Digits Clusterization

Unsupervised Machine Learning

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Framing the problem

Trying to find out the best number of clusters to understand out data, we followed the next steps:

1. Dimensionality Reduction: Finding is the best method for our data
2. Clustering Techniques
    - Kmeans
    - MiniBatchKmeans
    - Spectral
    - Agglomerative
    - Birch
3. Performance Conclusions: Metrics
4. Tuning

1. Dimensionality Reduction

1. DIMENSIONALITY REDUCTION: Finding the best method for our data

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PCA

(30 components, 85% variance ratio)

	precision	recall	f1-score	support
0	1.00	1.00	1.00	63
1	1.00	0.98	0.99	59
2	0.98	1.00	0.99	55
3	1.00	0.99	0.99	68
4	1.00	1.00	1.00	66
5	0.96	0.98	0.97	52
6	1.00	1.00	1.00	54
7	1.00	0.98	0.99	62
8	0.96	0.98	0.97	51
9	0.95	0.95	0.95	64
accuracy			0.99	594
macro avg	0.99	0.99	0.99	594
weighted avg	0.99	0.99	0.99	594

Accuracy: 0.99 %

?

LDA

(3 comp, 95% variance ratio)

	precision	recall	f1-score	support
0	1.00	0.98	0.99	53
1	1.00	0.98	0.99	42
2	0.98	1.00	0.99	41
3	1.00	0.96	0.98	52
4	1.00	1.00	1.00	47
5	1.00	0.95	0.97	39
6	0.98	1.00	0.99	43
7	1.00	0.96	0.98	48
8	0.92	0.97	0.95	37
9	0.92	1.00	0.96	48
accuracy			0.98	450
macro avg	0.98	0.98	0.98	450
weighted avg	0.98	0.98	0.98	450

Accuracy: 0.98 %

1. DIMENSIONALITY REDUCTION: Finding the best method for our data

SVM on original data

	precision	recall	f1-score	support
0	1.00	0.98	0.99	63
1	0.95	1.00	0.98	59
2	1.00	1.00	1.00	55
3	1.00	0.99	0.99	68
4	0.99	1.00	0.99	66
5	0.96	0.98	0.97	52
6	1.00	1.00	1.00	54
7	1.00	0.98	0.99	62
8	0.96	0.96	0.96	51
9	0.97	0.94	0.95	64
accuracy			0.98	594
macro avg	0.98	0.98	0.98	594
weighted avg	0.98	0.98	0.98	594

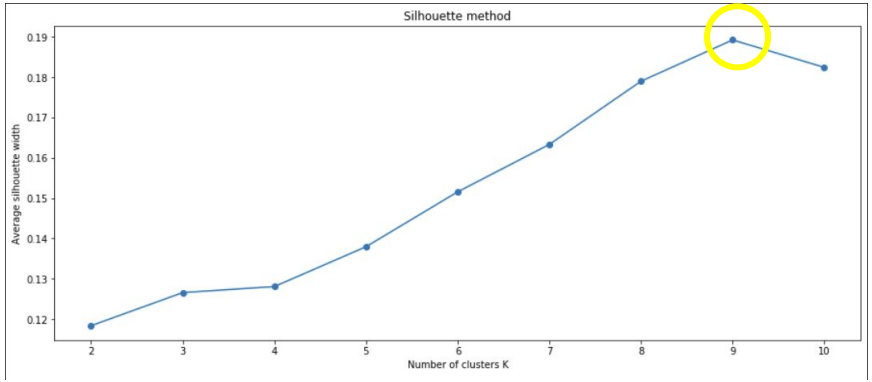
Accuracy: 0.98 %

	✓	✗ (Under 0.95)	Precision	Recall	F1-score
Original	5	0	98%	98%	98%
PCA	6	0	99%	99%	99%
LDA	6	2	98%	98%	98%

2. Clustering Techniques

2.0. Checking # clusters

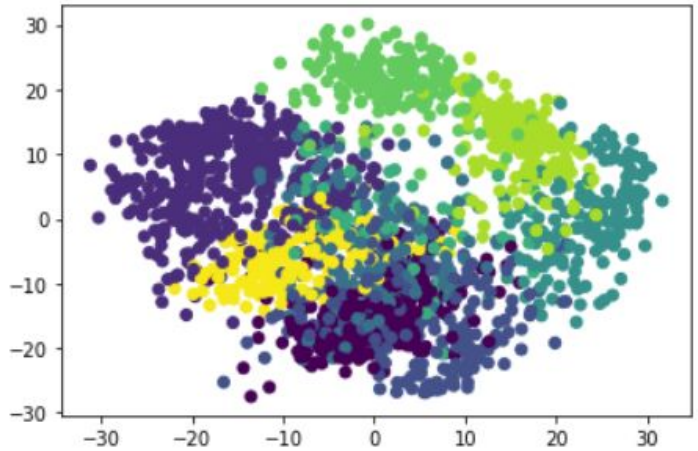
Silhouette Method → 9 clusters



Elbow Method → ?

2.1. KMeans

- With PCA




```
Kmeans_model_pca_09
Time execution: 1269.8
Homogeneity: 0.692
Completeness: 0.750
V-measure: 0.719
Adjusted Rand Index: 0.597
Adjusted Mutual Information: 0.717
==========================
```

2.2. MiniBatchKMeans (on PCA & 9 clust)

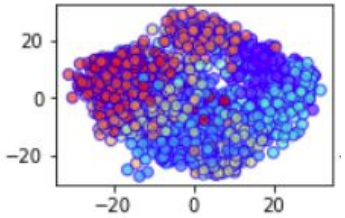
- We expected quite faster results that with KMeans but in this case the difference has just slightly improved:

1269.8 vs 1176.04

```
============================
Mini-batch Kmeans
Time execution: 1176.04
Homogeneity: 0.252
Completeness: 0.531
V-measure: 0.342
Adjusted Rand Index: 0.196
Adjusted Mutual Information: 0.340
============================
```

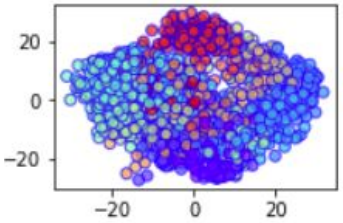
2.4. Birch

brc_02 = Birch(branching_factor=2, n_clusters=None, threshold=1.5)




```
Birch_02
Time execution: 3100.32
Homogeneity: 1.000
Completeness: 0.307
V-measure: 0.470
Adjusted Rand Index: 0.000
Adjusted Mutual Information: -0.000
=========================
Birch_50
Time execution: 3091.55
Homogeneity: 1.000
Completeness: 0.307
V-measure: 0.470
Adjusted Rand Index: 0.000
Adjusted Mutual Information: -0.000
```

brc_50 = Birch(branching_factor=50, n_clusters=None, threshold=1.5)



2. Clustering

KMeans, MiniBatchKMeans, Agglomerative, Birch

- **KMeans PCA over KMeans**:

  ↓ Computational cost

- **MiniBatchKmeans over KMeansPCA**:

  ↓ Time
  ↓ Performance

- **Agglomerative**:

  Different linkages perform indistinctly mediocre except for the “single” linkage which is even worse because results in a single cluster.

- **Birch:**

  It has the best performance in Time, Homogeneity, V-measure, and David Bouldin metrics. Completeness is quite good too.

3. Performance Conclusions: METRICS

3. PERFORMANCE CONCLUSIONS: Metrics

METRIC	TECHNIQUE	SCORE 1	TECH 2	TECH 3
Time execution:	OPTICS	1123.58	DB-SCAN	Birch_50
Homogeneity:	Birch_02, Birch_50 & DBSCAN	1	Kmeans	Agg_avg_link
Completeness:	OPTICS	1	Agg_avg_link	Kmeans
V-measure:	Kmeans	0.71	Agg_avg_link	Birch_02 & Birch_50
Adjusted Rand Index:	Kmeans	0.59	Agg_avg_link	MiniBatch
Adjusted Mutual Information:	Kmeans	0.71	Agg_avg_link	MiniBatch


Kmeans
(default n_clusters = 9)
2
1
3

Gràcies!

¡Gracias!

Thank you!