- The Contextual Map - a Context Model for detecting Affinities among Contexts

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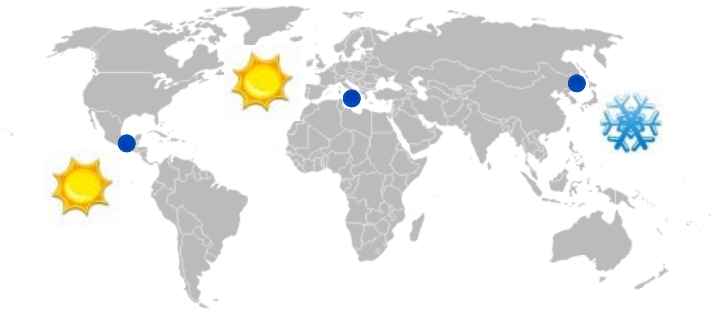
Introduction

- Context-awareness: information associated particular entities
  - Entities may be places, persons or objects
  - Context-aware Computing: acquisition, management and utilization of contexts
- Similarity among contexts is a current research domain
- **Geographical proximity** among objects in LBS-Systems

➔ **Contextual proximity** utilizing location-based mechanisms?

- Example: 3 weather stations
  - Located in Acapulco, Palermo, Wladiwostok
  - Acapulco & Palermo contextually similar
  - Wladiwostok & Acapulco contextually different



Research Background

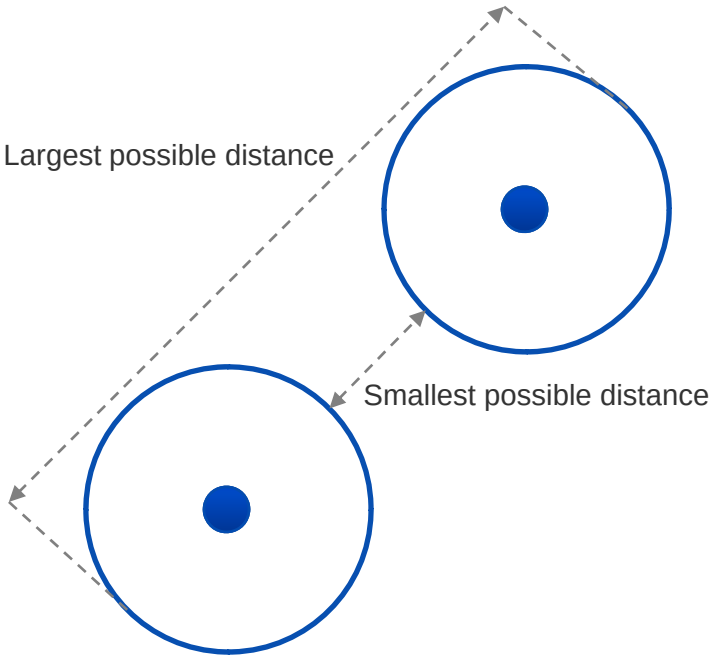
Context-aware Computing

- Capturing and processing contextual information from heterogeneous sources

Research Background

Efficient Proximity Detection in LBS

- Location updates enable proximity detection
  - Polling, periodic, zone-based, distance-based
  - Proximity threshold delimits proximity, separation threshold delimits separation
  - Minimal amount of location updates <-> maximal accuracy



Research Background

Efficient Proximity Detection in LBS

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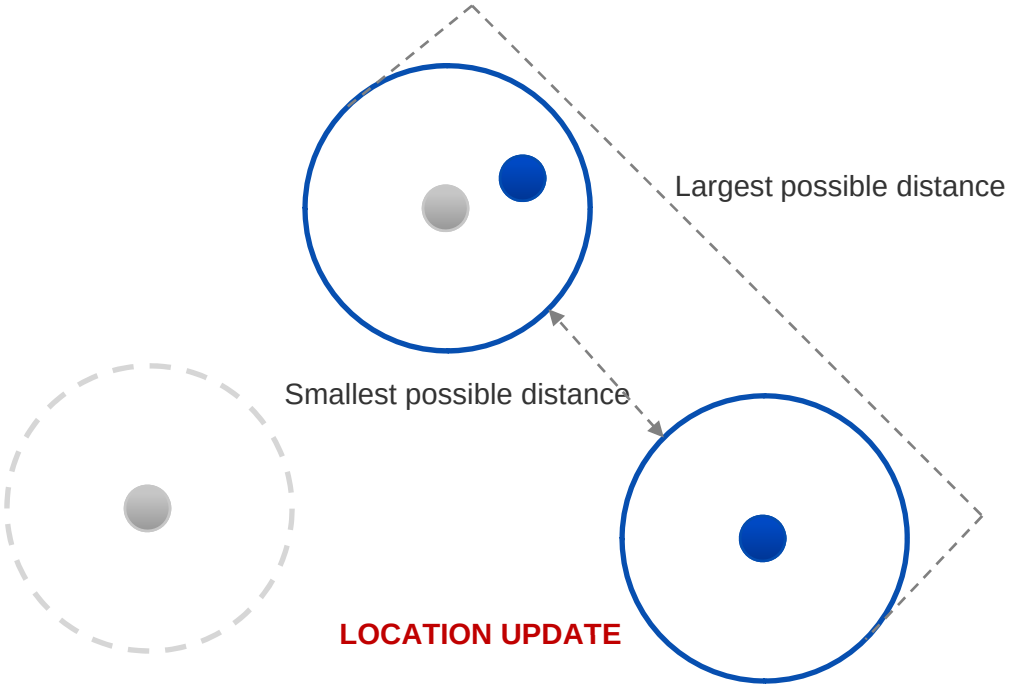


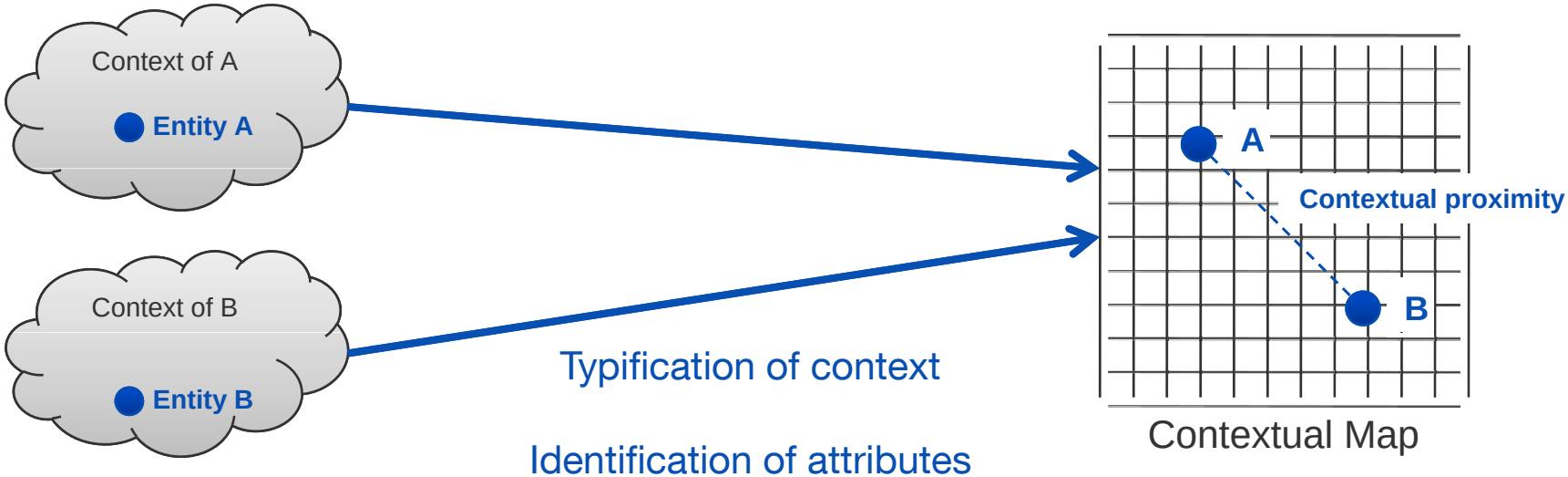
Contextual Map Model

Context Model

- Context of entity typified into **contextual ranges**
  - Example: weather station: environmental readings, location
- Ranges assigned with corresponding contextual attributes
  - Environmental readings: temperature, humidity, barometric pressure
  - Location: longitude, latitude, altitude
- Attributes are quantified
  - Environmental readings: [0, 100]
  - Location: Cartesian coordinates
- Quantified attributes mapped to multi-dimensional map
  - One Cartesian map per range
  - Each context attribute assigned to a dimension
  - **Proximity & separation detected via Euclidean distance**

Contextual Map Model

Context Mapping



Typification of context

Identification of attributes

Quantification of attributes

Application of the Contextual Map

Contextual Affinities

- A **Contextual Boundary** defines degree of affinity between contexts
  - May affect multiple ranges (context types)
  - scalar proximity threshold defines similarity degree on each range
  - Boundary **$B = (t_1, \ldots, t_n)$** affecting n ranges

- Range-specific contextual proximity
  - Euclidean distance between contexts *P* and *Q* on a particular range with *d* context attributes

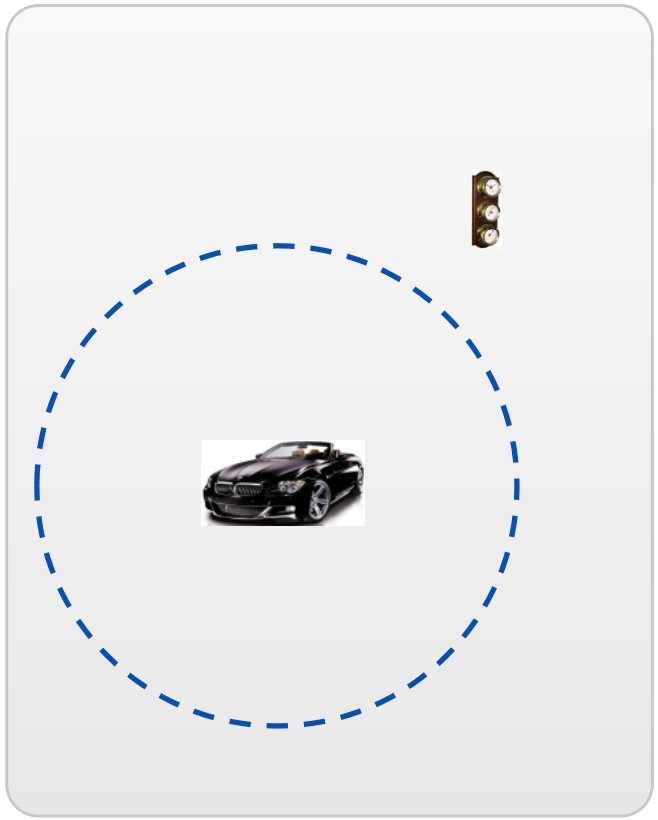
$$dist(P,Q) = \sqrt{\sum_{i=1}^{d} (p_i - q_i)^2}$$

- Boundary crossed if threshold exceeded on each affected range

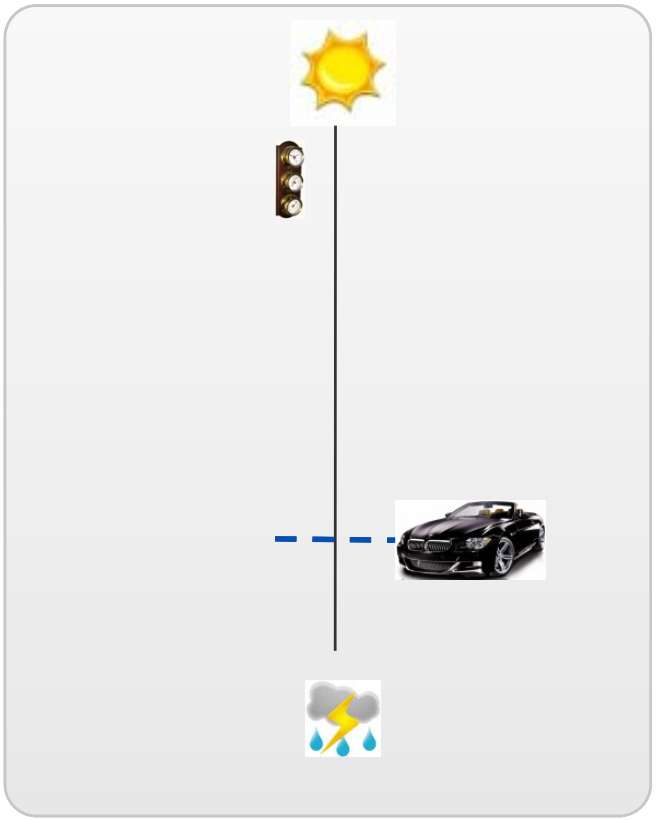
Application of the Contextual Map

Contextual Affinity Example

Location range



Environment range



Car driver

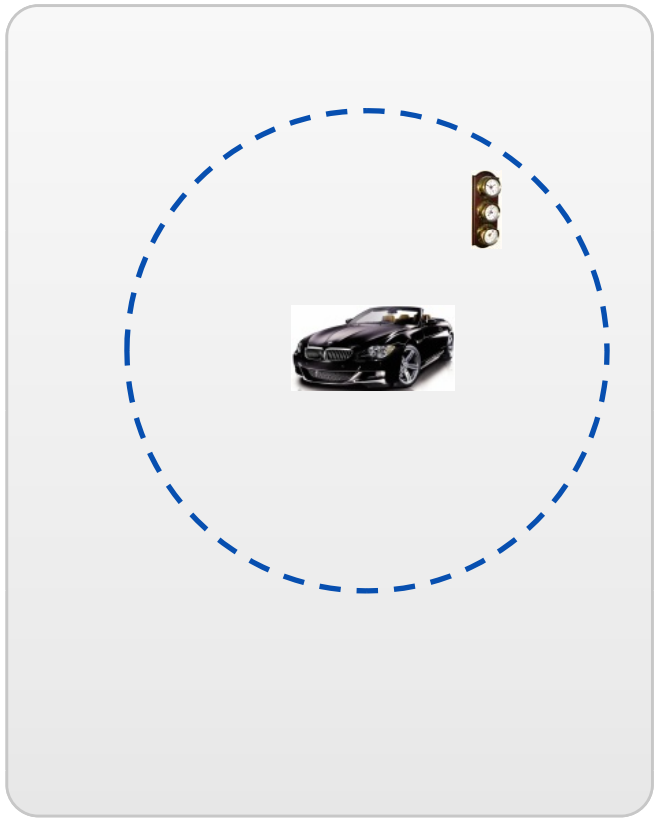
Weather station

Context Boundary

Application of the Contextual Map

Contextual Affinity Example

Location range



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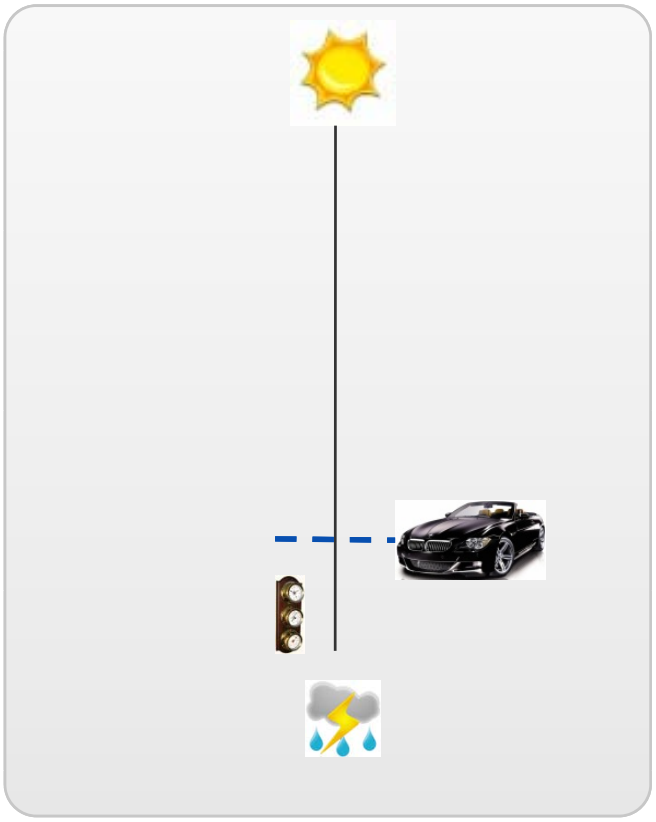

Car driver

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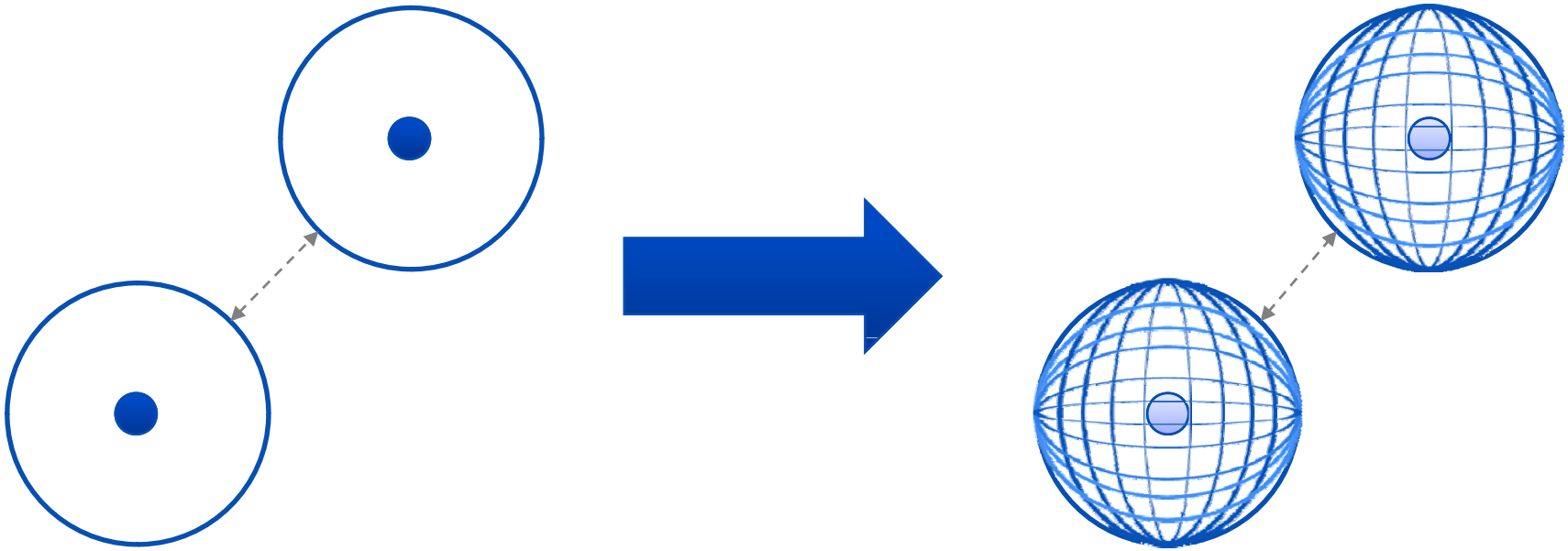
Context Boundary

Application of the Contextual Map

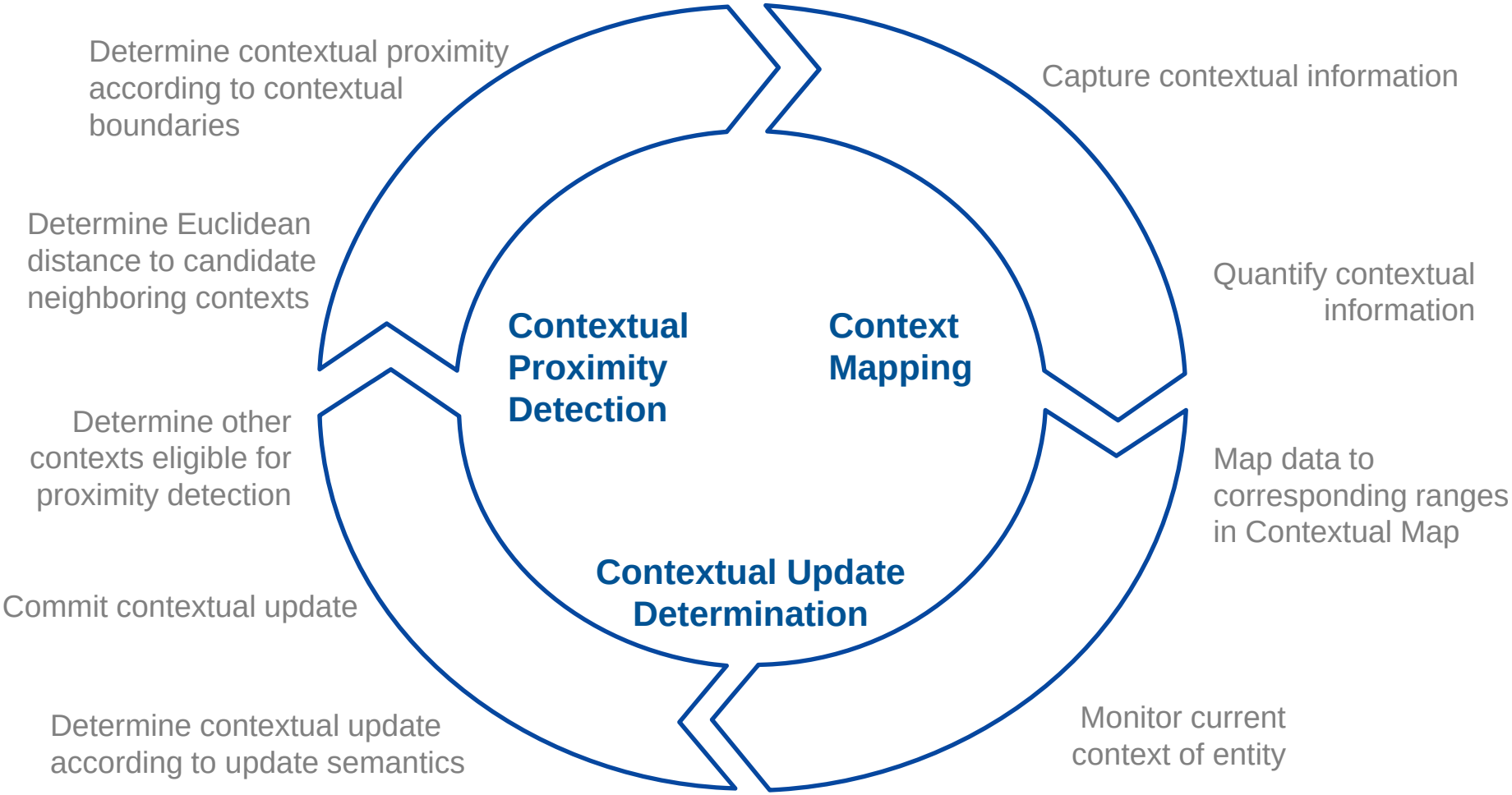
Update Semantics



Geographical Proximity Detection	Contextual Map
• 2-dimensional Euclidean space • Circular update zones	• multi-dimensional Euclidean space • Hypercubical update zones

Application of the Contextual Map

Overall Workflow



Conclusion & Outlook

- Contextual Map enables multi-dimensional abstraction of real-world context
  - Typified context attributes grouped in ranges
- Contextual affinity detection
  - Euclidean distances between context representation in Contextual Map
  - Context boundaries define similarity degree
- Outlook
  - Prototypic context model under development
  - Cluster detection allows deduction of contextual situations

Questions?

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