After 25 years of user modeling and adaptation… what makes us UMAP?

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Alternative title could be:

- from expert-driven adaptation to data-driven adaptation
  ... a still ongoing 25-year journey

- because
  1. that’s what has been happening (and it is inevitable)
  2. that’s what spawned spin-off research in recommender systems, social network analysis and much more
  3. that’s what starts clouding an essential UMAP goal: *understandable adaptation*
The *most adaptive system is the* human

- we adapt to (or put up with) circumstances that do not fit at all
- sometimes this is because of an (arbitrary) standard
- sometimes it is because of dictatorship (president or HiPPO management)
- “wisdom of the crowd” could tip the balance (but we will see why it does not work)
Warning: this talk touches on religion

- paradox: a data-driven analysis of this chart suggests that the expert-drive approach is right

source: wikipedia.org
Where did it start?

- photo: Peter and Paul, early apostles of adaptive web-based systems

picture taken by Natasha Stash
Example: teaching/tutoring and learning

source: wikipedia.org
Teaching versus Tutoring

• tutoring model:
  • one-on-one, interactive session with tutor and student
  • easy to do personalization
  • prohibitively expensive

• classroom model:
  • one expert (teacher) preaches to the whole class
  • one size fits all approach, no or little room for feedback

• only feasible solution: *automatic* personalization in on-line learning

• the need for one-on-one personalisation exists in many other areas (museum guides, troubleshooting systems, encyclopedias, on-line shopping, …)
So, let’s “automate” the teacher…

• the teacher (expert) decides that children should learn about *addition* before *subtraction*. But suppose that children can follow a link to either…

```python
#if knows_addition
    Now that you know how to add numbers we will learn how to subtract them…
#else
    Before we try to subtract numbers, let’s first learn how to add them: go to this lesson first.
#endif
```

• have you wondered whether this expert is right? do children *need* to learn adding before subtracting?
User Modeling – Adaptation Loop

System

Collected Data about user

Processes

User Model

Processes

Adaptation

Adaptation effect

figure by Brusilovsky, redrawn by Knutov
How to adapt: *adaptation techniques*

Latest taxonomy of adaptation techniques (PhD thesis of Evgeny Knutov)
How to adapt: adaptation techniques

Latest taxonomy of adaptation techniques [Knutov et al, 2009]
Discussion and Impact

Adaptive hypermedia has great potential. There seems to be no end to the amount of information available on the World Wide Web today. When authors, publishing this huge amount, would have the ability to write things differently or write different things, based on their knowledge of the reader, would they use that power? One can never answer that question without having realized the technical context to support it.

Many adaptive hypermedia systems have been created. However, the added complexity of authoring adaptive hypermedia and the limited functionality and performance issues of adaptive hypermedia systems have limited the amount of material produced. This thesis, and accompanying prototype GALE, is based on 15 years of experience of authors writing adaptive hypermedia and engineers developing systems to support them. It answers the questions raised in the introduction.
How It Works

The HTTP request URL (that can be seen in the address bar) contains the name of the concept requested. For the current concept 'How It Works' that is: http://gale.win.tue.nl/thesis/howitworks. A file on the server describes how accessing this concept should affect the user model. Every time a link is followed, the user model is updated. Before the page is sent, the server will use information in the user model to change the page and make it ‘more suitable’ to your needs. Various techniques are used to change the information in the page.

The links that lead to topics that are part of this thesis, can change in color. You might remember the various colors used:

- **blue**, when the link is recommended
- **purple**, when the link is recommended but you have already read its content
- **blueish purple**, when the link is recommended, you have already read its content, but in the meantime something has changed on the page
- **black**, when the link is not recommended
- **orange**, when the link refers to external material

Recommending links is based on properties found in the user model. I try to determine if a concept is suitable, based on your knowledge of prerequisite concepts (explained a bit further down). I keep track of how often you have visited concepts that were suitable. These user model properties are used as a basis for the link colors. Some expression determines what the CSS class of the link should be. The thesis.css file contains sections for the link classes 'good', 'neutral', 'bad', and others.
Example of layout adaptation
a word from our sponsors
(commercial break)

no I’m not kidding!
and no, you cannot skip it!
but it is going to be interactive!
Have you heard about…

- AHA!, a *general-purpose* adaptive hypermedia system, developed at the TU/e?
- GALE: the successor to AHA!, an even *more general-purpose* adaptive hypermedia system, from TU/e?
- Many of you probably have… but have you heard about it as the main topic of a talk at UMAP?
UMAP needs to open up to systems papers

- AHA! was presented at ACM Hypertext in 2006, using an *adaptive paper* and *adaptive presentation*
  
  this was great fun!

- GALE was presented at ACM Hypertext in 2011

- Application-independent adaptive systems have never been accepted at UMAP because without application there cannot be *user evaluation*
Typical questions we got...

• Q: How good is the adaptation in AHA! (or GALE)?
  • A: As good as what the author of an AHA! (or GALE) application creates

• Q: What does an AHA! (or GALE) application look like?
  • A: It looks like what the author creates, using HTML and CSS (with or without frameworks like Bootstrap)

• Q: Which adaptation techniques does AHA! (or GALE) support?
  • A: Every technique the author decides to use, including any number of link colors and annotations

• …
Which GP adaptive systems are there?

- besides AHA! and GALE... almost none... (not counting WiBAF, the latest TU/e platform) because you almost cannot publish about it

- but there is also no real need for other systems: GALE (as well as the older AHA!) is open source, and a majority of the applications and experiments published at UMAP could have created with GALE...

- many probably in less time than it took to create the technology from scratch...

- but of course for *you* AHA!, GALE and WiBAF all suffer from the *not invented here* problem
end of commercial break
Simple AHAM Reference Model

• Extension of the Dexter Hypertext Reference Model
The Domain Model and User Model

- **what** is the application about?
  - **concepts, topics, objects**
    - concepts to learn in a course
    - products to buy/sell in a store
    - topics for discussion groups, news, tweets

- **predefined** (e.g. in course) ⇒ **defined** (e.g. in news) ⇒ **generated** (e.g. with tweets)

- **what** can we adapt to? user, context...
  - **overlay model**: knowledge, interest... in each concept of the domain model
  - when DM becomes dynamically generated the **structure** of UM is also dynamically generated
connections are typically typed:
• to represent facts, e.g. Pieter Lastman was teacher of Rembrandt van Rijn
• to represent discourse or pedagogical relations, e.g. “A is a prerequisite for B”
  ≈ “A should be read or studied before B”
• the type allows an expert to define the same adaptation rule for all connections of that type
• interest in paintings by a painter may suggest interest in paintings by the painter’s teacher
More Domain Model: *connecting* concepts

Image from the CHIP project
The User Model: what can we adapt to?

- what do we know about the user?
  - *explicit* input from the user: name and other *personal* characteristics

- what do we know about the user *that is relevant for a specific application*?
  - *knowledge of*, or *interest in* concepts, topics, objects
  - using an *overlay model*: one user model concept for each domain model concept
  - *knowledge or interest* derived from *browsing behavior* or from *explicit verification* (tests, forms, etc.)
CHIP demo available at chip.win.tue.nl
UMAP’s most essential point: scrutability

figure by Knutov
Do we need to automate the expert?

- yes, because *doing everything manually is too much work*
- yes, because *some applications have rapidly evolving domain models* (e.g. tweets)
- question: also yes because *the expert may be wrong*?
Experts are wrong more often than we think

- up to the 1800’s: bloodletting to cure diseases
Relying on data requires *scientific approach*

Pierre Louis, 1836, had to treat people with pneumonia

- one of the first clinical trials; at random he applied
  - early, aggressive bloodletting, or
  - less aggressive measures
- at the end he counted the bodies
  - they were stacked higher over by the bloodletting sink
  - so bloodletting was not the best treatment,
  - but there was still no answer to the “why not” question
- on the Web doing controlled experiments to find out what works best is *cheap*… but that does not yet help us with the “why” or “why not” question
How to do UMAP data-driven adaptation?

1. it needs to be valid: shown experimentally to provide “good” (the best) adaptation
   - users must be happy (somewhat subjective)
   - effects must be good according to some objective measures

2. we need to understand why certain adaptation is generated and applied
   - this we may call “scrutable” adaptation

3. then we may start understanding why the adaption is good
   - we may start to understand how to improve adaptation
   - we may find more application-independent methods
flash commercial break
understand why?
submit to UMAP
no idea?

try elsewhere
(RecSys, HT, SIGIR, IUI, FLAIRS…)

image found on PaulsHealthBlog.com
end commercial break
Measuring satisfaction... missing data?

- satisfaction can be measured by asking (e.g. 5-point likert scale used in CHIP)

  177 Recommended artworks
  + View all artworks  View recommended tour

  11 Recommended topics
  Rendering of texture
  Lutes
  Symbolist
  Portraiture
  Domestic scenes

boolean: like/dislike, or “not interested” (YouTube)

- problem: what is the user’s opinion on items not recommended? and does it matter to know?
Filter Bubbles, and Wisdom of the Crowd

- “wisdom of the crowd” (and/or “ensemble learning”)
  - requires that each “agent” is independent (and right more than 50% of the time)
- this goes wrong in politics/elections: campaigning makes voters not independent
- continuous adjustment of adaptation:
  - combined user behavior is used to generate a recommendation: that is often a good recommendation
  - user behavior of users who are given that recommendation is then mixed in to refine the adaptation: this creates a filter bubble
- refinement of filtering taking the bias caused by previous filtering into account is still mostly an unsolved problem area
Measuring whether users follow advice quite well?
Measuring whether users follow advice

- some concepts have a high number of accesses through non-recommended links (total = 76 students)

Figure by Vinicius Ramos
Why do users not follow advice?

- “curiosity killed the cat”
- non-recommended links were visible
- when they appeared often it triggered curiosity
- another example where you cannot avoid showing non-recommended links:

screendump from iFanzy (ITEA Passepartout project)
How to *understand* adaptation?

- we do not like *black box adaptation*
  - hence we also do not like *black box user modeling*
- when we can inspect *how* the adaptation is done we have a chance of *understanding* it.
  - when we show how *weights of relationships* contribute to adaptation we can understand why liking one item leads to suggesting another
- can we enable automatic *weight adjustment* based on user actions?
Questions?

- Every keynote (or other talk) ends with “are there questions?”

- Not this one…
Answers?

- I already gave you the questions…
  - How can we know *why* certain adaptation (recommendation) is better than another (or even best)?
  - How can we find user modeling and adaptation methods that are good *application independent* methods?
  - How can we avoid filter bubbles when mixing user behavior from early and later users?
  - How can we make adaptation *understandable* and how can we make *meta-adaptation (adaptation of the adaptation) understandable*?

- Are there any answers?
  - Maybe at UMAP 2018, 2019…
And now for the adaptive paper…

go to: [http://gale.win.tue.nl/keynote/](http://gale.win.tue.nl/keynote/)

you can create an account or just browse anonymously (by leaving fields empty)