

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

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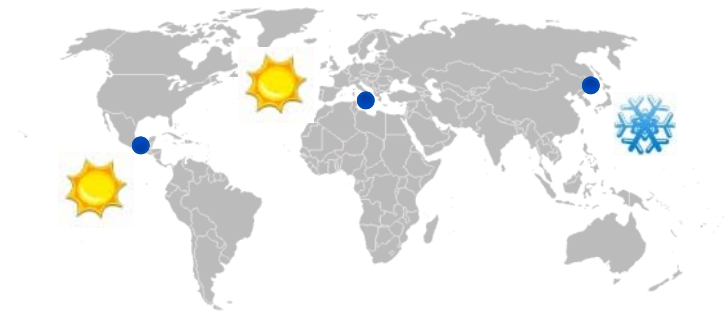
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Introduction

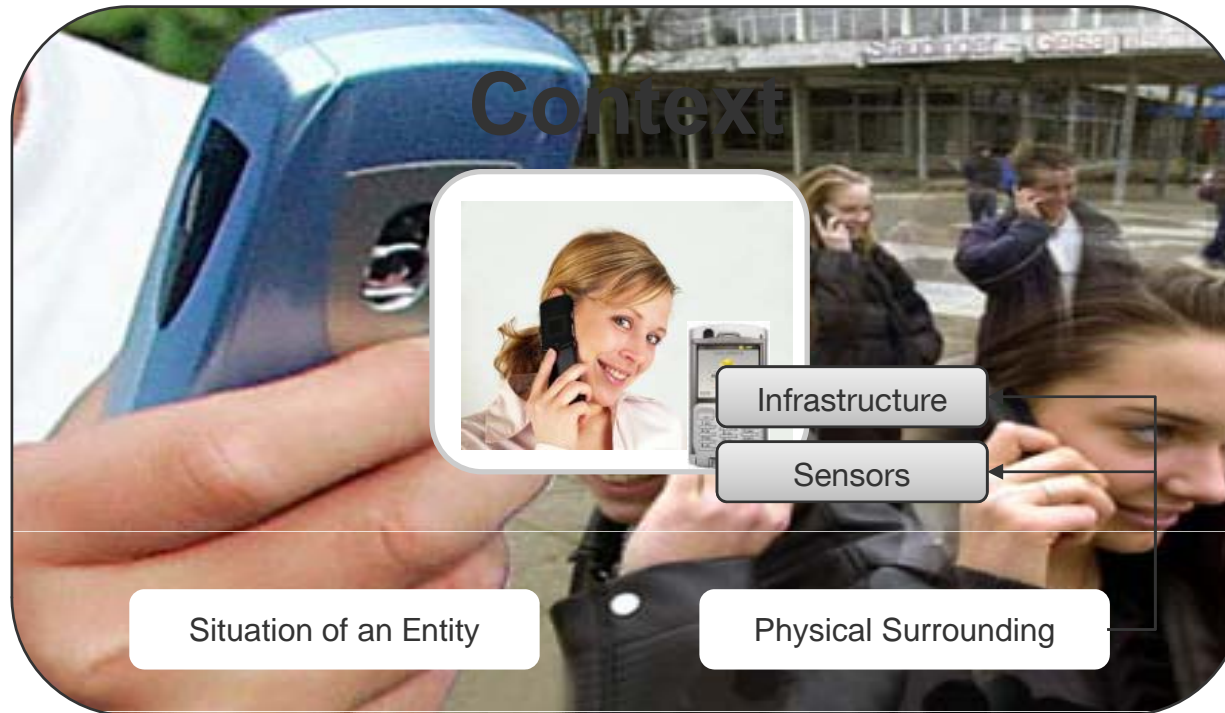
- Context-awareness: information associated particular entities
 - Entities may be places, persons or objects
 - Context-aware Computing: acquisition, management and utilization of contexts
- Similarity among contexts is a current research domain
- **Geographical proximity** among objects in LBS-Systems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

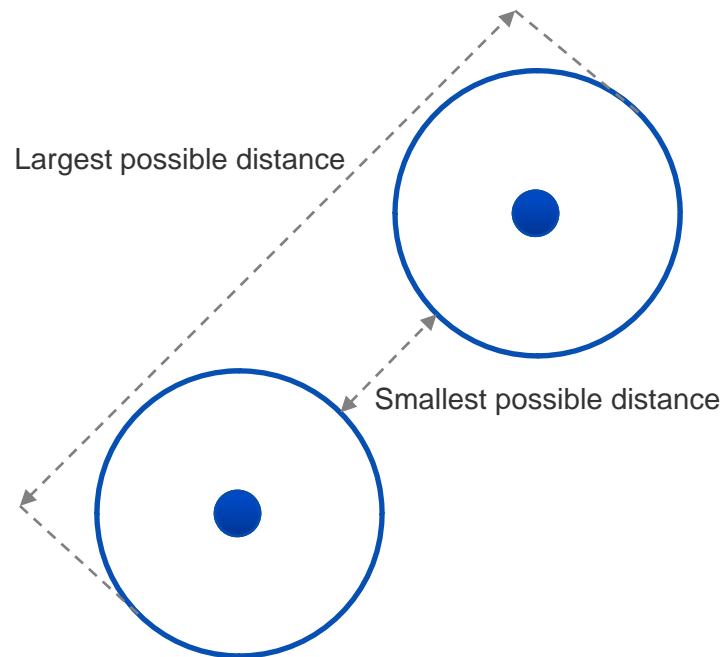


- Capturing and processing contextual information from heterogeneous sources

Research Background

Efficient Proximity Detection in LBS

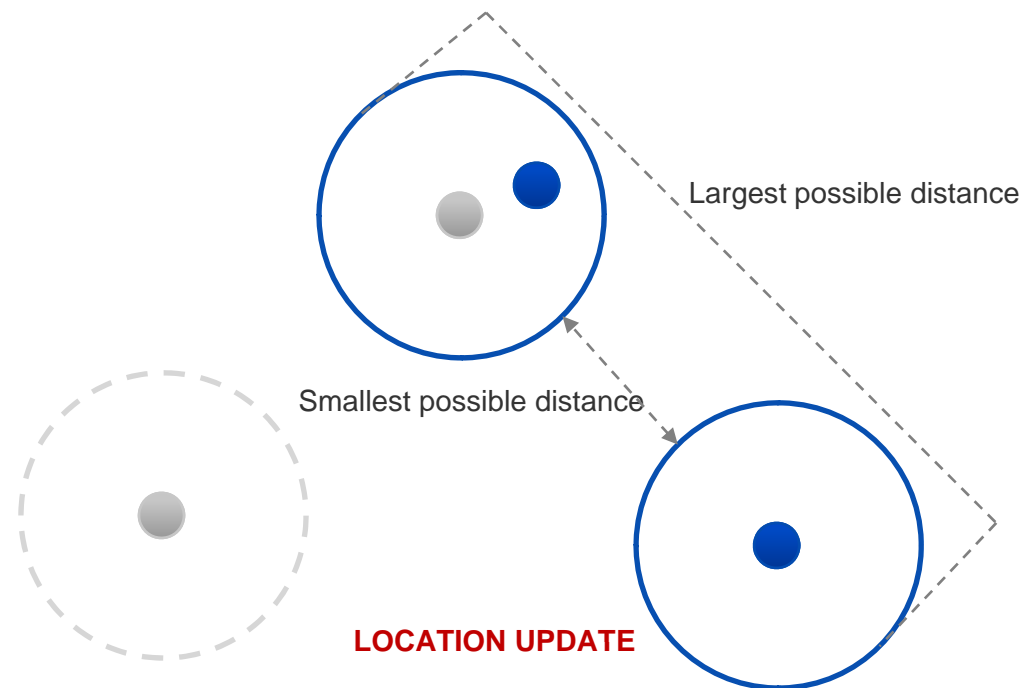
- Location updates enable proximity detection
 - Polling, periodic, zone-based, distance-based
 - Proximity threshold delimits proximity, separation threshold delimits separation
 - Minimal amount of location updates \leftrightarrow maximal accuracy



Research Background

Efficient Proximity Detection in LBS

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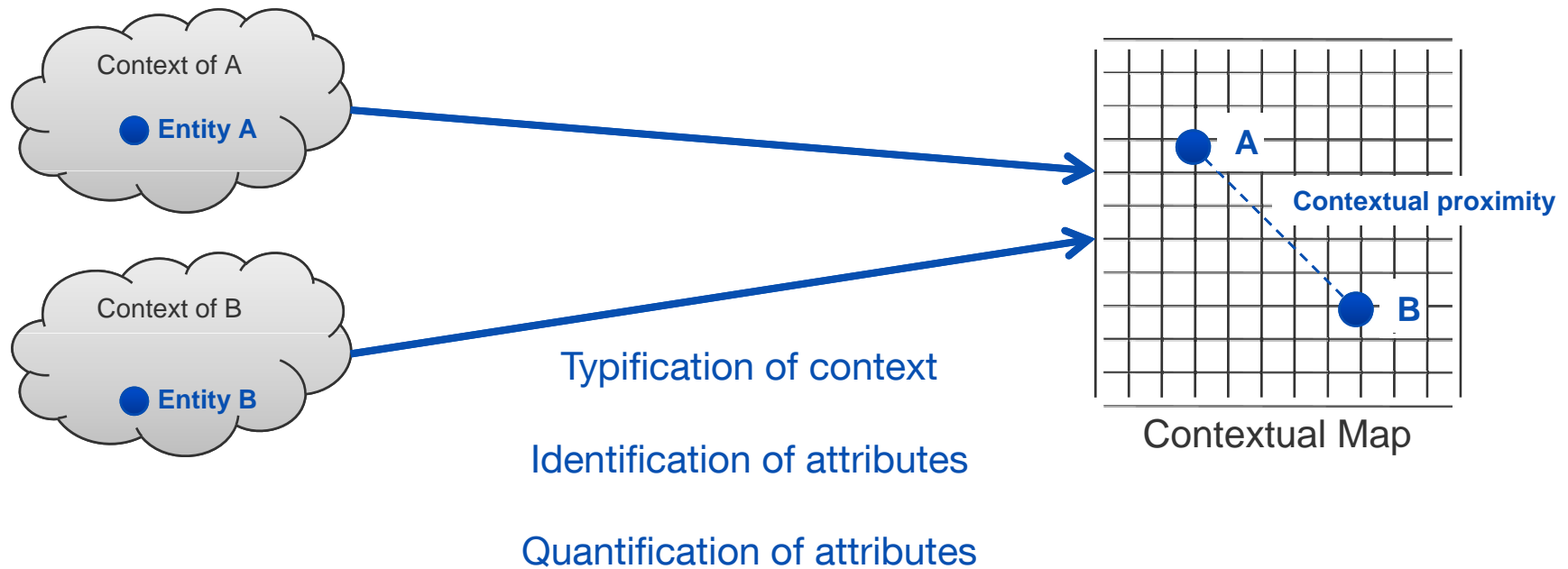
Contextual Map Model

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



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 $\mathbf{B} = (t_1, \dots, t_n)$ affecting n ranges
- Range-specific contextual proximity
 - Euclidean distance between contexts P and Q on a particular range with d context attributes

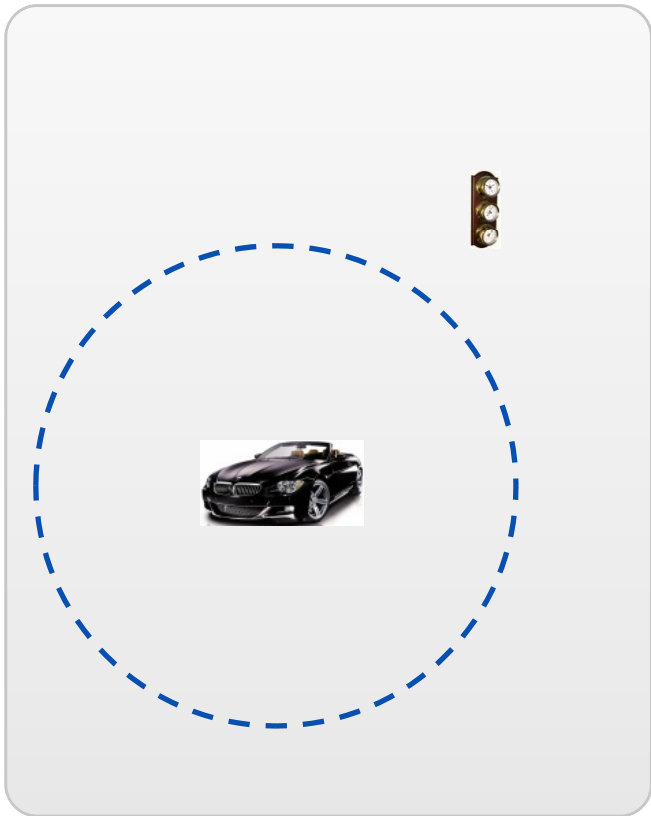
$$\text{dist}(P, Q) = \sqrt{\sum_{i=1}^d (p_i - q_i)^2}$$

- Boundary crossed if threshold exceeded on each affected range

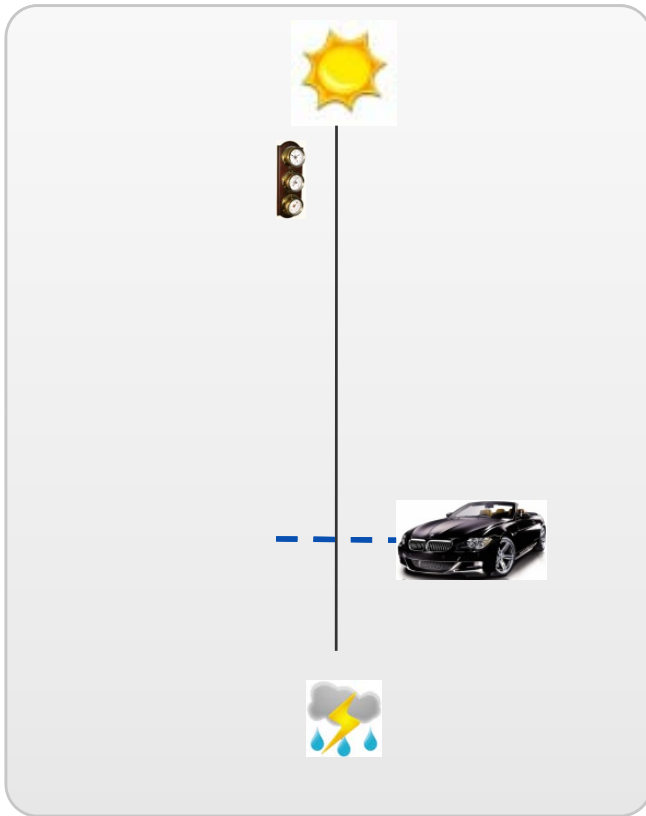
Application of the Contextual Map

Contextual Affinity Example

Location range



Environment range



Car driver



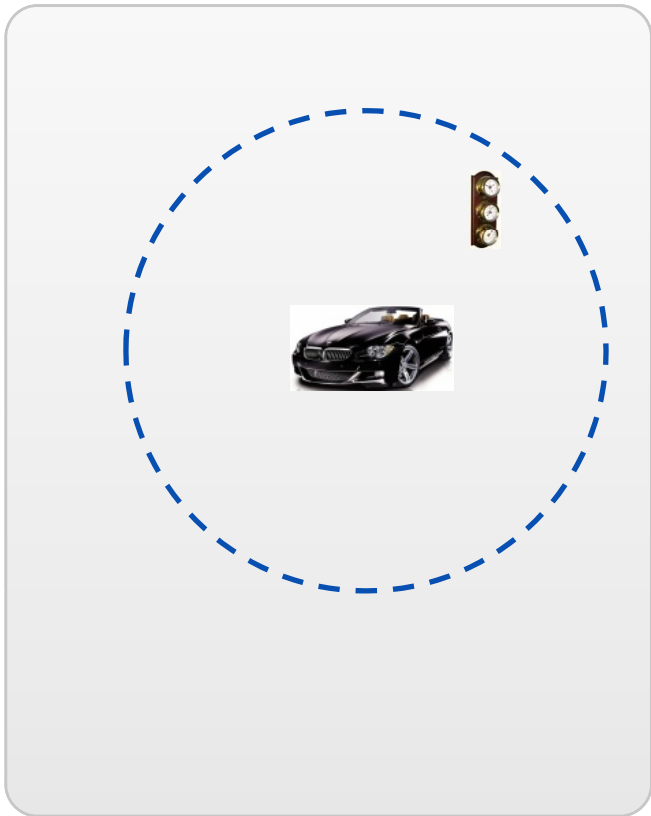
Weather station

Context Boundary

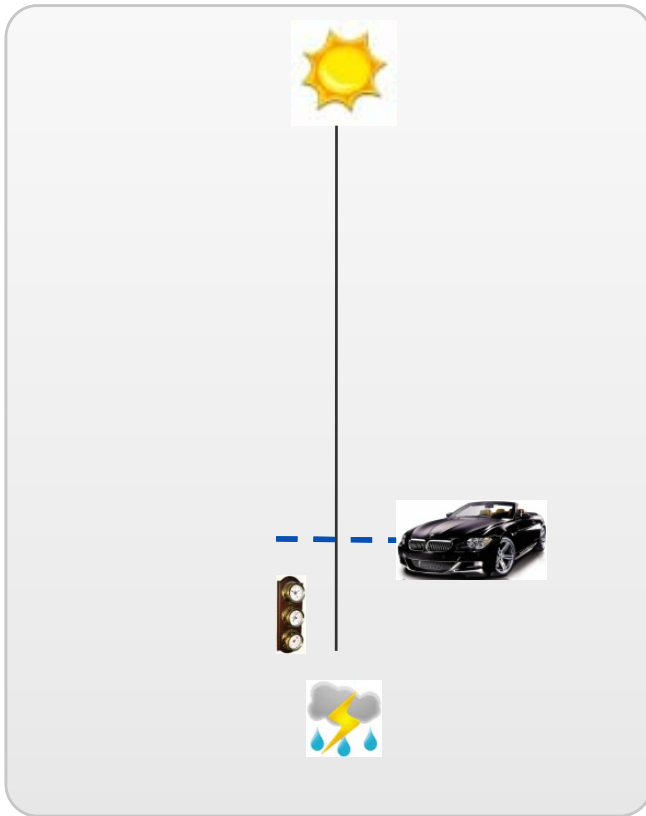
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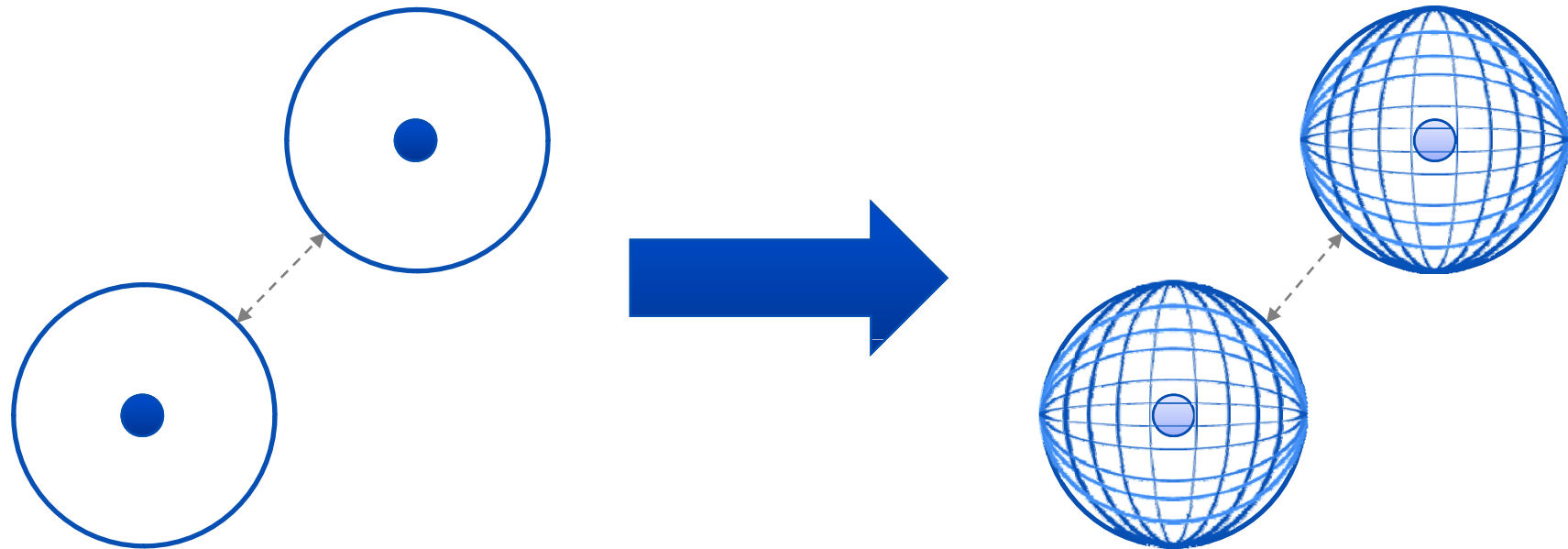
Weather station



Context Boundary

Application of the Contextual Map

Update Semantics



Geographical Proximity Detection

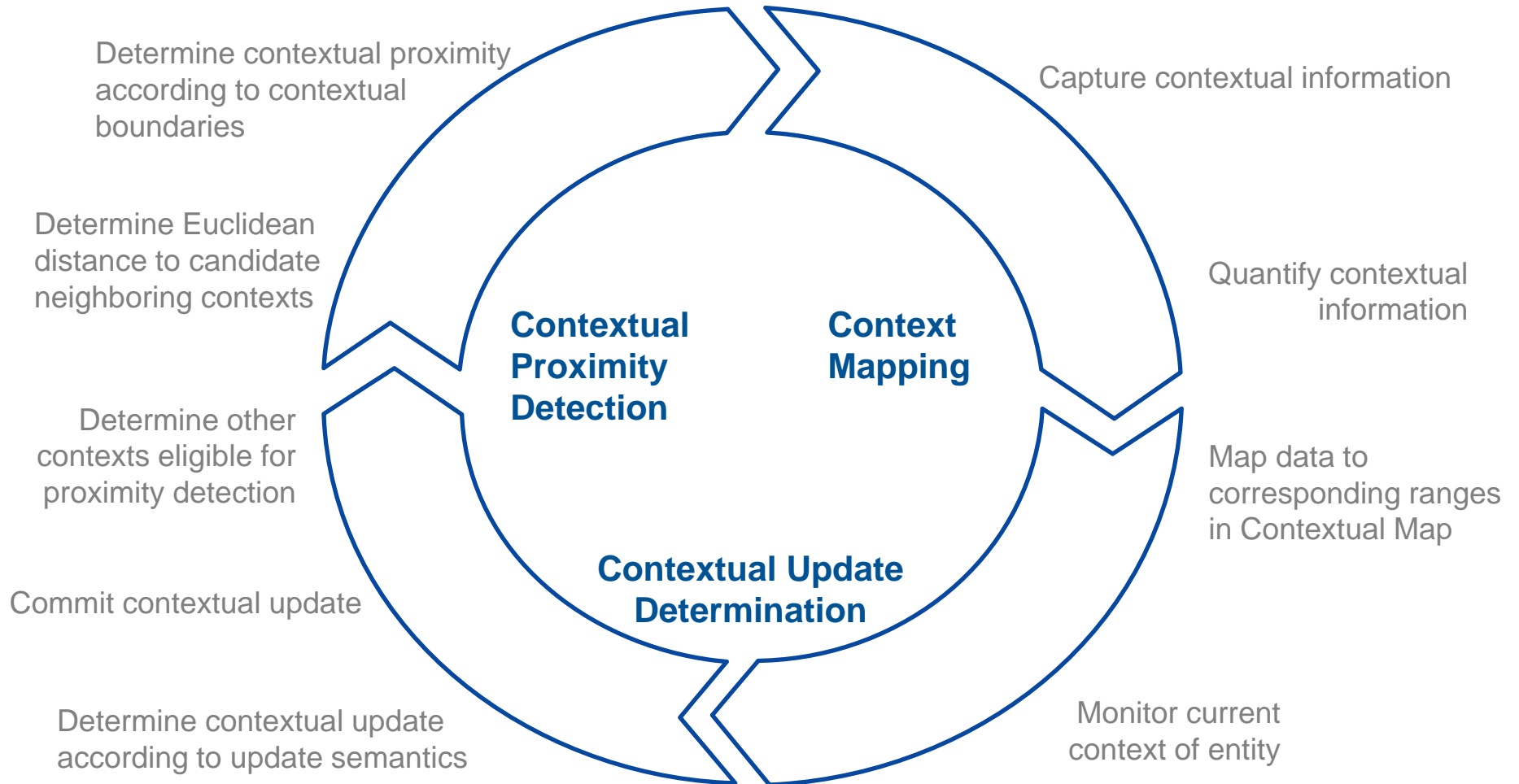
- 2-dimensional Euclidean space
- Circular update zones

Contextual Map

- 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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