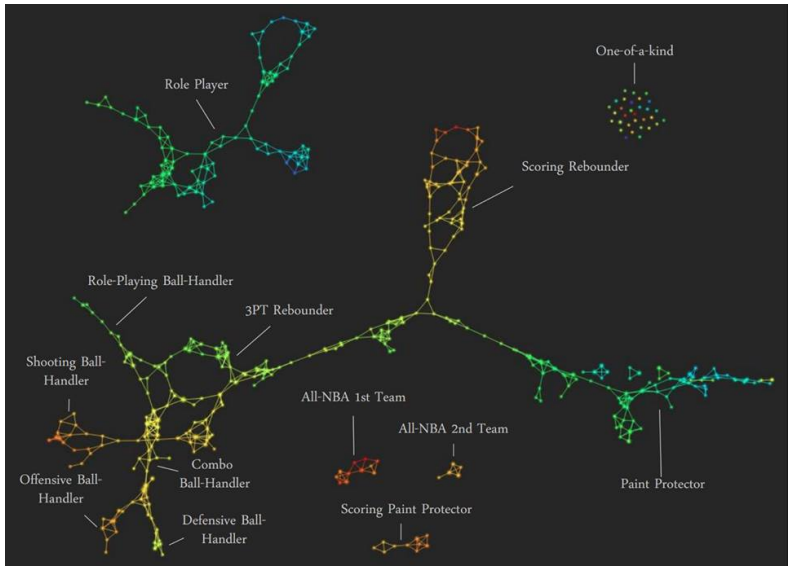
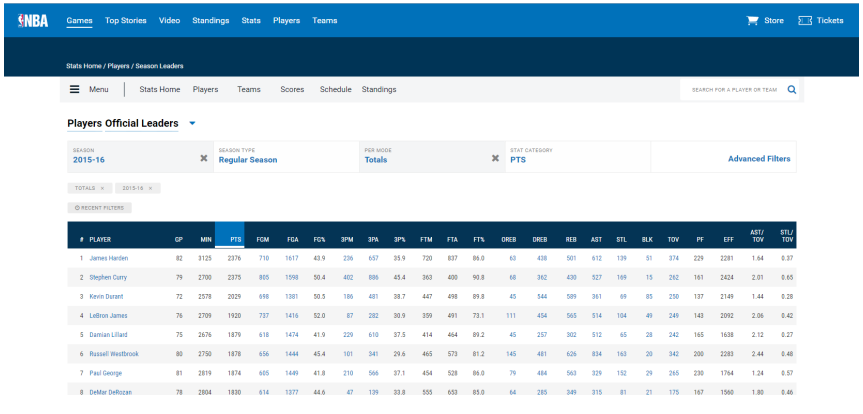


Extracting the data

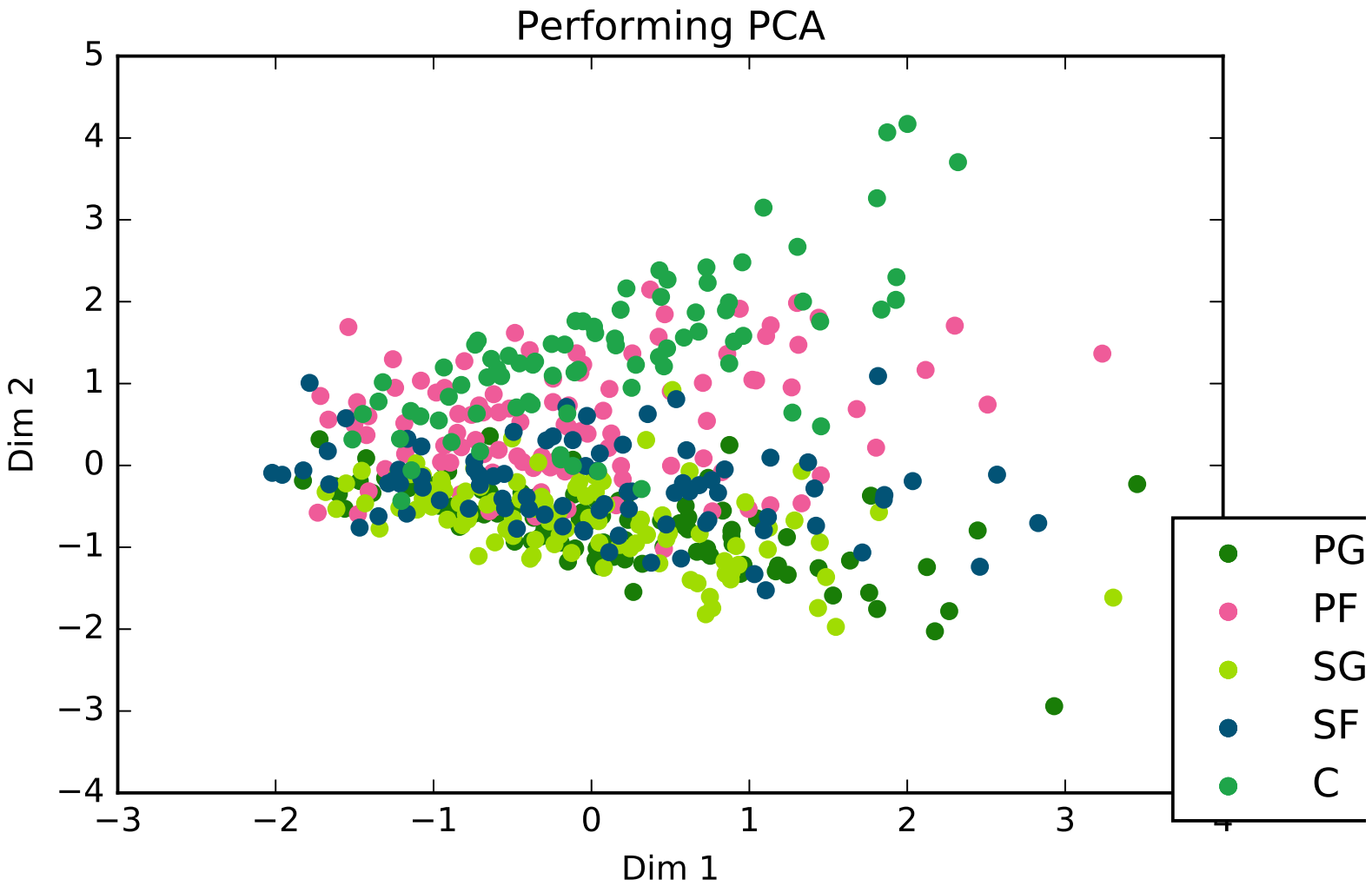
Extracting the data

- NBA official website
  - Data per Game (points per game, Blocks per game...)
  - 2015-2016 season
- ESPN website (obtain player's positions)

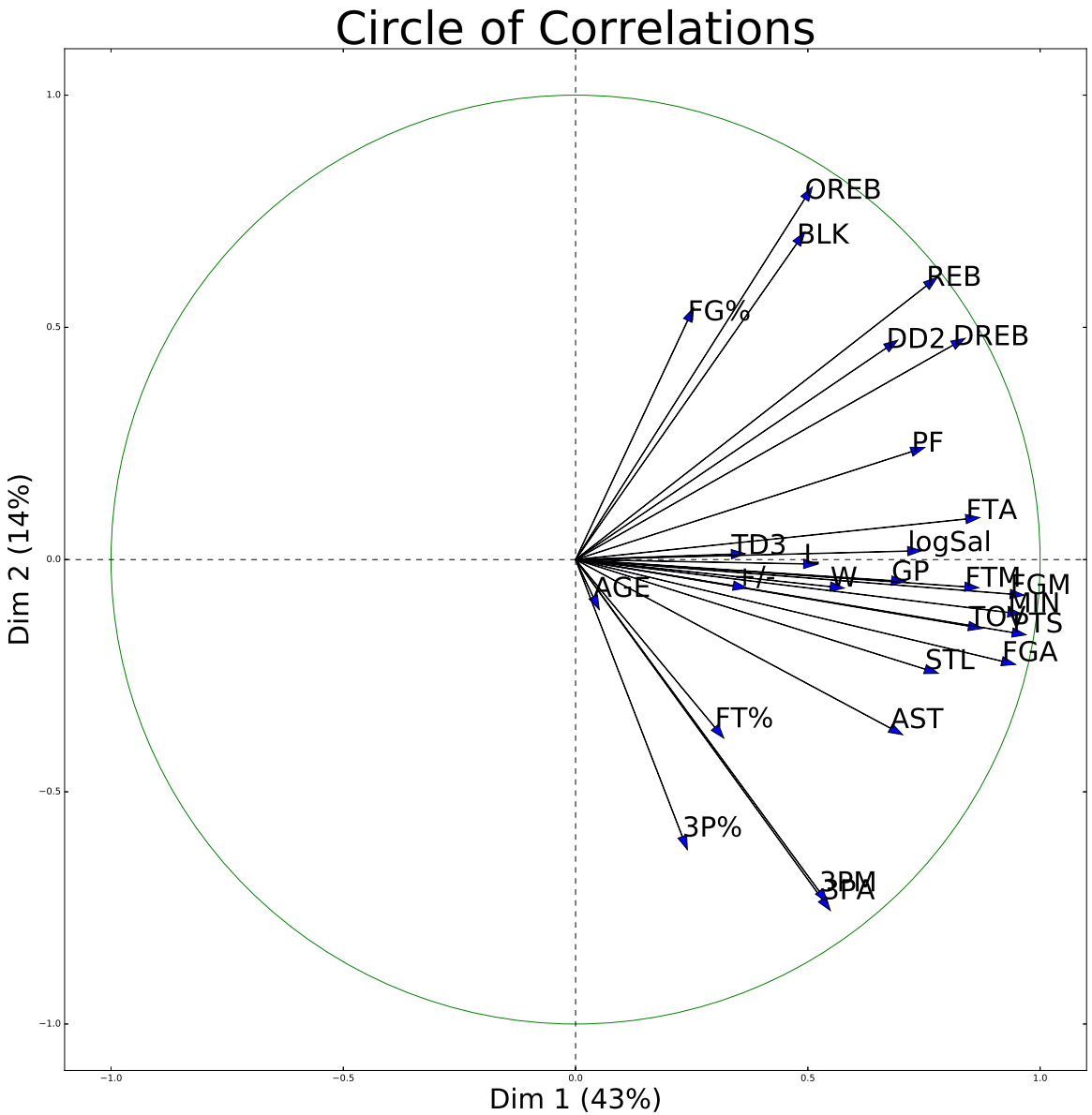


Visualizing the data via dimensionality reduction

Complete Dataset - PCA

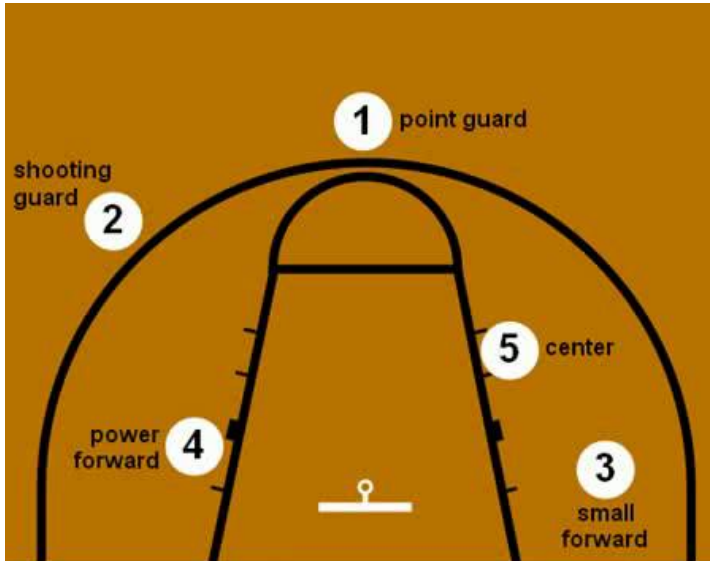


Complete Dataset - Correlation Graph



Complete Dataset

- 1^{st} Dimension: Player ability
  - Salary (log. scale)
  - Points
- 2^{nd} Dimension: Position on the Field
  - (offensive) rebounds,
  - Blocks,
  - 3 point field made/attempted



Feature selection and clustering analysis

Unsupervised methods for feature selection

- Laplacian score

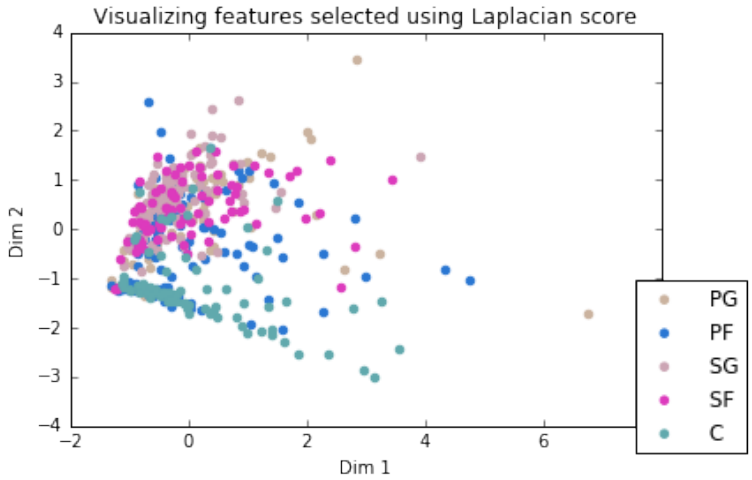
Unsupervised methods for feature selection

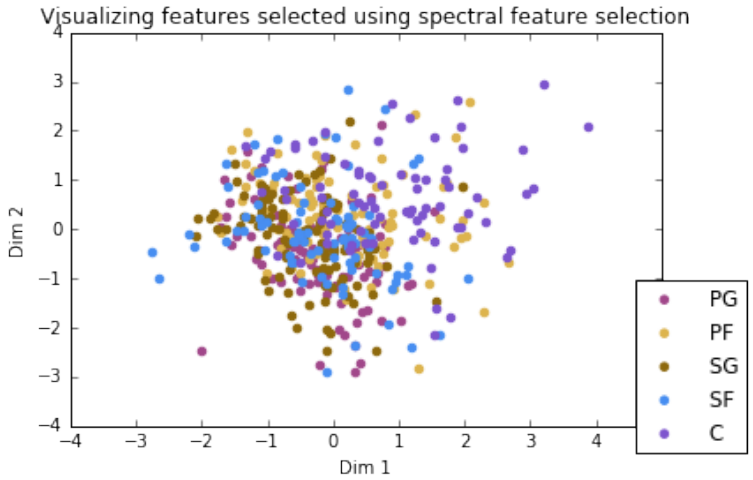
- Laplacian score
- Spectral Feature Selection

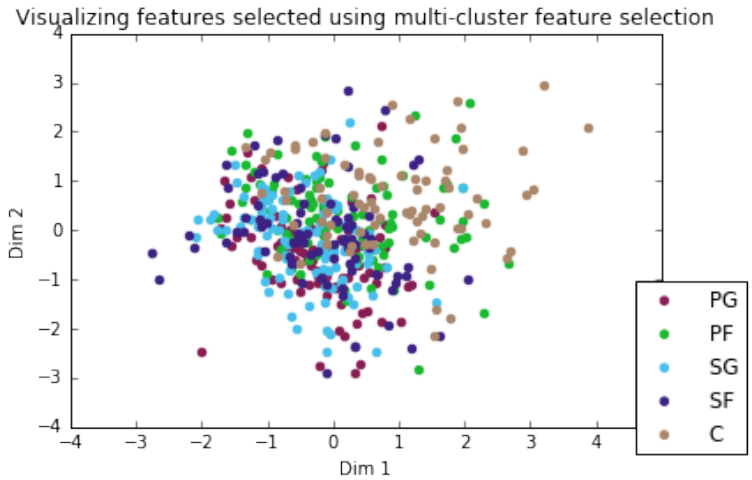
Unsupervised methods for feature selection

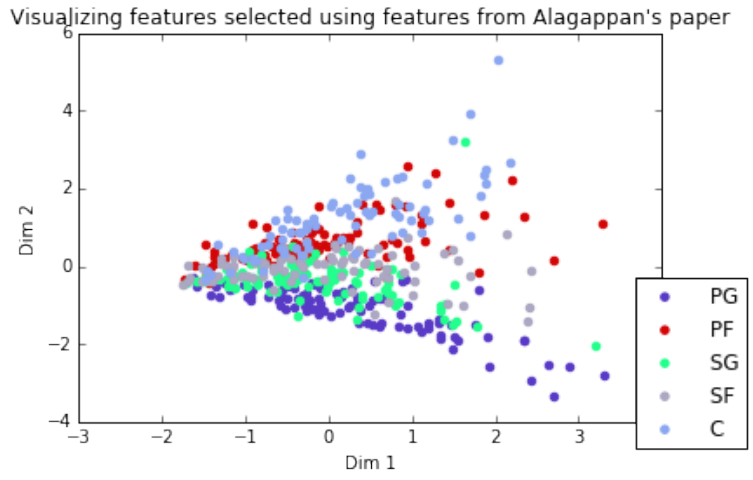
- Laplacian score
- Spectral Feature Selection
- Multi-Cluster Feature Selection

Visualizing the selected features









Evaluating a cluster

- Permutation-wise Accuracy

Evaluating a cluster

- Permutation-wise Accuracy
- Adjusted Rand's Index

Evaluating a cluster

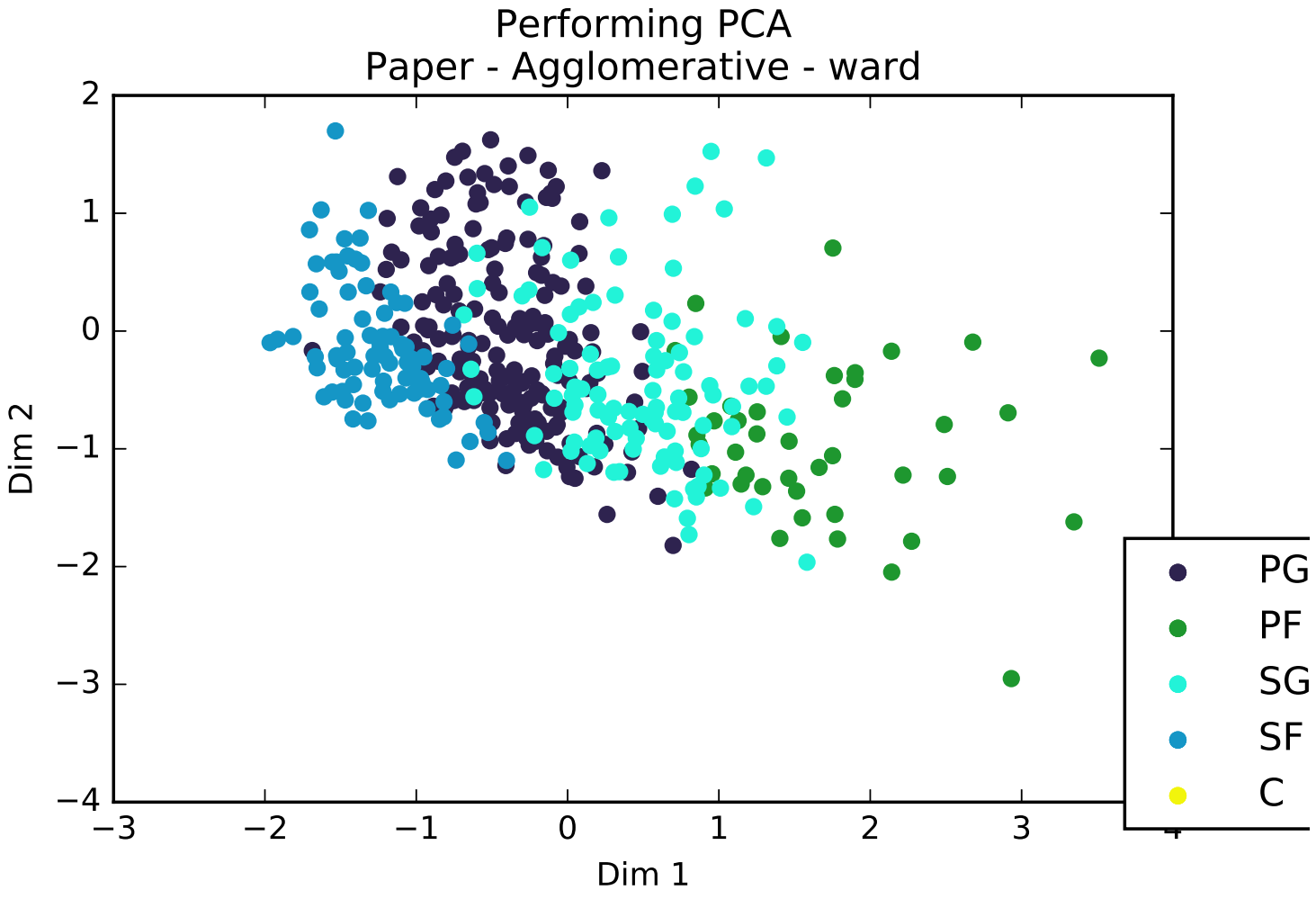
- Permutation-wise Accuracy
- Adjusted Rand's Index
- Silhouette score

Agglomerative Clustering

Table 1: Best performances for each evaluation metrics

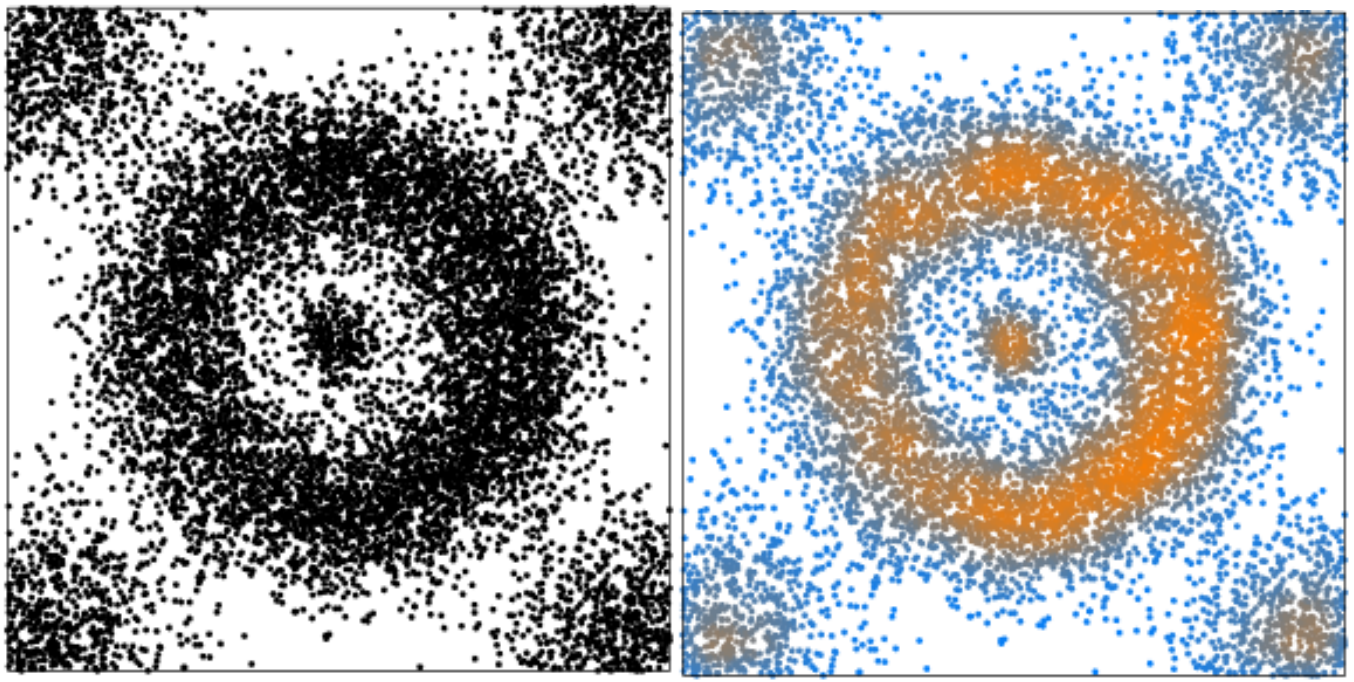
Metrics	Best score	Features	Linkage
Accuracy	37.8%	Alagappan's features	Ward
Rand's Index	0.093	Alagappan's features	Complete
Silhouette score	0.364	All the features	Average

Agglomerative Clustering



Mode-seeking

- Greater importance to peaks of density
- A Hill-Climbing scheme

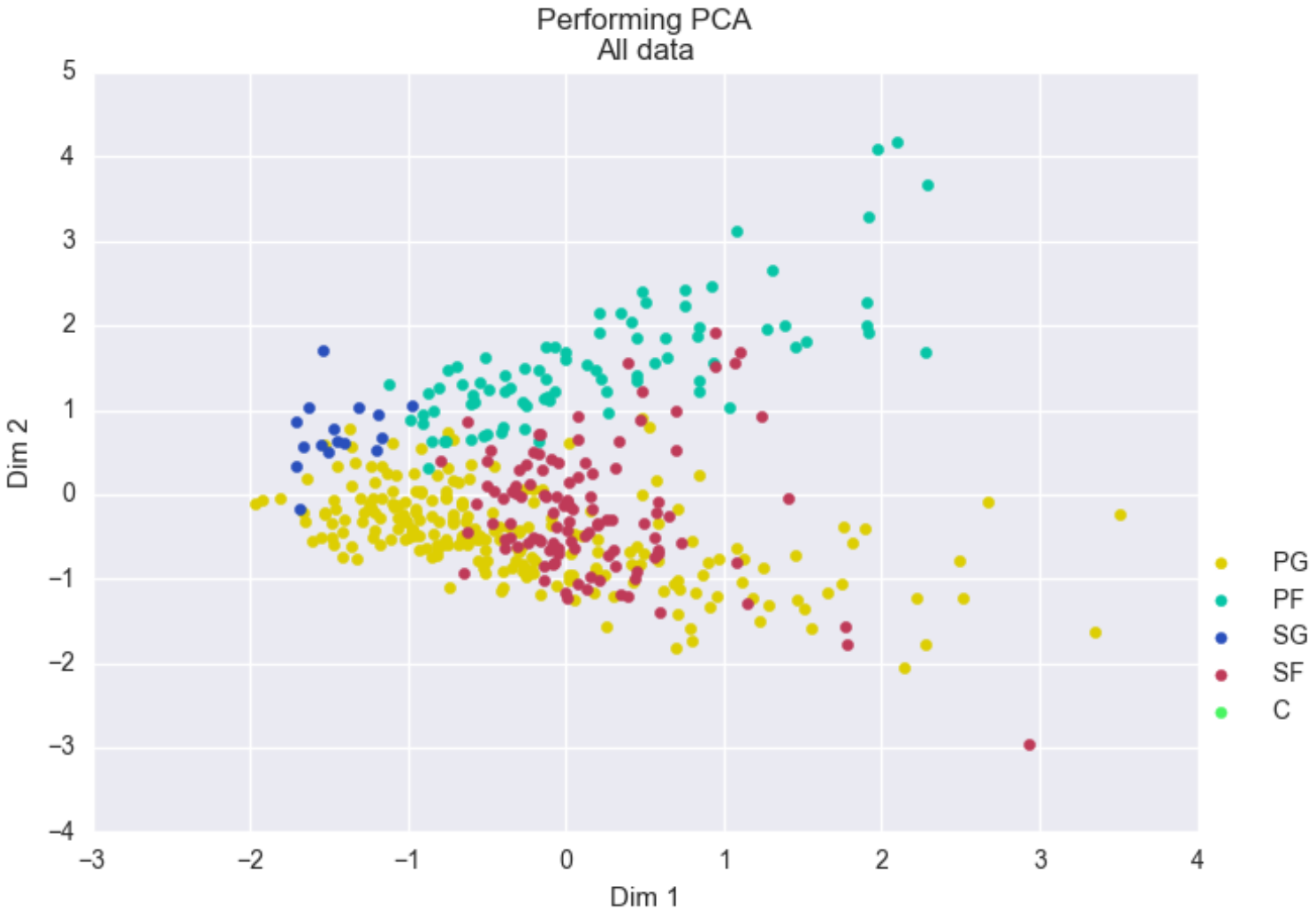


Mode-seeking

Table 2: Best performances for each evaluation metrics

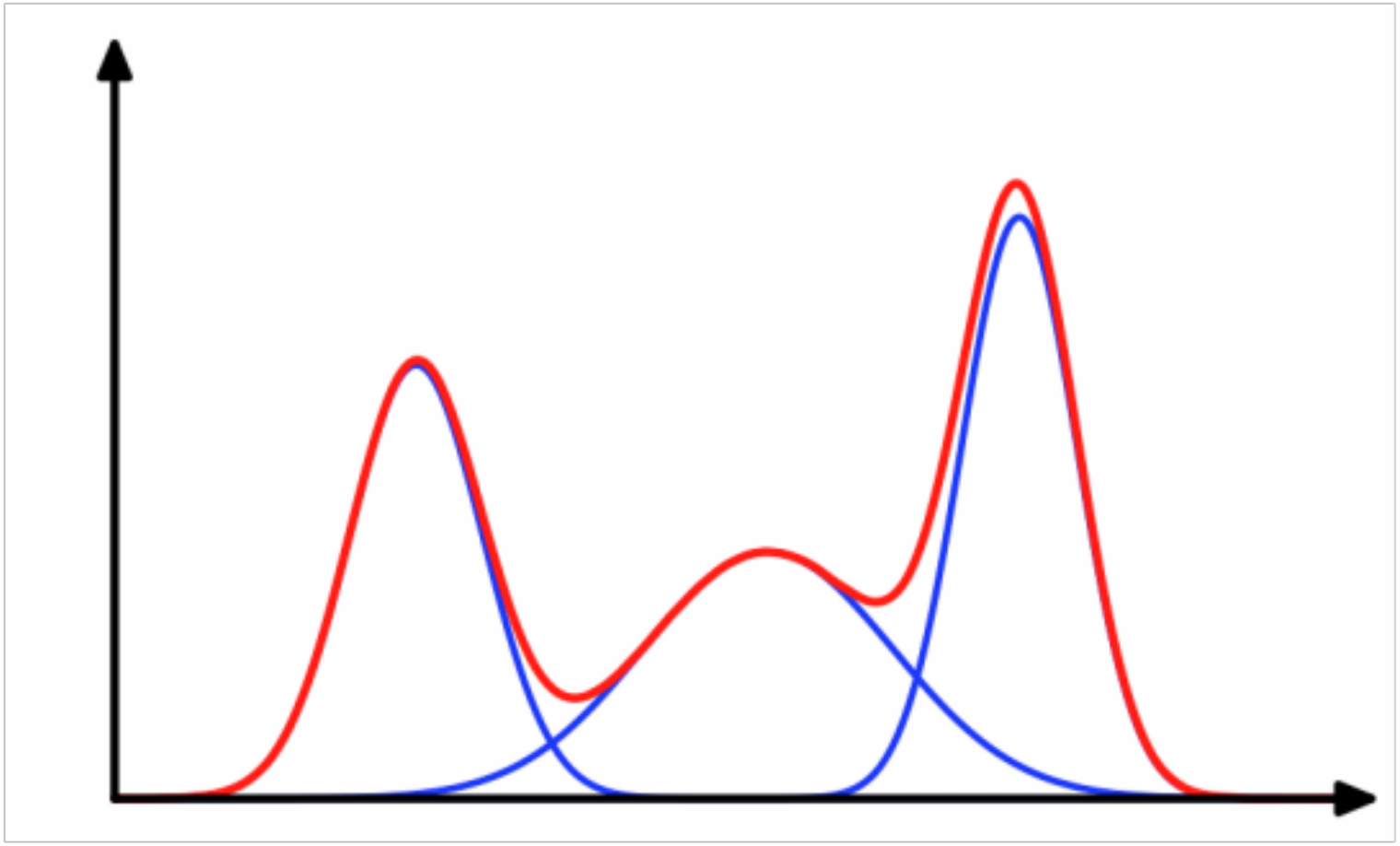
Metrics	Best score	Score range	Features	kDensity
Accuracy	34.9%	[0,100]	All the features	12
Rand's Index	0.137	[0,1]	All the features	16
Silhouette score	0.050	[-1,1]	Laplacian score	24

Mode-seeking



Gaussian Mixture Models

- Assumes data is sampled as a mixture of unknown Gaussian distributions



Gaussian Mixture Models

Table 3: Best performances for each evaluation metrics

Metrics	Best score	Features	Covariance type
Accuracy	39.67%	Alagappan's features	diagonal
Rand's Index	0.126	Alagappan's features	diagonal
Silhouette score	0.287	All the features	diagonal

Comparing with supervised algorithms

Table 4: Best performances on supervised classification

Classifier	Best accuracy	Features
Gaussian Process	55.37%	Alagappan's features
Decision Tree	51.24%	Alagappan's features
QDA	55.10%	All the features
Naive Bayes	43.80%	Alagappan's features
Linear SVM	48.98%	All the features
Neural Net	63.27%	All the features
RBF SVM	49.59%	Alagappan's features
Adaboost	54.55%	Alagappan's features
Random Forest	53.06%	All the features
Nearest Neighbors	52.07%	Alagappan's features

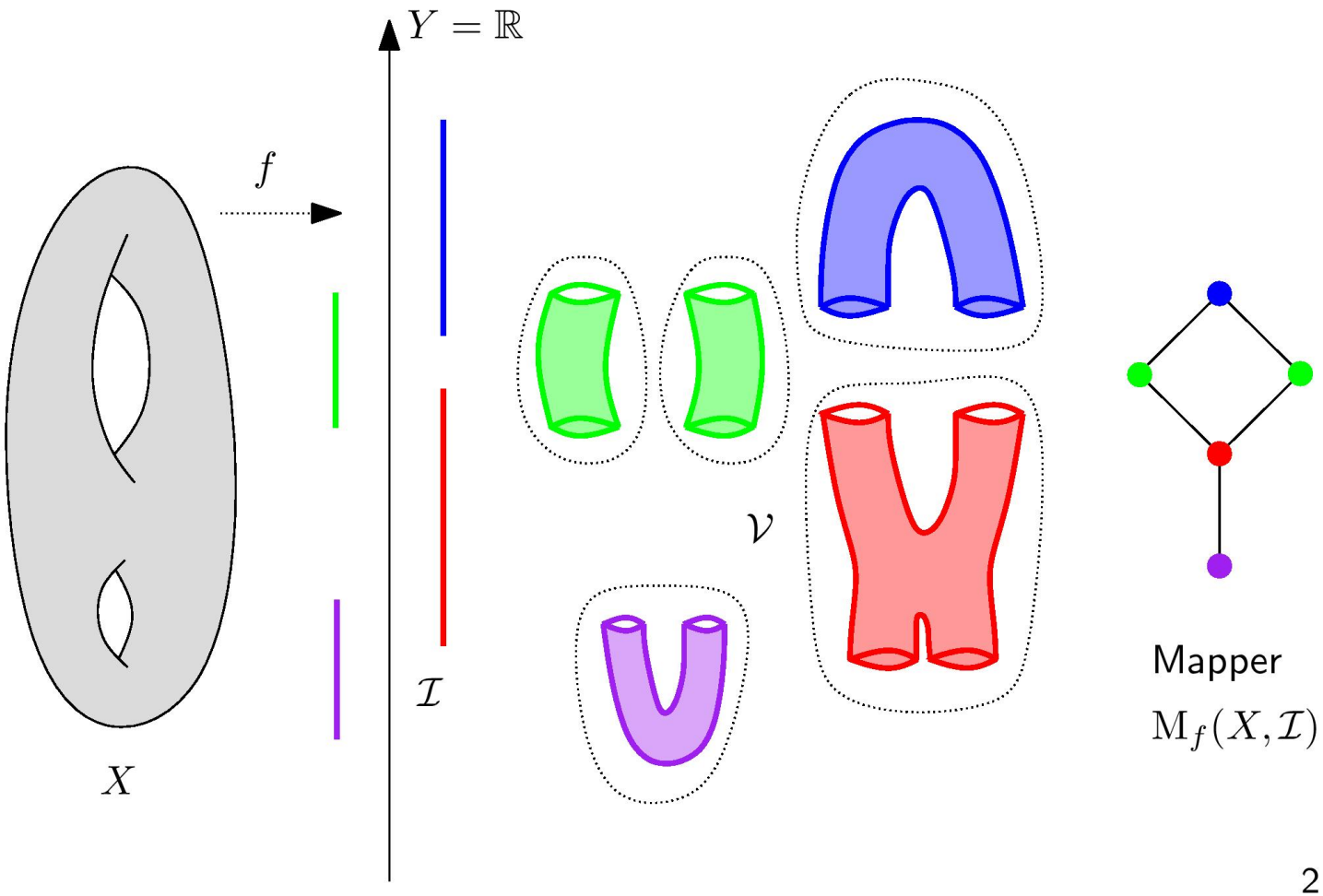
Analyzing other sets of field positions

Table 5: Best performances for each method

Method	Accuracy	Selected features	More
Common unsupervised	48.95%	Laplacian score	complete linkage
Mode-seeking	48.7%	All the features	ratio 3:1
Gaussian Mixture Models	67.5%	All the features	tied covariance
Common Supervised	79.59%	All the features	Neural net

Mapper

Mapper in the continuous setting



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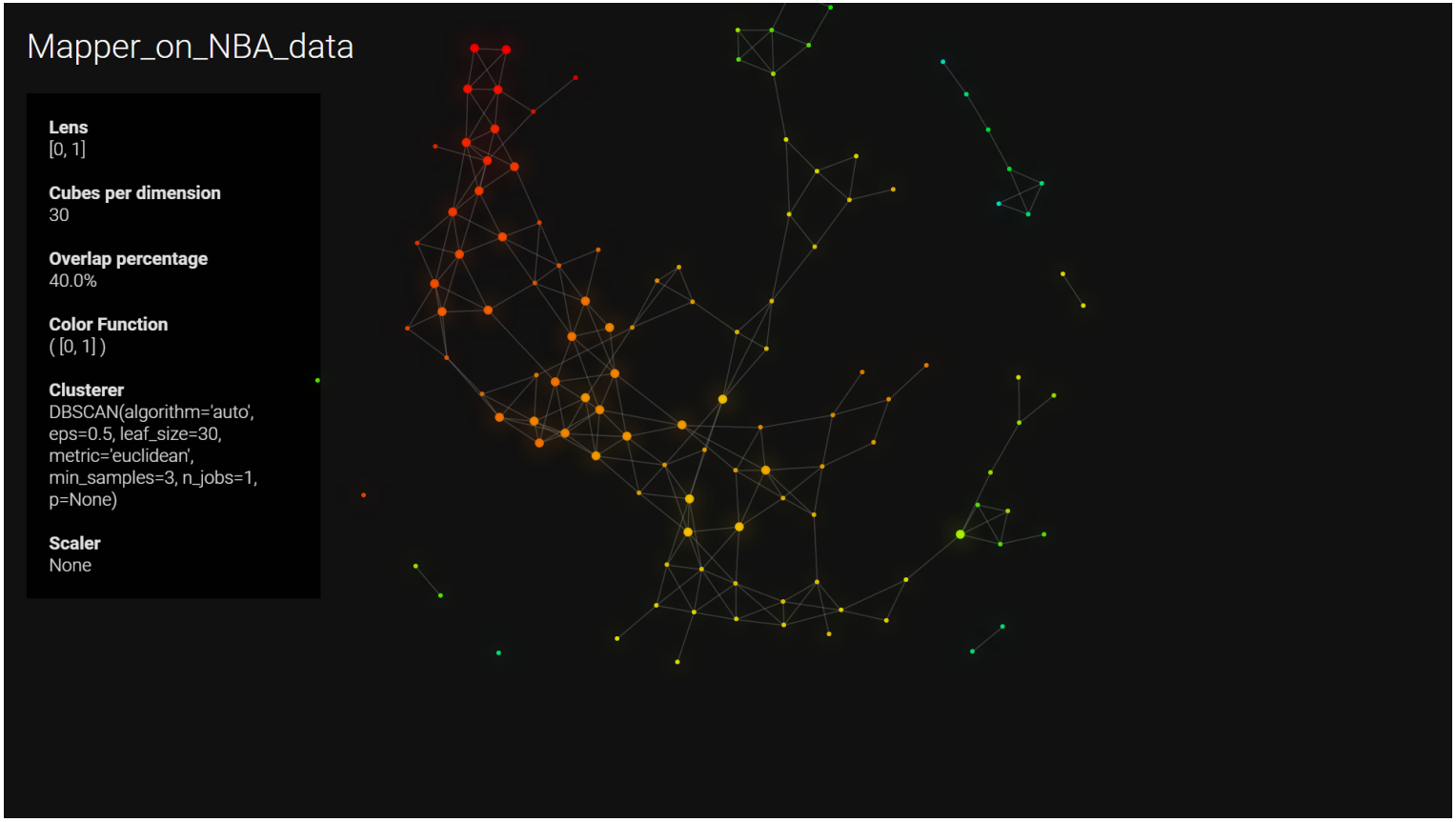
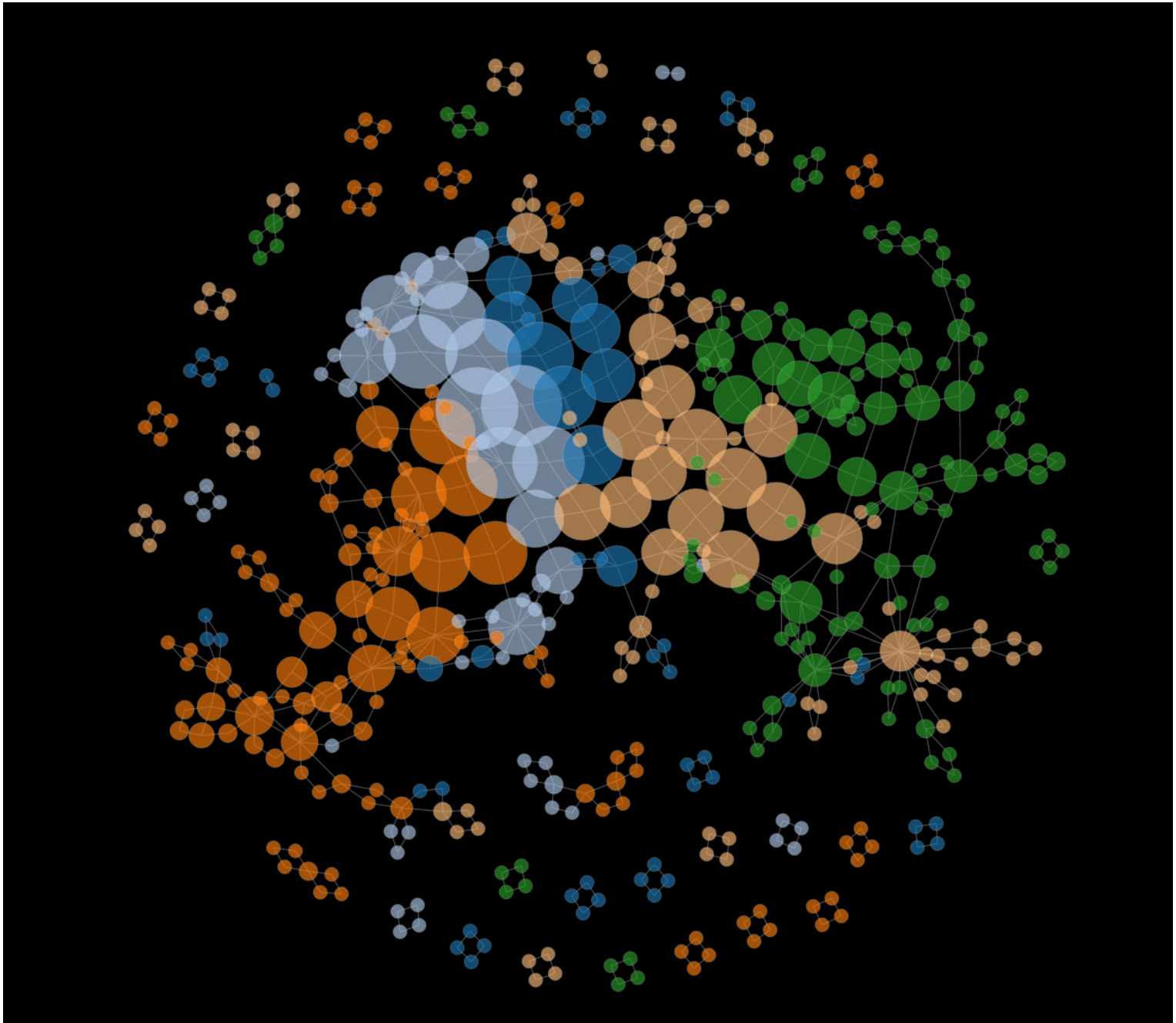
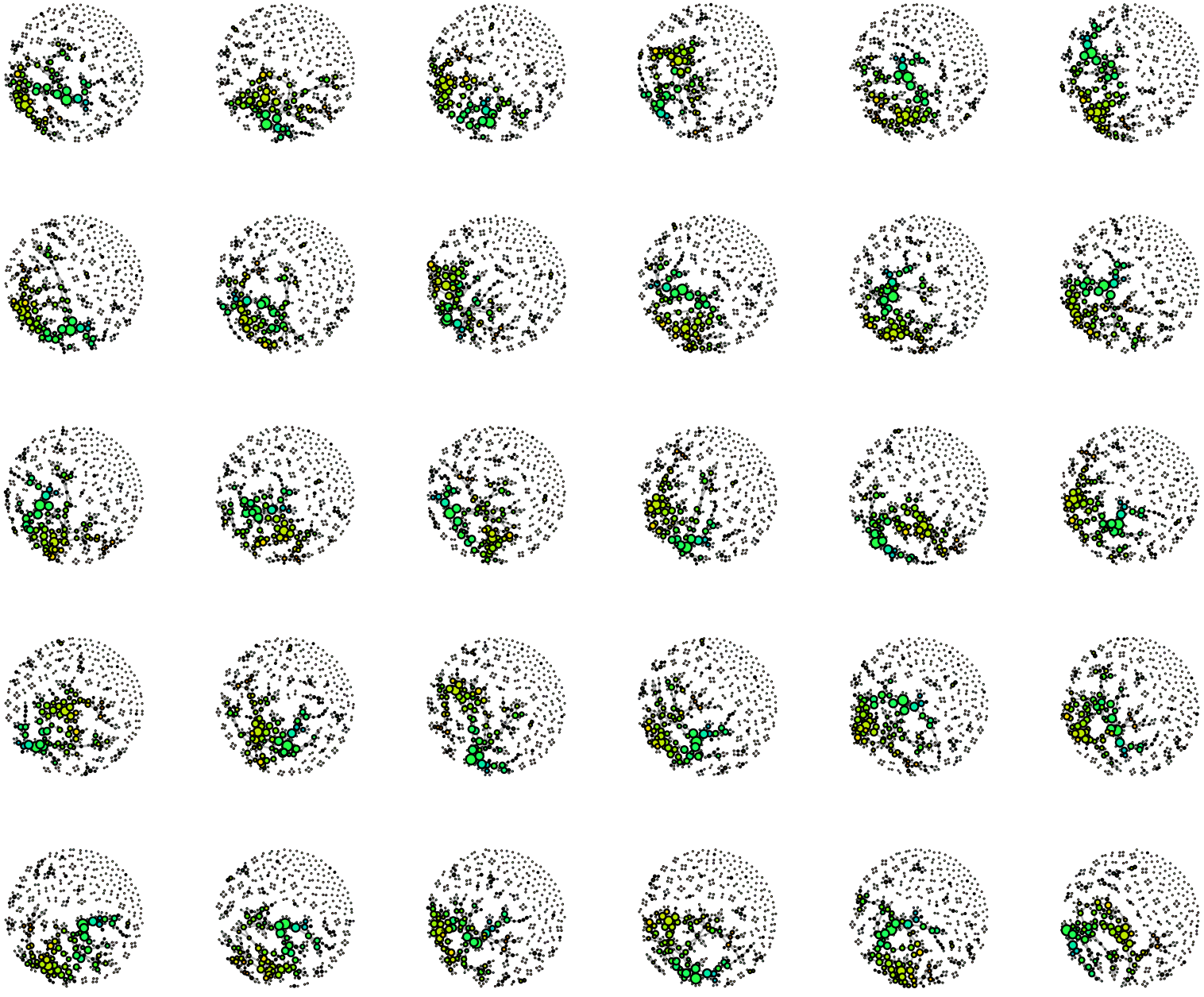
KeplerMapper



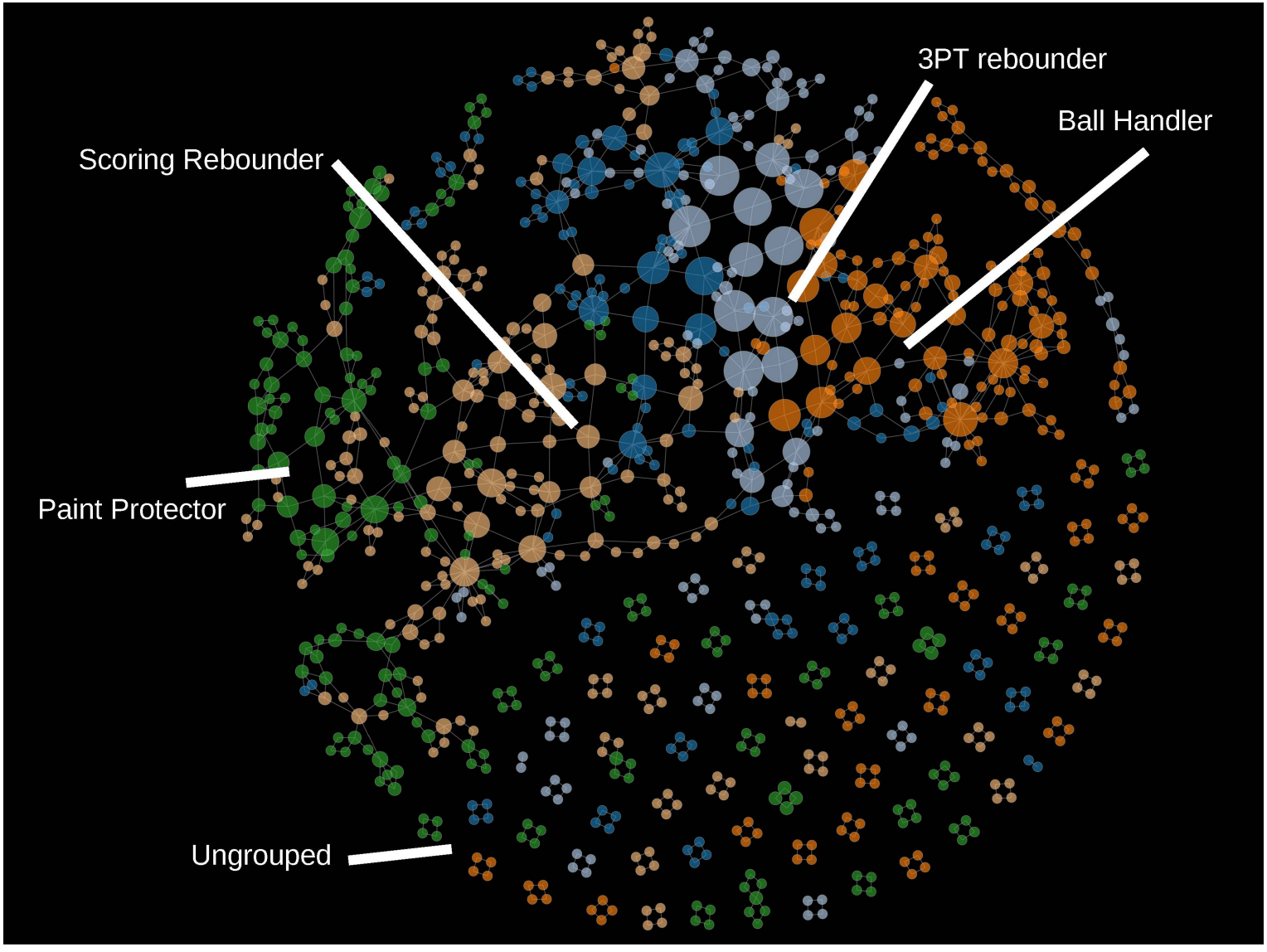
TDAMapper



Tuning parameters



Method's result



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Thank you

Questions?