Decomposing Activities of Daily Living to Discover Routine Clusters

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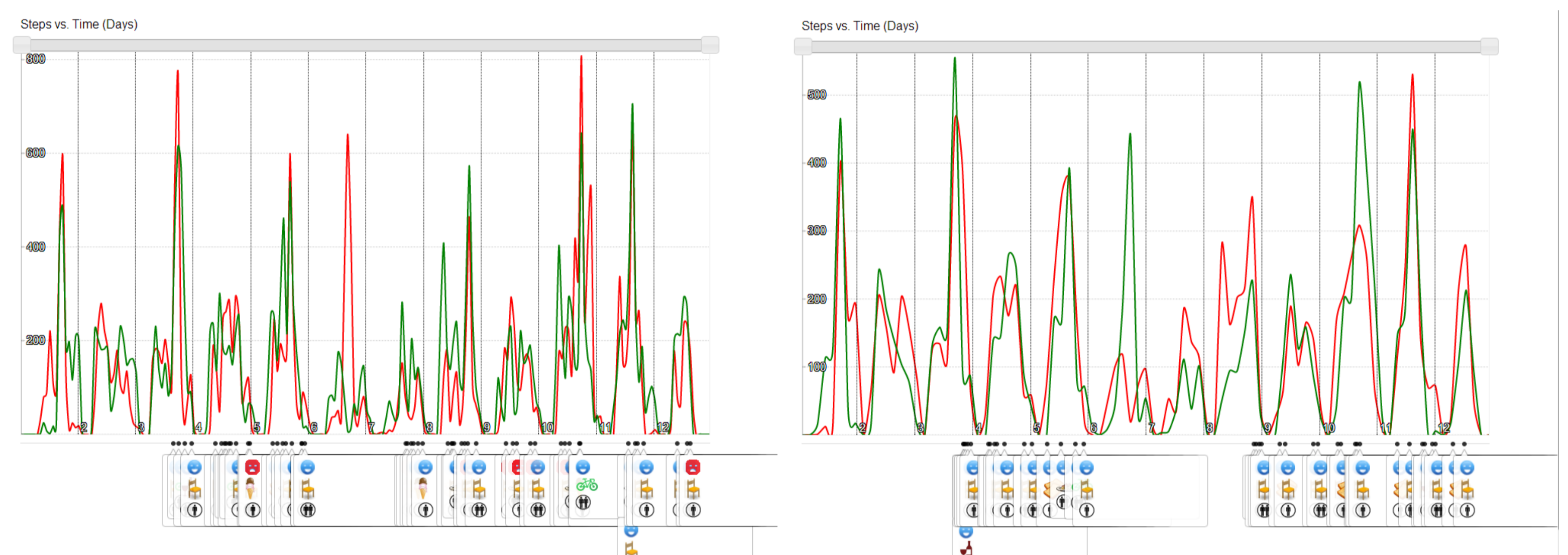FÉDÉRALE DE LAUSANNE

Objectives

- Gain insight from activities on a macro scale
- Capture common routines for elaborate statistical analysis
- *Provide directions for delivering personalized recommendations with lifestyle recommenders*
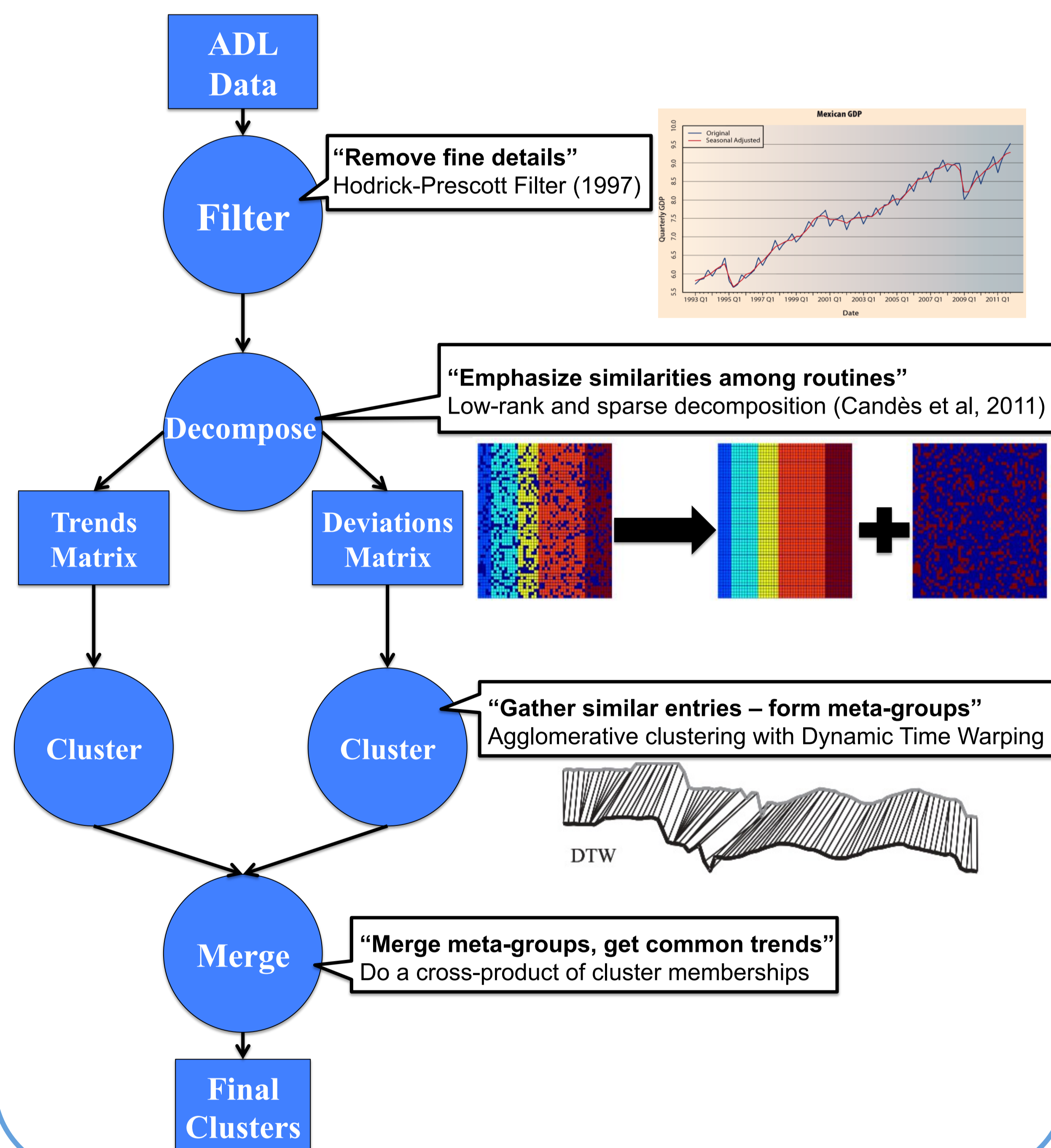
Motivations

People adopt routines:

- **Minor** differences, **major** similarities each day.
- Possibility to describe common characteristics: Early-morning people, night people, hikers, daily commuters,…

Trends of some example people that resemble their "exercise buddies":

Method

ADL Data

Filter — "Remove fine details" Hodrick-Prescott Filter (1997)

Decompose — "Emphasize similarities among routines" Low-rank and sparse decomposition (Candès et al, 2011)

Trends Matrix — Deviations Matrix

Cluster — Cluster — "Gather similar entries – form meta-groups" Agglomerative clustering with Dynamic Time Warping

DTW

Merge — "Merge meta-groups, get common trends" Do a cross-product of cluster memberships
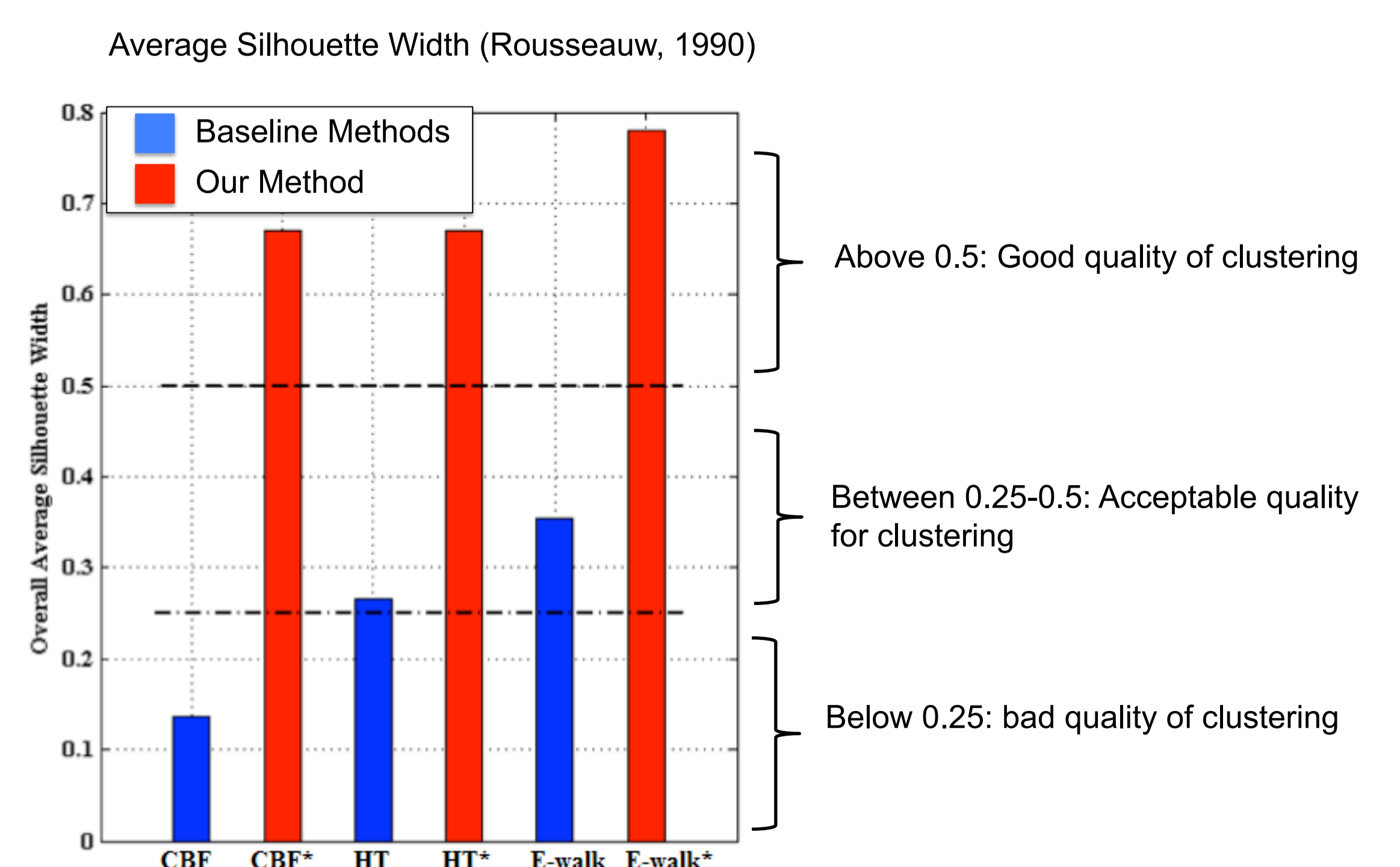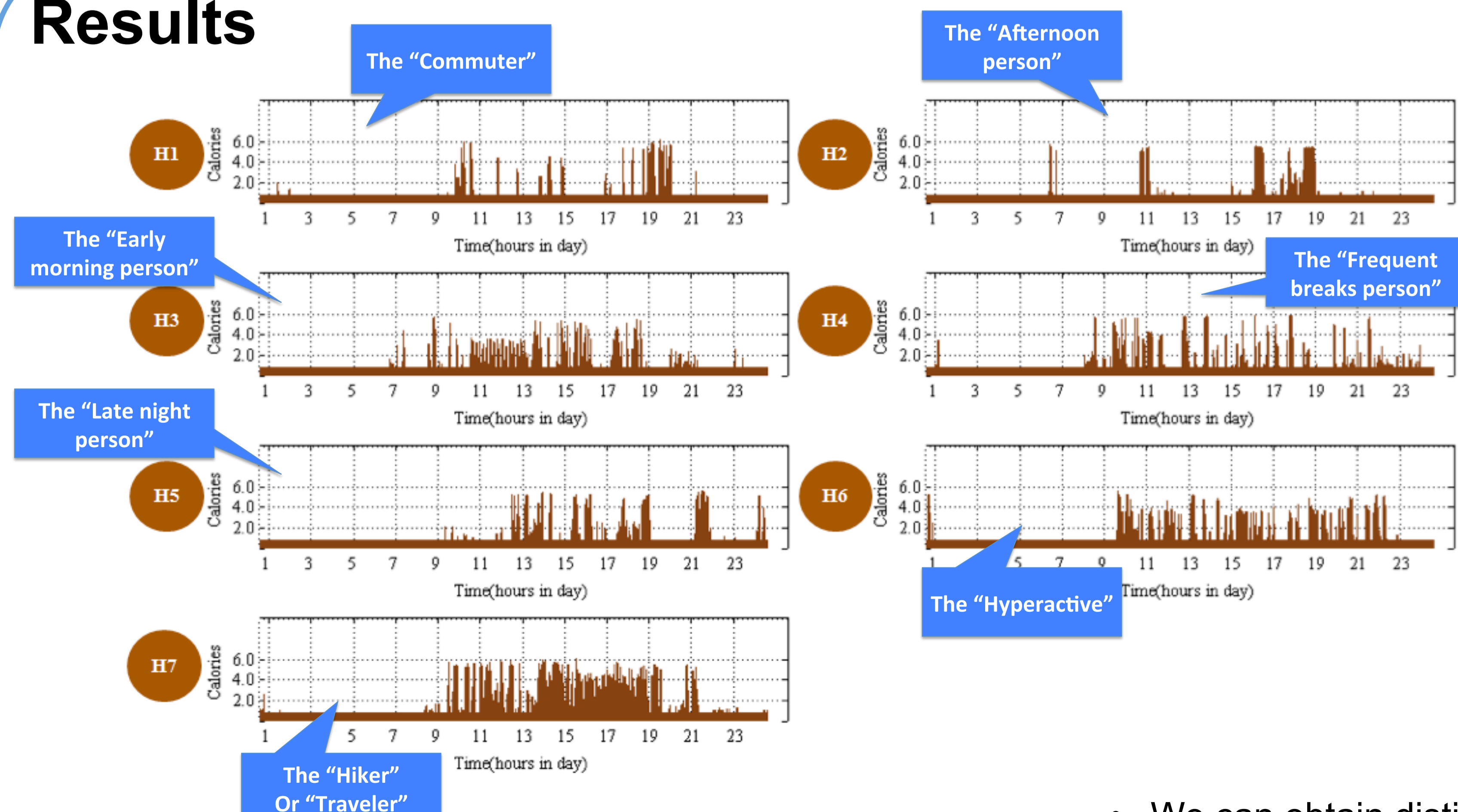
Final Clusters

Datasets

- **Cylinder-Bell-Funnel** (Keogh and Kasetty, 2002)
  - 256 artificial entries, 256 data points for each entry

- **HealthyTogether** (Chen and Pu, 2014)
  - 480 days of calories; 1440 data points for each day

- **E-Walk**
  - 236 people's steps over a month; 30 data points for each person

Results

The "Commuter" — H1
The "Afternoon person" — H2
The "Early morning person" — H3
The "Frequent breaks person" — H4
The "Late night person" — H5
H6 — The "Hyperactive"
H7 — The "Hiker" Or "Traveler"

Average Silhouette Width (Rousseauw, 1990)

Baseline Methods / Our Method

Above 0.5: Good quality of clustering
Between 0.25-0.5: Acceptable quality for clustering
Below 0.25: bad quality of clustering

CBF CBF* HT HT* E-walk E-walk*

SUMMARY:
- We can obtain distinct and meaningful clusters of common activity routines
- Specialized recommendations can be tailored for each common routine