



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

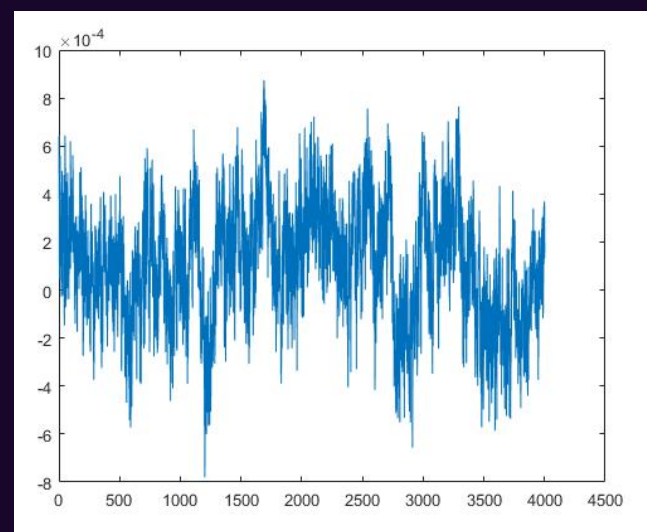




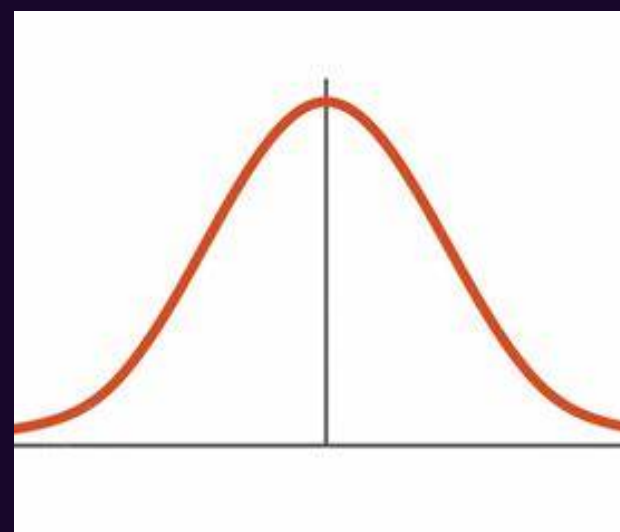
Fundamental Assumptions

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 y_1 and y_2 . They are independent if the information of y_1 does not contain information about the value of y_2 and vice versa.

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

03

There are as many signals as there are sources

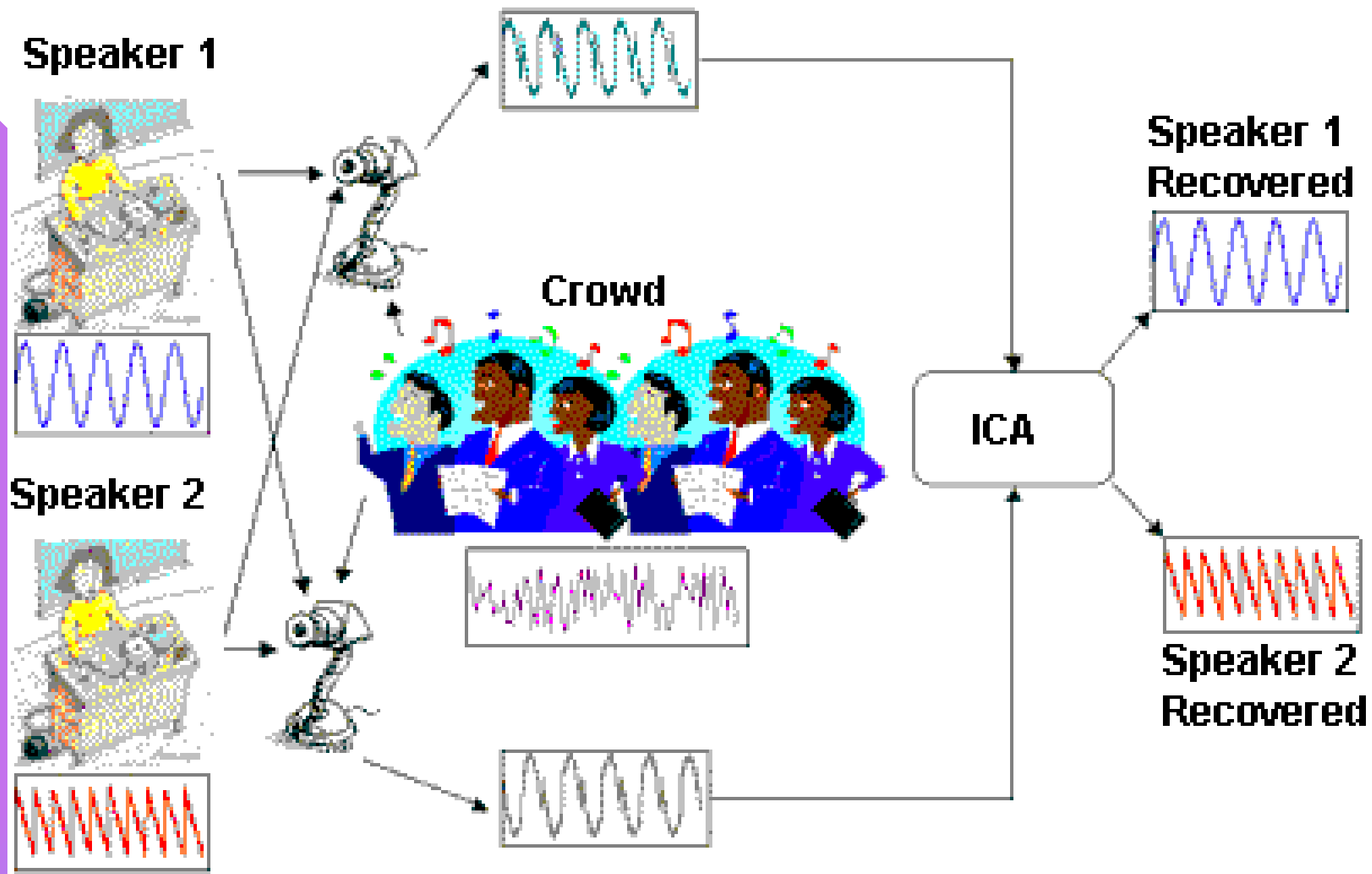
$$\begin{array}{lcl} x_1 & & s_1 \\ x_2 & \rightarrow & s_2 \\ x_i & & s_i \end{array}$$

x = signal
 s = source

04

Each signal is a linear combination of the sources

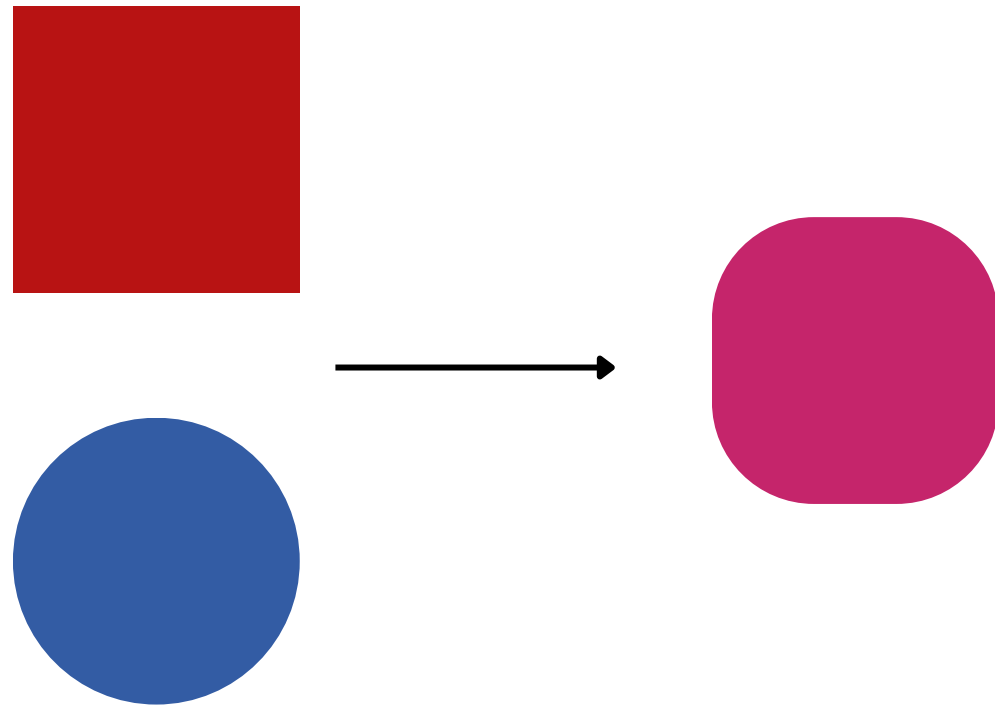
ICA



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

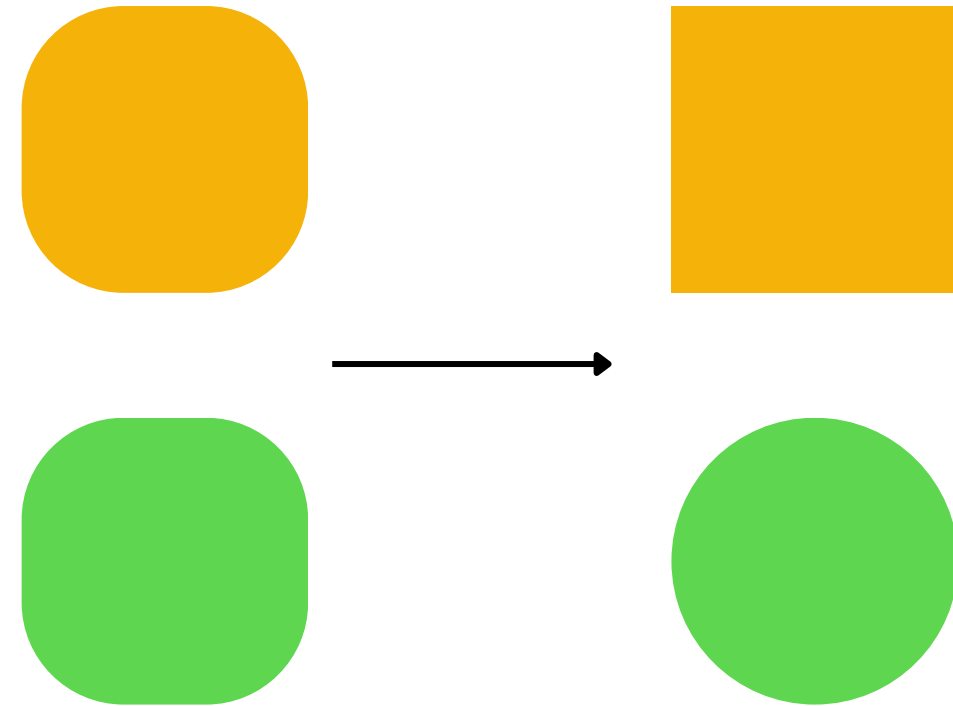
PCA



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



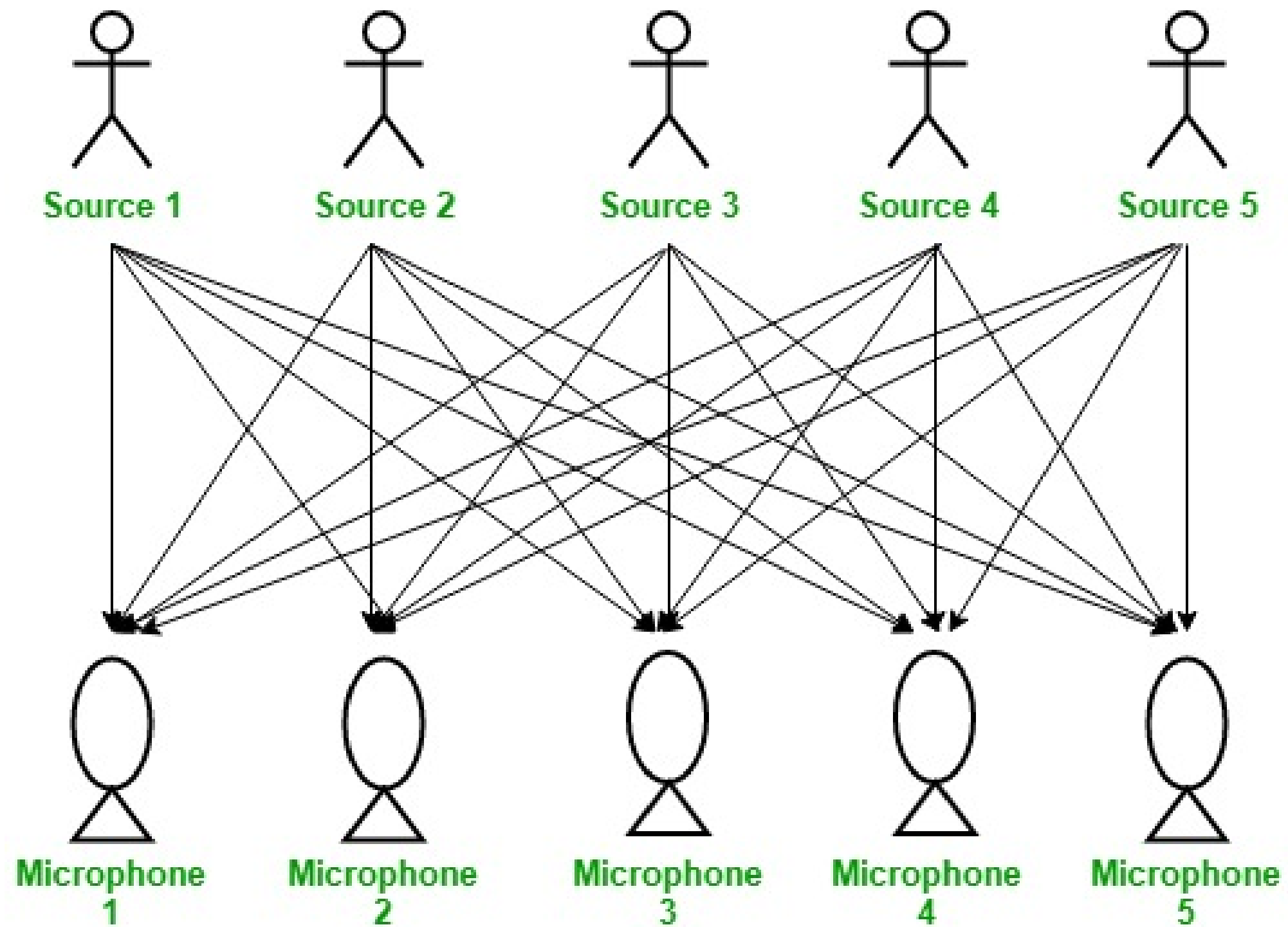
Interpretation



Applications



Example



References

- **A. Tharwat, "Independent component analysis: An introduction," Applied Computing and Informatics, vol. 17, Aug. 2018, doi: <https://doi.org/10.1016/j.aci.2018.08.006>.**
- **"ML | Independent Component Analysis," GeeksforGeeks, May 21, 2019. <https://www.geeksforgeeks.org/ml-independent-component-analysis/>**
- **E. Zvornicanin, "What Is Independent Component Analysis (ICA)?," Baeldung, May 04, 2023. <https://www.baeldung.com/cs/independent-component-analysis>**
- **Stroup, W. W. (2018). Analysis of Non-Gaussian data. En ASSA, CSSA and SSSA <https://doi.org/10.2134/appliedstatistics.2015.0081.c16>**
- **Alvarez, D. A., Electricista, I. P., Giraldo, E., Ingeniero, M. S., & Profesor Auxiliar, E. (s/f). ICA APLICADO A LA EXTRACCIÓN DE CARACTERÍSTICAS EN IMÁGENES. Edu.co. Recuperado el 19 de septiembre de 2023, de <https://repositorio.utp.edu.co/server/api/core/bitstreams/47dffe6a-eef6-4ec0-b751-ff20cf710547/content>**