Context Management and Self-Adaptivity for Situation-Aware Smart Software Systems

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Self-Adaptivity in Software Systems

Image source: http://school.discoveryeducation.com/clipart/clip/question.html
Self-Adaptive Systems

• A self-adaptive system continuously adjusts its behaviour at run-time in response to its perception of its environment and its own state in the form of fully or semiautomatic self-adaptation.

Situation-Aware Software Systems
Situation-Aware Software Systems

- Situation-awareness: the perception and comprehension of elements in the environment within a volume of time and space.

- Also called context-awareness

Situation-Aware Software Systems
Situation-Aware Software Systems

• Systems that understand themselves and their execution environment to deliver functionalities accordingly.
Situation-Aware Self-Adaptive Software Systems

- Situation-awareness vs. self-adaptation
  - Differences?
  - How do they complement each other?

Questions
The Autonomic Manager

How do situation-awareness and self-adaptation cooperate each other?
Situation-Aware Self-Adaptive Software Systems: Applications
SITUATION-AWARE SMART ONLINE SHOPPING
How to exploit situation-awareness and self-adaptivity in online shopping?
User-centric Situation-aware Smart Shopping Applications

Norha is in Markham, she is not in St. John’s!
User-centric Applications: Degree of Situation-Awareness

Norha lives in Victoria.

She is not a pizza lover!

However, Groupon wants her to eat pizza in St. John’s.

She is in Markham, right now!
The Problem: Dynamic Context

User locations are dynamic!

User preferences change continuously!
Context-Awareness in E-Commerce Today
Context Information

QUESTIONS
Context Information

• Any information that describes:
  – The state of entities that may affect the system operation or its interaction with the user
  – The relationship among these entities

• Must be representable at runtime

• Must be manipulable at runtime to manage its life cycle

Static Context vs. Dynamic Context
Dynamic Context

Context is any information useful to characterize the state of entities that can affect the behavior of the system and/or its interaction with the user.

Your Social Network  Your location  Your agenda  Your shopping preferences

Relevant context information evolves over time!

The monitoring infrastructure must be a self-adaptive system to manage dynamic context.
Dynamic Context Representation: Linked Data

Dynamic Context Reasoning: Semantic Web and Linked Data

- Tim Bernes-Lee
  - The inventor of the Web
- Highly recommended inspiring readings


http://en.wikipedia.org/wiki/Tim_Berners-Lee
Semantic Web

• Enables systems to smartly search, combine, and process web data based on the meaning that these data have to humans

More About Semantic Web
Dynamic Context Representation

Extensible Dimensions (e.g., Google product taxonomy)

Context Entities

Flexible semantics according to the business needs

Context privacy and security policies

Context Relationships
Dynamic Context Representation
Context Integration and Reasoning

anne.rdf: Anne’s initial context sphere model
Context Integration and Reasoning

Anne

CASCON2 011

Hilton Markham

Markham

Toronto

Markham

geo.rdf

anne.rdf
Context Integration and Reasoning

A partial integration of two RDF-SmarterContext models
Context Integration and Reasoning

Anne hostedBy CASCON2 011

CASCON2 011 hasIntegrated Hilton Markham

Hilton Markham locatedIn Markham isNearTo Toronto

Toronto isNearTo Markham

Symmetric

Applying SmarterContext inference rules

[nearTo: (?a pwc:locatedIn ?b) (?b pwc:isNearTo ?c) -> (?a pwc:isNearTo ?c)]
How to empower users to manage their personal context in e-shopping?
Problem: Users With No Control Over Personal Data

I should not have given you my data!

No worries, we will exploit your data on your behalf!

I should not have given you my data!
Optimizing Your Web Experience

Your user experience is limited!

Women Shopping Web Site 1
Optimizing Your Web Experience

My Shopping List

Women Shopping Web Site 1

Your web experience is optimized!
Optimizing Your Web Experience

Web interactions within the boundaries of individual web sites

Women Shopping Web Site 1

SportsWear Shopping Web Site 2

My wish list!

User-centric integration is incomplete!
Optimizing Your Web Experience

Women Shopping Web Site 1

My wish list!

SportsWear Shopping Web Site 2

User-centric integration is complete!
Optimizing Your Web Experience

Your web experience is not context-aware!
Optimizing Your Web Experience

Your web experience is context-aware!
Empowering users: The Personal Context Sphere
Value Creation with Personal Context

TOWARDS A NEW E-COMMERCE BUSINESS MODEL
The Actors

Convenience

Personalization

Customization

Shoppers

Price & Time Savings

Retailers

Revenue Generation

Market Opportunity

Cloud Providers
The Infrastructure

Shoppers

Retailers

Cloud Providers
Situation-Awareness and Self-Adaptation for Software Evolution

YouTube source: eBay Black Friday Birds Eye view
THANK YOU!