A Graph-Based Approach to Context Matching and some more title hello hello

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overview
What is AmI?

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- Context-Awareness
- Background
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- Matching
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- Future Work

Ambient Intelligence – or AmI – is an ubiquitous electronic environment that supports people in their daily tasks, in a proactive, but ”invisible” and non-intrusive manner. [?, ?]
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Constraints:
- limited storage
- limited performance
- large numbers
- much information
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Introduction

Approach

Elements of our approach:

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

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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. [?]
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Context-awareness enables:

- **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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- infrastructures for the processing of context information have been proposed [? , ?, ?, ?, ?, ?].

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- context as associations [? , ?].

Context-Awareness

- semantic networks, concept maps [?] and conceptual graphs [?].

- graph matching (e.g. for image processing [?])

- we are not discussing ontology alignment [?].
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**Representation of Context**

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The agent of a user holds a context graph $G = (V, E)$:

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

- patterns are also graphs. The graph for pattern \( s \):

\[
G_s^P = \left( V_s^P, E_s^P \right)
\]

\[
V_s^P = \{ v_i \}, \quad v_i = \text{string } | \text{URI } | ?, \quad i = 1, n
\]

\[
E_s^P = \{ e_k \}, \quad e_k = (v_i, v_j, E_{\text{RegExp}}), \quad v_i, v_j \in V_s^P, \quad k = 1, m
\]

where \( E_{\text{RegExp}} \) is a regular expression formed of strings or URIs.
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 $G^P_s \ k$-matches a subgraph $G'$ of $G$, if the condition for edges above is fulfilled for $m - k$ edges in $E^P_s$, $k \in [1, m - 1]$, $m = ||E^P_s||$ and $G'$ remains connected.
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:

- Computer Science & Engineering Department
- Andrei Olaru, Adina Magda Florea
- ACSys Workshop 2010
- Timisoara, Romania, 24.09.2010
Why?

- need to have decentralized, local, not pre-defined context-awareness.

What we presented:

- a generic representation for context, based on graphs.
- the notion of context matching for the detection of compatible contexts, and a possible generic mechanism for solving problems.
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Why?

- need to have decentralized, local, not pre-defined context-awareness.
- need a mechanism that is simple and generic.

What we presented:

- a generic representation for context, based on graphs.
- the notion of context matching for the detection of compatible contexts, and a possible generic mechanism for solving problems.
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Future work:

- devise an efficient algorithm for context matching.
- large context graphs, many matching (contradictory?) context patterns.
- work on the idea of incompatible contexts.
- uncertainty of information.
- temporality, history of context.
Thank you!

Any Questions?