CSA402

Lecture 15

Introduction to User Modelling

References

[Bru96] Brusilovsky, P. (1996): 'Methods and Techniques of adaptive hypermedia', in *User Modelling and User Adapted Interaction*, v6, n2-3, pp 87-129

[Kob93] Kobsa, A. (1993): 'User Modeling: Recent Work, Prospects and Hazards', in M. Schneider-Hufschmidt, T. Kühme and U. Malinowski, (eds) *Adaptive User Interfaces: Principles and Practice*. Amsterdam: North Holland Elsevier. Available online at: http://fit.gmd.de/~kobsa/papers/1993-aui-kobsa.pdf

[Ric83] Rich, E.A. (1983): 'Users are Individuals : Individualising User Models', in *International Journal of Man-Machine Studies*, Volume 18.

[GHN+97] Green, S. *et. al*. (1997): 'Software Agents: A review'. Available online at: http://www.cs.tcd.ie/research_groups/aig/iag/pubreview.ps.gz

Overview

- Adaptive systems in general need to represent the user in some way so that the system (interface and/or data) can be adapted to reflect the user's interests, needs and requirements

- The representation of the user is called a user *profile* or a user model

- UM has its roots in philosophy/AI, and the first implementations were in the field of natural-language dialogue systems

- For adaptive systems, user model must *learn* (at least some of the) user requirements/preferences

- User models can be simple or complex, but remember that you can only get out of them what you put in!

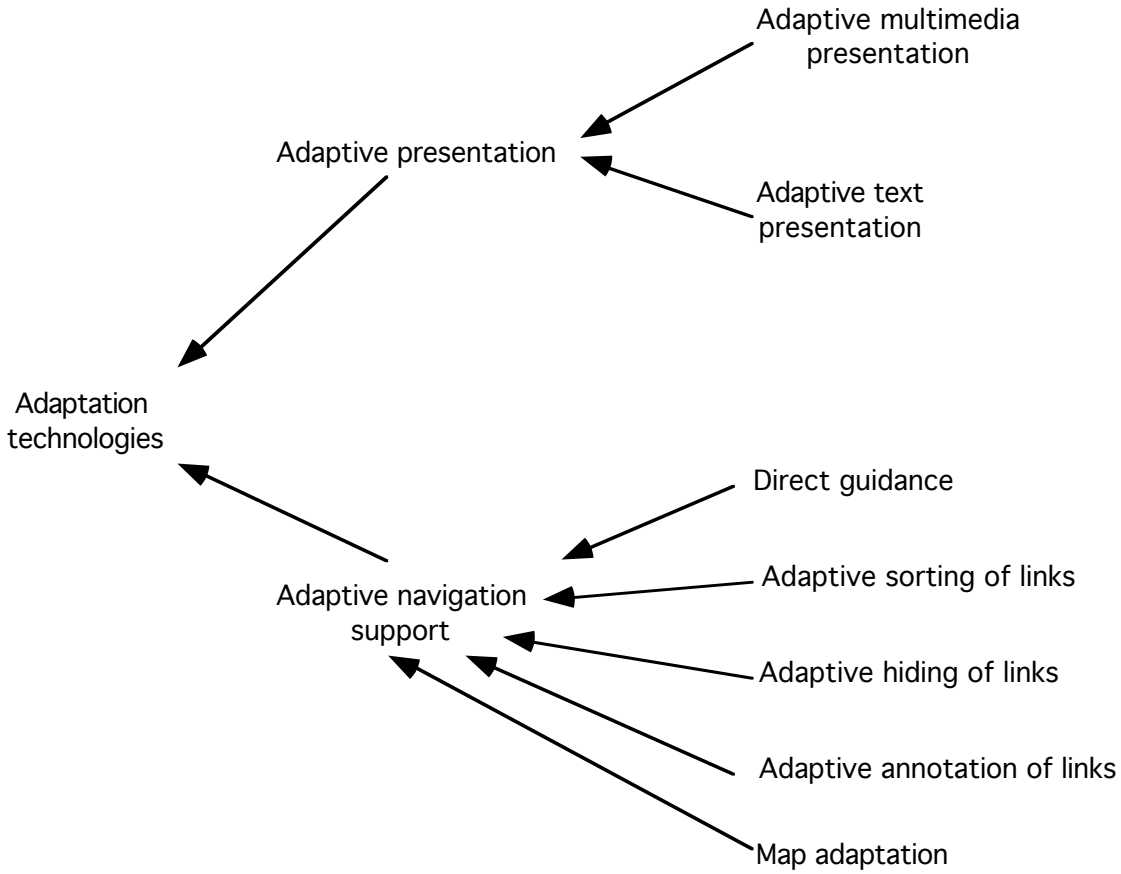
What can user modeling be used for

- Plan recognition
- Anticipating behaviour/user actions
- User interests
- Information filtering
- User ability

Why is a User Model required in AHSs?

- A user model is required to adapt hyperspace to reflect the users preferences, needs and requirements

- The level of adaptation in hypertext systems is summarised in the following diagram



From Brusilovsky, P. 1998. 'Methods and Techniques of Adaptive Hypermedia', in Brusilovsky, P., Kobsa, A., and Vassileva, J. (eds). 1998, *Adaptive Hypertext and Hypermedia*. Amstedam: Klewer Academic Publishers, pg. 14.

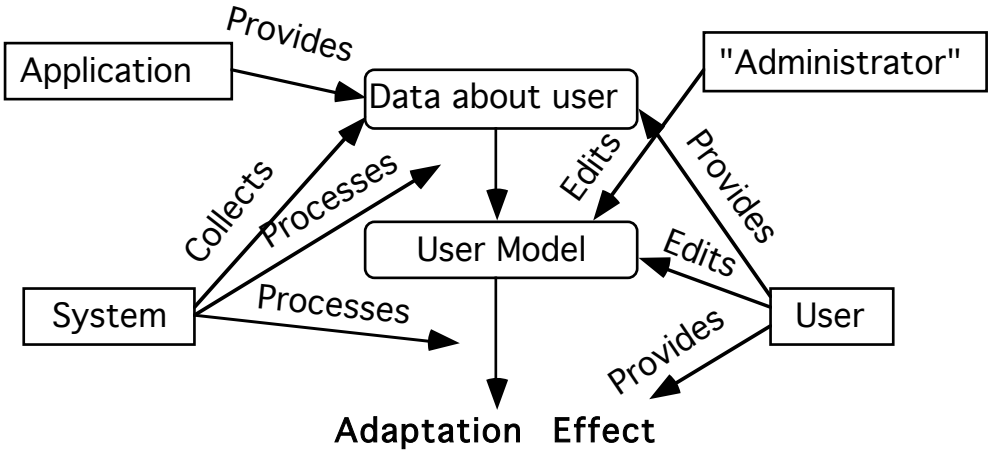
Stages in the adaptation process

- Collecting data about the user
- Processing data to build/update user model
- Applying user model to provide the adaptation

  Last stage always fully automated in adaptive hypertext systems

  1st and 2nd stages may require user intervention. Ideally, fully automated

  If user and system need to co-operate to achieve adaptivity, then it is called *collaborative* user modelling



Collaborative user modelling in adaptive hypermedia (from [Bru96]

Difference between model of user's *cognitive state* and model of what the user knows (*user knowledge*)

- *Empirical quantitative models* make no effort to *understand* or *reason* about the user
- Contain surface knowledge about the user
- Knowledge about the user is taken into consideration explicitly only during the design of the system and is then hardwired into the system (early expert systems)
- *Analytical cognitive models* try to simulate the cognitive user processes that are taking place during permanent interaction with the system
- These models incorporate an explicit representation of the user knowledge
- The integration of a knowledge base that stores user modeling information allows for the consideration of specific traits of various users

- Rich [Ric83] introduces a taxonomy where she classifies analytical cognitive user models along three dimensions

1 1st dimension: Rich distinguishes between canonical and individual UM

- In a canonical model, there is one single, typical user, while an individual UM has to be able to tailor its behavior to a heterogeneous variety of users

2 2nd dimension: Rich separates explicit and implicit user models

- An explicit model is built explicitly by the user. An implicit model is built by the system (monitors user behavior and acquires other user information)

3 3rd dimension: long-term and short-term modeling, where the short-term modeling systems focus on building up a UM during a single session, while the former concentrate on information that changes more slowly over time, i.e., over a whole series of sessions

How is user knowledge acquired?

- Prompting the user, e.g.interview (explicit)

- Observing user behaviour (implicit)

- Certainty vs. uncertainty (probabilistic)

What type of information might it be desirable for a UM to learn?

- User interests (long-, short-term)
- user plans and short-term intentions
- Domain knowledge
- User preferences
- user ability
- user beliefs (about the system, e.g.)

How do you know what's of interest to the user?

- User has already declared interest
- Others were interested in the same things

User model types (mostly from machine learning):

- value-attribute pairs
- hidden markov models
- bayesian networks
- rule-bases
- graphs (hierarchical stereotyping)

Building a user model [GHN+97]

- Symbolic classifiers: classify users according to user *features* (which may be obtained via interview or by observation, and then maintained automatically)... e.g., stereotypes

- Sub-symbolic classifiers: using neural networks to achieve classification based on pre-existing classes and features (supervised NNs), or NN is allowed to catergorise based on actual observation to find "natural" classes (competitive learning) (unsupervised NNs)

- Symbolic and sub-symbolic classifiers learn off-line

- The following learn on-line

  Reinforcement learning
  Learning by observtion
  Instructional learning

- Probably need different ML techniques learn different types of information