

User Behavior Observations for Supporting Offline Delivering of Learning Materials in a Mobile System

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Outline

- Motivation
- User Modeling for Hoarding
- Automatic Extraction of Attributes
- Possible Techniques
 - Data Mining Algorithms
 - Collaborative Filtering
 - Sequential Patterns
 - Exclusion of data
- Conclusions

Our Motivation for Analyzing User Behavior

- Mobile Learning - 'Anytime, Anywhere'

- Clark Quinn, 2000

"The vision of mobile computing is that of *portable* (even wearable) computation: rich interactivity, *total connectivity*, and powerful processing - a small device that is *always networked*, allowing easy input through pens and/or speech or even a keyboard when necessary (though it may be something completely different like a chord keyboard), and the ability to see high resolution images and hear quality sound."

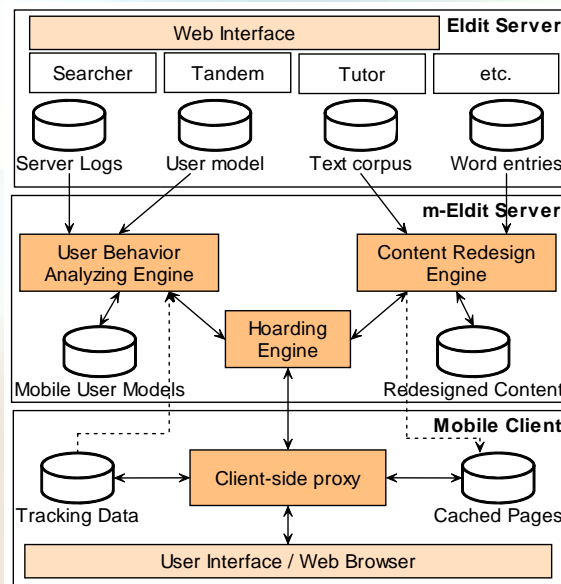
Our Motivation for Analyzing User Behavior

- 2005 reality:
 - devices had really become mobile in the sense of light, small and powerful
 - there are quite a lot of technological ways to connect to the internet, through WAP, GPRS, Wi-Fi and etc.
 - still users have long periods of disconnection
 - Intentional: too expensive
 - Not intentional: lack of proper infrastructure

Our Motivation for Analyzing User Behavior

- To allow 'any time, anywhere' access to the learning materials
 - to support **offline** access of learning content
- Often the device available memory is not big enough to contain all material of a system
 - a decision should be made what to put on the device
- To free the user from annoying procedures of pre-fetching content
 - decide automatically what the user will need
- **Hoarding** is a technique for selecting set of documents to be uploaded and used when disconnected
 - should adjust to every user specific needs

Our Context



Our test field

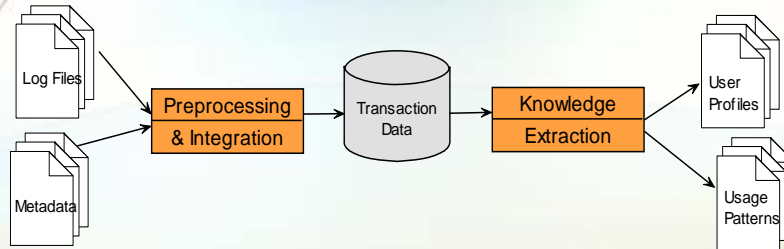
- ELDIT -An innovative electronic language learning system that helps to prepare for the exams in bilingualism in South Tyrol and for everybody interested in learning German or Italian language
- ELDIT consists of: electronic learner's dictionary, a text corpus, quizzes, a tandem module, an adaptive tutor, etc. (about 800 texts and highly interconnected associated word entries) – **More than 600MB data**
- **MOBILE ELDIT** – for PDAs (32-64MB memory)



User Modeling for Hoarding

- **User behavior**
 - browsing styles, e.g. consecutive, random, interest (subject)-driven, etc. ;
 - preferred type of educational media (e.g. the user prefers video to combination of text and pictures) ;
 - quick browser or deep-explorer etc.
- **User knowledge**
 - awareness of the user's competence in a certain subject (i.e. beginner, intermediate, advanced)
 - list of all the topics or concepts that the user already knows (or we know he/she doesn't know)
- **User preferences** (*not needed for hoarding*)
 - preferred presentation or interaction styles

Automatic Extraction of Attributes



- **Generic users**
 - Typical usage patterns
 - Categorization of users
 - Relations between items
 - etc.
- **Particular user**
 - Learning style
 - Knowledge obtained
 - Difficulties
 - etc.

Techniques

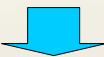
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• Data Mining

➤ Example Data:

| | LO ₁ | LO ₂ | LO ₃ | LO ₄ | LO ₅ | LO ₆ |
|----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Session ₁ | 0 | 0 | 0 | 1 | 1 | 1 |
| Session ₂ | 1 | 1 | 1 | 0 | 0 | 0 |
| Session ₃ | 0 | 0 | 0 | 1 | 1 | 1 |
| Session ₄ | 0 | 0 | 1 | 0 | 1 | 1 |
| Session ₅ | 1 | 1 | 1 | 0 | 0 | 0 |
| Session ₆ | 1 | 0 | 1 | 0 | 0 | 0 |
| Session ₇ | 1 | 0 | 0 | 0 | 1 | 1 |

➤ Association Rules:


 LO₂ ⇒ LO₁ ; LO₂ ⇒ LO₃ ; LO₄ ⇒ LO₅ ;
 LO₅ ⇒ LO₆ ; LO₆ ⇒ LO₅ ;

“Almost every time when the LO₁ was viewed also LO₃ was viewed in the same session”
 (where LO₁ might be an example problem and LO₃ the solution given by the lecturer)

Techniques

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- Data Mining**

- Clustering (on the example data above):

| Cluster | Instances | Centroids |
|----------|---|-------------|
| cluster0 | 4 (57%) Session ₁ ; Session ₃ Session ₄ ; Session ₇ | 0 0 0 0 1 1 |
| cluster1 | 3 (43%) Session ₂ ; Session ₅ Session ₆ | 1 1 1 0 0 0 |

- MORE (specific) Association Rules:



| Cluster | Associations |
|----------------------|--|
| cluster ₀ | LO ₁ ⇒ LO ₅ ; LO ₃ ⇒ LO ₅ LO ₃ ⇒ LO ₆ ; LO ₄ ⇒ LO ₆ |
| cluster ₁ | LO ₁ ⇒ LO ₃ ; LO ₃ ⇒ LO ₁ |

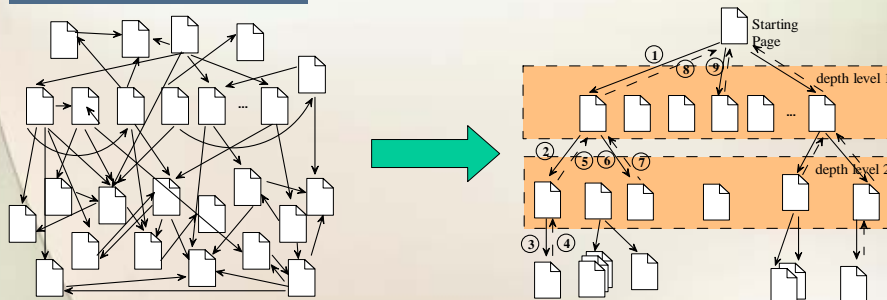
Techniques

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- Collaborative Filtering**

$$similarity(\vec{A}, \vec{B}) = \cos(\vec{A}, \vec{B}) = \frac{\vec{A} \cdot \vec{B}}{\|\vec{A}\| * \|\vec{B}\|}$$

- Sequential Patterns**

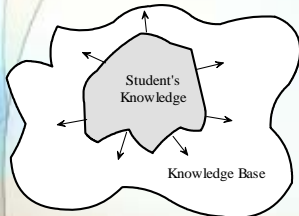


Possible Techniques

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- **Excluding data from user sets**

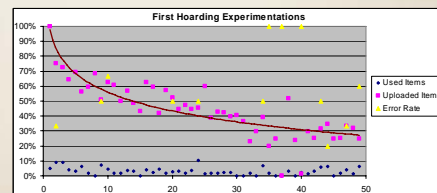
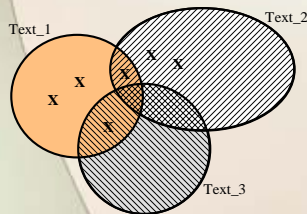
! We mind on usage log files



User knowledge is a subset of the knowledge base

What the user decided not to see is what the user knows

We might exclude from the hoarding set overlapping objects that are already known



Conclusions

- Our goal is to support **user on the move**
- We study the Hoarding problem - the **automatic selection** of learning material to be used during **offline periods**
- Hoarding depends on system's awareness of the **user specific needs**, problems, behavior characteristics and preferences
- We would like to **provide tips and guidelines** on possible approaches, useful parameters settings of the algorithms and ect.

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THANK YOU!

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