Erlernen von Benutzerverhalten in Ubiquitous Environments

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Master Informatik - Anwendungen 2

Inhalt

AW 1 Context Awareness im Living Place Hamburg

- Klärung von Begrifflichkeiten
- Vorstellung verschiedener Kontext Architekturen

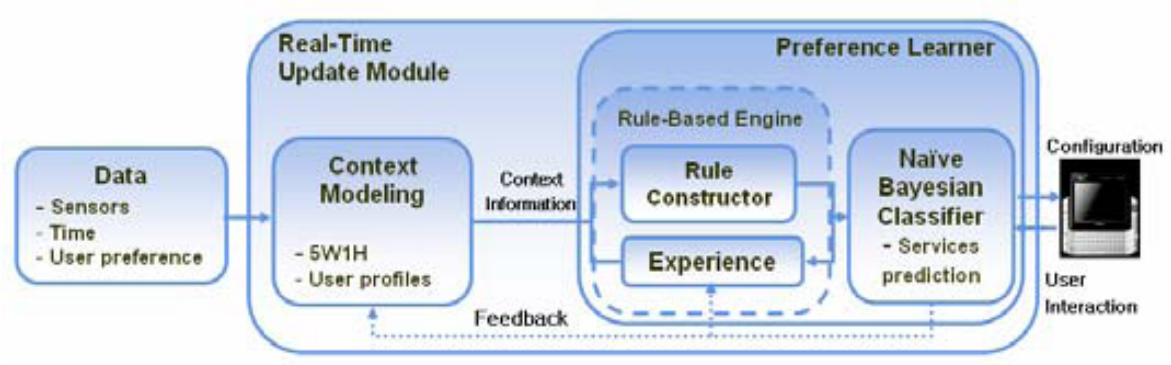
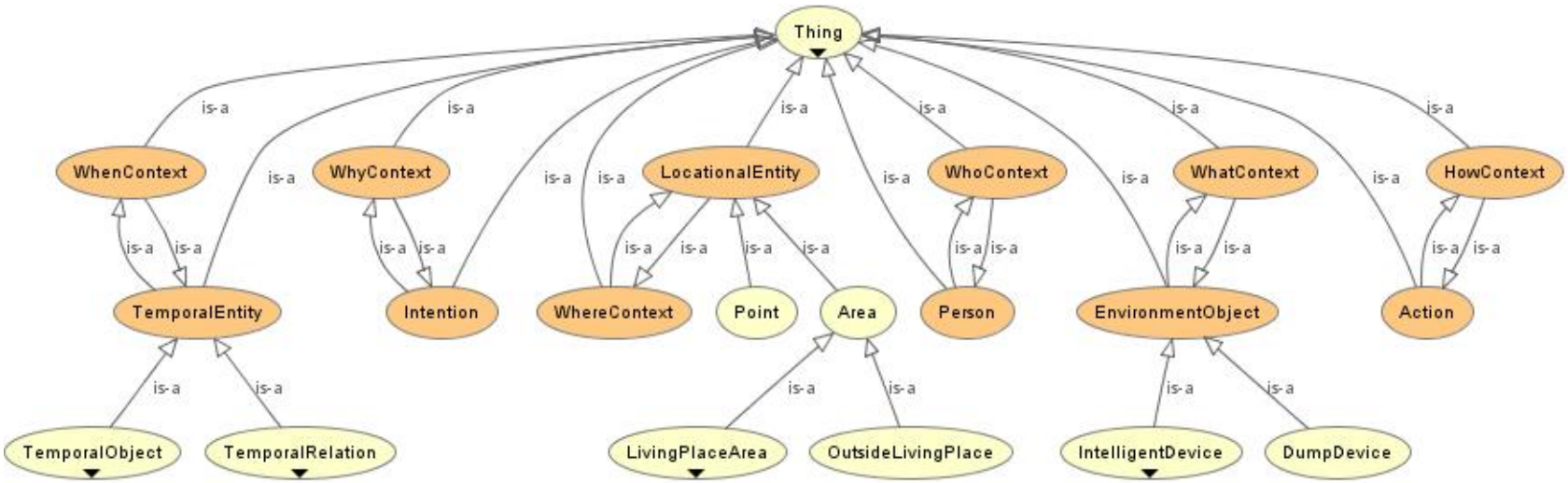


Abbildung: Context Aware Learning System [4]

- Vorstellung von Lernverfahren zur Kontextbestimmung
  - Bayes Classifier
  - Support Vector Machine

Projekt 1 im living place

- Context Ontologie 5W1H



- API für Protegé
- SVM Framework angucken

Übersicht

- **Fuzzy Q-Learning HBSS**
- Conflict Resolution and Preference Learning in Ubi-Environment

Fuzzy-State Q-Learning-based Human Behavior Suggestion System in Intelligent Sweet Home [2]

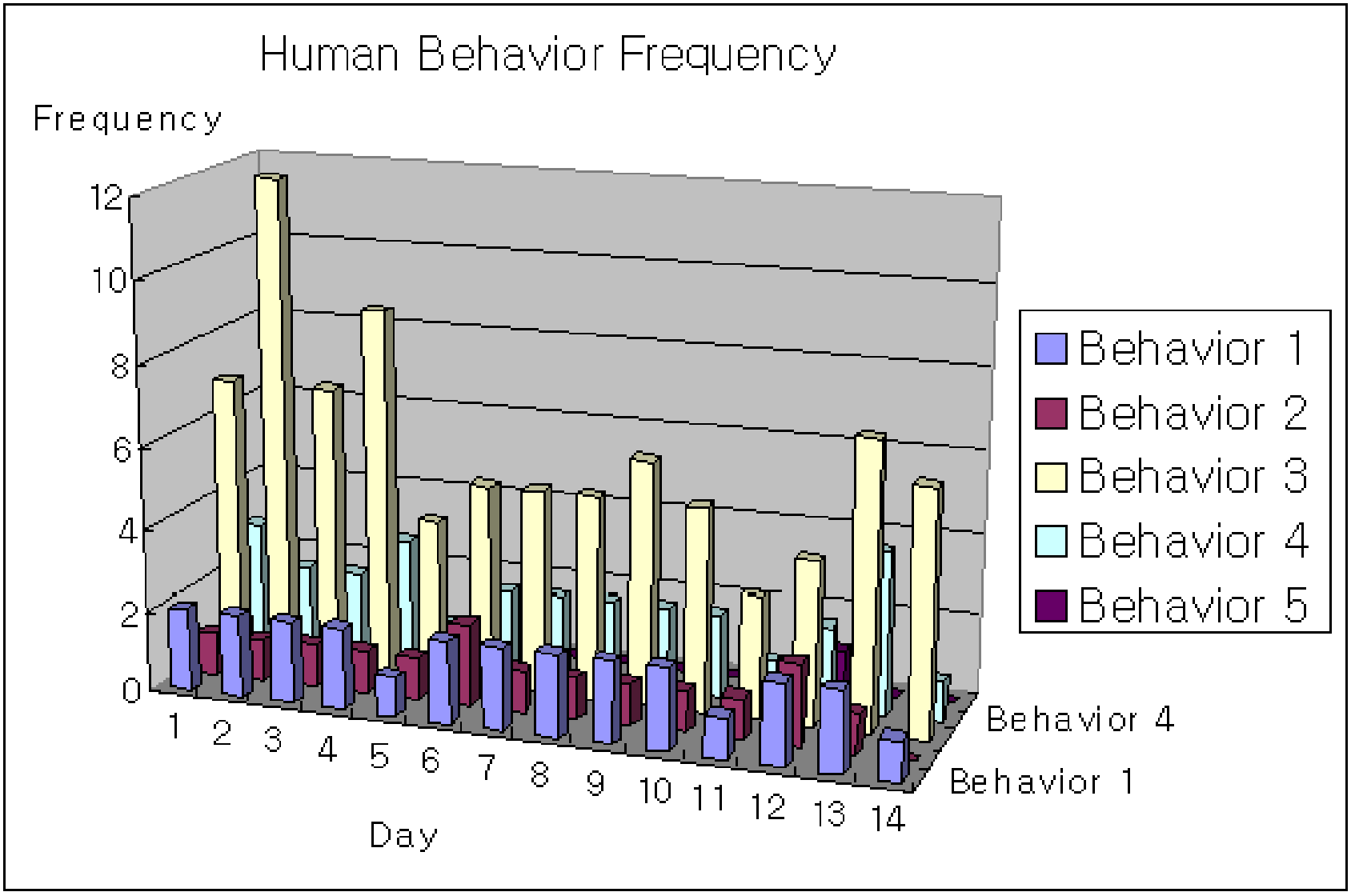
- Paper für IEEE International Conference on Fuzzy Systems 2009
- Korea Advanced Institute of Science and Technology
- Unterstüzung Demenzkranker durch intelligente Wohnung

Abbildung: Visuelle Unterstützung des Bewohners

Eigenschaften

- Human Behavior Suggestion System (HBSS)
  - Erlernt Verhaltensmuster
  - Trifft Vorhersagen
  - Verhaltensvorschläge als Erinnerung
- Basierend auf Fuzzy Logic und Q-Learning
- Besonderheit: Beachtet Periodizität des Benutzerverhaltens

Verhaltensperiodizität



Features

Situation

Time, Location, Temperature, Helligkeit, Luftfeuchtigkeit,...

User

Sequenz des vorhergehenden Verhaltens, Stimmenlautstärke, Blutdruck, Körpertemperatur,...

Regular Frequency

Durchschnittliche Häufigkeit einer Verhaltensweise als Periode

Fuzzy und Q-Learning

- Fuzzy Logik gut für:
  - Inkonsistenz
  - Ungenauigkeit
  - Mehrdeutigkeit
- Q-Learning effektiv für:
  - Sequenzielle Daten z. B. zeitliche Reihenfolge
- Kombiniert: Fuzzy-State Q-Learning Algorithmus
- Benötigt Situation Features und Sequent des User Verhalten

Fuzzy-State Q-Learning Algorithmus

Procedure : Fuzzy-State Q-Learning

Step1. Initialization

Decide the parameters, learning rate α *, discount factor* γ *, and number of fuzzy partition* C.

Step2. Fuzzy Partition for the state with uncertainty

For given attributes with uncertainty $X = \{x_1, \cdots, x_N\}$,

construct C *fuzzy partitions* v_i $(i = 1, \cdots, C)$
by any fuzzy clustering method with a normalized membership, $\mu_i(x_k) = \dfrac{1/\|x_k - v_i\|^2}{\sum_{j=1}^{C} 1/\|x_k - v_j\|^2}$.

Step3. Fuzzy Q-Learning

Initialize Q-values, $Q_j(s,a)$ *for* $\forall s, a, j$.

Do

$S \leftarrow$ *current state*

Select the action $a^* = \arg\max_a FQ(s,a)$ *,where* $FQ(s,a) = \sum_{j=1}^{C} \mu_j(x) Q_j(s,a)$

Execute the action by moving to the new state s'*, and get reward* r.

Update $Q_j(s,a) \leftarrow Q_j(s,a) + \alpha_j \{r + \gamma \max_{a'} FQ(s',a') - Q_j(s,a)\}$ *for* $\forall j$
,where $\alpha_j = \alpha \cdot \mu_j(x)$.

until Q-values converge or maximum number of trials are reached.

Fazit

- Getestet mit „echten“ Trainingsdaten
- Leider keine Erwähnung wie der Reward berechnet wird
- Fuzzy-States der unscharfen Features müssen festgelegt werden

TABLE 3 A Success rate using a Fuzzy Membership Function

	General feature	General feature with a averaged frequency feature
Success rate	63.88%	72.2%

Übersicht

- Fuzzy Q-Learning HBSS
- **Conflict Resolution and Preference Learning in Ubi-Environment**

Conflict Resolution and Preference Learning in Ubiquitous Environment

Wo und Was

- Real-Time and MultiMedia Lab, Department of Computer Engineering, Kyung Hee University, Korea
- Erlernen von Nutzer Vorlieben (User Preferences)
- Konfliktauflösung zwischen Benutzerpräferenzen
- Bayesian RN-Metanetwork (RN = Relevant Network)

Szenario

Office

In the morning, secretary comes to the office. When she enters the room, the light is turned on and the curtain is opened. The music player plays the secretarys favorite song. After that, professor arrives. Because the priority of professor is higher than that of secretary, the music is changed to professors favorite. When a student enters the office and sits down on the chair in front of professors desk, knowing that professor is having a meeting with his students, the music will be switched off...

- Erfüllbar durch festgelegte Regeln
- Problem bei anderem Verhalten

Erweitertes Szeanrio

Stop the Music

The music playing is stopped. Even though the command is from the remote control on the secretarys desk, it does not totally mean that the secretary herself wants to stop the music. Maybe professor uses that remote control, or maybe the secretary does it because professor tells her to do. Moreover, there are some possible reasons that he or she does not want to listen to music at this time. The data from other sensors should be used to detect the person who wants to stop the music and his/her reason, so that the next time when the same situation happens, the music will be automatically stopped.

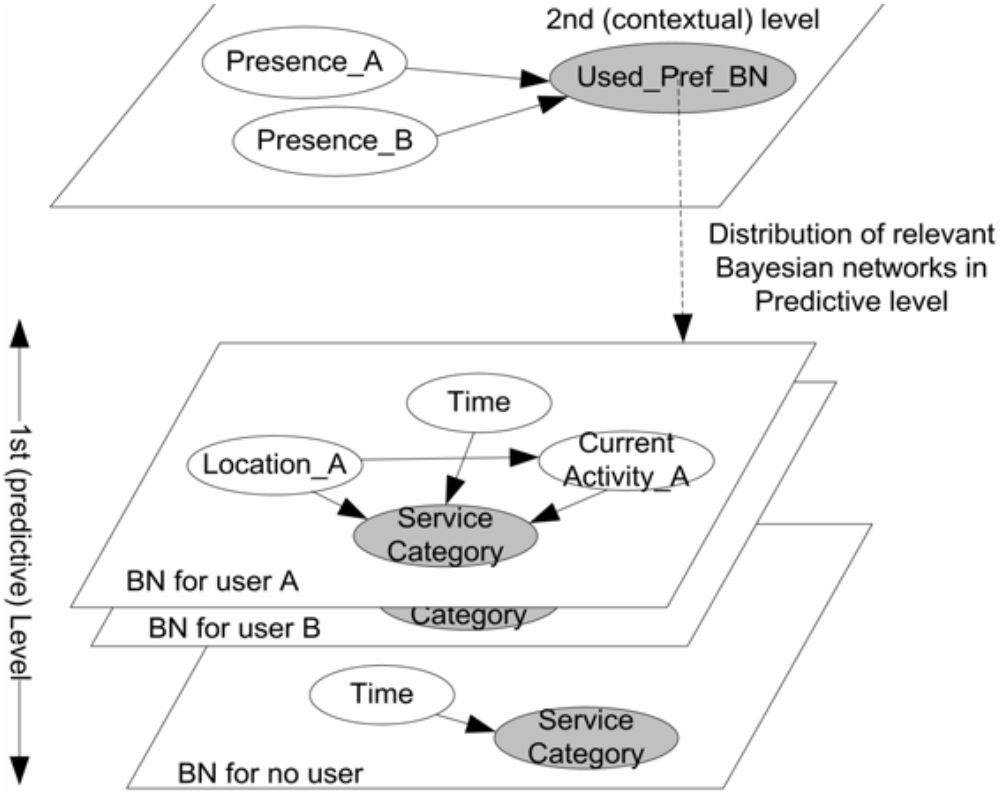
Anforderungen

Modellieren von:

- User Preferences
- Unsicherheiten
- User Prioritäten
- Online Learning (Adaption)(Algorithmus voll beschrieben)
  - Feedback implizit positiv

–> Umsetzung mittels Bayesian RN Network

Bayesian RN Metanetwork

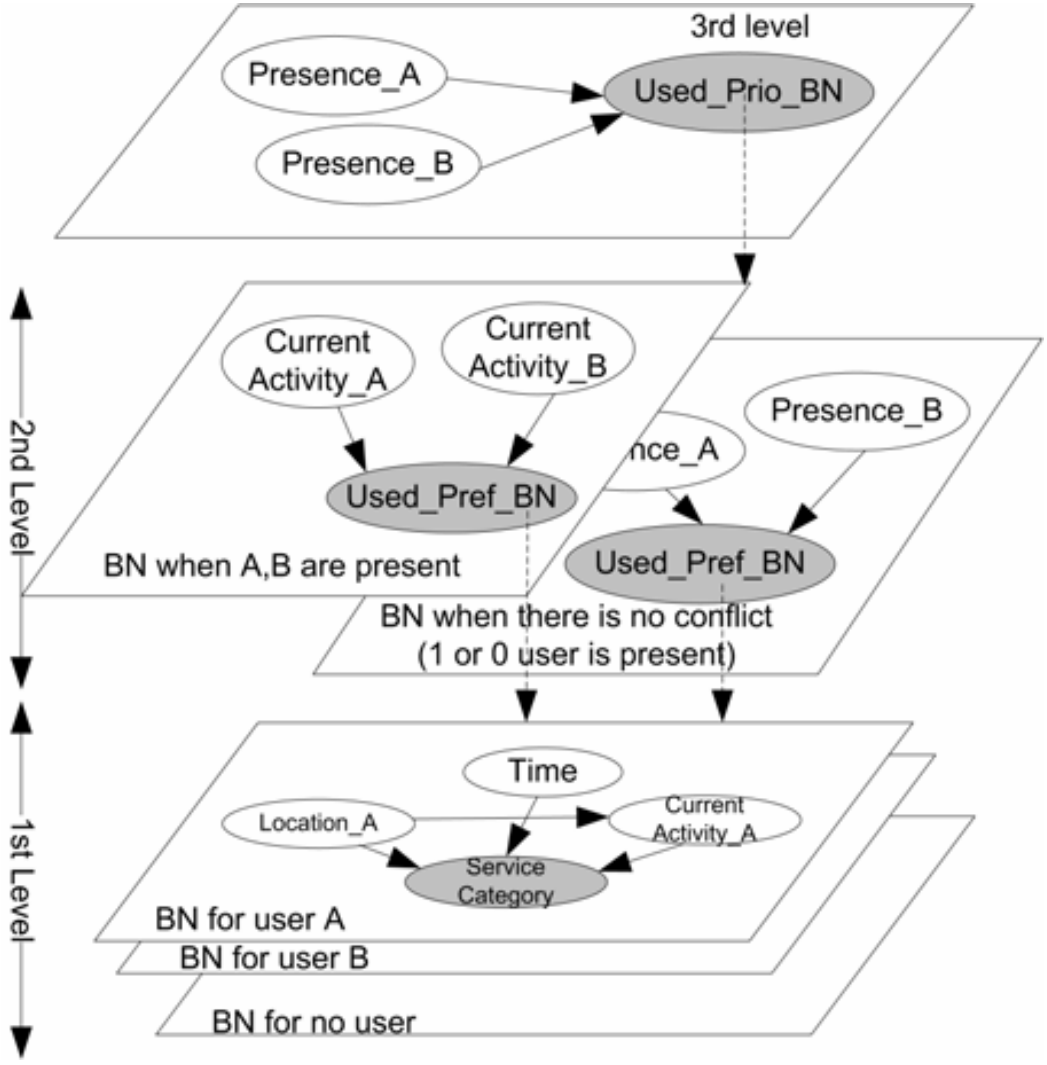


Presence_A	Y		N	
Presence_B	Y	N	Y	N
Use_A_pref	0.5	1	0	0
Use_B_pref	0.5	0	1	0
Use_Nouser_pref	0	0	0	1

Eigenschaften

- Zwei Level
  - Wahrscheinlichkeiten im 1st Level abhängig von Wahrscheinlichkeitsverteilungen im 2nd Level.
- Als MAS möglich -> Pro User BN ein Agent - Mechanismen beschrieben in [1]

Verhalten bei gleicher User Priorität



Bedingte Wahrscheinlichkeiten

Conditional probability of Used_Prio_BN node in 3rd level Bayesian network

Presence_A	Y		N	
Presence_B	Y	N	Y	N
Use_AB_prio	1	0	0	0
Use_single_prio	0	1	1	1

Conditional probability of Used_Pref_BN node when both A and B are present

CurrentActivity_A	Working		Sleeping	
CurrentActivity_B	Working	Sleeping	Working	Sleeping
Use_A_pref	0.5	0.3	0.9	0.5
Use_B_pref	0.5	0.7	0.1	0.5
Use_Nouser_pref	0	0	0	0

Fazit

- BN bieten grafische Methode für Abhängigkeitsmodellierung
- Wahrscheinlichkeits Propagation wird beschrieben
- Adaption der Bayesian Networks wird beschrieben
- Durch MAS Fähigkeit skalierbar: Pro User ein Agent

- Konkretes Szenario für living place
- Auswahl Lernverfahren
- Ontologie und ActiveMQ einbinden
- Prototyping Projekt2

Ende

Danke für die Aufmerksamkeit und viel Erfolg für die Prüfungen!

Noch Fragen?

[1] Alex M. Andrew. *PROBABILISTIC REASONING IN MULTIAGENT SYSTEMS: A GRAPHICAL MODELS APPROACH*. Cambridge University Press, 2002.

[2] Sunha Bae, Sang Wan Lee, Yong Soo Kim, and Zeungnam Bien. Fuzzy-state q-learning-based human behavior suggestion system in intelligent sweet home. In *Fuzzy Systems, 2009. FUZZ-IEEE 2009. IEEE International Conference on*, pages 283 –287, 20-24 2009.

[3] Md. Kamrul Hasan, Kim Anh, Lenin Mehedy, Young koo Lee, and Sungyoung Lee. Conflict resolution and preference learning in ubiquitous environment.

[4] Jieun Lee, Sanghoun Oh, and Moongu Jeon. A new context-aware learning system for predicting services to users in ubiquitous environment. *ISUVR '07 5th International Symposium on Ubiquitous Virtual Reality*, 2007.