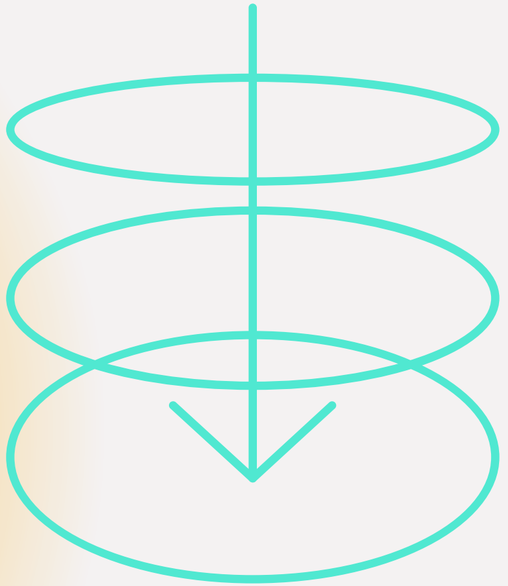
Introduction to

t-SNE

non-linear dimensionality reduction



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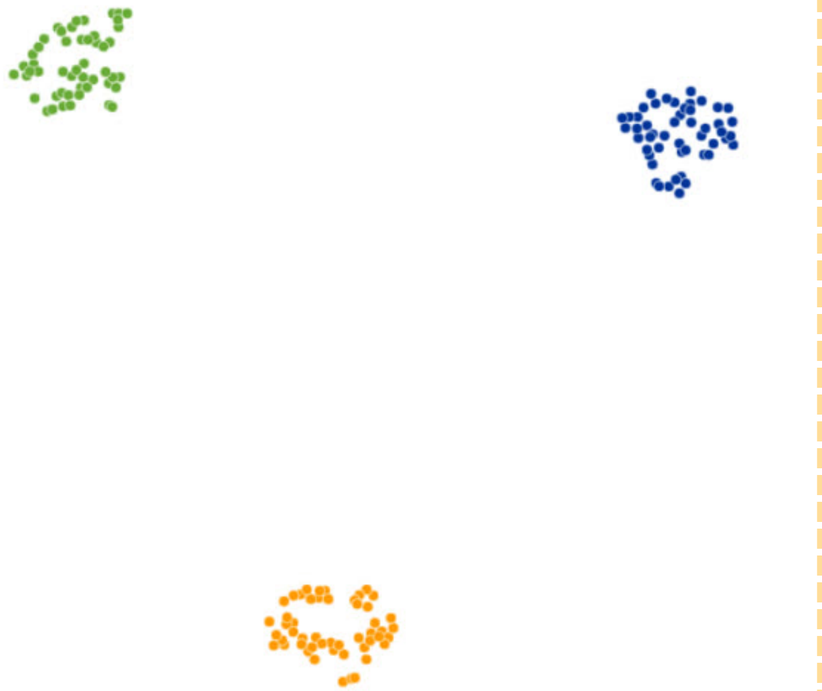
Team 5

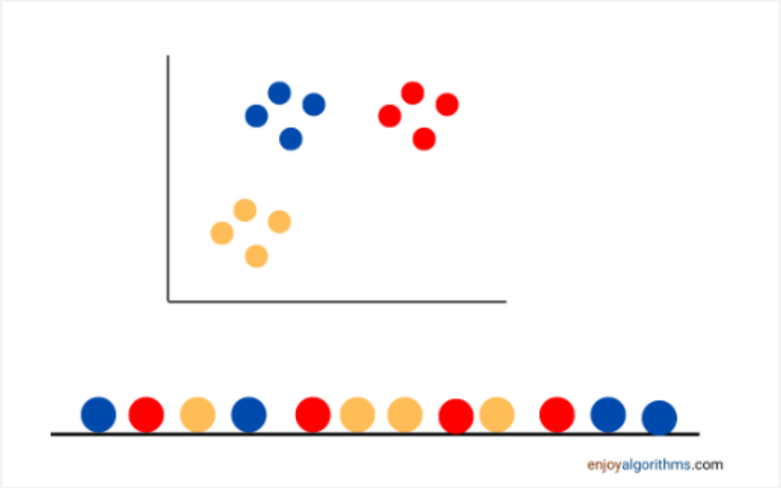
01 - Definition

- Unsupervised dimensionality reduction technique.
- For data exploration and visualizing high-dimensional data.
- It separate data that cannot be separate by a line.
- Easiest to use when features are numeric.



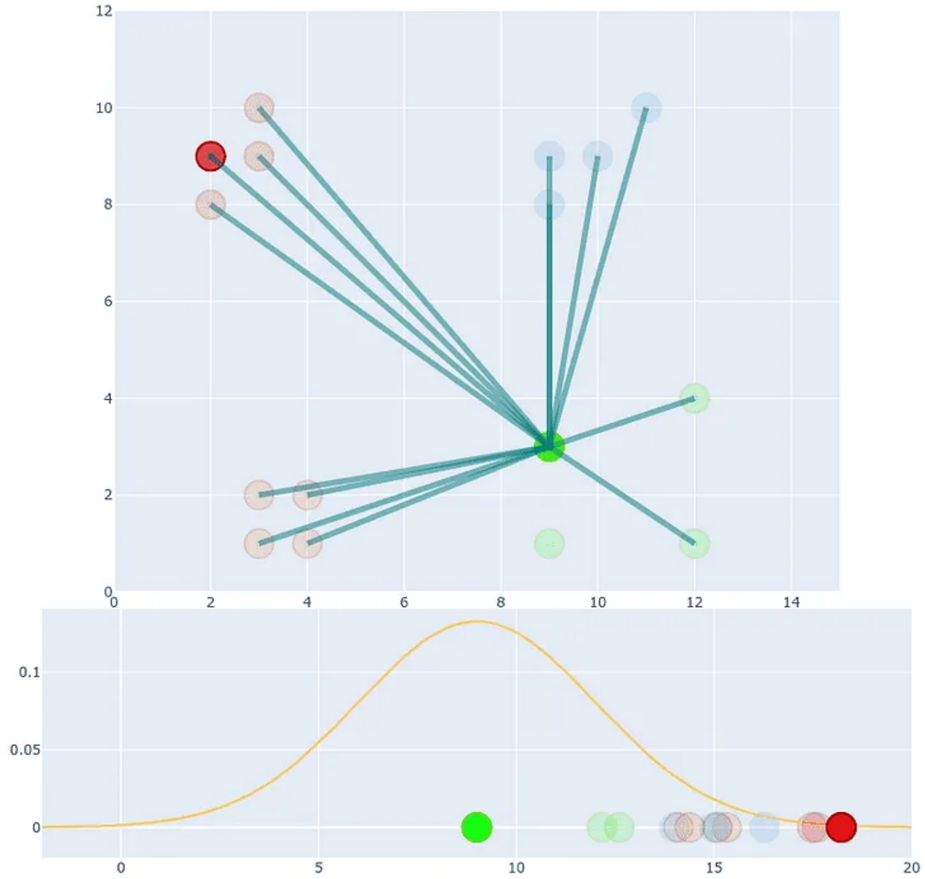
02 - How it works

1. Similarity Measure
2. Mapping to Lower Dimension
3. Divergence Minimization
4. Cluster Formation



03 - Steps

1. Calculate joint probabilities (Gaussian).
2. Low dimension space.
3. Calculate joint probabilities (t-distribution).
4. Calculate divergence.
5. Optimize.

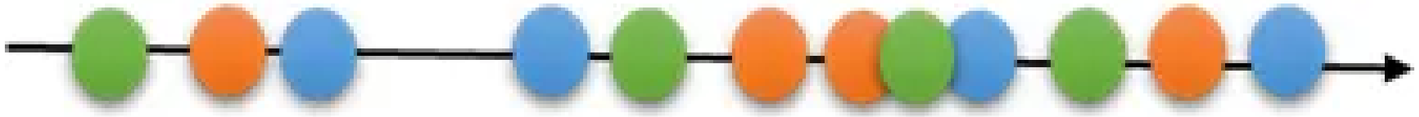


$$p_{j|i} = \frac{\exp\left(-\|x_i - x_j\|^2 / 2\sigma_i^2\right)}{\sum_{k \neq i} \exp\left(-\|x_i - x_k\|^2 / 2\sigma_i^2\right)}$$

$$p_{ij} = \frac{p_{j|i} + p_{i|j}}{2n}$$

Gaussian distribution

t distribution

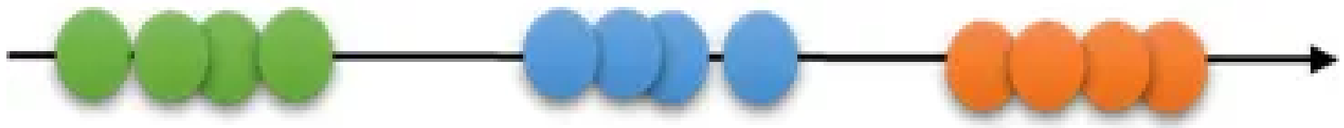


$$q_{ij} = \frac{\left(1 + \|y_i - y_j\|^2\right)^{-1}}{\sum_{k \neq l} \left(1 + \|y_k - y_l\|^2\right)^{-1}}$$

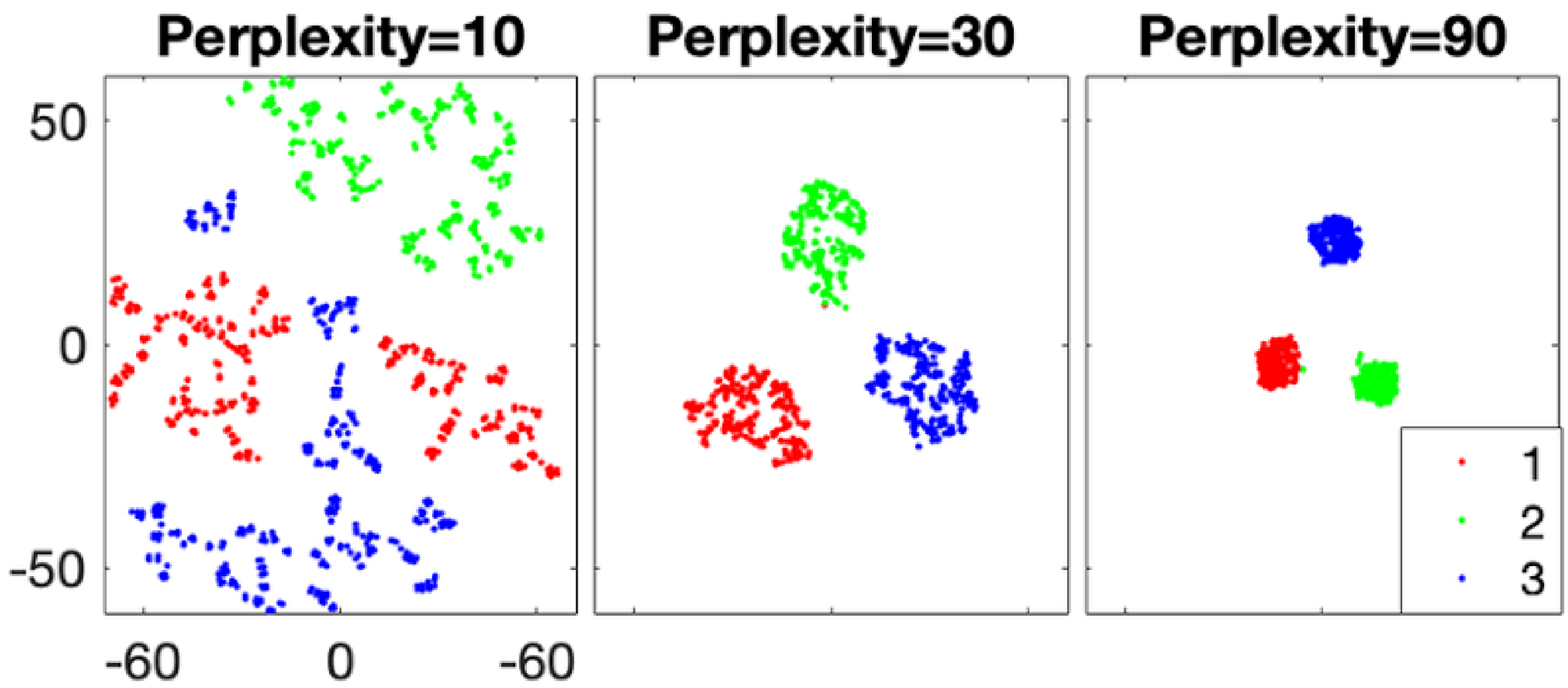
Kullback-Leiber divergence

$$C = D_{\mathrm{KL}}(P \parallel Q) = \sum_{x \in \mathcal{X}} P(x) \log \left(\frac{P(x)}{Q(x)} \right)$$

$$C = KL(P||Q) = \sum_i \sum_j p_{ij} \log \frac{p_{ij}}{q_{ij}}$$

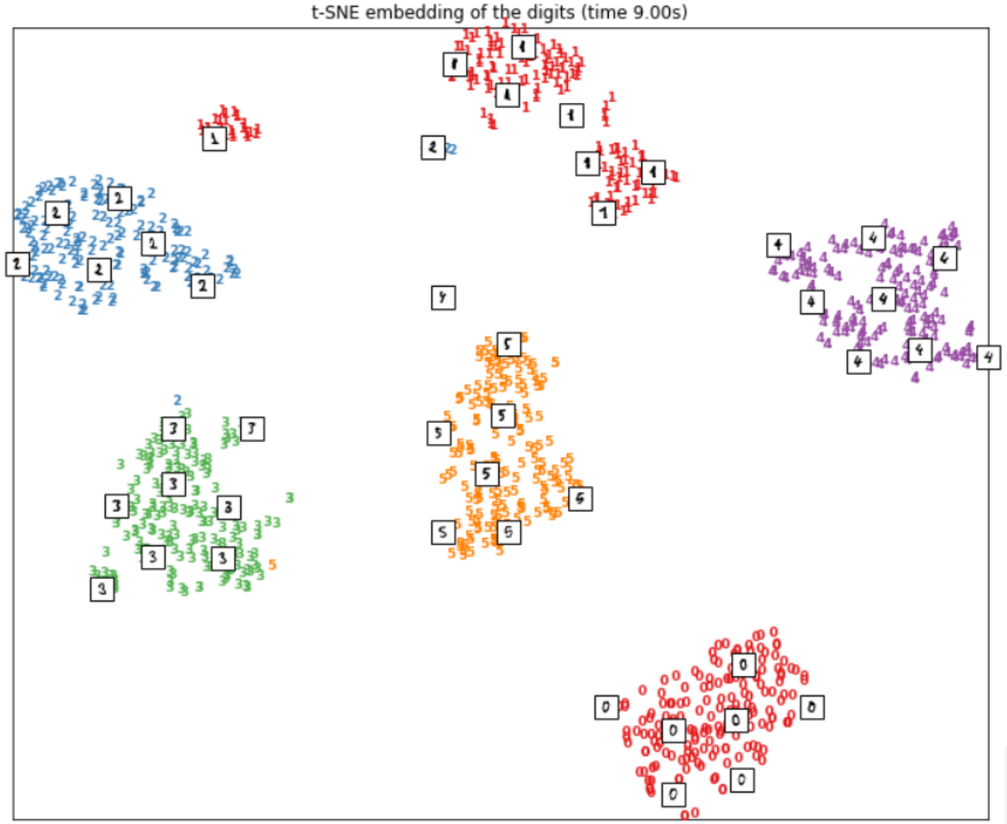


04 - t-SNE perplexity



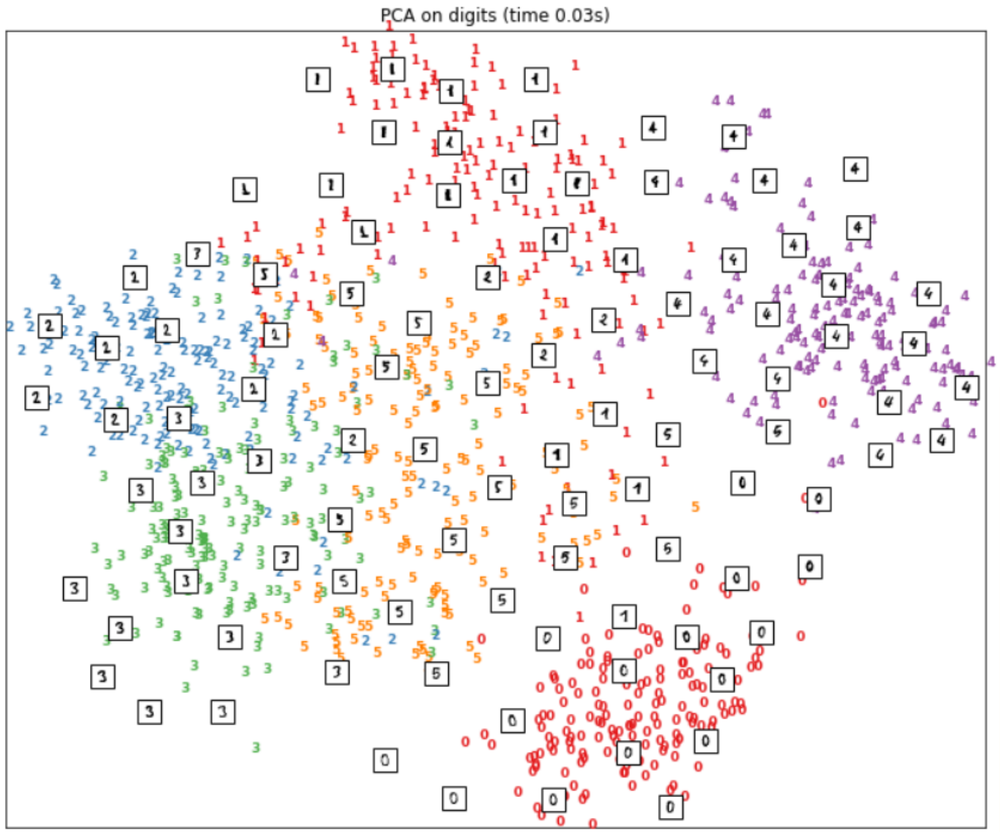
05 - TSN-E vs PCA

- Nonlinear technique.
- Lower dimensional space.



Dimension reduction with the t-SNE method

- Preserving large pairwise distances.
- Maximize variance.



Dimension reduction with ACP

06 - Advantages and Disadvantages

Advantages

1. Handles Non-linear Data
2. Preserves Local Structure

Disadvantages

1. Computational Complexity
2. Non-Deterministic

07-References

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THANKS!