Problems and Opportunities in Context-Based Personalization

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Data Management:
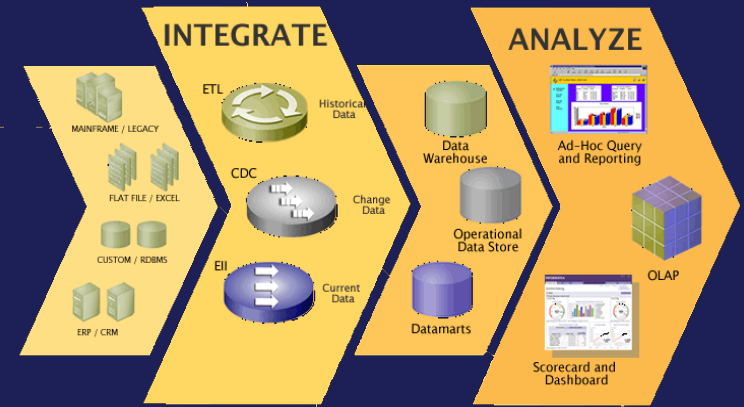## What does it mean today?

- Standard DBMSs technology is limiting for many applications
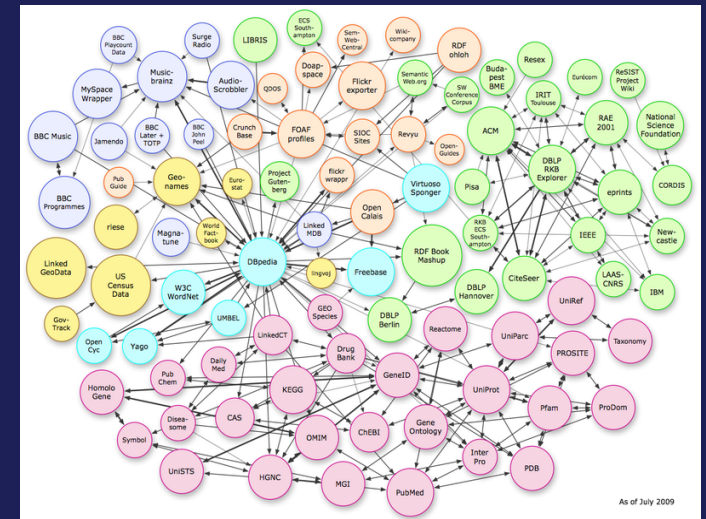
Data Management:
What does it mean today?

- Standard DBMSs technology is limiting for many applications

- What do users want from us?
  - data integration/exchange
  - heterogeneity
  - mobility

  - incompleteness/uncertainty
  - interaction with the physical world
  - personalization
  - manage the information overload

Information Overload and Noise:
Personalization and context-awareness

- **Context-based personalization**: shaping answers (to queries) according to the user's preferences and situation (i.e., context).

  - model and collect characteristics of the users (or groups of)

  - mostly implicit (behavioral analysis, sensing, …)

  - non-functional (e.g., data quality)

Information Overload and Noise:
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evolution of personalization

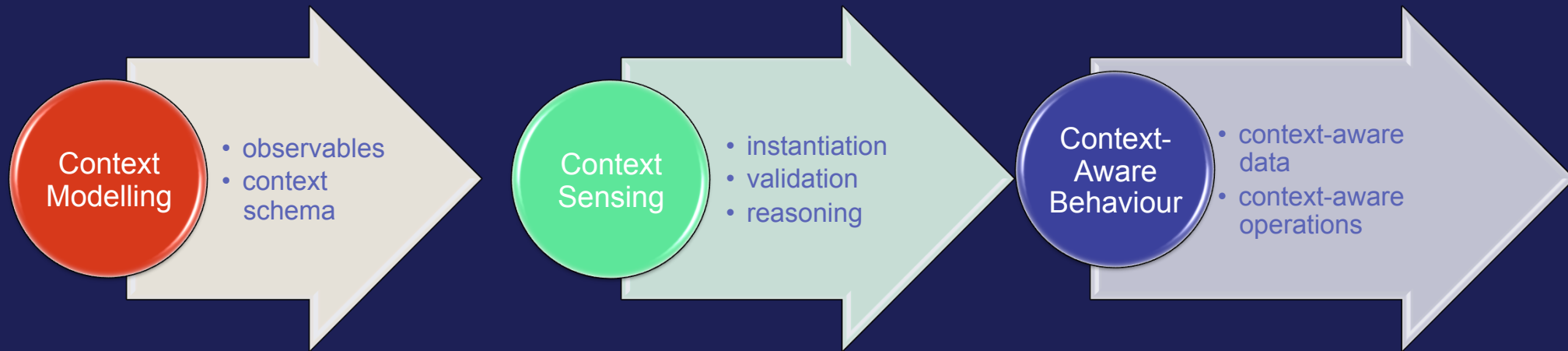user profile
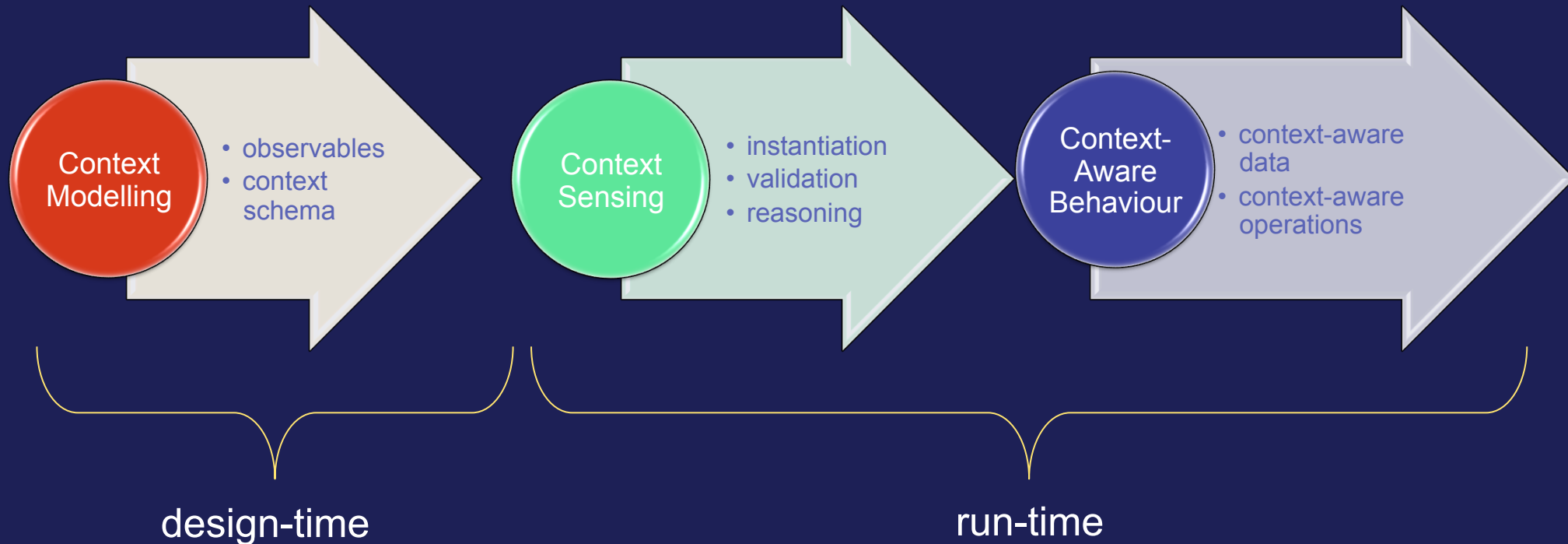- static
- user-based

user situation
- static
- context-based

user processes
- dynamic
- context and preference based
- Involve sensing and sociality

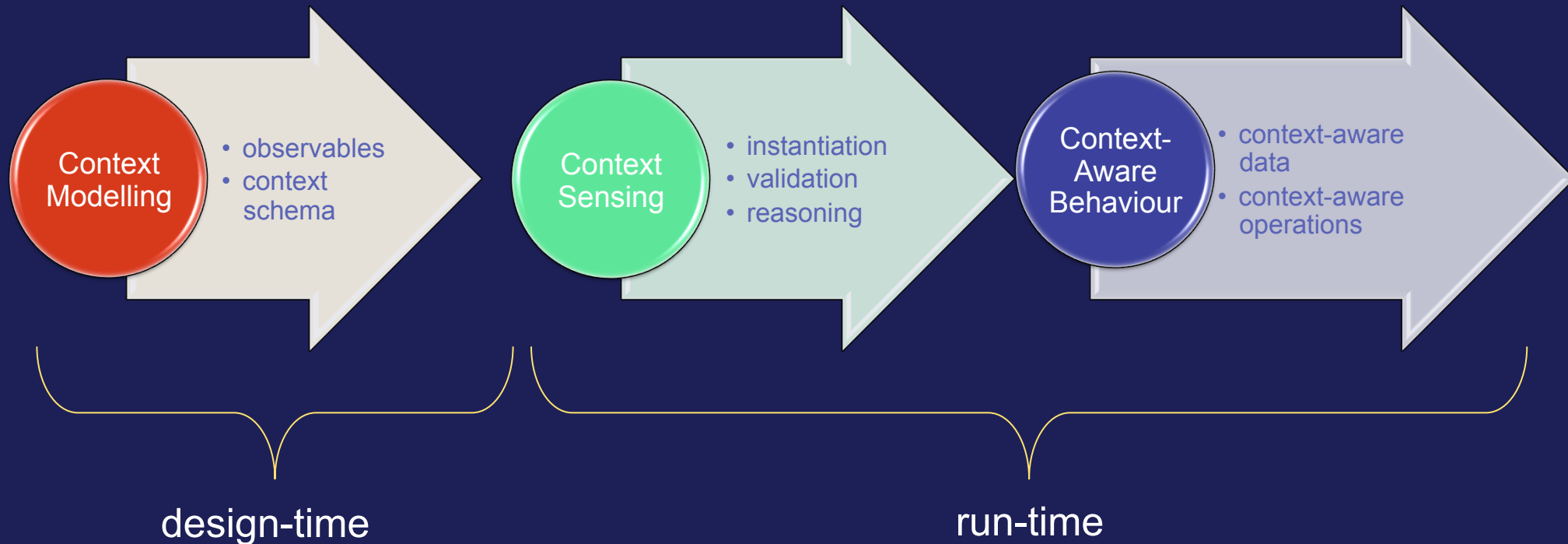# Information Personalization:
Context-aware *data tailoring*

Context Modelling
- observables
- context schema

Context Sensing
- instantiation
- validation
- reasoning

Context-Aware Behaviour
- context-aware data
- context-aware operations

Information Personalization:
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Information Personalization:
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- Context Modelling
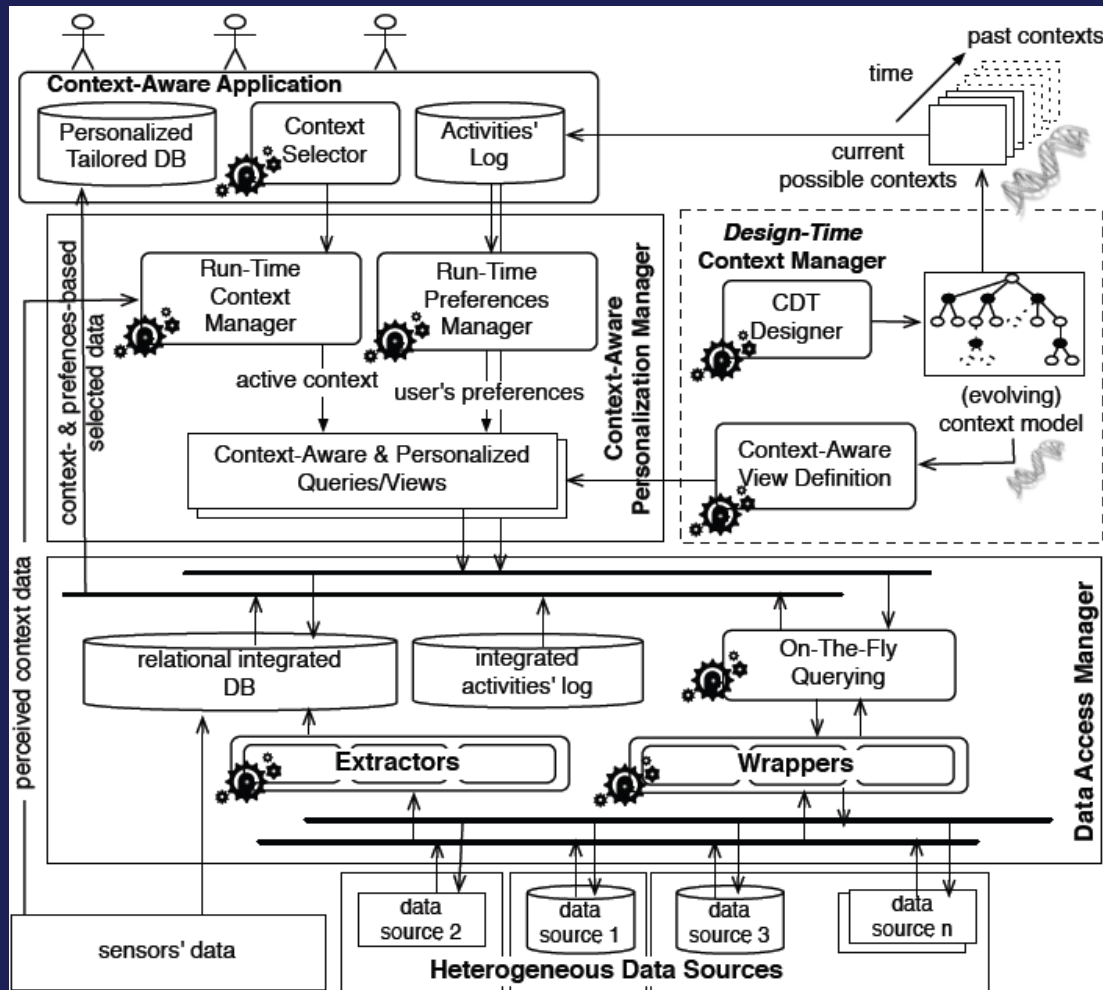 - observables
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design-time

run-time

is that really so?
… will see later

Information Personalization: Context-ADDICT

Context-aware data design, integration, contextualization and tailoring.

C. Bolchini, C. Curino, G. Orsi, E. Quintarelli, R. Rossato, F.A. Schreiber, L. Tanca. And what can context do for data? (Commun. ACM) – 2009
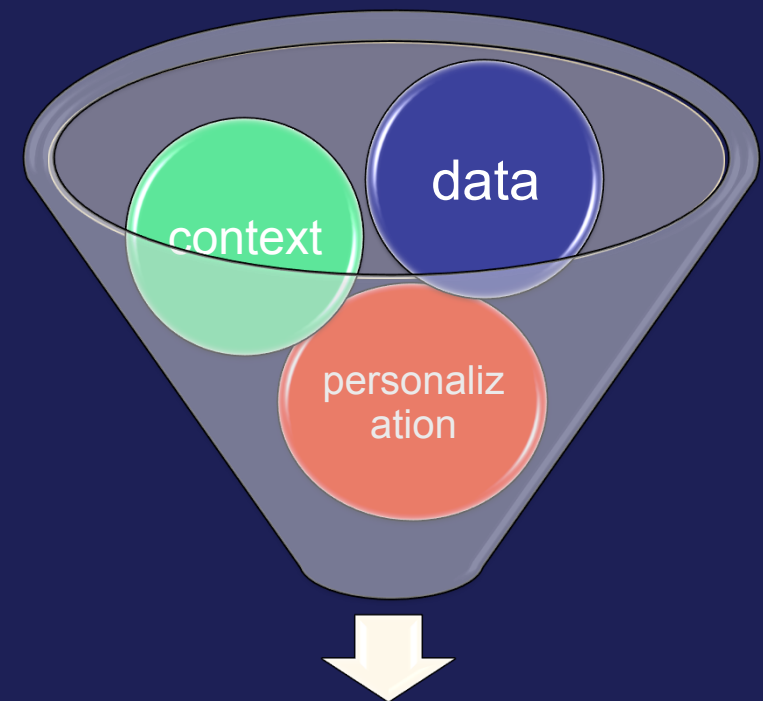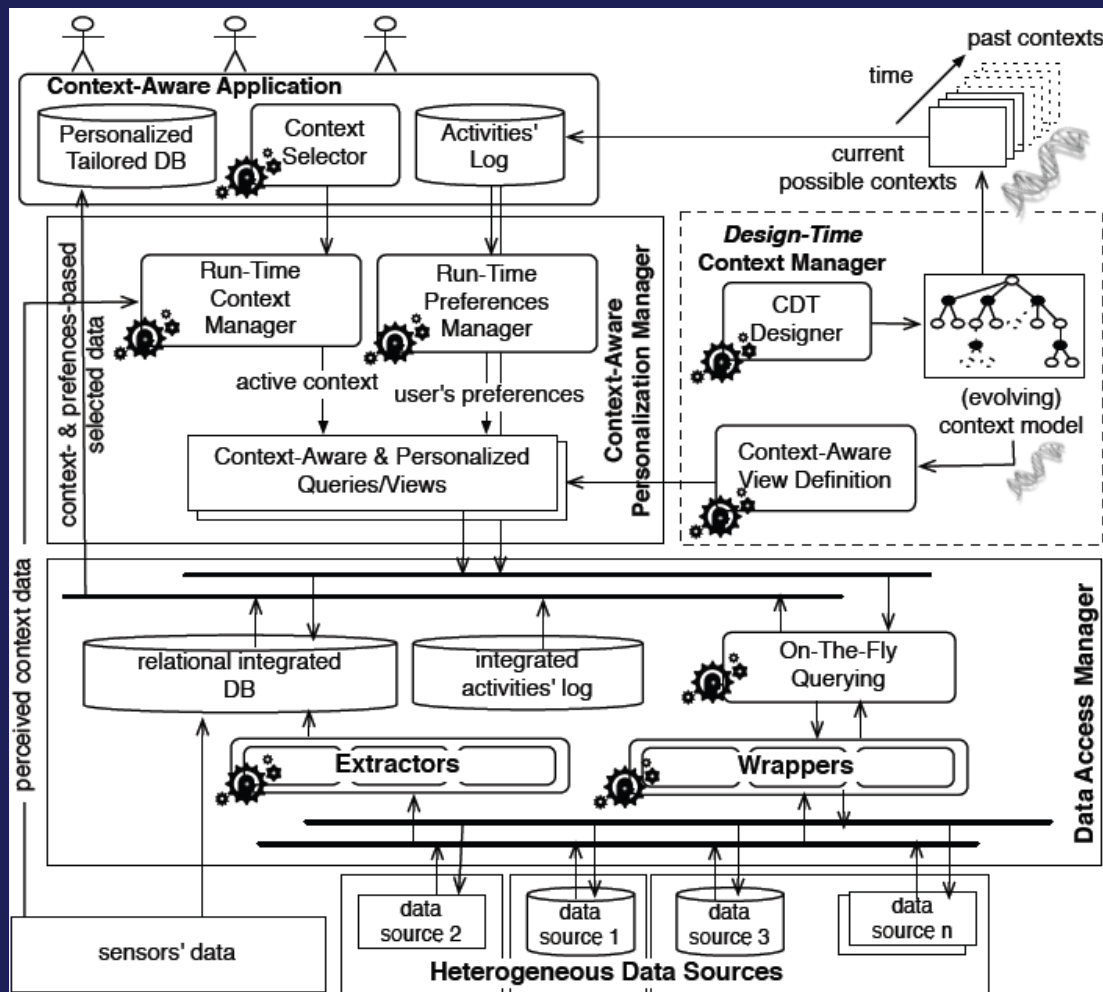
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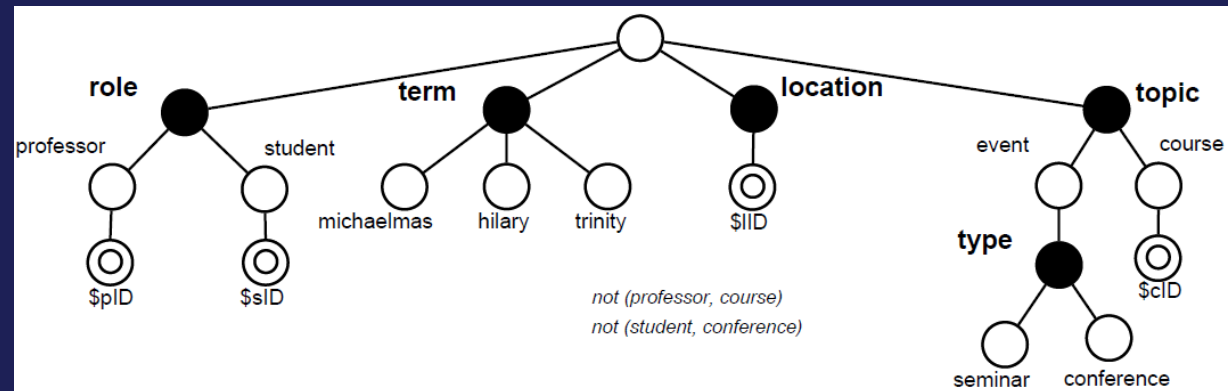
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Context Representation and Management: Model

- **Context Model**
  - generality
  - multiple abstraction levels
  - expressivity
  - tractability of context querying and reasoning

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C. Bolchini, C. Curino, E. Quintarelli, F.A. Schreiber, L. Tanca.
Context information for knowledge reshaping. (Int. J. Web Eng. Technol.) – 2009
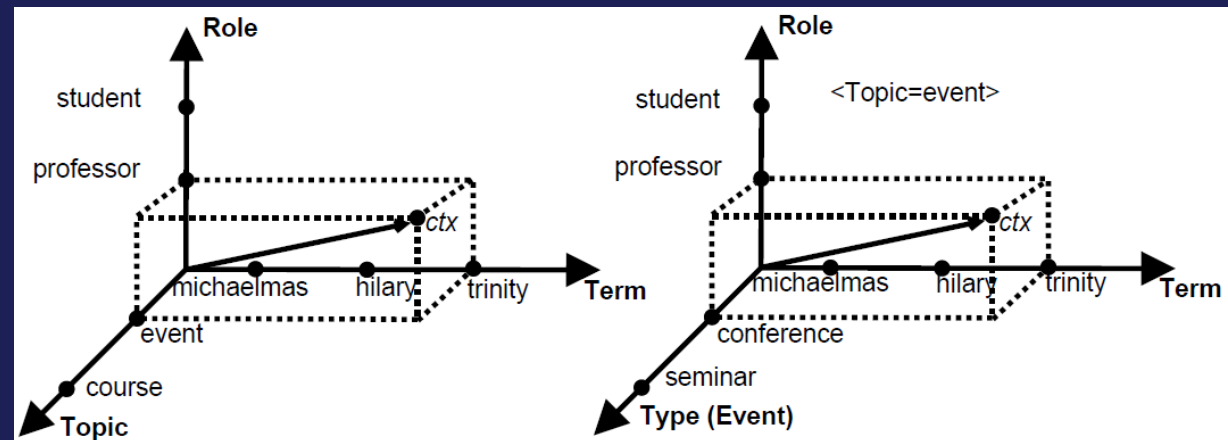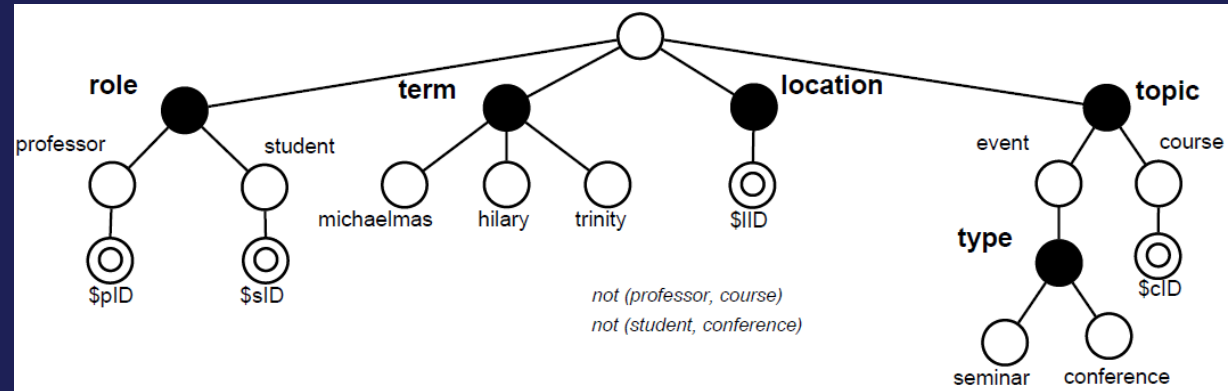
Context Representation and Management: Data tailoring
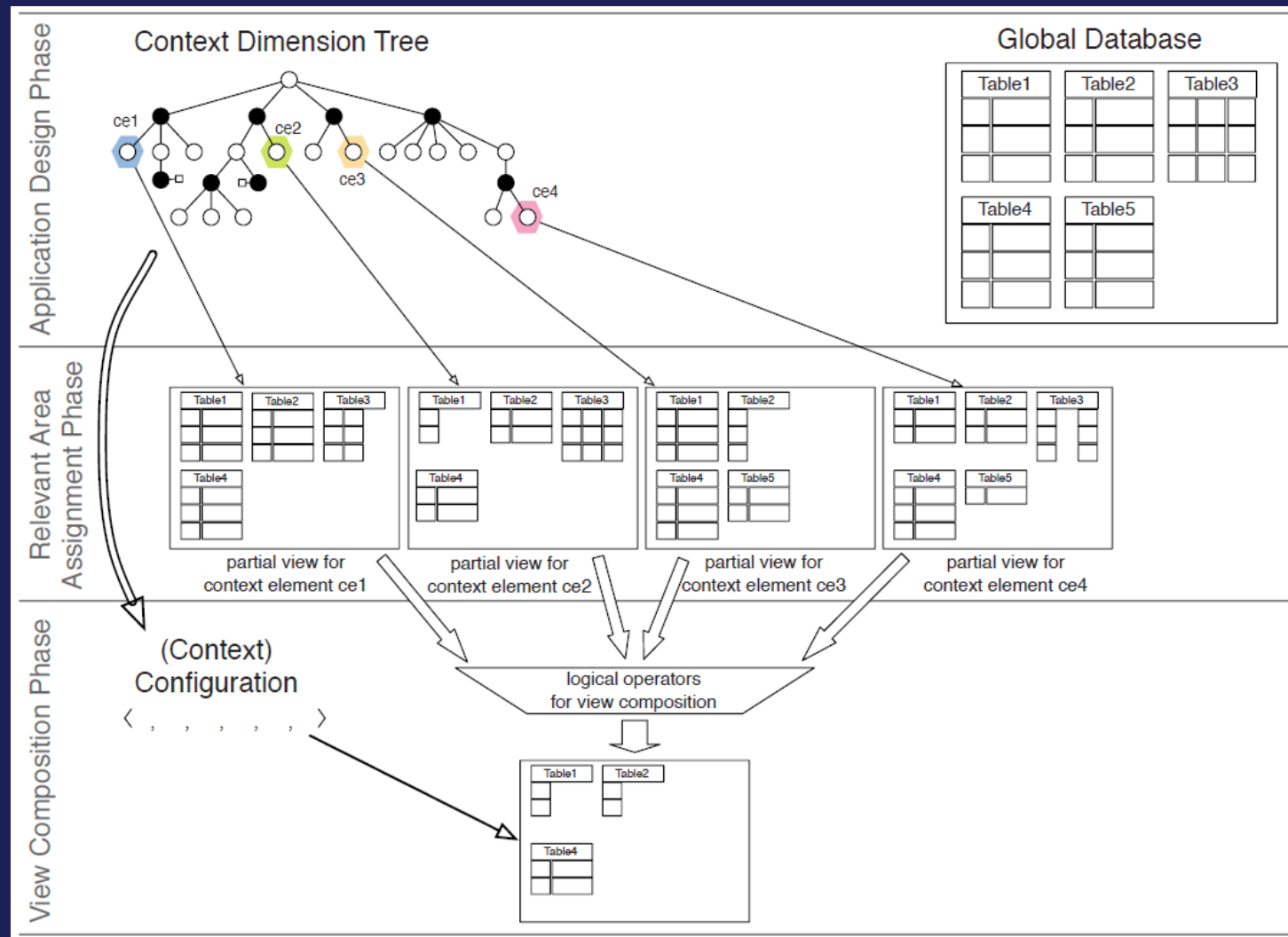
C. Bolchini, E. Quintarelli, R. Rossato.
Relational Data Tailoring Through View Composition (ER) - 2007.

Context Representation and Management: Evolution

- Operations:

  - insert

  - delete

  - replace

Guarantee the context-schema ←→ context-instance consistency

E. Quintarelli, E. Rabosio, L. Tanca.
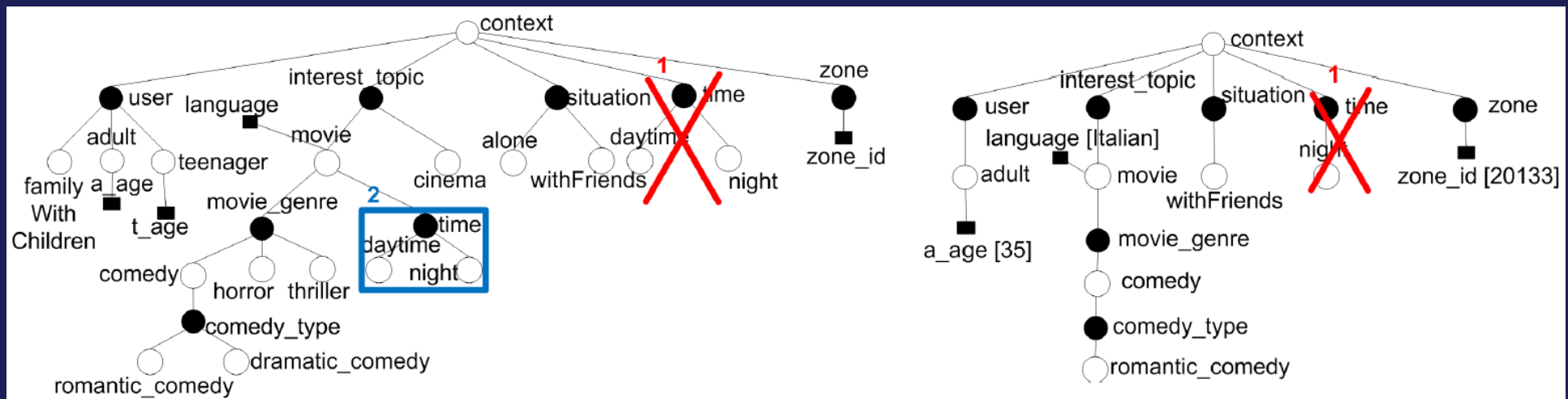Context management and evolution. (ER) – 2011.

Personalization Management: Context vs preferences

- **Context:**

  - coarse grained

  - targets *classes* of users

- **Preferences:**

  - fine grained

  - targets individual users

- **Deriving preferences:**

  - explicit input

  - mining
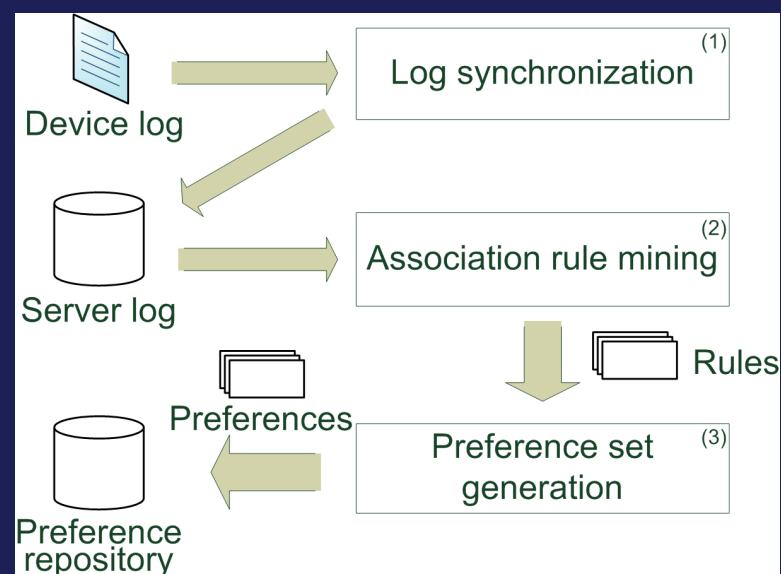
σ-rules

$<C \rightarrow cond, conf>$

*A. Miele, E. Quintarelli, L. Tanca.
A methodology for preference-based personalization of contextual data. (EDBT) – 2009.*

Personalization Management: σ-rules

- We are interested in σ-rules, correlating contexts and data

Personalization Management: σ-rules

- We are interested in σ-rules, correlating contexts and data

- A σ-rule on a relation R(X) is a tuple: <C → cond, conf>

  - *C*: a context

  - *cond:* a conjunction of conditions in the form *A=value*, where *A* is an attribute belonging to R(X) or to a relation reachable from R(X) through foreign keys

  - *conf*: is the confidence of the association rule C → cond

Example:

< situation=alone, interest-topic=classroom → classroom.type='computerized', 0.73 >

Data Access Management:
Heterogeneity and semantics

heterogeneity

- ontologies
  - data
  - context
  - views

- Reverse engineering
  - schema inference
  - transiency

- query rewriting
  - query answering
  - reasoning

Design time operations

Run time operations: Integration

Dimension tree

interest topic · Dimension · didactic · research · teacher · HOLDER · exam · univ · CNR · student

Domain Ontology

professor · student · get_shortest · class

Data Schema Ontologies

1 · class · student · enrollment · instructor · 2 · 3

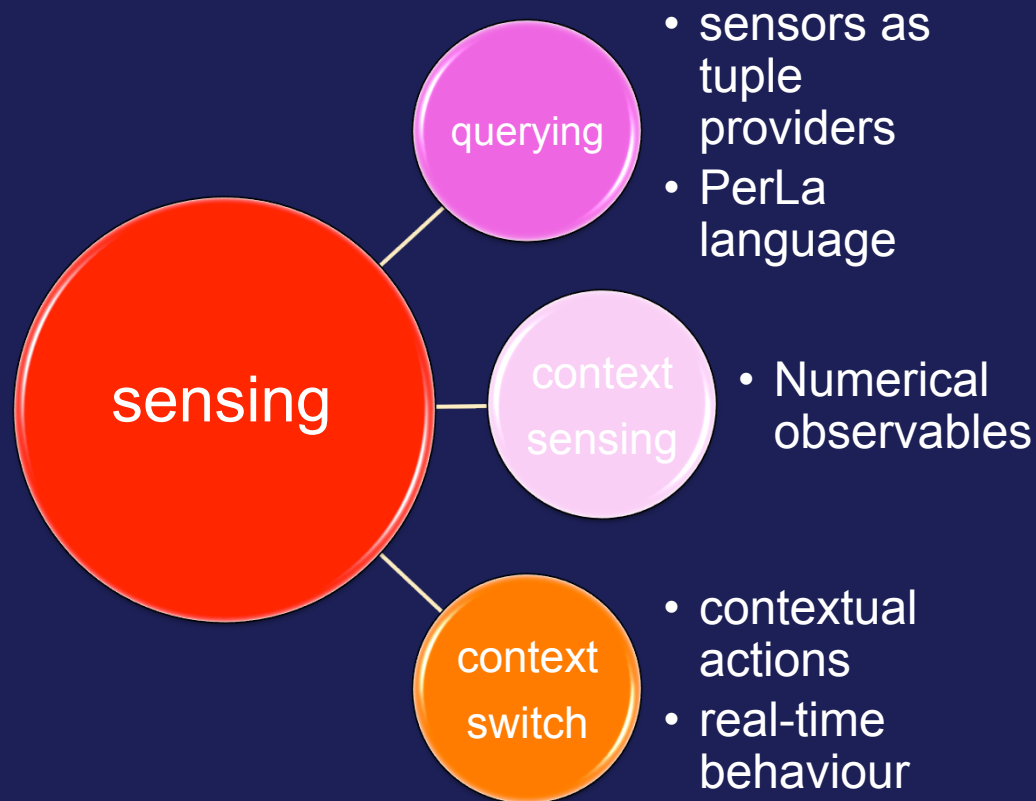4 · 5 · person · professor · 6

G. Orsi,
Context Based Querying of Dynamic and Heterogeneous Information Sources. (PhD Thesis)

Data Access Management:
Sensing and actuation

- sensors as tuple providers
- PerLa language

- Numerical observables

- contextual actions
- real-time behaviour

sensing

querying

context sensing

context switch

Plain PerLa

```
CREATE OUTPUT STREAM Monitoring
  (temperature FLOAT, humidity FLOAT,
  location_X FLOAT, location_y FLOAT)
AS LOW:
/*Low level query*/
EVERY ONE
SELECT temperature, humidity,
  location_x, location_y
SAMPLING EVERY 1 m
  EXECUTE IF EXISTS (temperature) AND
    isInVineyard(location_x, location_y)
REFRESH EVERY 10m
```

Context PerLa

```
CREATE CONTEXT Growth_Monitoring
ACTIVE IF phase = 'growth' AND role='farmer'
        AND Disease.Type=3
        AND Disease.Affected_Hectares = 200
ON ENABLE:
SELECT humidity, temperature
WHERE humidity > 0 AND temperature > 0
SAMPLING EVERY 6 h
EXECUTE IF EXISTS humidity, temperature
    AND location='vineyard'
ON DISABLE:
    DROP Growth_Monitoring;
REFRESH EVERY 1 d;
```

F.A. Schreiber, R. Camplani, M. Fortunato, M. Marelli, G. Rota.
PerLa: A Language and Middleware Architecture for Data Management and Integration in Pervasive Information Systems. (IEEE TSE) – 2011.

Context-Awareness and Personalization
What's next?

- Mature enough for a serious personalization theory
  - serious as in "let's prove that!"

- Process-centric, dynamic and social context management
  - static context models are limiting

- Context as a bridge between software and physical world
  - sensors and actuators

- Effective vs private personalization

Applications
Make it useful

Emergency Management

G. Orsi, L. Tanca, E. Zimeo.
Keyword-based, context-aware selection of natural language query patterns. (EDBT) - 2011.

Pervasive Advertisement

L. Carrara, G. Orsi.
A new perspective in pervasive advertisement. (submitted Percom) – 2011.

This is the end
Thank you

Giorgio Orsi

Fabio A. Schreiber

Letizia Tanca

Cristiana Bolchini

Elisa Quintarelli