SEGSys: A mapping system for segmentation analysis on energy consumption

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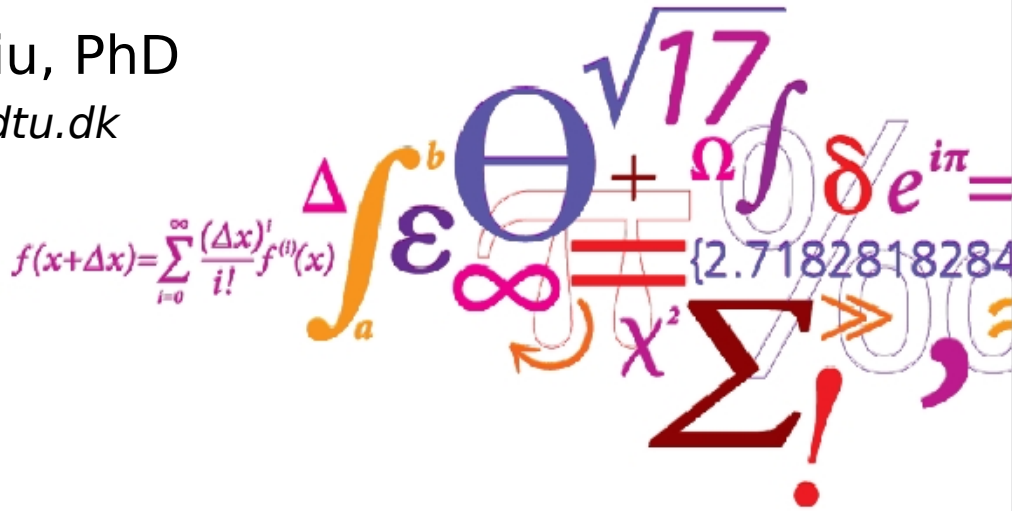

DTU Management Engineering
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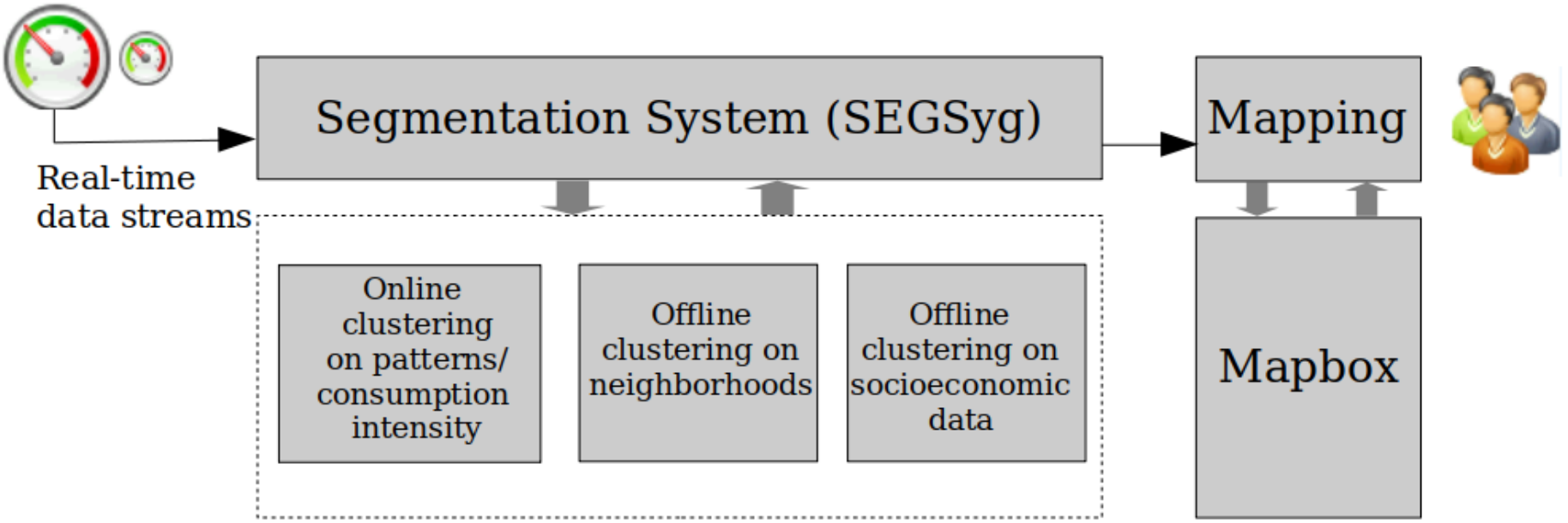
Introduction

- **Segmentation analysis is one of the most important features of Energy Managment System (EMS).**
  - Benefits to Utilities
  - Benefits to Customers

- **Segmentation analysis:**
  - Based on consumption intensity/pattern
  - Based on neighborhood
  - Scio-demographic factors
  - Others

System Architecture



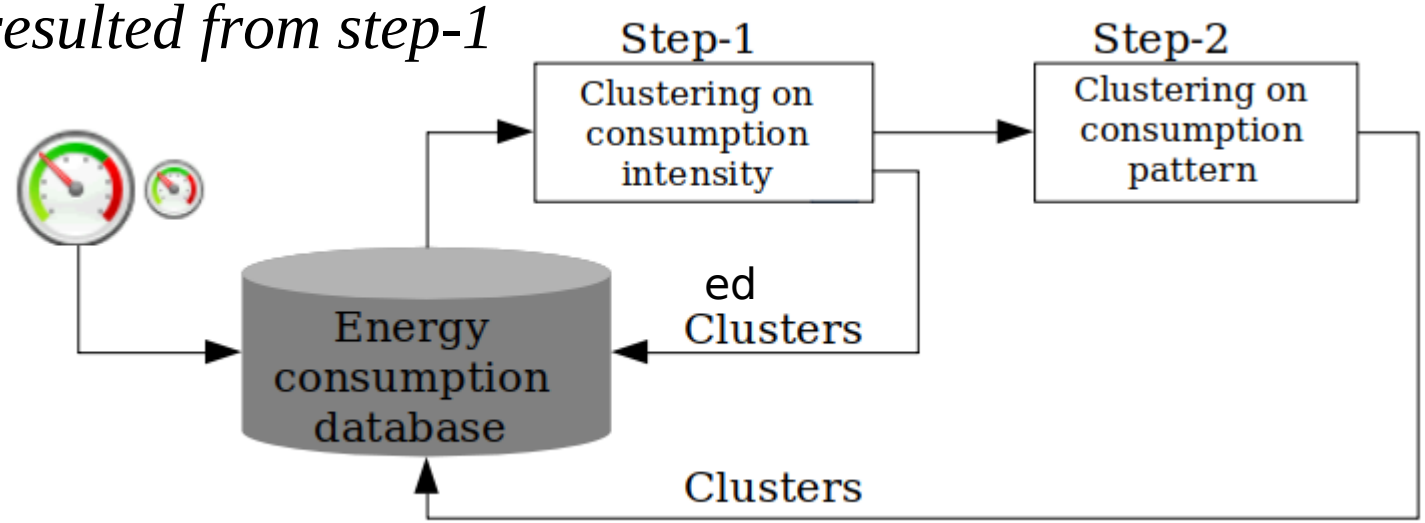
Segmentation based on consumption intensisty/patterns

- **A two-step segmentation method for energy con sumption intensity / pattern**

  - Use BIRCH clustering method

  - Segmentation on consumption intensity: *representitive load profiles at low/medium/ high consumption for individual household*

  - Segmentation on patterns on *normalized representative load profiles resulted from step-1*



Segmentation based on consumption intensisty/patterns

- **BIRCH Clustering**

$$CF = (N, \overrightarrow{LS}, \overrightarrow{SS})$$

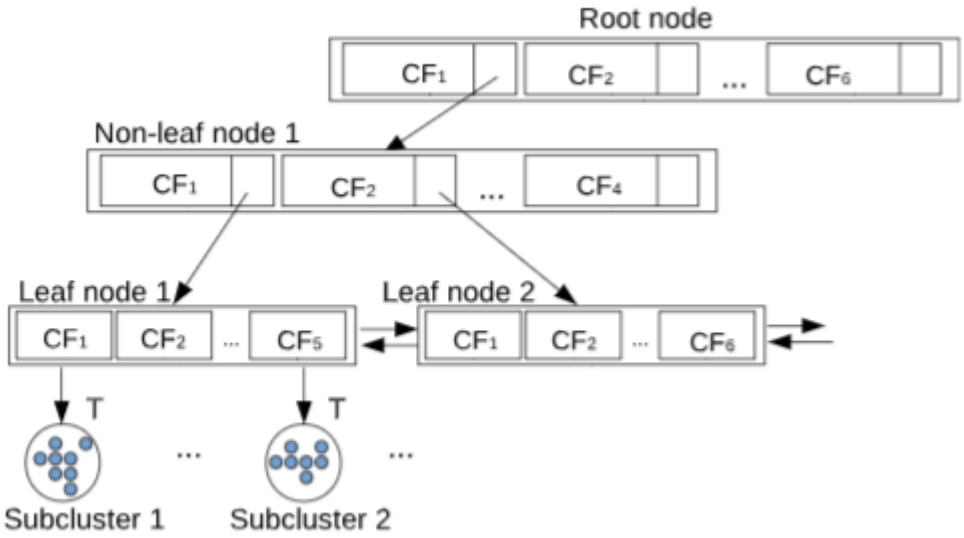
where

$$\overrightarrow{LS} = \sum_{i=1}^{N} \vec{X}_i$$

$$\overrightarrow{SS} = \sum_{i=1}^{N} (\vec{X}_i)^2$$

$$\vec{C} = \frac{\sum_{i=1}^{N} \vec{X}_i}{N} = \frac{\overrightarrow{LS}}{N}$$

$$R = \sqrt{\frac{\sum_{i=1}^{N} (\vec{X}_i - \vec{C})^2}{N}} = \sqrt{\frac{N \cdot \vec{C}^2 + \overrightarrow{SS} - 2 \cdot \vec{C} \cdot \overrightarrow{LS}}{N}}$$

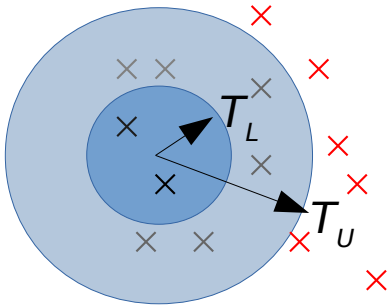


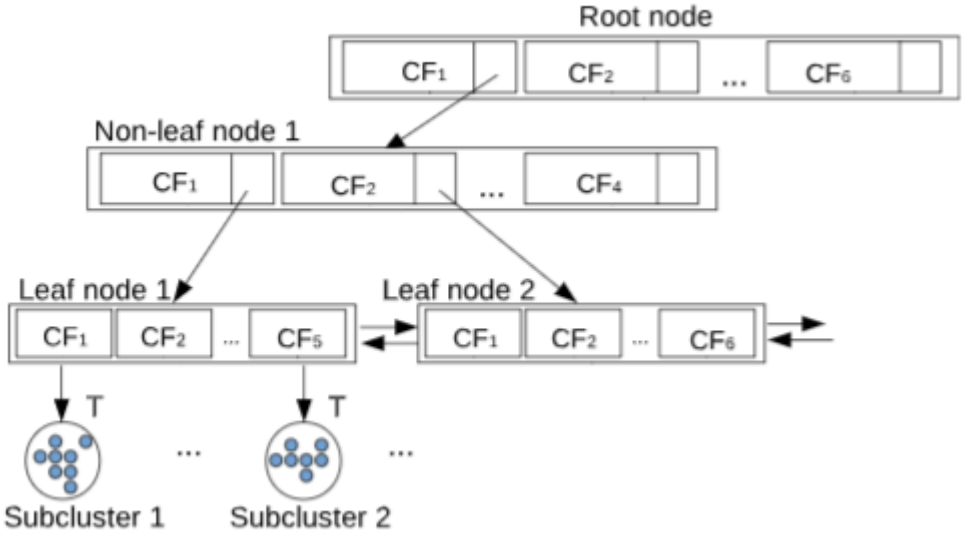
Segmentation based on consumption intensisty/patterns

- **BIRCH Clustering**

  - High performance
  - Low memory footprint
  - Process data when add a new data point:
    e.g., Extreme value detection

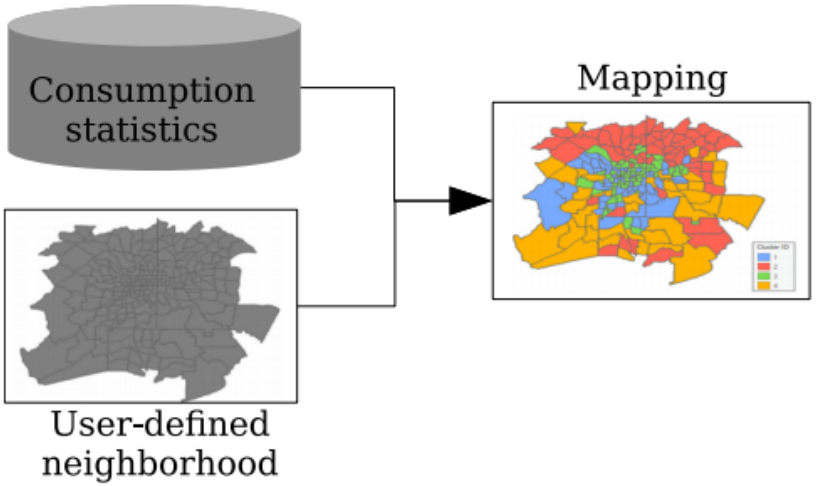
$$prob = \begin{cases} 0 & \text{if } D \le T_L \\ 1 & \text{if } D \ge T_U \\ \frac{D - T_L}{T_U - T_L} & \text{if } T_L < D < T_U \end{cases}$$





Segmentation based on neighborhood

- **User-defined neighborhoods**
  - Generate by online mapping tool
  - Third-party shapefiles
- **Compute energy consumption statistics segmented based on neighborhoods**
  - Measures: sum, mean, percentile, ...
  - Visualization:
    change over time



Segmentation based on scio-demographic factors

- **Compute energy consumption statistics segmented based on scio-demographic factors:**
  - Measures: sum, mean, percentile, ...
  - Segmented by:
    a) household characteristics: size, type, age, ..
    b) dwelling characteristics: area, type, year, ..
    ...

Demo of the prototype system

- **Demo**

Q & A