Evaluating the probabilistic side of proactive computing

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Objectives

The present research project represents a work in progress, which aims to validate through a theoretical and empirical study the probabilistic side of proactive computing. We aim to implement the user-oriented proactive behaviour into a target system and to validate it with regard to probabilistic aspects of data matching. The main objective of the current work, is to elaborate an effective methodology, allowing to integrate probabilistic aspects of data detection. We base our key approach on stochastic evaluation of user's cognitive states. For fulfilling the given objectives, we use the local search engine and its medical database as a target environment for our experiments.

Deterministic side

In a previous study, we investigated the deterministic side of proactive computing, including the possibility of implementing the preprogrammed set of context aware-capable rules for the purposes of augmenting a target system with a proactive type of behaviour [1]. In order to enhance, and to elaborate the deterministic part of a theoretical structure, we currently focus on studying the probabilistic side of proactive computing.

Probabilistic side

We use statistics as a main technique for an algorithm to connect to the specifics of users' cognitive states, and to integrate the aspects of the probabilistic approach. If collected and allocated properly, the statistics may reveal various types of information, related to a user's contextual characteristics, including the user's cognitive states, search objectives and interests. Several types of statistics are applied, including time detectors, timers, selection data, mouse clicks, time intervals, data interrelations, data associations and disassociations. The given, or similar combinations of statistics allow to perform the algorithmic computations upon a data in order to reveal the user's hidden cognitive states and the different aspects of associated context settings.

Cognitive modelling

In order to find effective strategies to relate the aspects of human cognition to the specifics of software systems, we explore the potentials to include the cognitive science expertise into proactive computing research. Such position prompts us to translate and to adapt the attributes of human cognitive processes into an algorithmic level. One of the strategies to be considered is a *Cognitive modelling* approach. We choose the cognitive modelling methodology as a technique to design two models of a user's mental variations, and thus to implement the probabilistic inference of the user's cognitive states during a search activity. For the purposes of the current study, we have specified two cognitive states to be tested, that is the user's state of satisfaction and dissatisfaction, expressed in relation to the search results of medical terminology.

Cognitive science expertise

Consequently, we use a cognitive science expertise in order to define the specifics of users' cognitive processes and their representations in overt behaviour. Later, we relate the defined cognitive characteristics to a statistical data. Therefore, the particular sequence of a statistical data represents a distinct aspect of a user's cognitive state. The main idea is to allocate the statistics into logical, coherent sequences, chain of sequences, patterns and eventually models, which will represent in the end overtly manifested instances of users' cognitive states.

Proactive scenarios

In order to detect a model of a user's cognitive state, we create a set of rules, allocated into proactive scenarios. Each scenario has its own objective, to identify the specific type of a corresponding data instance. Once, the relevant type of statistics is detected, the initial rule will launch a new rule, associated with a next type of statistics in a data sequence. All proactive scenarios are designed around different aspects of users' context and their associated cognitive states.

Model approximation

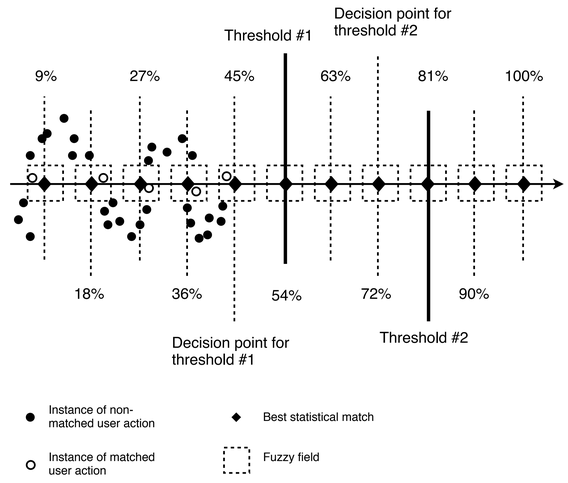

Figure 1: Representation of a model matching process

A model is detected through its gradual approximation by proactive scenarios. During model progression, the algorithm is set to estimate a probability of a user's moving towards the closest threshold. Here we apply the Bayesian statistics, where given the evidence of previous user's actions, we estimate the probability if model's data will keep matching the user's data until the end of an active model. If the algorithm estimates positively the user's future actions, the system will launch proactive mediating-actions, corresponding to the needs of a current situation. The thresholds are the points on a model, which correspond to a percent representing the status of a model progression. The objective of thresholds is to mark the absolute endmost moment of triggering the corresponding proactive actions.

Rule's engine

All proactive scenarios are managed by *Rules Engine*, representing the main part of the proactive system. The compound rules of proactive scenarios are processed by Rules Engine, which is responsible for storing, executing and iterating the rules [2].

Conclusions

The presented steps of ongoing experiments aim to apply the cognitive modelling as a key strategy for implementing the probabilistic aspects of a model estimation. The given approach allowed us to update the initial system framework, and thus to delineate the new guidelines for the upcoming implementation procedures. Our future work will respectively consist of a further framework elaboration and its empirical assessment.

References

[1] Denis Shirnin, Sandro Reis, and Denis Zampunieris. Experimentation of Proactive Computing in Context Aware Systems: Case Study of Human-Computer Interactions in e-Learning Environment. In *CogSIMA, 2013*, pages 269–276, San Diego, US, February 2013.

[2] Denis Zampunieris. Implementation of Efficient Proactive Computing Using Lazy Evaluation in a Learning Management System. *International Journal of Web-Based Learning and Teaching Technologies*, 3(1):103–109, 2008.

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