UNIVERSIDAD POLITÉCNICA DE YUCATÁN

MACHINE LEARNING

ICA: INDEPENDENT COMPONENT ANALYSIS

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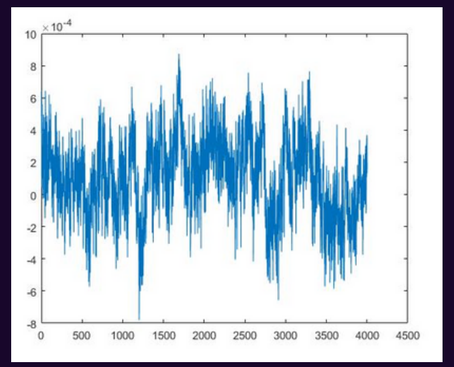
Cocktail Party Problem

At a cocktail party, there are many sounds happening at the same time

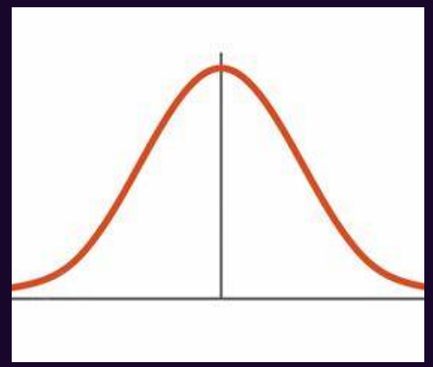
- Conversations you are a part of
- Conversations you are not a part of
- Background music
- Outside noises

Fundamental Assumptions

01 The sources have a non-Gaussian distribution



Non Gaussian



Gaussian

02 The sources are statistically independent

For this, two random scalar values are considered, which are variables y1 and y2. They are independent if the information of y1 does not contain information about the value of y2 and vice versa.

$$P(A \cap B) = P(A)P(B)$$

03 There are as many signals as there are sources

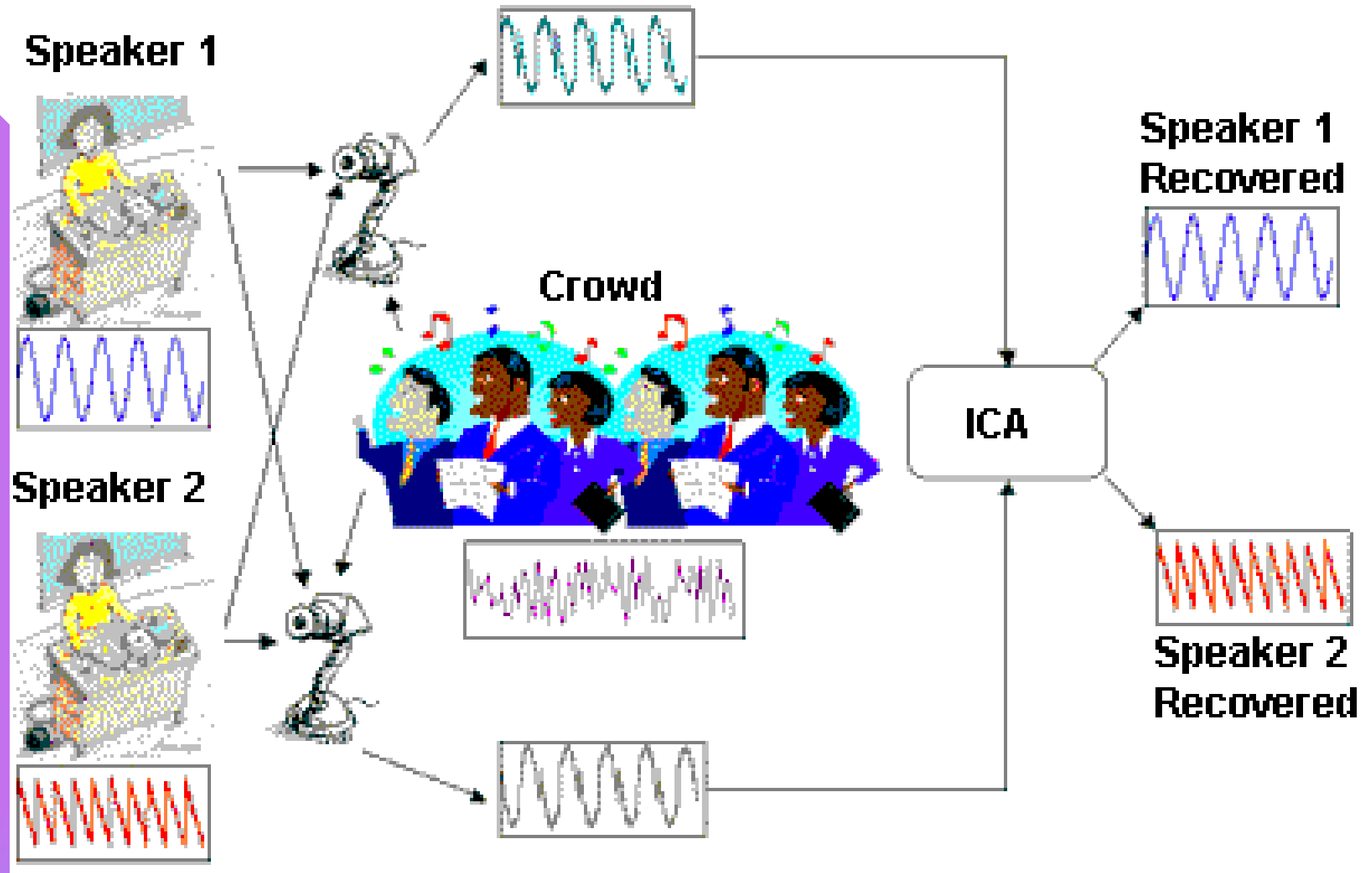
$$\begin{matrix} x_1 \\ x_2 \\ x_i \end{matrix} \rightarrow \begin{matrix} s_1 \\ s_2 \\ s_i \end{matrix}$$

x = signal

s = source

04 Each signal is a linear combination of the sources

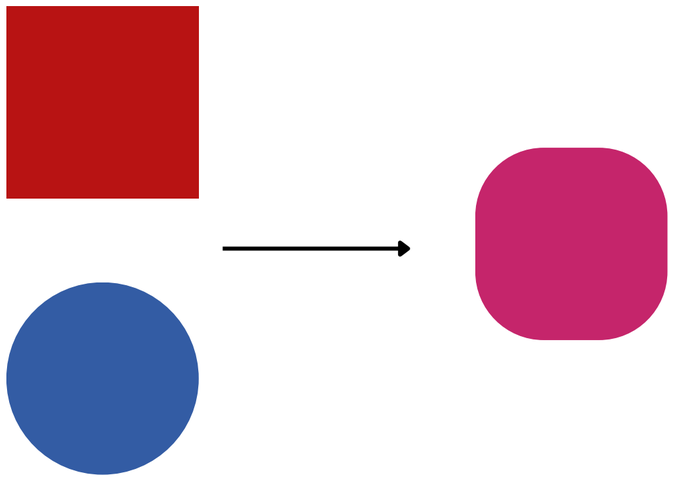
ICA



Independent Component Analysis (ICA) is a technique used in signal processing and statistics that is used to separate a mixture of complex signals into their original individual components. The idea behind ICA is to decompose a data set into components that are as independent as possible from each other.

PCA vs ICA

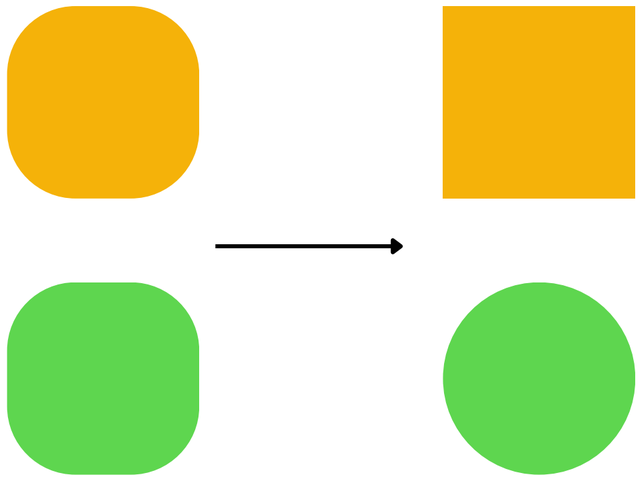
PCA



Compresses information

Requires preprocessing: autoscaling

ICA



Separates information

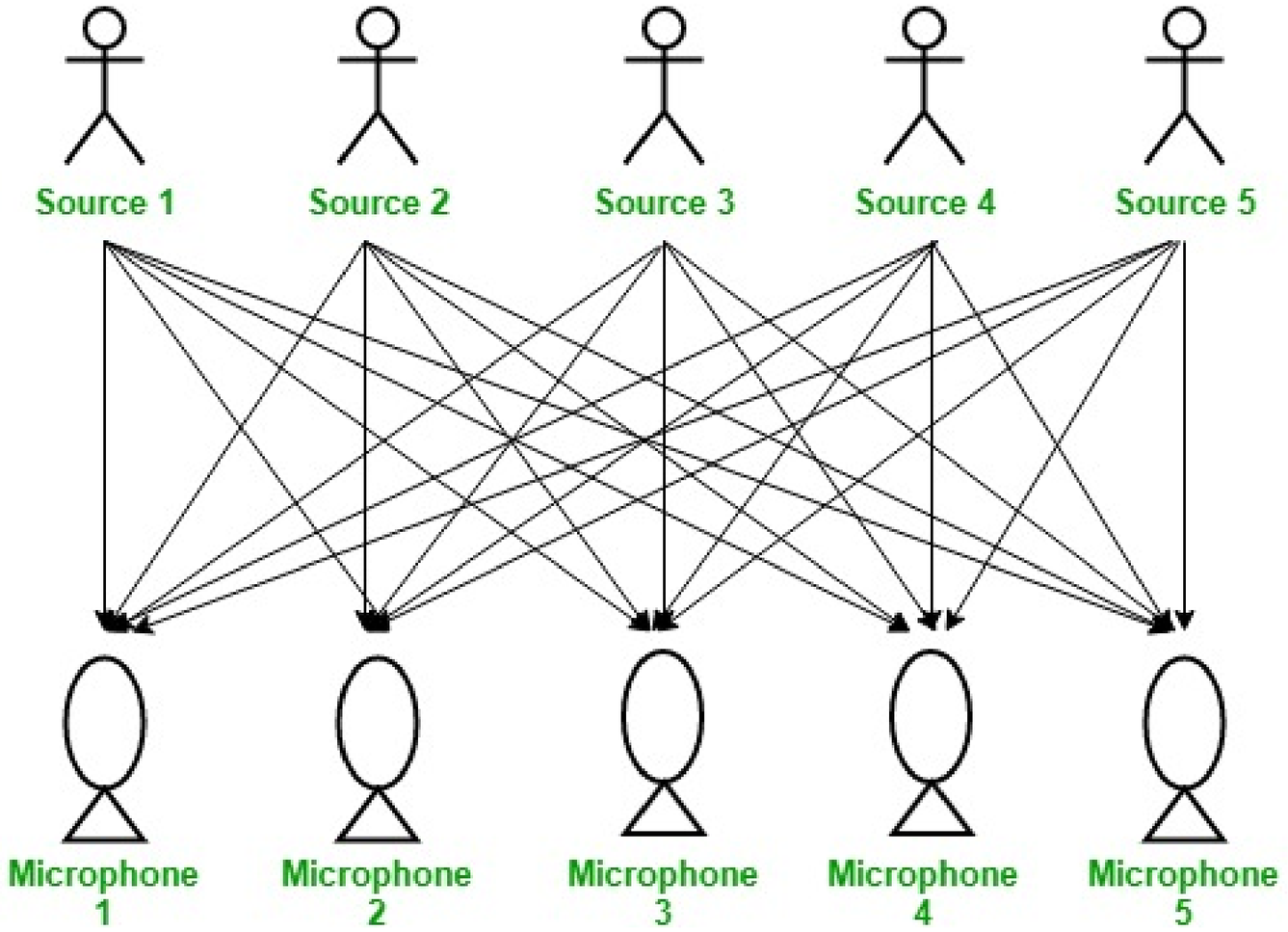
Requires preprocessing: autoscaling

Often benefits from applying PCA first

Steps for ICA

- Data Collection
- Preprocessing
- Problem formulation
- Application of ICA
- Evaluation of results
- Interpretation
- Applications

Example


Source 1
Source 2
Source 3
Source 4
Source 5
Microphone 1
Microphone 2
Microphone 3
Microphone 4
Microphone 5

References

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