
NOVA
IMS
Information
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School
Data Mining
211020
NOVA-IMS 2019/2020
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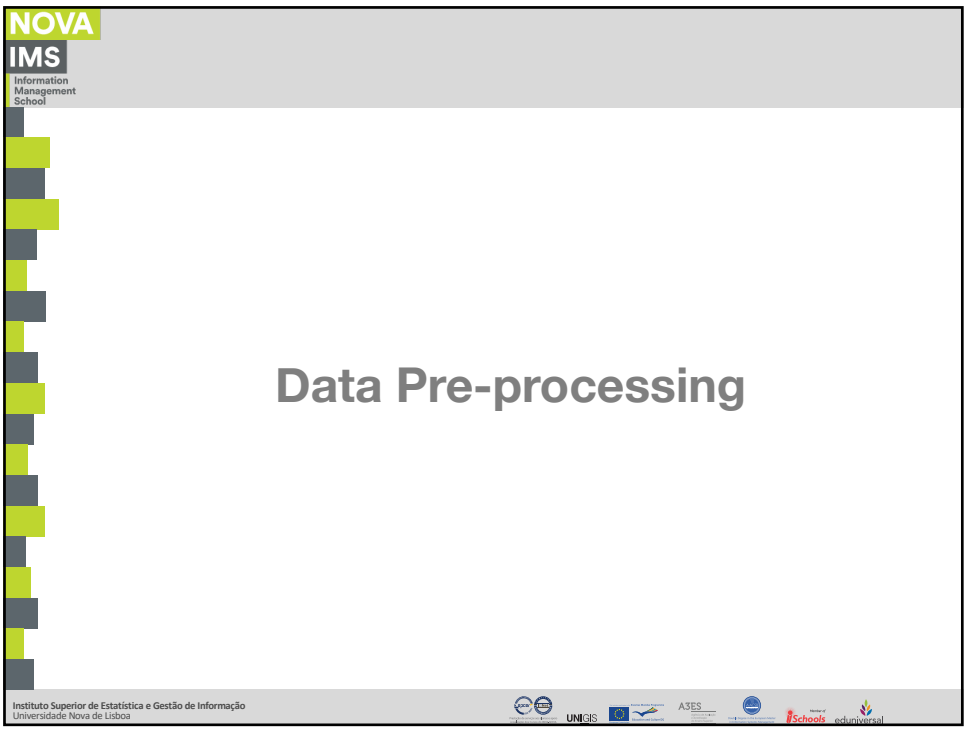
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Data Preprocessing

- **Reasons:**
  - Noise Reduction;
  - Signal amplification;
- **Tasks:**
  - Domain-specific knowledge application;
    - Constructing ratios and derived variables
  - Size Reduction of the Input Space;
    - Remove correlated variables
    - Remove irrelevant variables
  - Normalization;

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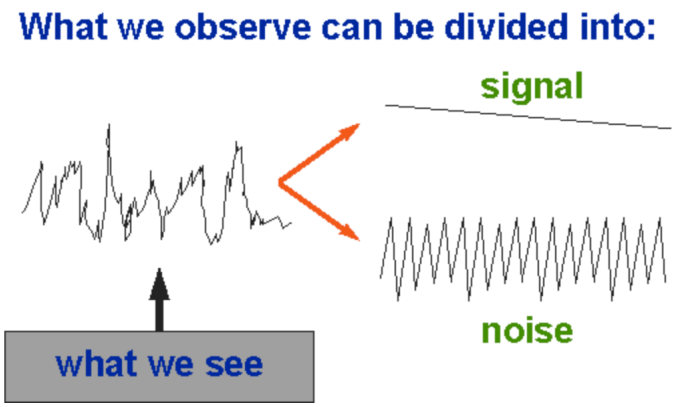
Data Preparation



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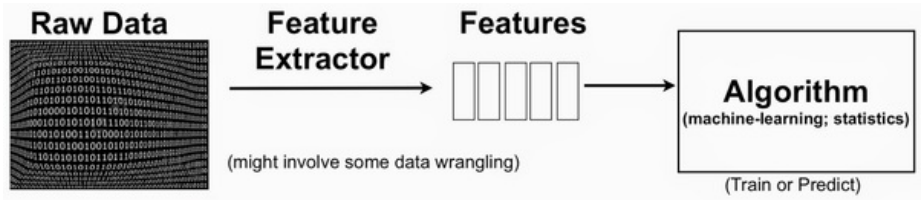
Data Preparation



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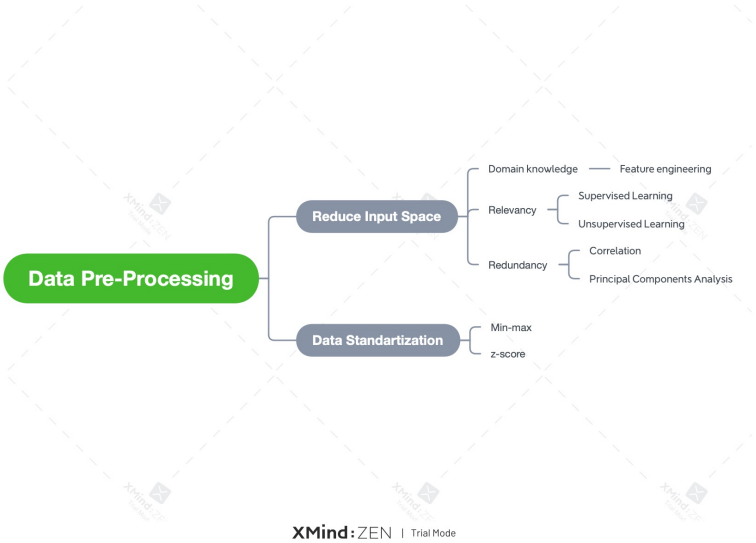
Data Preparation



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Reducing Input Space

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Data Preprocessing

- **Additional considerations about data:**
  - Curse of dimensionality – the input space grows exponentially with the number of input variables;
  - The larger the input space, the more data and computing power we need.

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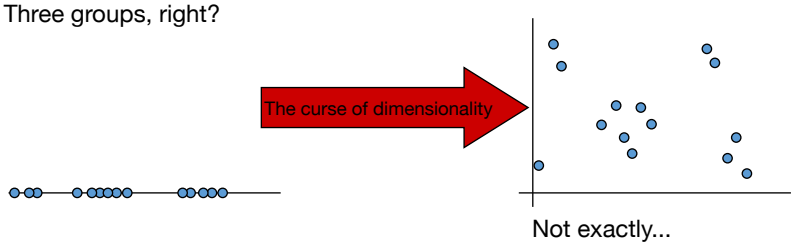
Data Preprocessing

Three groups, right?



When the dimensionality increases, the space becomes more sparse and it becomes more difficult to find groups

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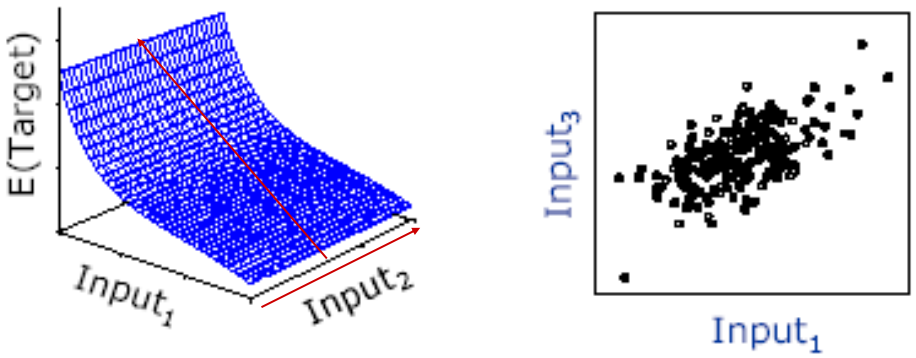
Data Preprocessing

- **Size Reduction of the Input Space** (or feature selection):

Two major principles:

Relevance and Redundancy



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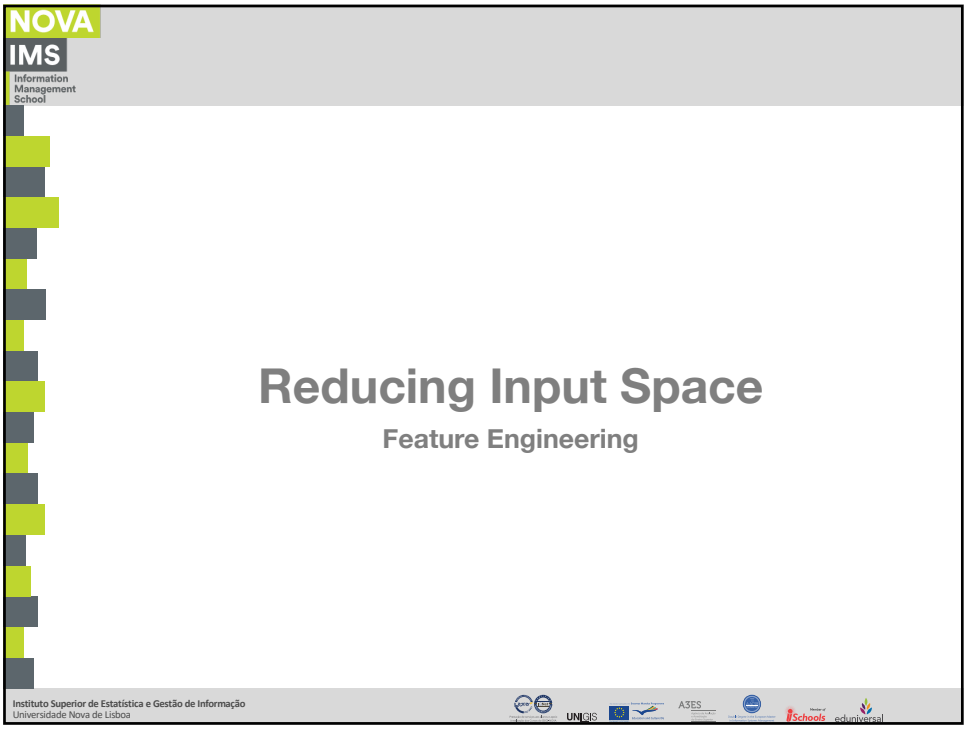

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Data Preprocessing

- **Size Reduction of the Input Space:**
  - To create input combinations
    - Height2/weight (obesity index)
    - Population/area (density)
    - Euros spent/nº of purchases (average buy)
    - Euros spent/time as customer
    - Debt/income
    - Average number of different products purchased per transaction
    - Relative spend on each product

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- **Size Reduction of the Input Space:**
  - To create input combinations
    1. Average time between transactions (transaction interval)
    2. Variance of transaction interval
    3. Customer stability index (ratio of (2)/(1))

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Reducing Input Space

Relevancy

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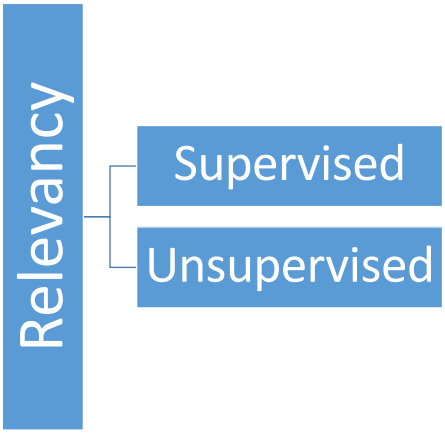
Data Preparation



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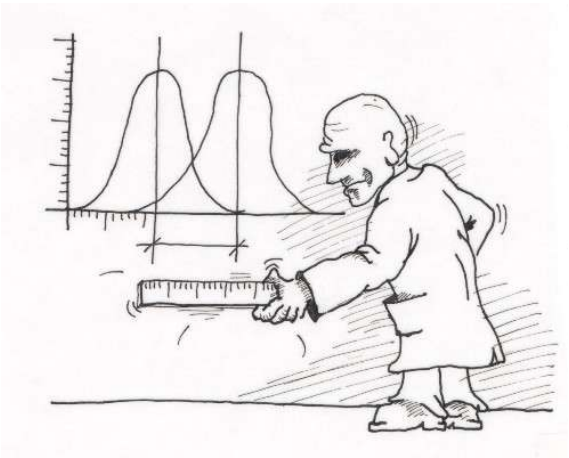
Data Preprocessing

- **Size Reduction of the Input Space:**



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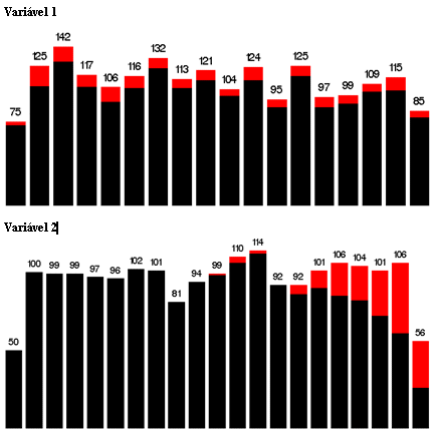
- **Size Reduction of the Input Space:**



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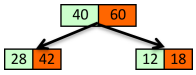
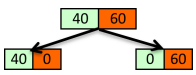
- **Size Reduction of the Input Space:**
  - Heuristic feature selection methods:
    - Best single features
      - Choose by information gain measures (e.g. entropy)
      - A feature is interesting if it reduces uncertainty



No improvement



Perfect Split

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Reducing Input Space

Redundancy

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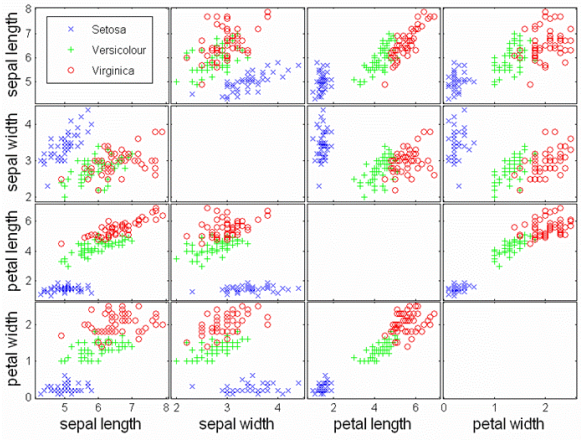
Data Preprocessing

- **Size Reduction of the Input Space:**



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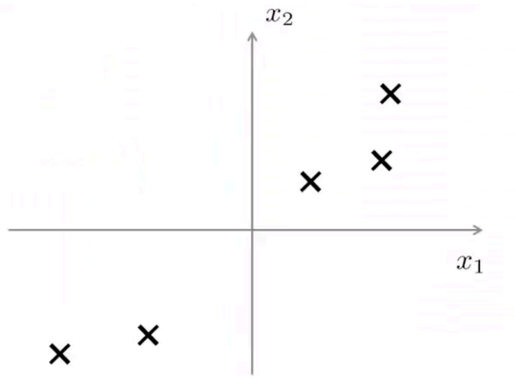
- **Size Reduction of the Input Space:**
  - Principal Component Analysis
    - A procedure that uses an **orthogonal transformation** to convert a set of observations of possibly correlated variables into a set of values of **linearly uncorrelated variables called principal components**.
    - The number of principal components is **equal to the number of original variables**.
    - This transformation is defined in such a way that the first principal component has the **largest possible variance** (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance.

- **Size Reduction of the Input Space:**
  - Principal Component Analysis



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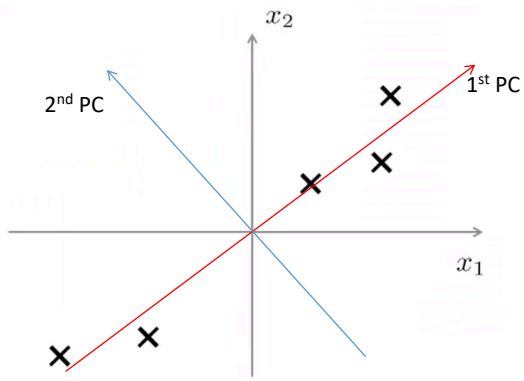
Data Preprocessing

- **Size Reduction of the Input Space:**
  - Principal Component Analysis



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Data Preprocessing

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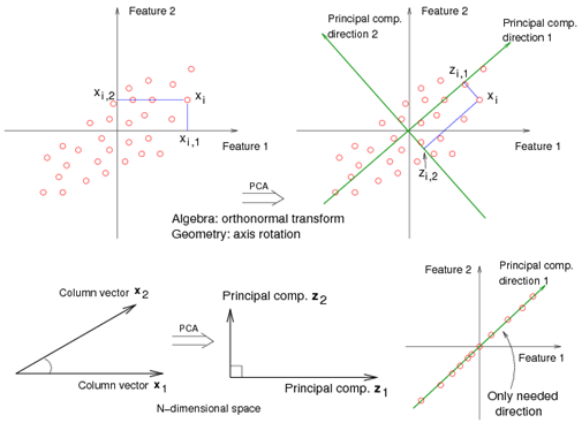

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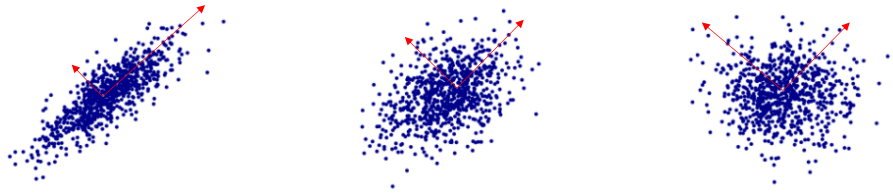
- **Size Reduction of the Input Space:**
  - Principal Component Analysis



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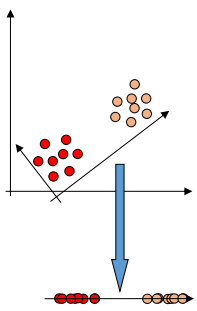
Data Preprocessing

- **Size Reduction of the Input Space:**
  - Principal Component Analysis (careful)



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Data Preprocessing

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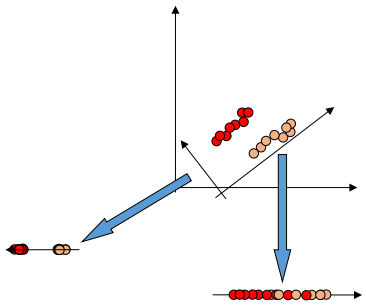

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Data Preprocessing

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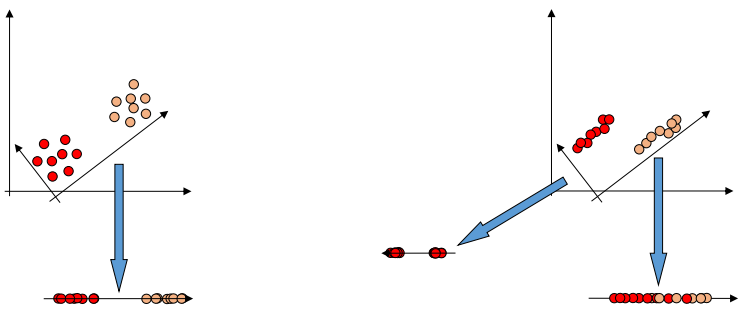
  - Principal Component Analysis (careful)



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Data Standardization

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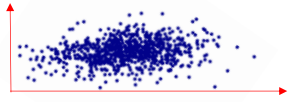
- **Normalization:**
  - Models assume that the distances in different directions of the input space have the same importance.
  - Variables come in many **different scales** (percentages, euros, kilos, meters, days…)
  - Normalization: is about adjusting values measured on different scales to a common scale



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- **Normalization:**
  - Min-Max $$y' = \left(\frac{y - \min 1}{\max 1 - \min 1} \right) \underbrace{(\max 2 - \min 2) + \min 2}_{\text{optional}}$$
  - Zscore $$y' = \frac{y - \mu}{std}$$

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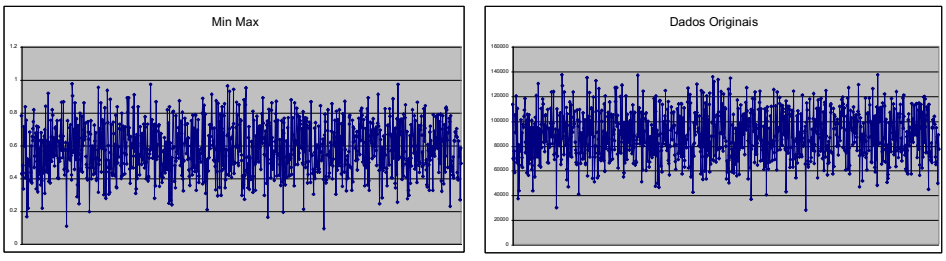
- **Normalization:**



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