Sequential plugins

Strings, Chains, Sequences, Intervals

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Sequences

Sequences are built from a set of elements of the same type called **Alphabet**

For example, DNA is composed of a succession of nucleotides. There are four different nucleotides that constitute the alphabet,

$\Sigma = \{adenosine\,(A),\ cytidine\,(C),\ guanosine\,(G),\ thymidine\,(T)\}$.

Sequential plugins

Sequences

Sequential plugins are developed for the **GALACTIC** framework to mine sequential data.
We distinguish 3 types of plugins.

Characteristics

Descriptions

Strategies

characteristics

Characteristics

Characteristics define the types of data taken for analysis. For example, binary data, numeric, sequential ... etc.

We have implemented four plugins that represent four types of sequential data:

Strings	$a_1 a_2 \dots a_n$
Chains (sequences)	$[a_1, a_2, \dots, a_n]$
Temporal sequences	$[(t_1, a_1), (t_2, a_2), \dots, (t_n, a_n)]$
Interval sequences	$[((\underline{t}_1, \overline{t}_1), a_1), ((\underline{t}_2, \overline{t}_2), a_2), \dots, ((\underline{t}_n, \overline{t}_n), a_n)]$

Descriptions

A description δ is an application which provides predicates describing a set of objects $A \subseteq G$ according to their characteristics.

Depending on the characteristics, We have implemented some descriptions that use predicates of several types "*subsequence* of", "*super-sequence* of", etc.

Descriptions	Predicates
Simple	Maximal common K-subsequences
Complete	Maximal common subsequences
Affix	Maximal subsequences: prefix-suffix
Distance	Maximal subsequences with distances
Time Frame	Maximal subsequences and minimal supersequences

Strategies

A strategy σ refines a concept $(A, \delta(A))$ into subconcepts composed of a reduced set of objects $A' \subset A$ described by bigger subsequences $\delta(A) \sqsubseteq \delta(A')$. It corresponds to the generation of immediate predecessors in the lattice.

- Simple: with generation of all possible sub-sequences.
- Augmented: with generation of subsequences by adding an item of the alphabet to the predicates of the description.
- Distance: based on the distances between elements of the sequences.
- Alphabet: for the description of super-sequences; an element of the alphabet is removed each time.

Wine City

- This dataset is coming from the Wine City museum
- Gathered from the visits on a period of one year (May 2016 to May 2017).
- This dataset has been cleaned and processed before.
- Visitors navigate from modules to modules exploring the museum.
- The museum is open, and they are not “Guided”.

Wine City

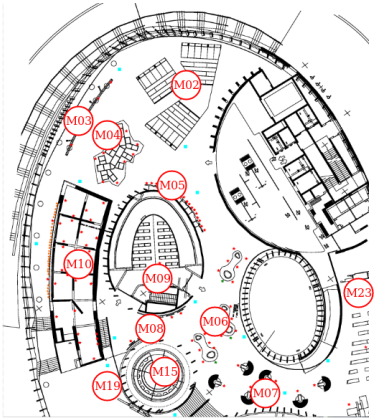
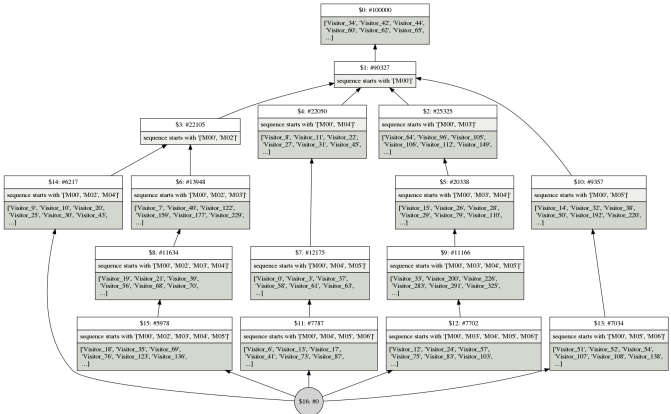


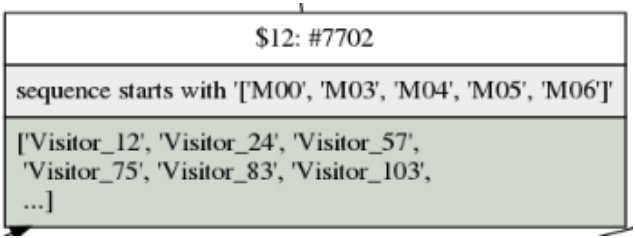
Figure 1: Modules location in the museum

Wine City with prefix match

Using LimitFilter strategy with support = 5000 (100000 visitor)



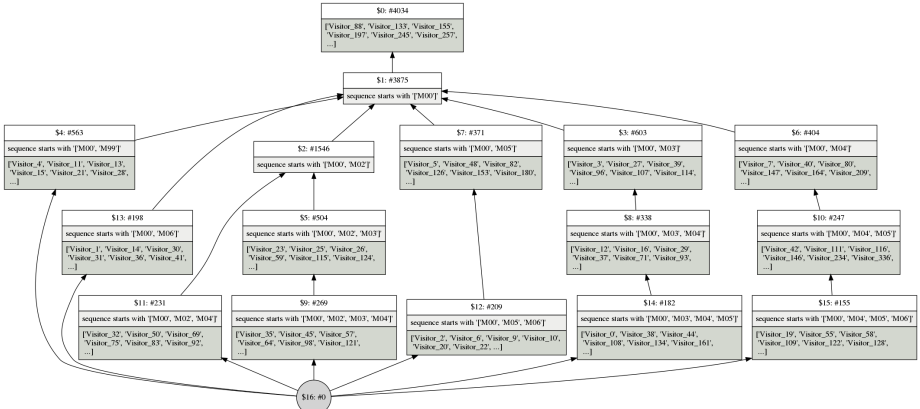
Wine City with prefix match



7% of visitors starts with M00 M03 M04 M05 M06

Wine City with prefix match

LimitFilter strategy with support = 150 (~9000 visitor)



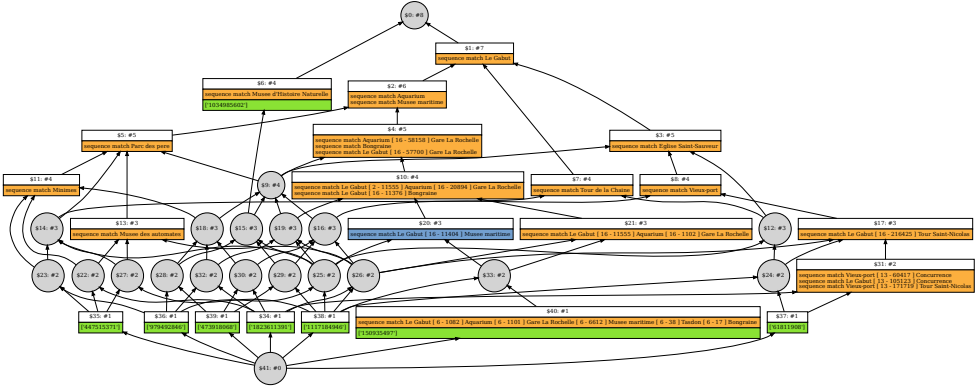
GéoLuciole

- GPS trajectories of people's movements in the city of La Rochelle in France.
- The data have been collected by a specific application named *GéoLuciole*, developed for the DA3T[2] project.
- 20 trajectories.

[2]System for the Analysis of Numerical Traces for the development of Tourist Territories (Dispositif d'Analyse des Traces numériques pour la valorisation des Territoires Touristiques)

GéoLuciole with Complete description

Middle strategy and Complete Description.



Axes

We consider three aspects (Axis) of a trajectory : Spatial, Movement and Activities

Axis 1

[“Centre-Ville”,“La Guinguette”,“Les Minimes”,“Centre-Ville”]

Axis 2

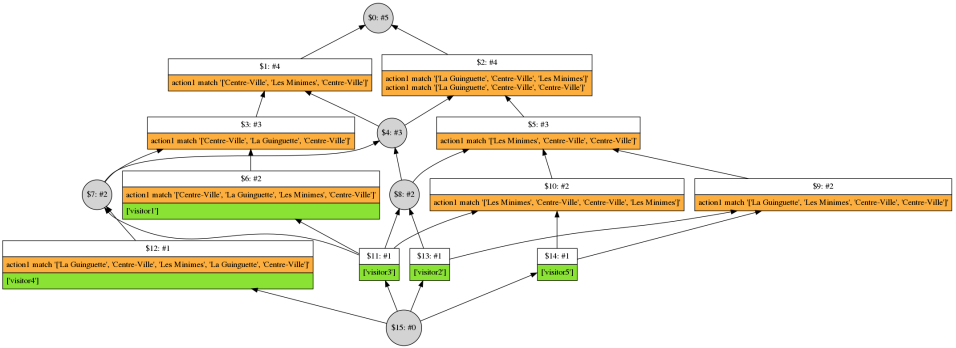
[“Stop”,“Marche”,“Marche”,“Stop”,“Stop”,“Vélo”,“Marche”,“Stop”]

Axis 3

[“Repas”,“Repas”,“Cinéma”,“Repas”,“Repos”]

Axis 1 using MCS description

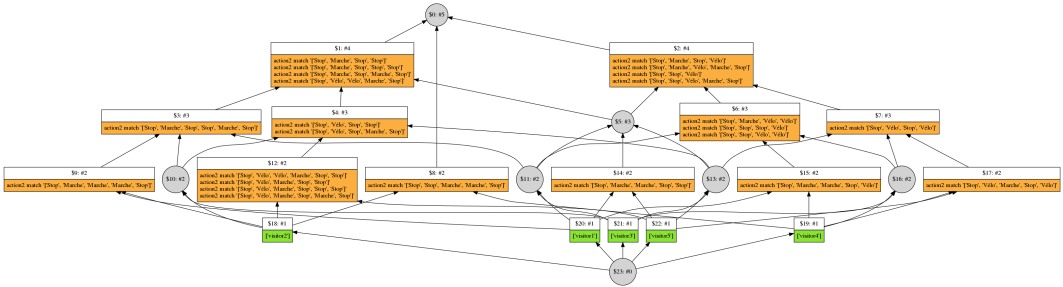
Analysis for level 1, using MCS description



Number of predicates : 9

Axis 2 using MCS description

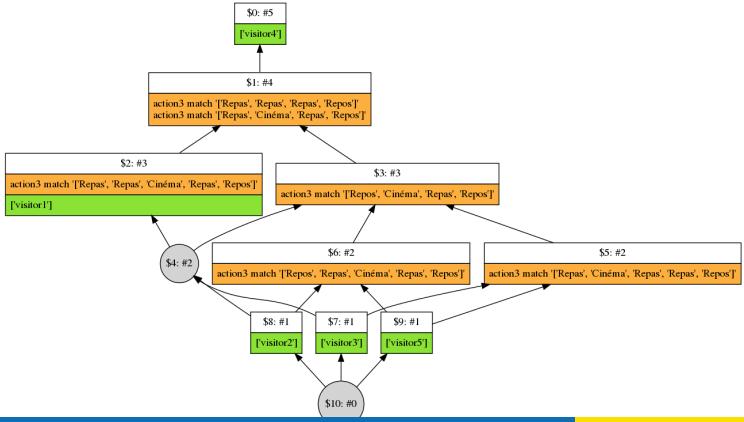
Analysis for level 2, using MCS description



Number of predicates : 24

Axis 3 using MCS description

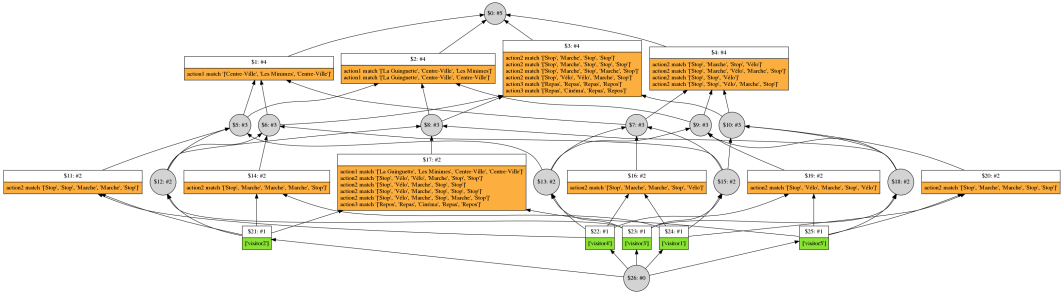
Analysis for level 3, using MCS description



Number of predicates : 6

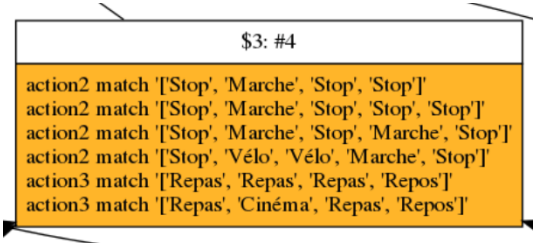
Multi-axis analysis using MCS description

Analysis for all axis, using MCS description



Number of predicates : $24 < 39 = 9 + 24 + 6$

Multi-axis analysis using MCS description



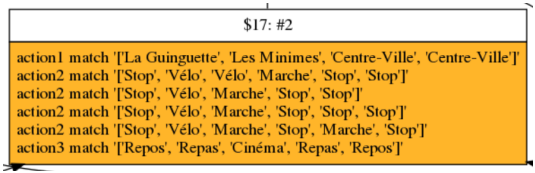
4 individuals make these subsequences for movement (action 2):

- stop, marche, stop, stop
- stop, marche, stop, stop, stop
- stop, marche, stop, stop, stop
- stop, marche, stop, marche, stop
- stop, vélo, vélo, marche, stop

The same individuals also did these activities (action 3):

- repas, repas, repas, repos
- repas, cinéma, repas, repos

Multi-axis analysis using MCS description



2 individuals make these subsequences for spatial (action 1):

- La Guinguette, Les minimes, Centre ville, Centre ville

For the movement (action 2):

- stop, vélo, vélo, marche, stop, stop
- stop, vélo, marche, stop, stop
- stop, vélo, marche, stop, stop, stop
- stop, vélo, marche, stop, marche, stop

And for the activities (action 3):

- repos, repas, cinéma, repas, repos

Multi-axis analysis using MCS description

If we analyse the three levels separately we get:

- number of predicates: $39 = 9 + 24 + 6$
- number of concepts: $61 = 11 + 24 + 16$

With multi-axis we get:

- number of predicates: 24
- number of concepts: 27

Conclusion

We used the NextPriorityConcept algorithm and the **GALACTIC** framework to analyse sequential data, we developed many kinds of descriptions and strategies representing different ways of analysing sequential data: strings, chains, sequences, and intervals.

Contact

GALACTIC web site

https://galactic.univ-lr.fr

GALACTIC mailing list

https://ml.univ-lr.fr/sympa/info/galactic

THANKS

For listening ;)