Exploring sequences with VISUAL-TimePAcTS

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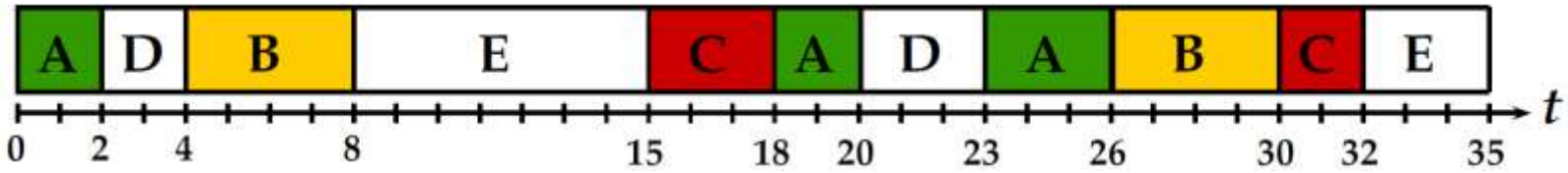
LiU expanding reality

Focus on sequences

Introduction
Background
VISUAL-TimePAcTS
Highlighting
Mining
Exploring
Clustering
Conclusions

- Event-sequence data
- Composed of sequences of ordered events
- Exact or relative time



time use data

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Sequences in everyday life

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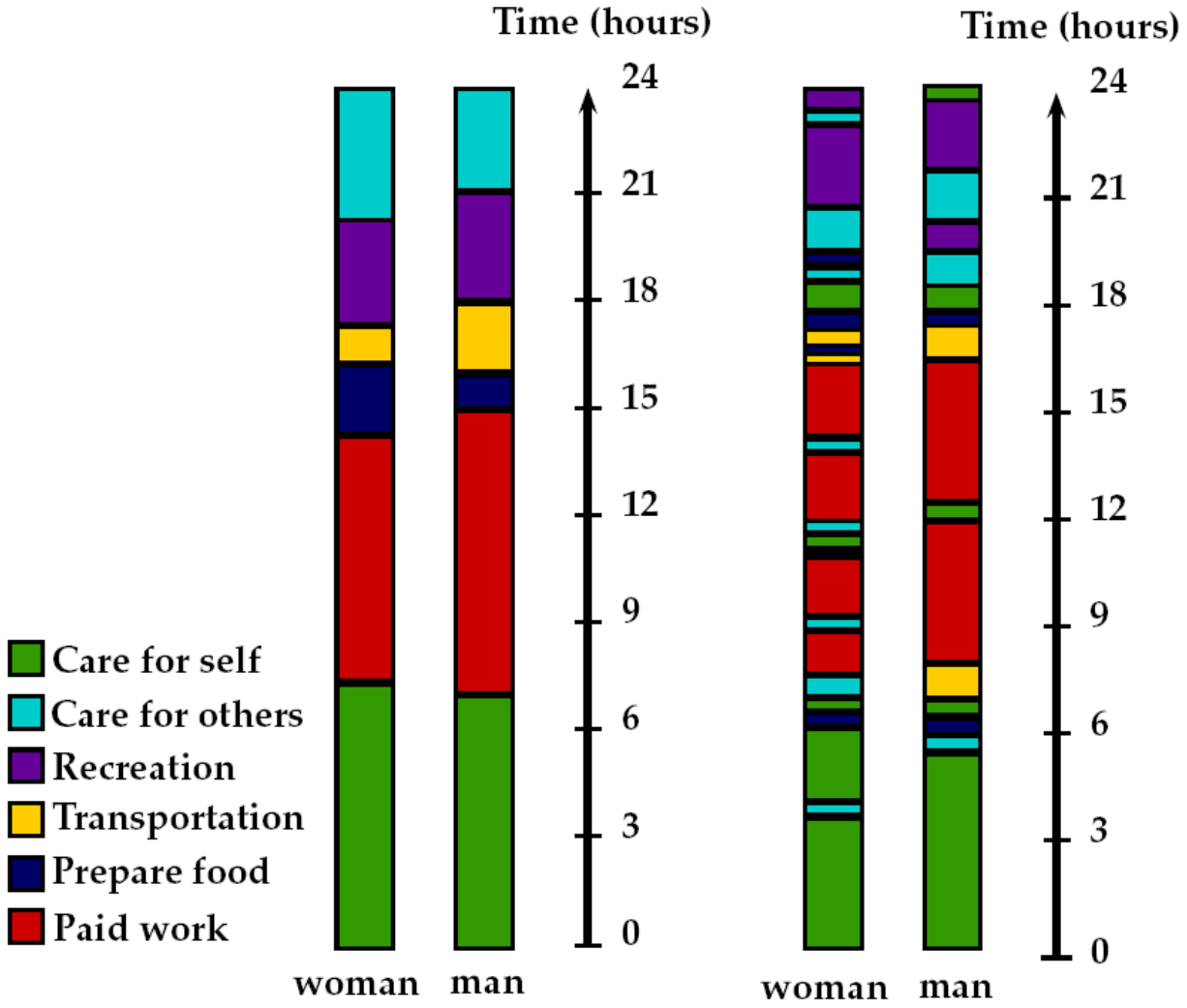

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Analysis task

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- Communicate data
- Compare sequences
  - Content, structure
- Identify patterns
  - Combinations of activities exhibiting interesting behaviour
  - Frequent, evenly distributed, repetitive, outliers
- Compare and visually analyse pattern distribution
- Classify, predict

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VISUAL-TimePAcTS

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Conclusions

- **VISUAL**ization
- **Time**
- **P**lace
- **Ac**tivities
- **T**echnologies
- **S**ocialization

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VISUAL-TimePAcTS

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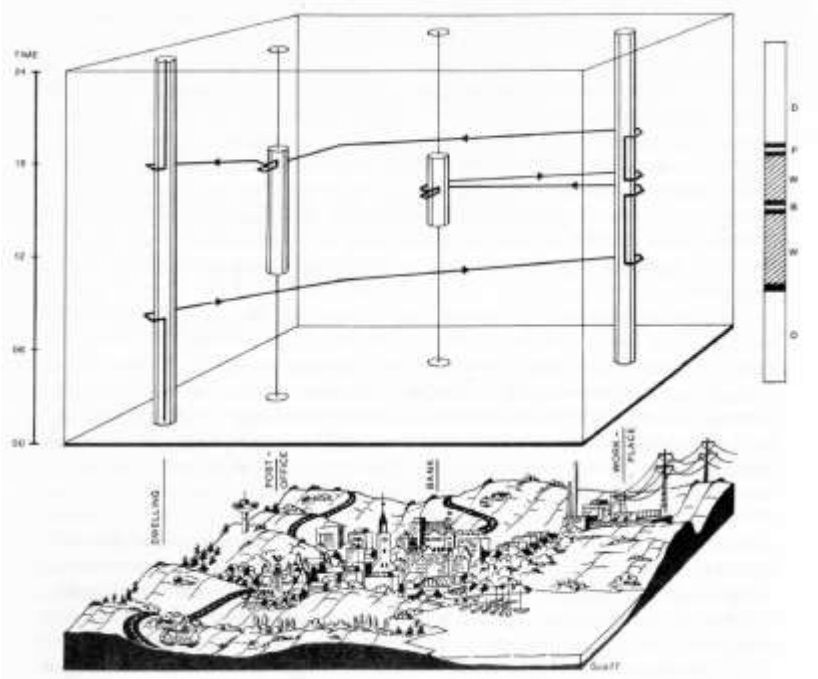
- *Algorithmically guided visual analysis* tool for
  - exploring event-sequences; time use data and
  - detecting sequential patterns
- Time-geographic approach and representation
  - Focus on individual
  - Activity path
- Testbed for research



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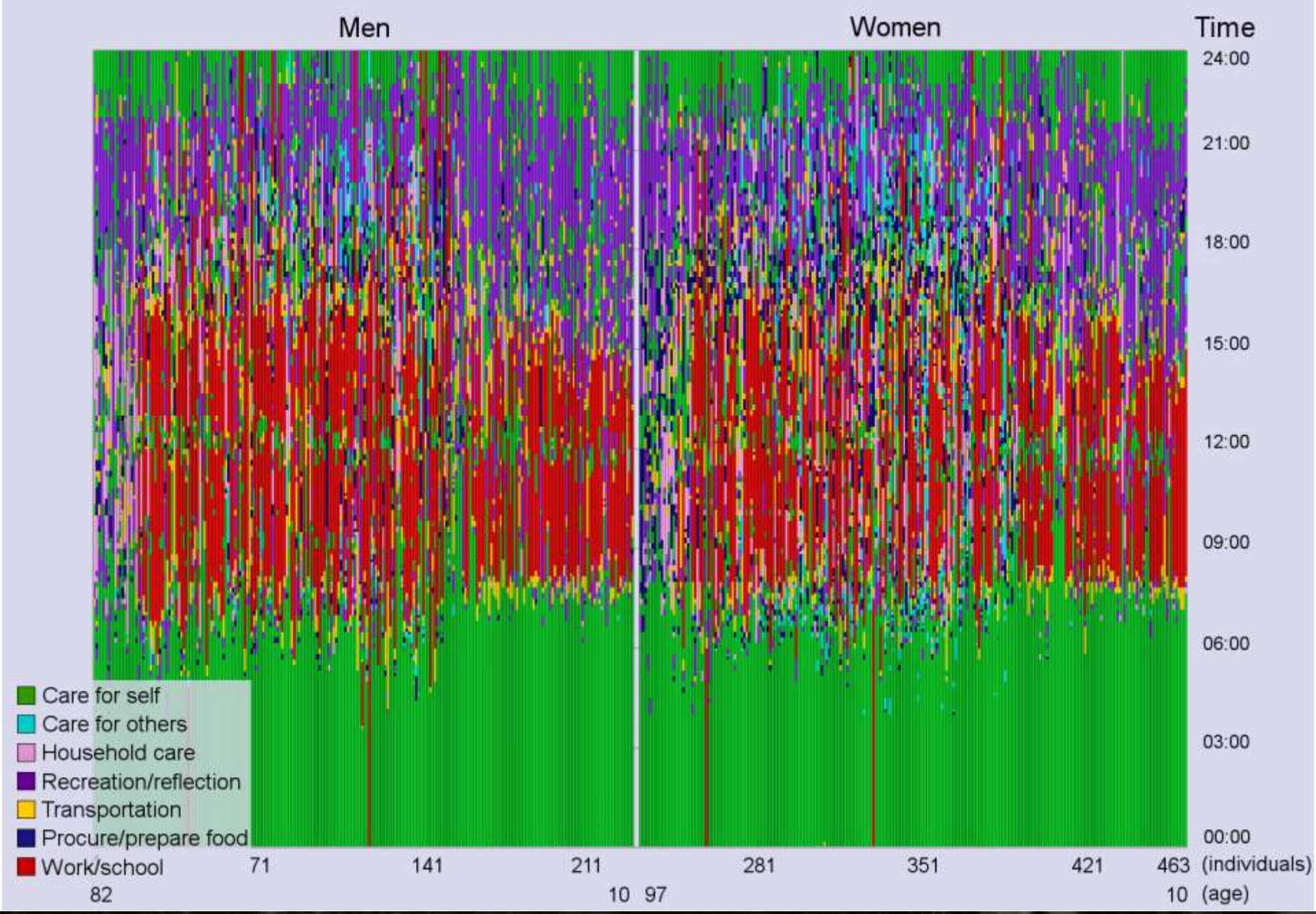
Men
Women
Time
24:00
21:00
18:00
15:00
12:00
09:00
06:00
03:00
00:00
Care for self
Care for others
Household care
Recreation/reflection
Transportation
Procure/prepare food
Work/school
71
141
211
281
351
421
463
(individuals)
82
10
97
10
(age)

Overview

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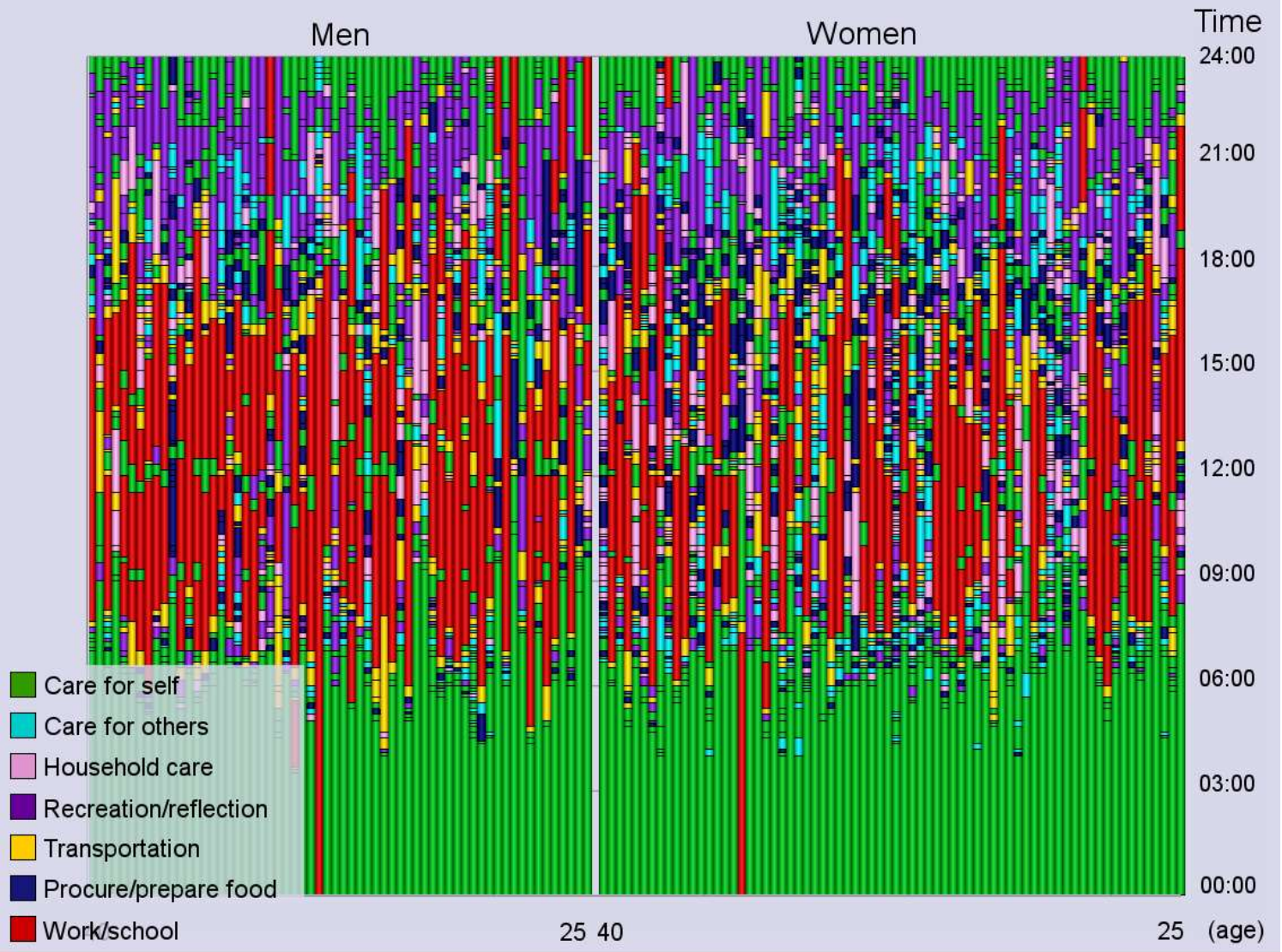

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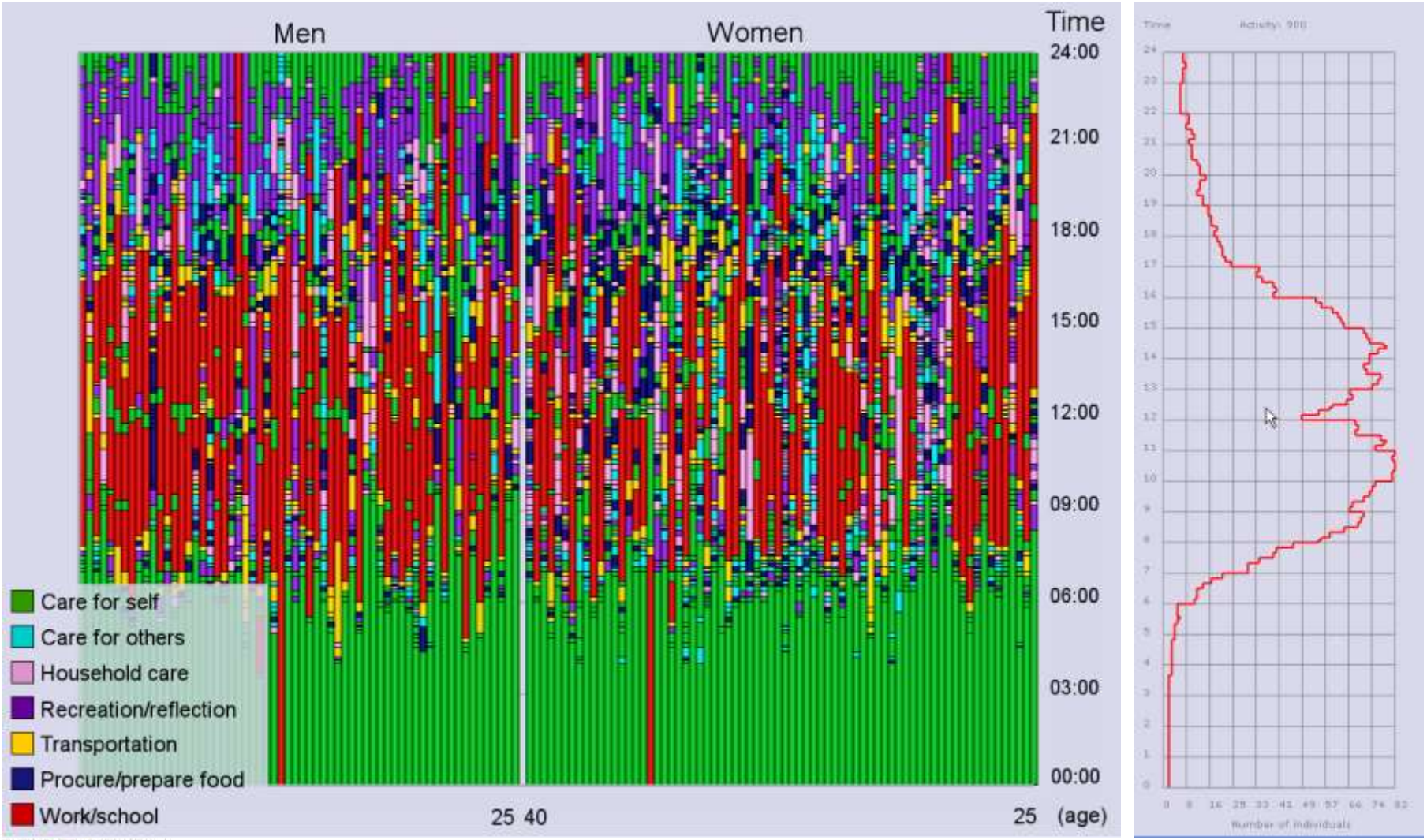
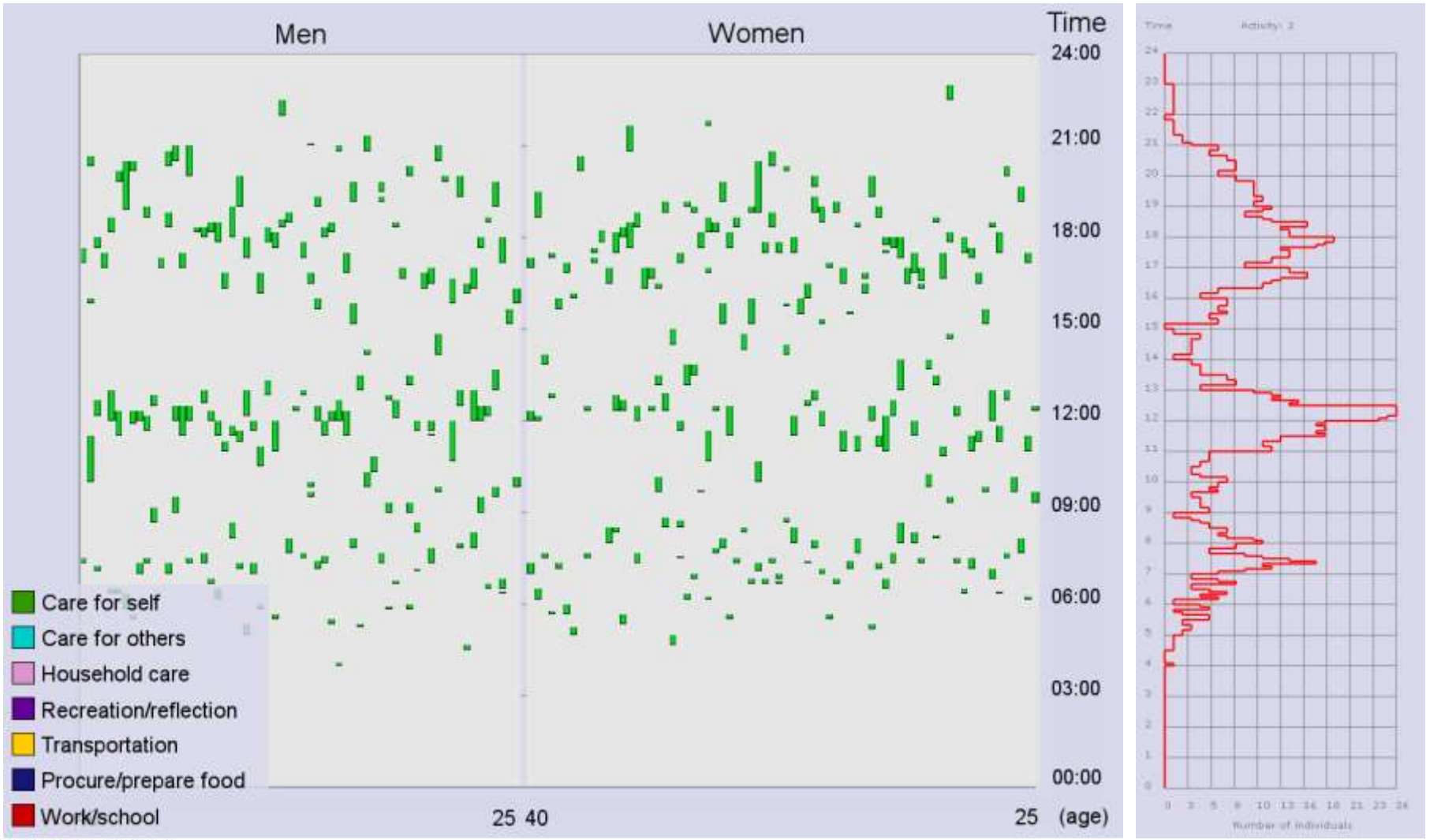
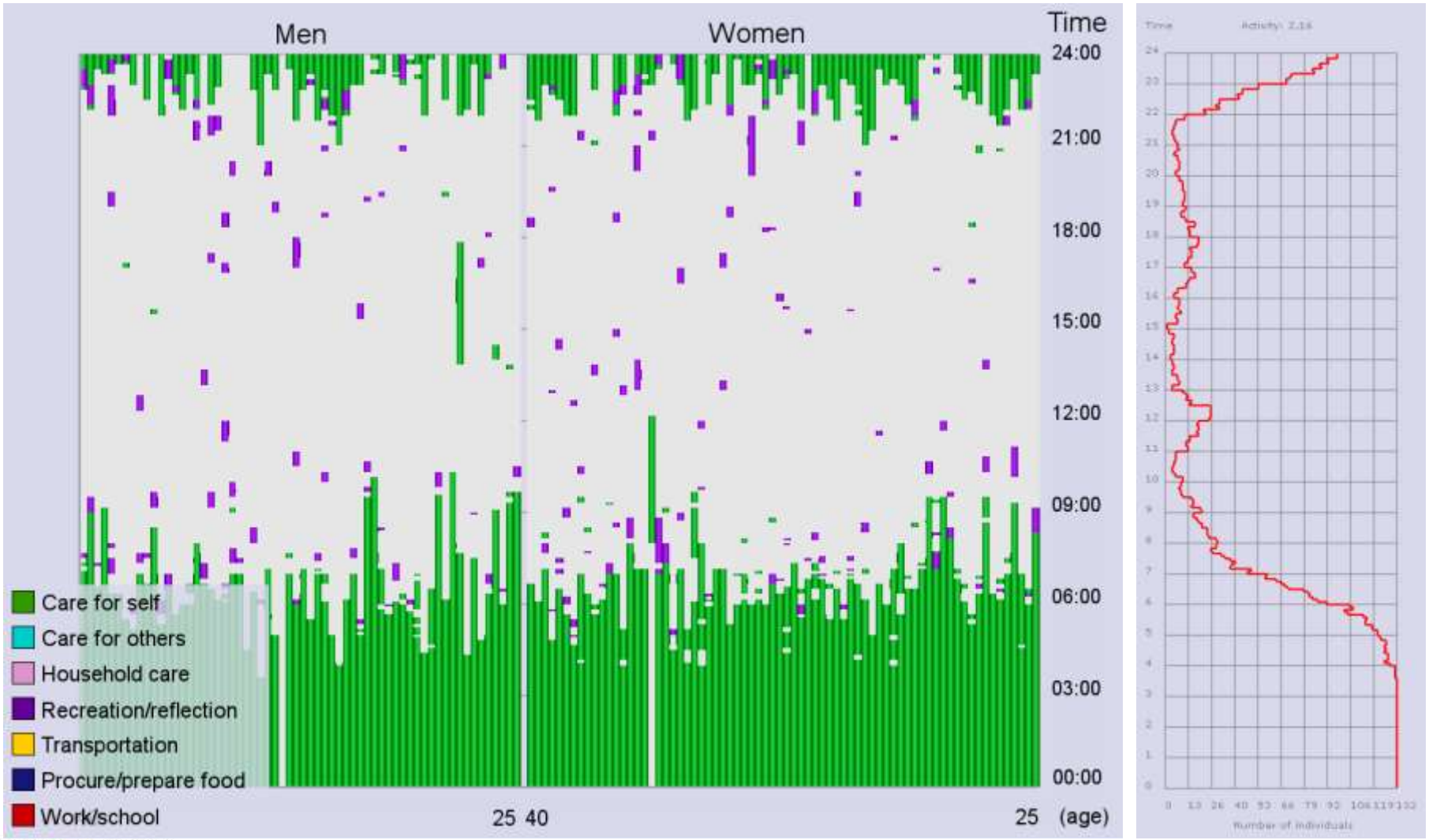
Highlighting



Highlighting



Highlighting



Sequential pattern mining

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- *Sequential pattern*: interesting sub-sequence of activities
  - Activities belonging to same project or practice
- *Sequential pattern mining*: Given a database of time diaries (sequences of activities performed during the day), the problem of sequential pattern mining is to discover all sequential patterns that have a user-specified minimum support, defined as the number of customer-sequences that contain this pattern.
- Detect
  - Interesting behaviour
  - Trends

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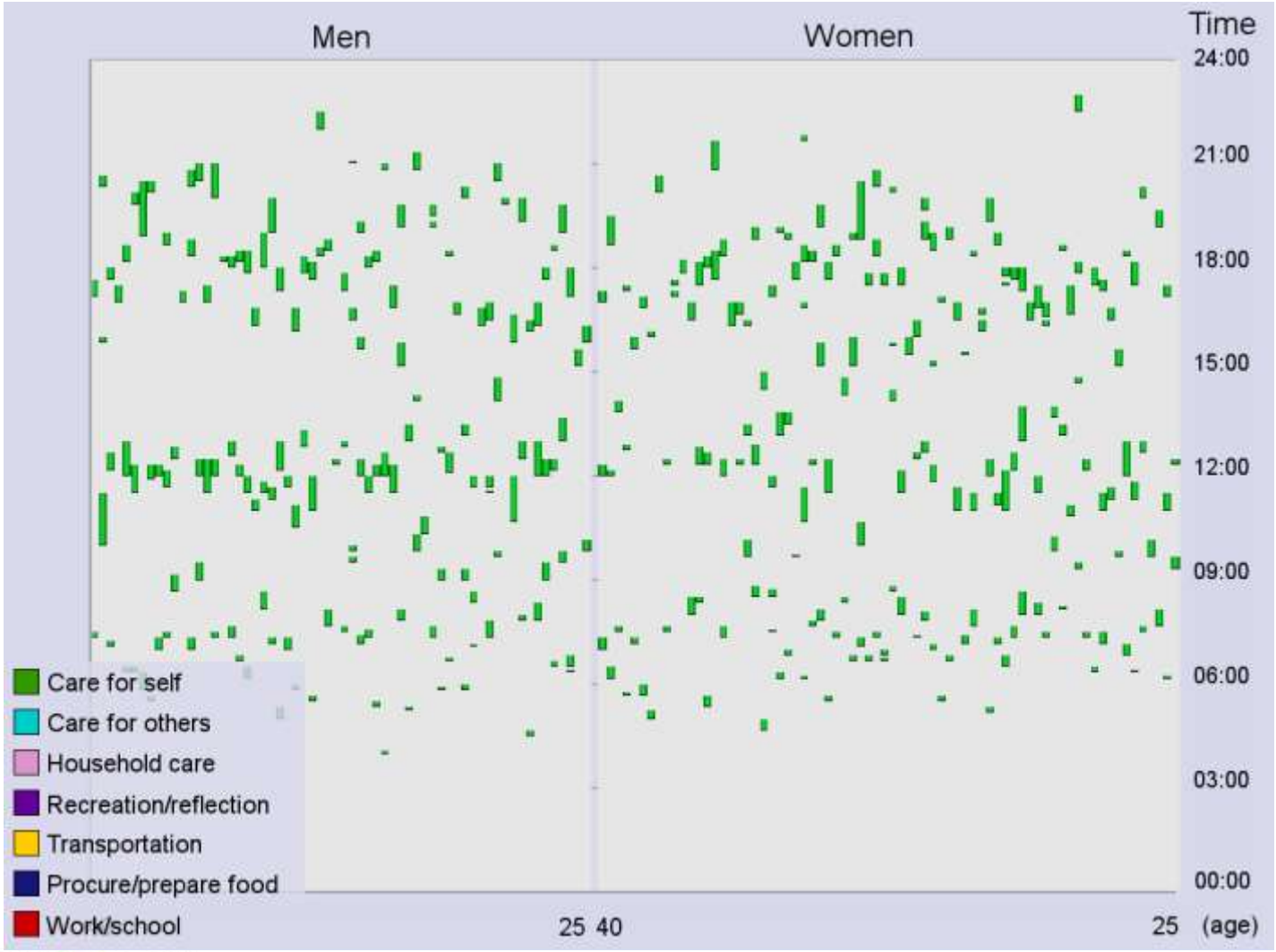
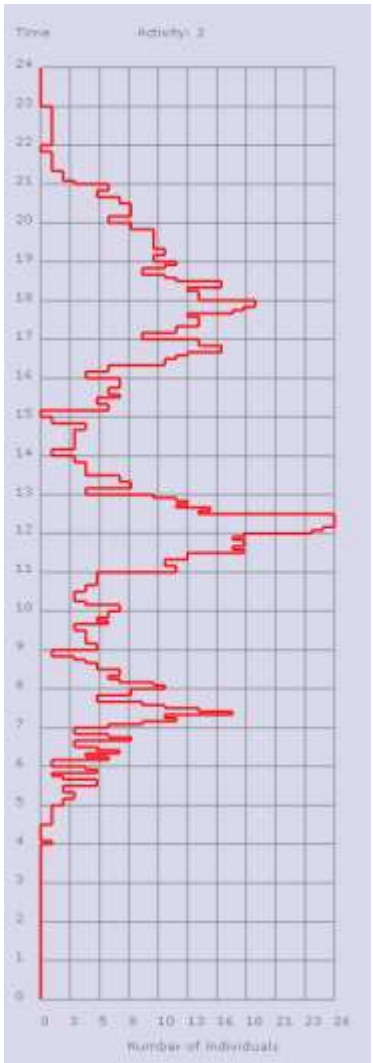
Sequential pattern mining





Sequential pattern mining

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- *Apriori approach*
  - Bottom up
  - Candidate generation
  - Pruning
  - *n*-patterns iteratively
  - In VISUAL-TimePAcTS
- *Pattern growth approach*
  - Divide and conquer
  - Compress database into fp-tree
  - No candidate generation
  - Currently developed

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Interactive exploration

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- Tree inspired exploration tool
- Systematic identification of sequences
- Graph similarity approach
- Using algorithm for web searching
- Exploration controlled by user

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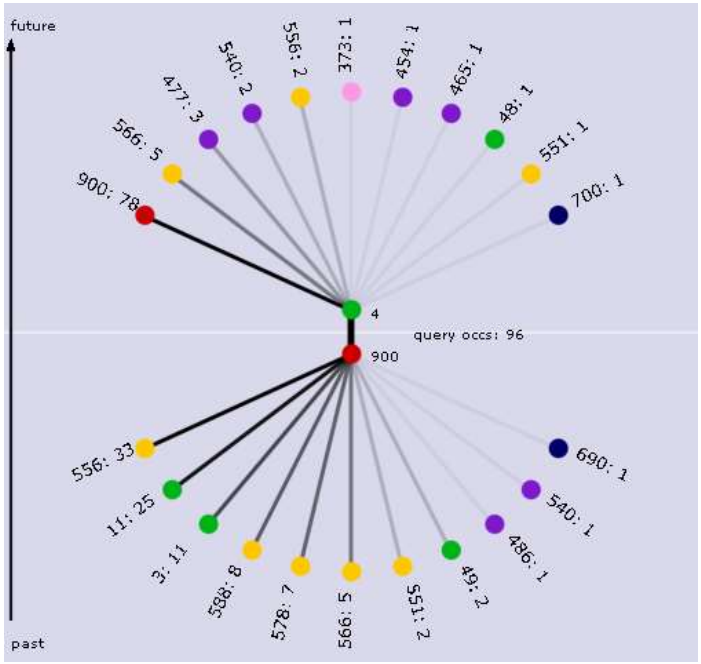
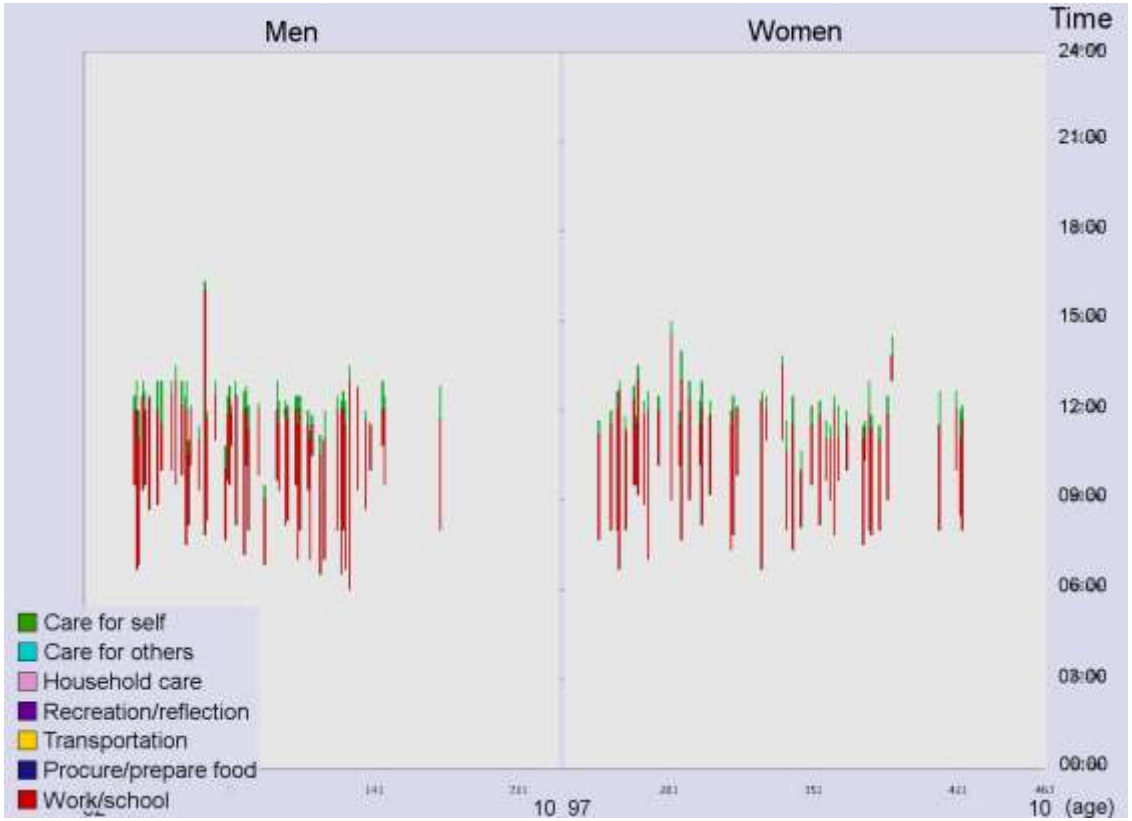
Interactive exploration





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Clustering

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- Given an interesting sequence pattern
  - i.e. interesting behaviour, practice
- Identify similarly behaving groups
  - How practice is performed

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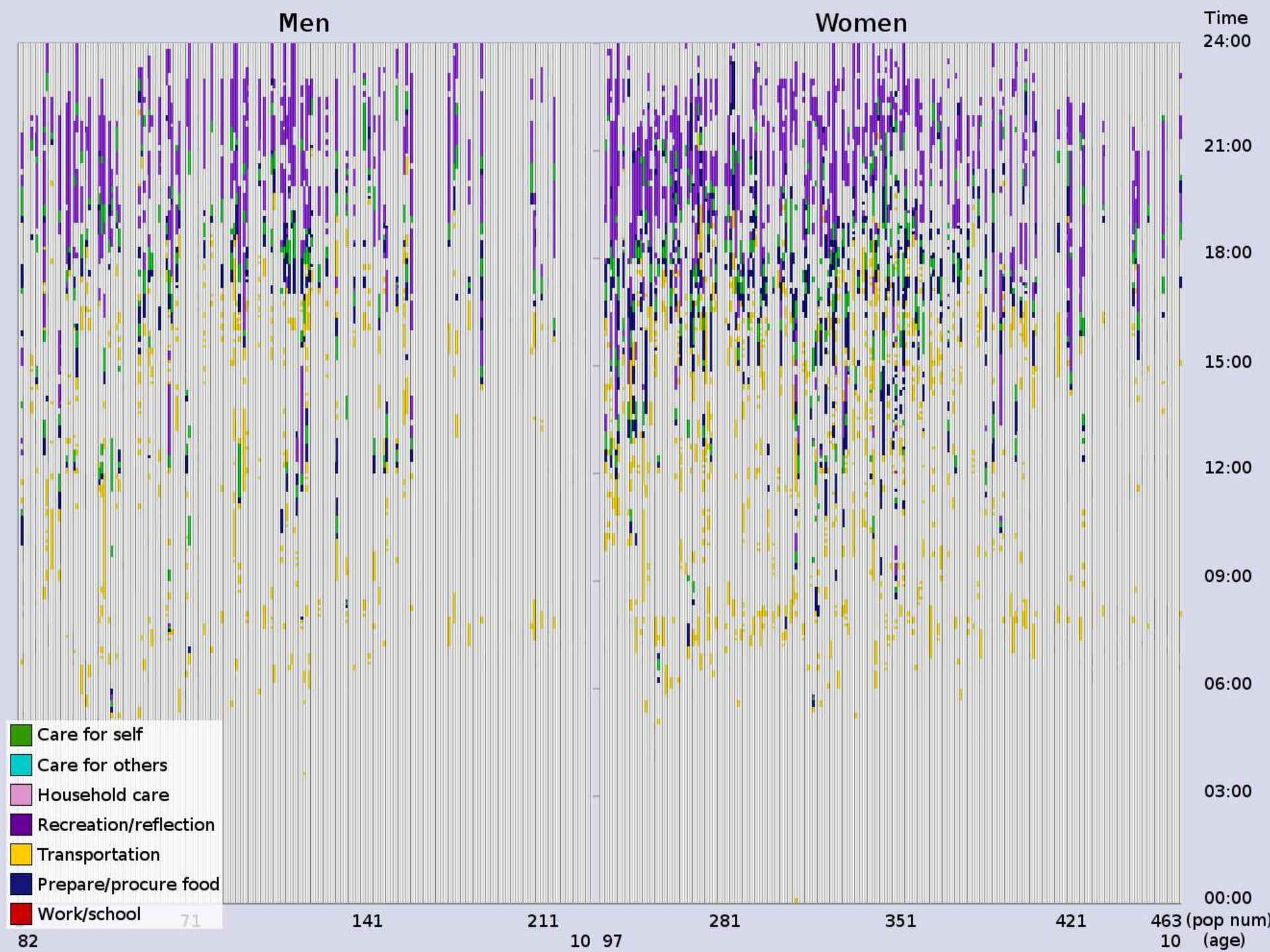
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03:00
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463 (pop num)
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Clustering

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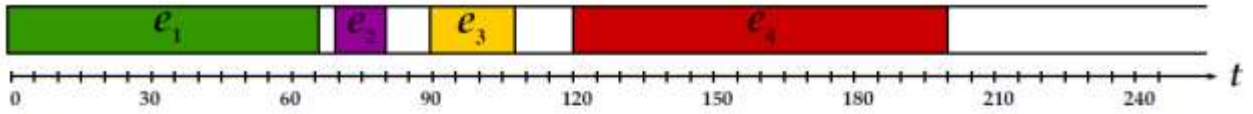
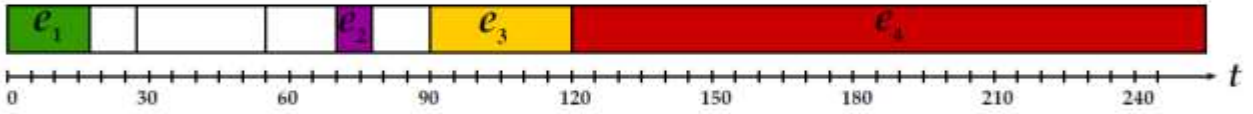
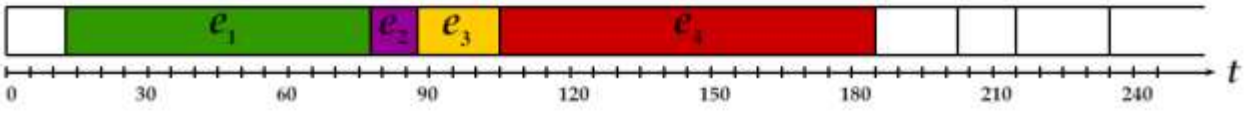


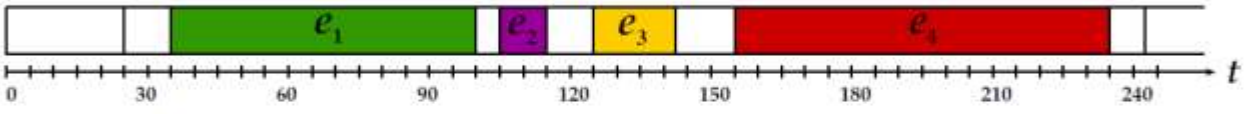
(a) Reference sequence containing the sub-sequence e_1, e_2, e_3, e_4 against which the other are compared.



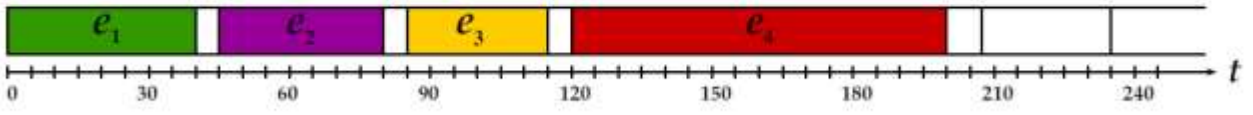
(b) The start times of the sub-sequence events are equal to the reference, their duration and intervening periods differ.



(c) The duration of each of the sub-sequence events is the same, their start times and the intervening periods differ.



(d) The sub-sequence is identical to the reference but is displaced in time.



(e) The total sub-sequence has equal duration to the reference, but the distinct events have different start times and durations.

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Similarity measures

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1. Fragmentation
2. Variation
3. Number of occurrences
4. Sequence start time
5. Sequence duration
6. Events duration
7. Gap size
8. Gap duration
9. Gap type

Record measures

Query-match measures

Gap measures

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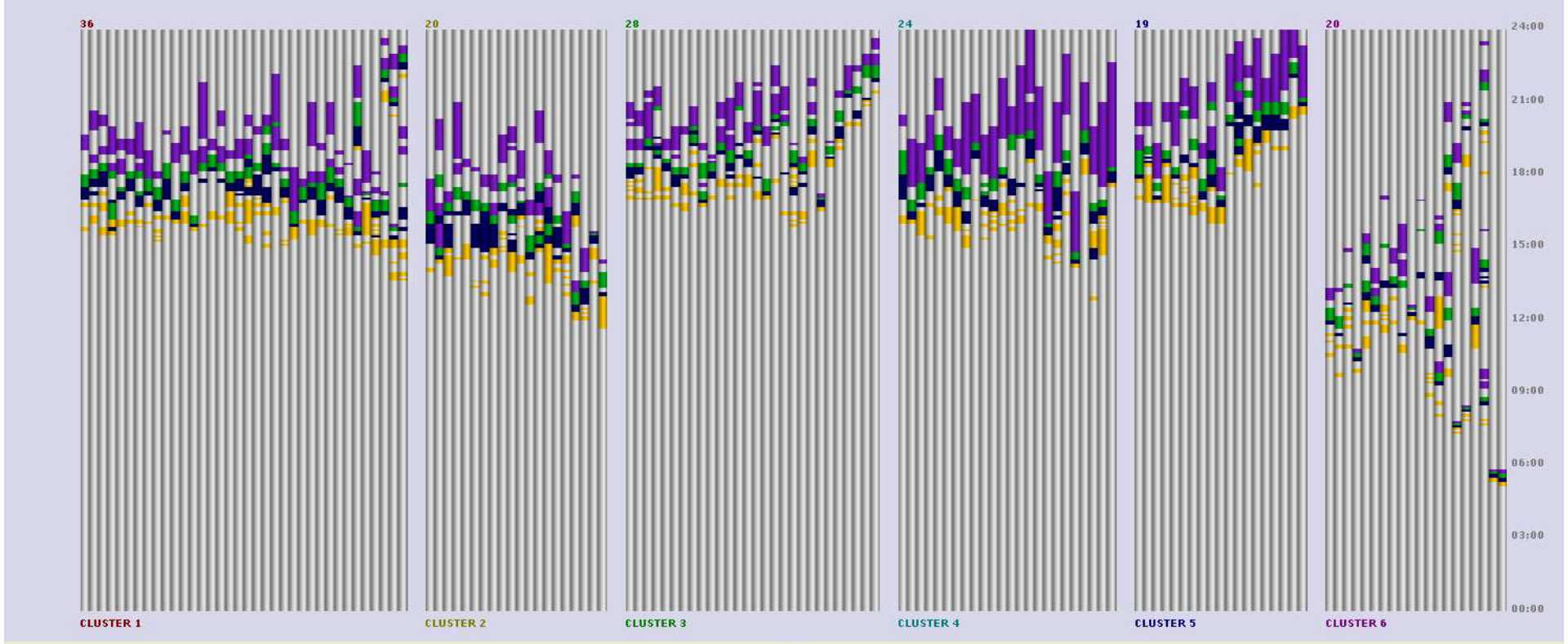
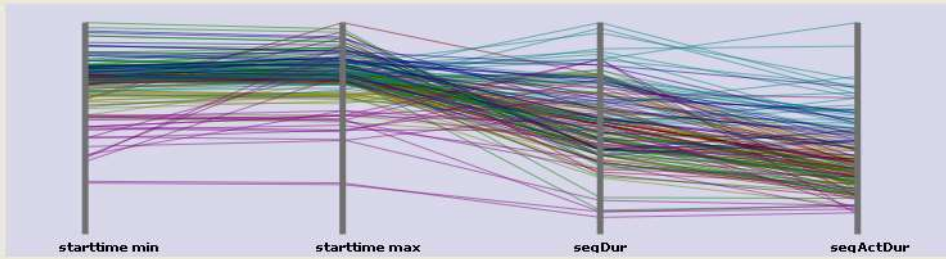
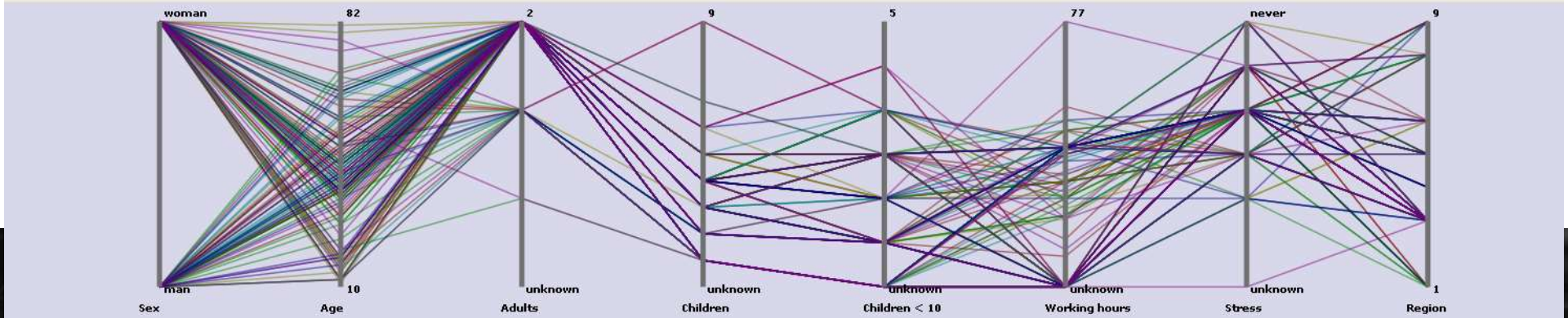

36
20
28
24
19
20
24:00
21:00
18:00
15:00
12:00
09:00
06:00
03:00
00:00
CLUSTER 1
CLUSTER 2
CLUSTER 3
CLUSTER 4
CLUSTER 5
CLUSTER 6


CL 6
CL 5
CL 3
CL 4
CL 2
CL 1
BAD
GOOD
starttime min
starttime max
seqDur
seqActDur


starttime min
starttime max
seqDur
seqActDur


woman
man
Sex
82
10
Age
2
unknown
Adults
9
unknown
Children
5
unknown
Children < 10
77
unknown
Working hours
never
unknown
Stress
9
1
Region

Currently ongoing project

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- Data collection (PODD)
- Change in high-dimensional temporal data
  - Domain expertise in focus
- Interactive sequence mining
  - Domain expertise in focus
- Similarity of activities – activity landscapes

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Thank you!

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