A Graph-Based Approach to Context Matching

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A Graph-Based Approach to Context Matching

- Approach
- Context-Awareness
- Representation
- Patterns
- Solving Problems

overview
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Approach

Elements of our approach:

- fully distributed system
- use of software agents
- use local information and local communication

Context-Awareness

Representation

Patterns

Solving Problems
Any information that can be used to characterize the situation of entities (i.e. whether a person, place or object) that are considered relevant to the interaction between a user and an application, including the user and the application themselves. [Dey, 2001]

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· *pro-activity* – anticipate problems, detect compatible or incompatible contexts.

· *non-intrusiveness* – communicate with other agents, considering privacy, in order to obtain more information on the context.
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**Our goal:** A simple, generic formalism that allows agents in a multi-agent system, that have only local knowledge, to share and process context-related information and to solve problems.
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· context-matching ·
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The agent of a user holds a context graph $G = (V, E)$:

$V = \{v_i\}$, $E = \{e_k\}$, $e_k = (v_i, v_j, \text{value})$ where $v_i, v_j \in V$, $i, j = 1, n$, $k = 1, m$ values are strings or URI identifiers.
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CATIIS Ziua Doctoranzilor.
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**Problem:** Alice should also think about some means of transportation to the concert.

- patterns are also graphs. The graph for pattern $s$:

$$G_s^P = (V_s^P, E_s^P)$$

$$V_s^P = \{v_i\}, \quad v_i = string \mid URI \mid ?, \quad i = 1, n$$

$$E_s^P = \{e_k\}, \quad e_k = (v_i, v_j, E\_RegExp), \quad v_i, v_j \in V_s^P, \quad k = 1, m$$

where $E\_RegExp$ is a regular expression formed of strings or URIs.
agents can communicate and share information.

information sharing is done by starting from shared context and try to extend the common context.
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If a pattern $G_s^P = (V_s^P, E_s^P)$ k-matches the subgraph $G' = (V', E')$ of $G$, we can define a problem $p$ as a tuple $(G_s^P, G_p^P)$, where $G_p^P$ is the problem’s graph:

- $G_p^P = G' \cup G_x^P$
- $G_x^P = (V_x^P, E_x^P)$
- $V_x^P = \{v \in V_s^P, v \notin \text{dom}(f)\}$
- $E_x^P = \{e \in E_s^P \text{ for which condition (2) is not fulfilled}\}$

Note that $G_x^P$ (the unsolved part of the problem) is a subgraph of $G_s^P$. 
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One more pattern:
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- infrastructures for the processing of context information have been proposed [Hong and Landay, 2001, Harter et al., 2002, Lech and Wienhofen, 2005, Henricksen and Indulska, 2006, Baldauf et al., 2007, Feng et al., 2004].

- context as associations [Henricksen and Indulska, 2006, Bettini et al., 2010].

- semantic networks, concept maps [Novak and Canás, 2006] and conceptual graphs [Sowa, 2000].

- graph matching (e.g. for image processing [Bengoetxea et al., 2002])

- we are not discussing ontology aligment [Viterbo et al., 2008].
The pattern *matches* subgraph $G'$ of the context graph $G$ if every non-$?$ vertex from the pattern must match a different vertex from $G'$; every non-regular-expression edge from the pattern must match an edge from $G'$; and every regular expression edge from the pattern must match a series (possibly void, if the expression allows it) of edges from $G'$.

A pattern $G_s^P$ *$k$-matches* a subgraph $G'$ of $G$, if the condition for edges above is fulfilled for $m - k$ edges in $E_s^P$, $k \in [1, m - 1]$, $m = ||E_s^P||$ and $G'$ remains connected.
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Inexact graph matching by means of estimation of distribution algorithms.
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Thank You!

Any Questions?