



Engineering and modeling social and technical Information Systems

Sigma team

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Workshop Kobe University – Grenoble Alpes University



Research topics

- Human organisations shaped by and for users
- Building social engineering methods for IS

Process-Aware
Social
Ubiquitous Information System

Business Process
Service Oriented
Gamification

Natural modelling
Text mining
User centered design

Device management
Multi scale data &
information management

- Innovation, society, multidisciplinary

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Text Mining for Scientific IS

Contact
Cyril Labbé

- Automatic detection of automatically Generated publications – [SciDetect](#)

<http://scidetect.forge.imag.fr>

SciDetect



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Grenoble
Alpes

SPRINGER NATURE

- Fact Checking Nucleotide Sequences in Life Science Publications

[Seek & Blastn Tool](#) detects obvious error in the claimed use of nucleotide sequence reagents

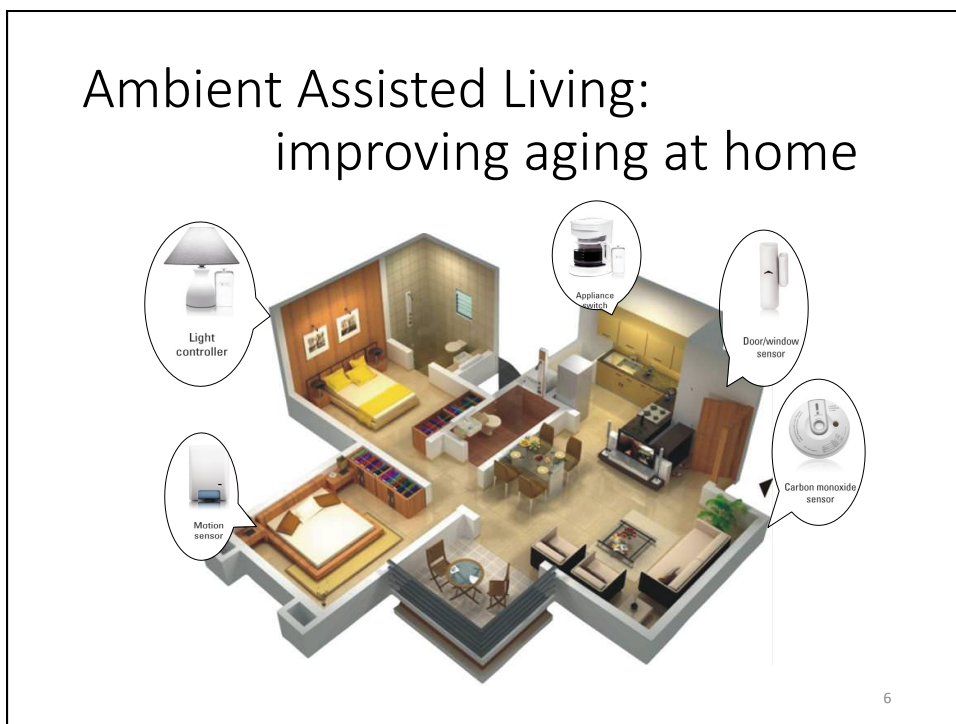
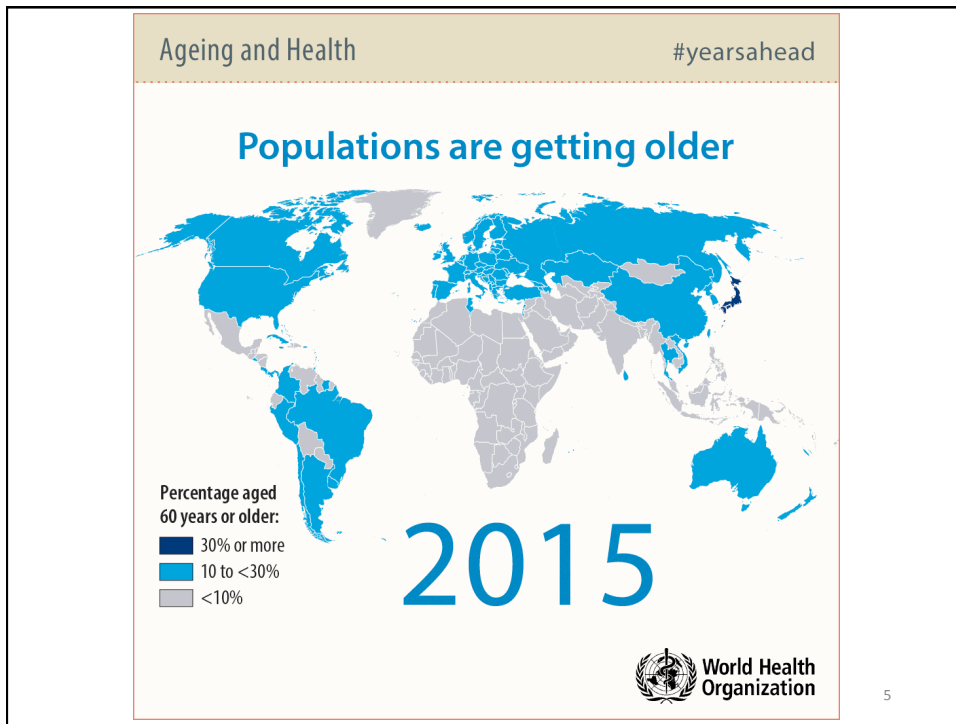
<http://scigendetection.imag.fr/TPD52/>



Modeling and Learning context-enriched behavior patterns

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Smart Homes for Elder Care in every day life

- Understanding behavior to improve services
- Identifying behavior changes which can reveal well-being deteriorations & new requirements
- Changes must be analyzed *with respect to* a personal pattern



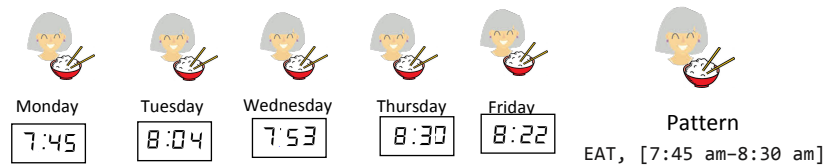
Context-enriched Behavior Patterns learning and management



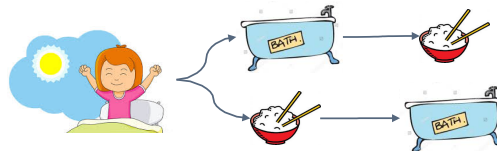
$b = \{\text{WAKE_UP}, 7:30 - 7:50\} | \{\{\text{WEATHER}, \text{RAINY}\}\}$

$b = \{\text{WAKE_UP}, 8:30 - 9:30\} | \{\{\text{DAY}, \text{SUNDAY}\}\}$

Behavior Pattern, activity or sequence of activities with an usual schedule



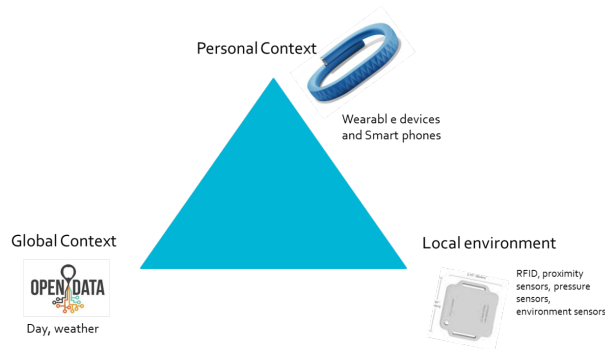
Usual activity (partial) order

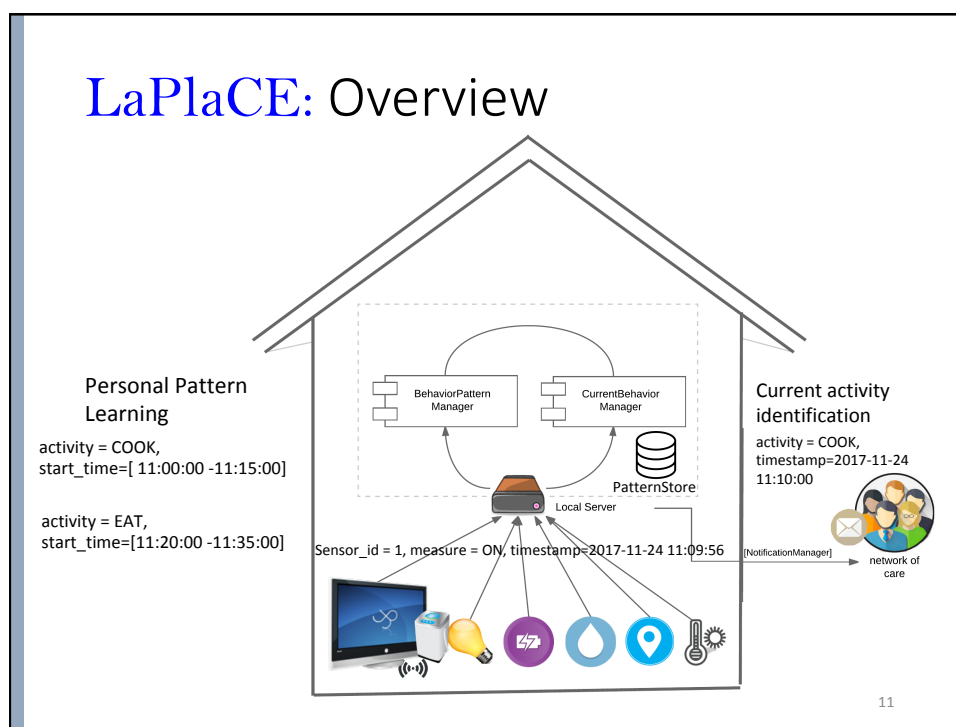


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Context is important for behavior analysis

- Some patterns may be unnoticed or may be incorrectly interpreted if context is not considered
- Context attribute values may be provided at different scales





LaPlACE: Learning behavior Patterns with Context Enrichment

- A formal model for representing context-aware behavior patterns
- An algorithm (TIME) for learning context-aware behavior patterns from activity observations in a single scan
- Comparison of online observations against expected patterns (distance measure)

LaPlaCE choices

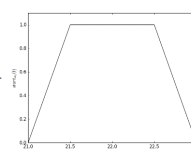
- Formal model helping behavior understanding and explaining behavior differences
- Context management: flexible number of dimensions (considered independent)
- Start time learning and representation
 - Consider with behavior learning for stream processing
- Evolution of patterns
 - Adaptive windows from stream processing
- Learning activity ordering
 - Frequent sequence mining

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LaPlaCE Model

LaPlaCE Model Concepts

Fuzzy Time Interval $f : \mathbb{X} \rightarrow [0, 1]$



Activity

$$\mathcal{A} = \{a_1, a_2, \dots, a_n\}$$

$$\mathcal{A} = \{\text{SLEEP, COOK, EAT, GO_OUT, SHOWER}\}$$

Context attribute

$$\mathcal{C} = \{c_1, c_2, \dots, c_n\} \quad c_i = [c_i.name, c_i.dom]$$

$$\mathcal{C} = \{\text{DAY, WEATHER}\}$$

$$day = [\text{DAY, (MONDAY, TUESDAY, \dots, WEEK, \dots)}]$$

Location

$$\mathcal{L} = \{l_1, l_2, \dots, l_n\}$$

$$\mathcal{L} = \{\text{BEDROOM, BATHROOM, DINING, KITCHEN}\}$$

Context data record $cr = \{cr_1, cr_2, \dots, cr_n\}$

$$cr_i = (k, v) \wedge \exists c \in \mathcal{C} : k = c.name \wedge v \subseteq c.dom$$

$$cr = \{(\text{DAY, MONDAY}), (\text{WEATHER, RAIN})\}$$

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Representing patterns

Activity Pattern $p = \{a_i, l, \text{start}_p(t), \text{duration}_p(t)\}$
 with $a_i \in A, \quad l \subseteq L$

$p = \{\text{EAT, DINING, [7:00-7:15], [15min-30min]}\}$

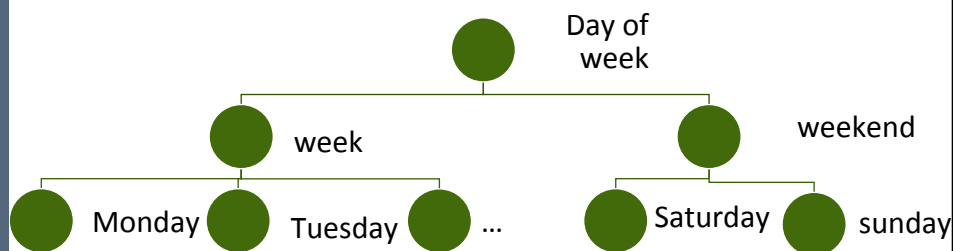
$p = \{\text{EAT, DINING, [18:00-19:30], [45min-75min]}\}$

Behavior Pattern $b = (\text{set of activity patterns, relation order among them})$

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Lago P, Jiménez-Guarín C, Roncancio C. Contextualized behavior patterns for change reasoning in Ambient Assisted Living: A formal model. Expert Systems. 2017;e12189. <https://doi.org/10.1111/exsy.12189>

Context attributes define structure using *is-a* relation

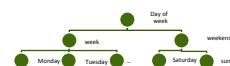


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Lago P, Jiménez-Guarín C, Roncancio C. Contextualized behavior patterns for change reasoning in Ambient Assisted Living: A formal model. Expert Systems. 2017;e12189. <https://doi.org/10.1111/exsy.12189>

A contextualized behavior pattern and variations

Contextualized Behavior Pattern: $b|cr$



A behavior pattern given a context data record

$P=\{\text{EAT, DINING, [7:00-7:15], [15min-30min]}\} | (\text{DAY, WEEK})$

$P=\{\text{EAT, BEDROOM, [8:30-9:15], [45min-75min]}\} | (\text{DAY, SUNDAY})$

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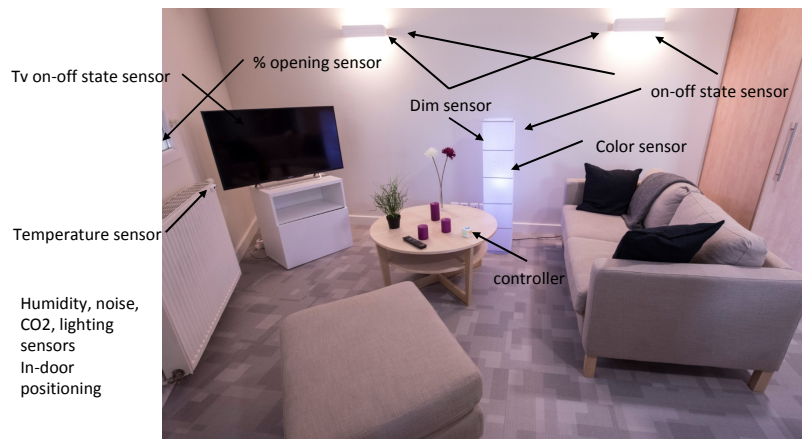
Lago P, Jiménez-Guarín C, Roncancio C. Contextualized behavior patterns for change reasoning in Ambient Assisted Living: A formal model. Expert Systems. 2017;e12189. <https://doi.org/10.1111/exsy.12189>

Comparing observations to pattern: similarity measure

- Considers the order of the activities
- Considers context data using multiple attributes
- May use semantic similarity of context attributes
 - Bedroom vs. study room vs. Bathroom
- It allows to reason about unseen behaviors or rare contexts by comparing them to similar patterns

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Experimentation: Unobtrusive and stigma-free sensing at home



Dayly-living activities



Shower



Sleep



Work



Eat



Cook



Wash Dishes



Watch Tv



Go to bathroom

ContextAct@A4H dataset

- 200+ variables
- 28 days of data (7 in summer and 21 in fall)
- 473 011 tuples of data in change point representation
- 397 activity observations
- **Context variables:** weather, temperature, noise, humidity, visitors (among others)

Key role for experimentation and research validation

- Contextual behaviour patterns learning and analysis

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Conclusions and perspectives

- Results on contextual behaviour patterns
- Further research to support
 - more complex situations (several places)
 - multiple residents
 - personalized services

ContextAct@A4H, a rich public dataset

- variety of sensors, variables and activities
- <https://goo.gl/EdCPUF>
- <https://amiqua4home.inria.fr>