# From Adaptive Hypermedia to the Adaptive Web Systems

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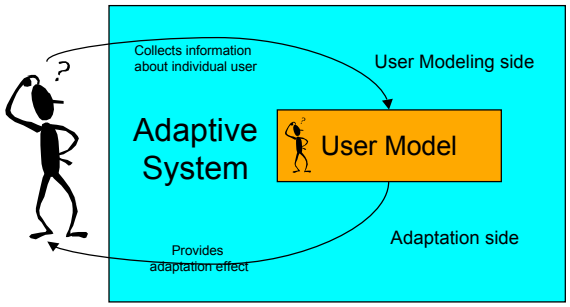
## WWW: One Size Fits All?

- Unknown before variety of users
- Yet almost all of them offer the same content and the same links to all
  - Stores
  - Museums
  - Courses
  - News sites
- Adaptive Web-based systems and sites offer an alternative. They attempt to treat differently users that are different from the system's point view

# What can be taken into account?

- Knowledge about the content and the system
- Short-term and long-term goals
- Interests
- Navigation / action history
- User category,background, profession, language, capabilities
- Platform, bandwidth, context…

# Adaptive systems

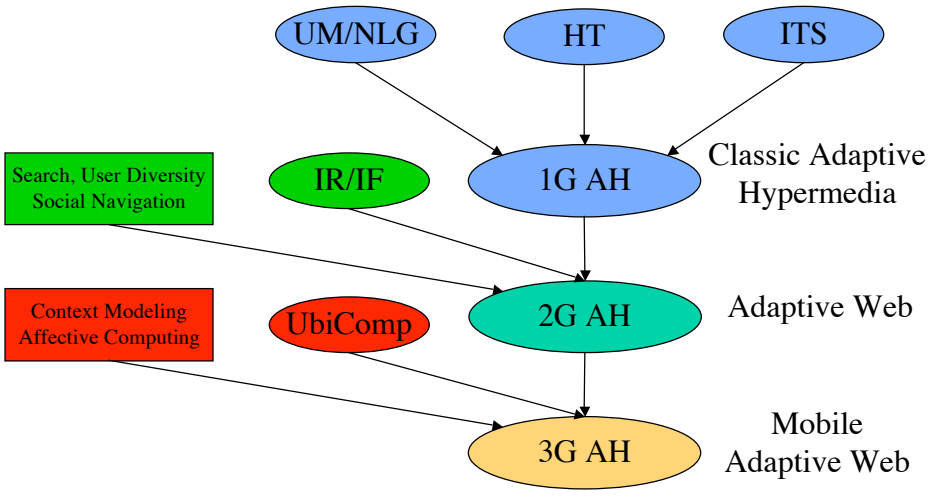



Classic loop “user modeling - adaptation” in adaptive systems

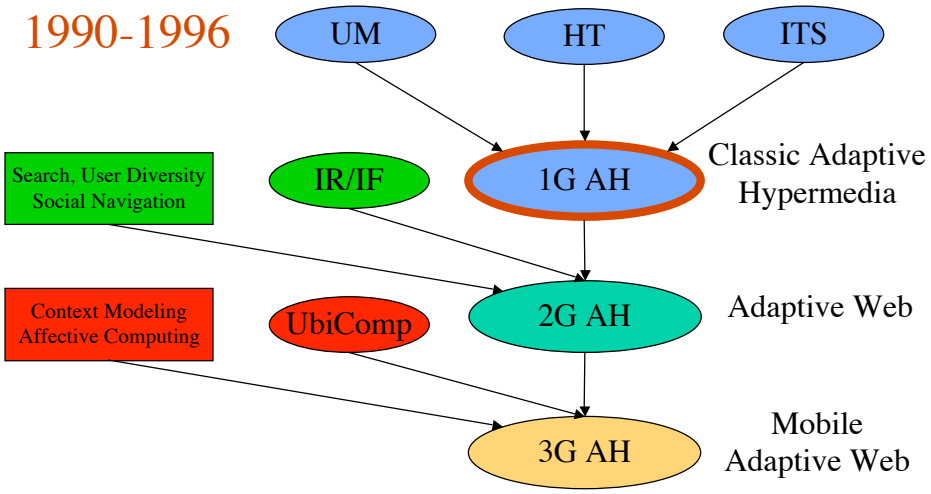
# Outline

- How hypertext and hypermedia can become adaptive?
- What constitutes the Adaptive Web?
- What we have learned from our work on Adaptive Hypermedia and the Adaptive Web
  - Take Home Messages (look for THM!)

# From AH to AW and Beyond



# Classic Adaptive Hypermedia




# Do we need Adaptive Hypermedia?

Hypermedia systems are almost adaptive but ...

☑ Different people are different

☑ Individuals are different at different times

☑ "Lost in hyperspace"

We may need to make hypermedia adaptive where ..

⇨ There us a large variety of users

⇨ Same user may need a different treatment

⇨ The hyperspace is relatively large

## So, where we may need AH?

- Educational Hypermedia
  - Hypadapter, Anatom-Tutor, ISIS-Tutor, Manuel Excell, ELM-ART, InterBook, AHA
- On-line Information systems
  - MetaDoc, KN-AHS, PUSH, HYPERFLEX
- On-line Help Systems
  - EPIAIM, HyPLAN, LISP-Critic, ORIMUHS

## What Can Be Adapted?

- Web-based systems = Pages + Links
- Adaptive presentation
  - content adaptation
- Adaptive navigation support
  - link adaptation

## Adaptive Presentation: Goals

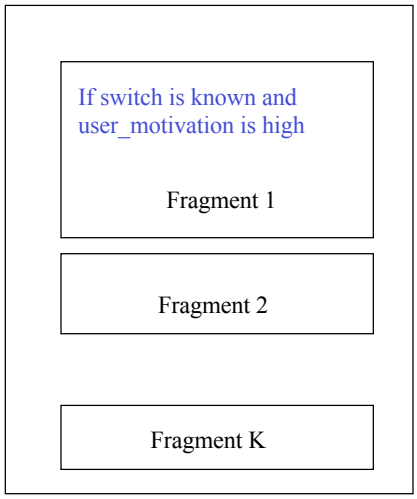
- Provide the different content for users with different knowledge, goals, background
- Provide additional material for some categories of users
  - comparisons
  - extra explanations
  - details
- Remove irrelevant piece of content
- Sort fragments - most relevant first

## Adaptive presentation techniques

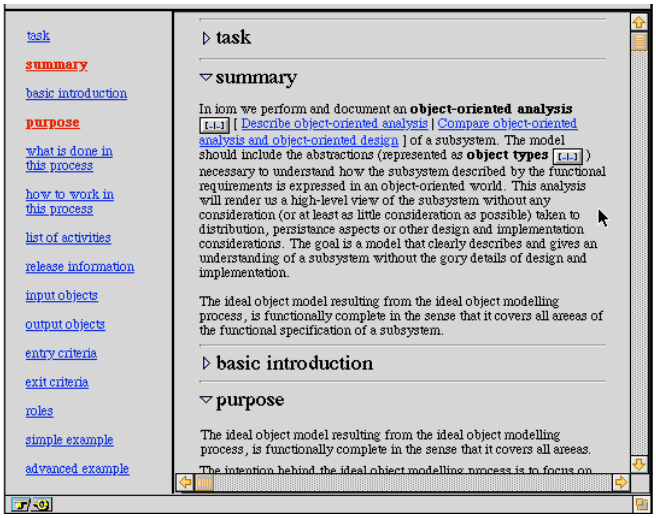
- Conditional text filtering
  - ITEM/IP
- Adaptive *stretchtext*
  - MetaDoc, KN-AHS
- Frame-based adaptation
  - Hypadapter, EPIAIM
- Natural language generation
  - PEBA-II, ILEX

# Conditional text filtering

- Similar to UNIX cpp
- Universal technology
  - Altering fragments
  - Extra explanation
  - Extra details
  - Comparisons
- Low level technology
  - Text programming




# Adaptive Stretchtext (PUSH)



## Adaptive presentation: evaluation

- MetaDoc: On-line documentation system, adapting to user knowledge on the subject
- Reading comprehension time decreased
- Understanding increased for novices
- No effect for navigation time, number of nodes visited, number of operations

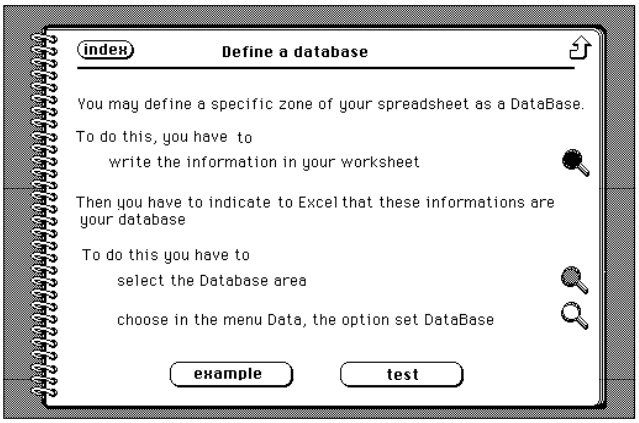
## Adaptive navigation support: goals

- Guidance: Where I can go?
  - Local guidance (“next best”)
  - Global guidance (“ultimate goal”)
- Orientation: Where am I?
  - Local orientation support (local area)
  - Global orientation support (whole hyperspace)

# Adaptive navigation support

- Direct guidance
- Hiding, restricting, disabling
- Generation
- Sorting
- Annotation
- Map adaptation

# Adaptive annotation: Icons

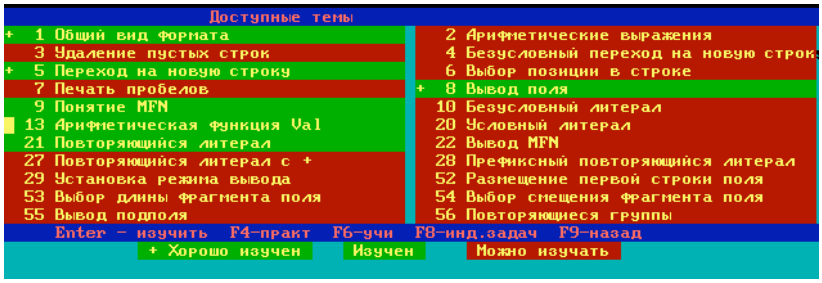



Annotations for topic states in *Manuel Excell*: not seen (white lens) ; partially seen (grey lens) ; and completed (black lens)

# Adaptive annotation: Font color

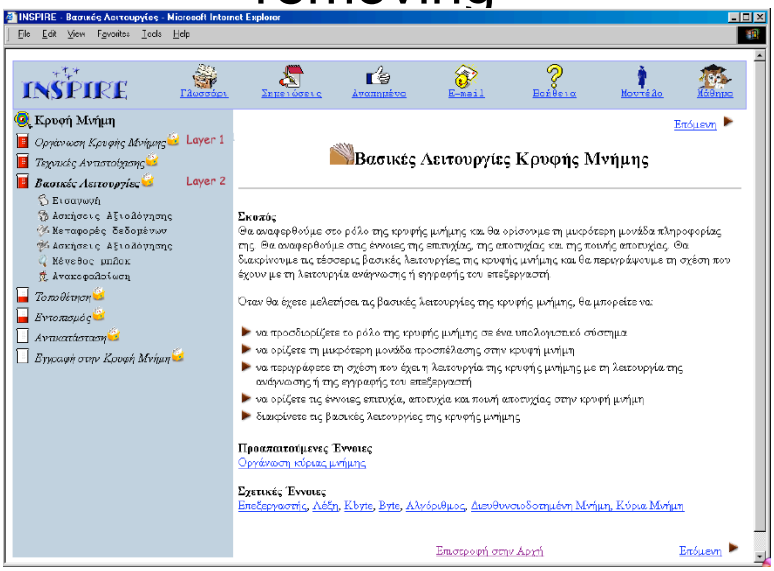

Annotations for concept states in *ISIS-Tutor*: not ready (neutral); ready and new (red); seen (green); and learned (green+)

# Adaptive hiding




Hiding links to concepts in *ISIS-Tutor*: not ready (neutral) links are removed. The rest of 64 links fits one screen.

# Adaptive annotation and removing




# Evaluation of Adaptive Link Sorting

- HYPERFLEX: IR System
  - adaptation to user search goal
  - adaptation to "personal cognitive map"
- Number of visited nodes decreased (significant)
- Correctness increased (not significant)
- Goal adaptation is more effective
- No significant difference for time/topic

## Evaluation of Adaptive Link Annotation and Hiding

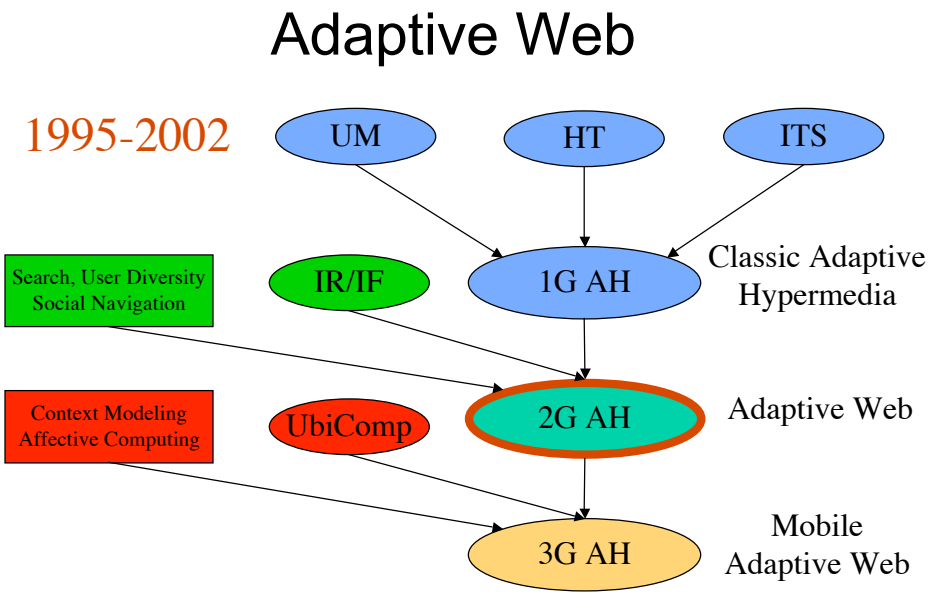
- ISIS-Tutor, an adaptive tutorial
- The students are able to achieve the same educational goal almost twice as faster
- The number of node visits (navigation overhead) decreased twice
- The number of attempts per problem to be solved decreased almost 4 times (from 7.7 to 1.4-1.8)

## THM1: It works!

- Adaptive presentation makes user to understand the content faster and better
- Adaptive navigation support reduces navigation efforts and allows the users to get to the right place at the right time
- Altogether AH techniques can significantly improve the effectiveness of hypertext and hypermedia systems

# THM2: AH is best of both worlds

- The Artificial Intelligent approach: machine intelligence makes a decision for a human
  - Adaptive NL generation, sequencing
- The HCI approach: human intelligence is empowered to make a decision
  - Classic stretchtext and hypertext
- Adaptive hypermedia: human intelligence and AI collaborate in making a decision



## Adaptive Web: Why?

☑Different people are different

☑Individuals are different at different times

☑"Lost in hyperspace”

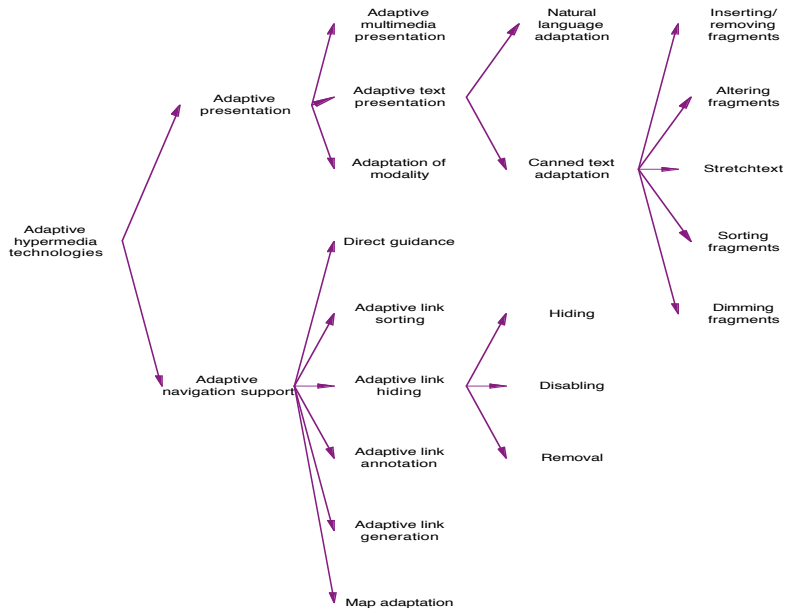
⇨Large variety of users

⇨Variable characteristics of the users

⇨Large hyperspace

## Adaptive Hypermedia Goes Web

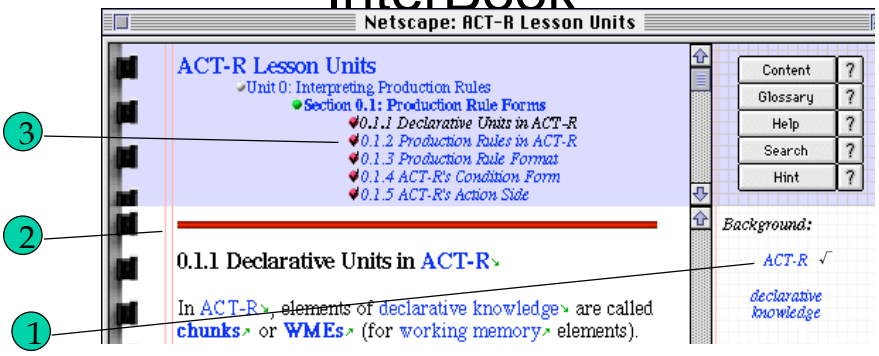
- Implementation of classic technologies in classic application areas on the new platform (but more techniques)
- New search-related technologies
- New user modeling challenges
- Integrated adaptive systems
- New application areas




# InterBook: Web-Based AH

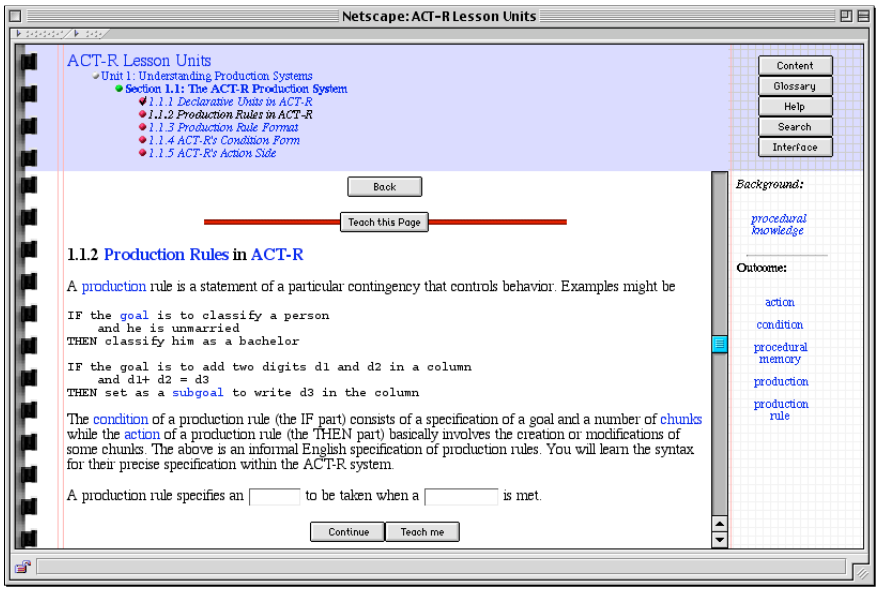
- An authoring shell and a delivery system for Web-based electronic textbooks
- Explores several adaptive navigation support technologies
- Oriented towards Web-based education needs

# Adaptive annotation in InterBook




1. State of concepts (unknown, known, ..., learned)
2. State of current section (ready, not ready, nothing new)
3. States of sections behind the links (as above + visited)

## Book view



## Results

- No overall difference in performance
- Sequential navigation dominates

...but ...

- Adaptive annotation encourage non-sequential navigation
- Helps to those who follow suggestions
- The adaptation mechanism works well

## THM3: AH is not a Silver Bullet

- A viewpoint: AH is an alternative to user-centered design. No need to study the user - we will adapt to everyone
- The truth:
  - AH is a powerful HCI tool - as mouse, visualization, VR
  - We need to study our users and apply all usual range of usability techniques - we just have one more tool to use in our repository

## The Need to Find It

- Background
  - Adaptive Information Retrieval and Filtering
  - Machine Learning
- Old techniques
  - Guidance: WebWatcher
  - Annotation: Syskill and Webert, MovieLens
- New technique
  - Recommendation (link generation): Letizia, FAB, SiteIF

## THM4: Not all adaptive Web systems are adaptive hypermedia

- Many IR and IF filtering systems use an old search - oriented IR approach
  - No real hyperspace, no browsing, no AH
- Most of advanced recommenders use simple 1-D adaptive hypermedia techniques - guidance, sorting, generation
- Power of a recommendation engine could be enhanced by power of a proper interface

# User Modeling Challenges

- Low bandwidth for user modeling
  - Extended user feedback
    - Rating, bookmarking, dowloading, purchasing…
  - Collaborative filtering and Social navigation
    - GroupLens, FireFly, FootSteps, … Amazon.com
  - Integrated Systems
- Wider variety of users
  - Adapting to disabled users: AVANTI
  - Adapting to learning styles: INSPIRE

# Application Areas: Old and New

- Web-based education
  - InterBook, ELM-ART, AHA!, KBS-Hyperbook, MANIC
- On-line information systems
  - PEBA-II, AVANTI, SWAN, ELFI, MovieLens
- Information retrieval, filtering, recommendation
  - SmartGuide, Syskill & Webert, IfWeb, SiteIF, FAB, AIS
- E-commerce
  - Tellim, SETA, Adaptive Catalogs, …, Amazon.com
- Virtual museums
  - ILEX, Power, Marble Museum, SAGRES
- Performance Support Systems

## Integrated Adaptive Web Systems

- Integrate several “systems”, traditionally independent, inside one Web application
- Several user modeling and adaptation techniques, one user model
- Better value for users
- Improved quality of user modeling

## Exploring Integrated Systems

- ELM-ART (1996-1998) - integrated ITS for LISP programming
- ADAPTS (1998-1999) - integrated performance support systems for avionics technicians
- KnowledgeTree (2000-2003) - integrated architecture for E-Learning
- CUMULATE (2002-2003) - centralized user/student modeling server

# Adaptive Information Services

- Early prototypes: Basaar, FAB, ELFI
- Integrates content-based and collaborative technologies
- Integrates search and filtering
- Integrates user-driven and adaptive personalization
- Example: http://www.n24.de

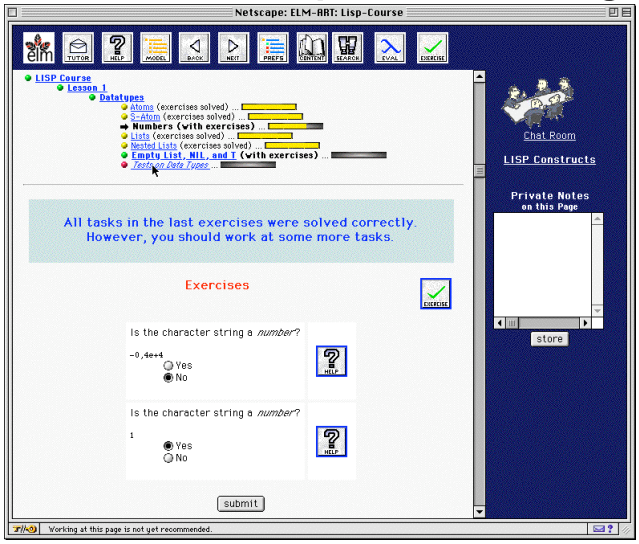
## ELM-ART: Integrated Web-based Adaptive Educational System

- Model: adaptive electronic textbook
  - hierarchical textbook
  - tests
  - examples
  - problems
  - programming laboratory
- Extra for Web-based teaching
  - messages to the teacher
  - chat room

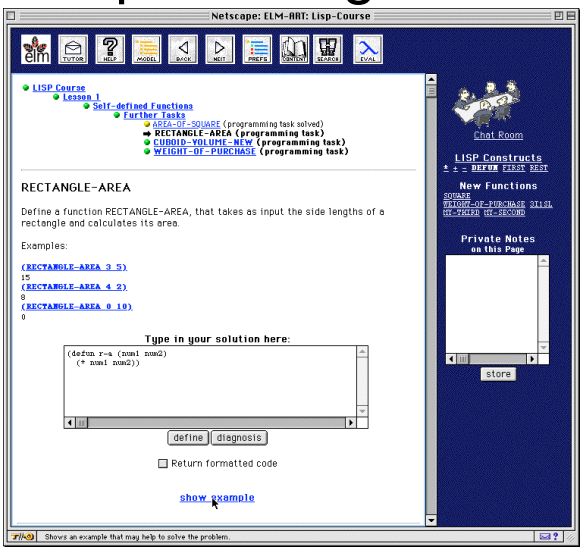
## Adaptivity in ELM-ART

- Adaptive navigation support
- Adaptive sequencing
- Adaptive testing
- Adaptive selection of relevant examples
- Adaptive similarity-based navigation
- Adaptive program diagnosis

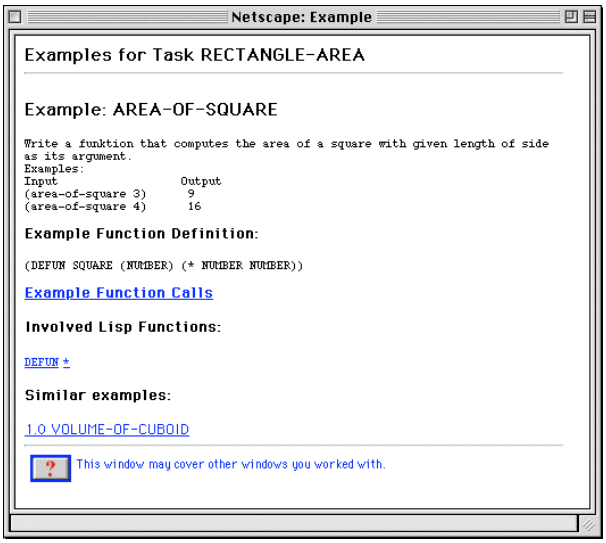
# ANS + Adaptive testing

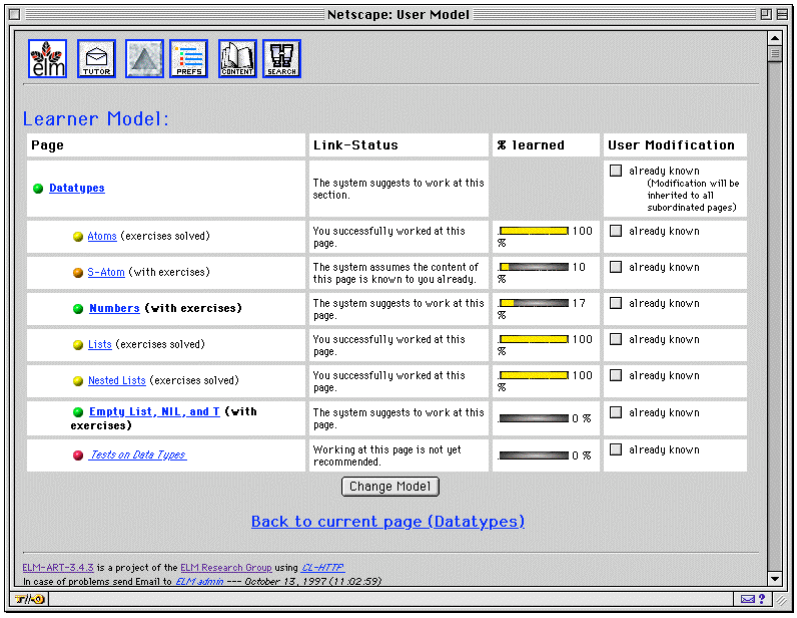



# Adaptive Diagnostics

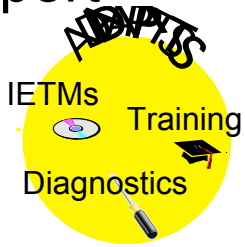


# Similarity-Based Navigation



# ADAPTS: Integrated Adaptive Performance Support

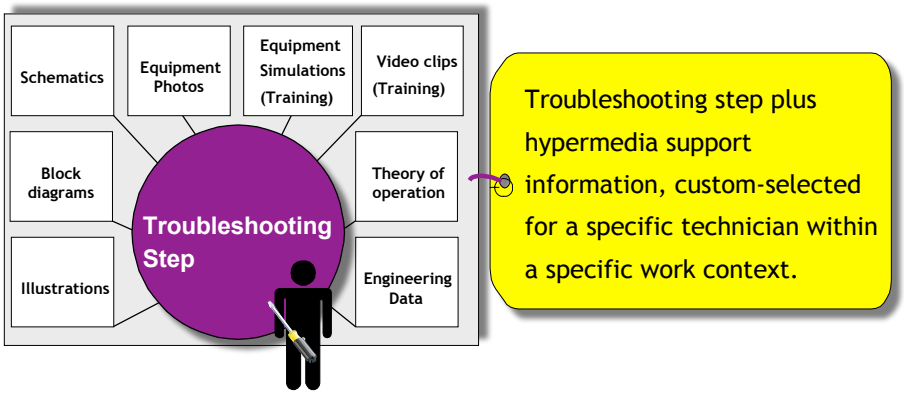



☑Architecture for integration of:

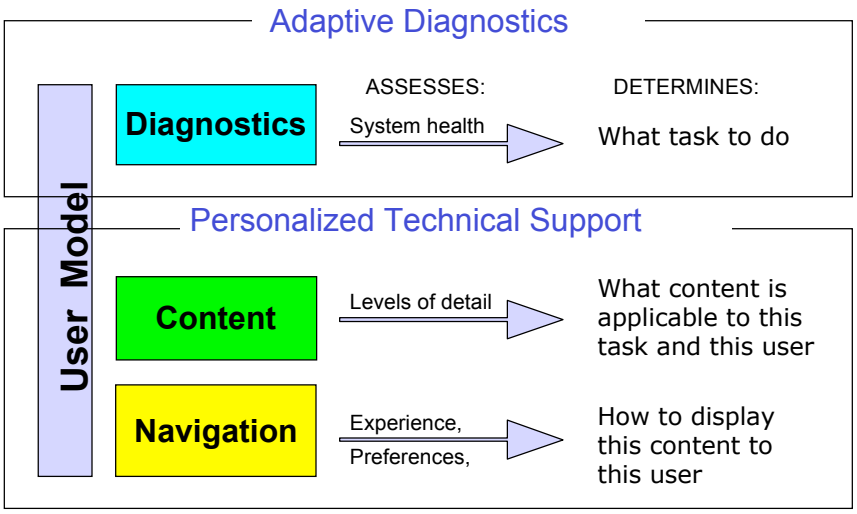
- Diagnostics
- Technical Information
- Performance-oriented Training

☑ A demonstration for "Best of both worlds" case: Human and Artificial intelligences work together

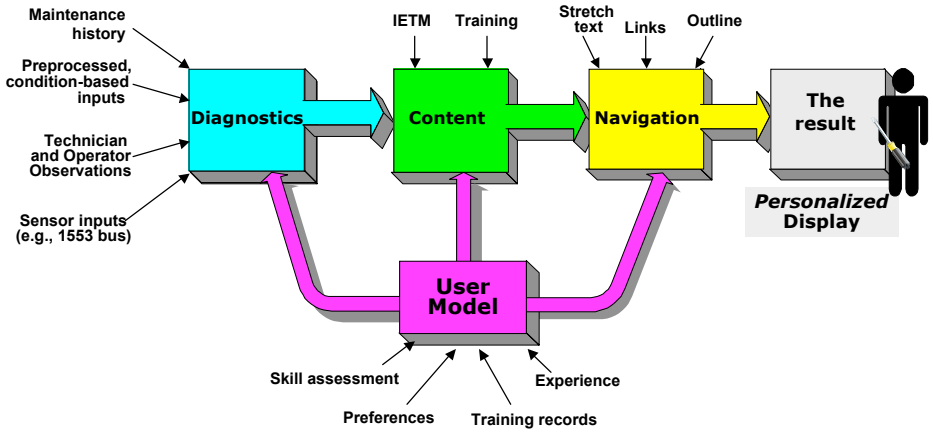
# What's in adaptive IETM?



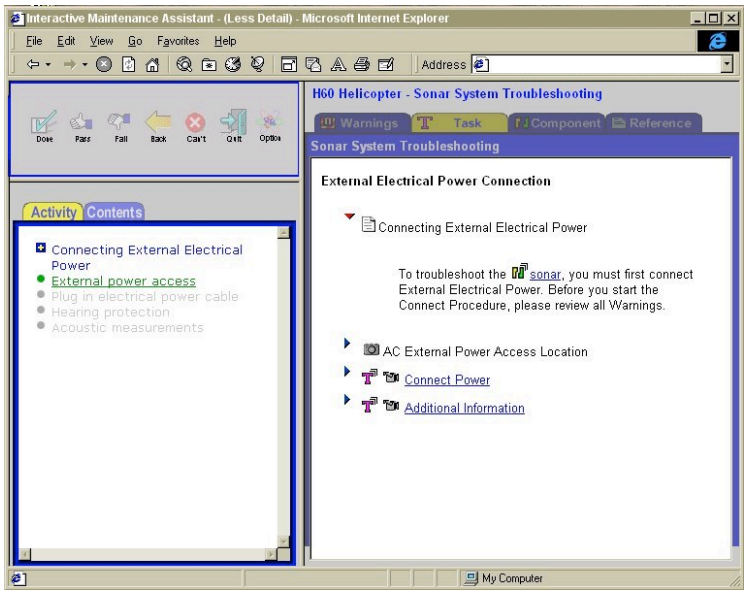

*ADAPTS dynamically assembles custom-selected content.*




# How do we make decisions?



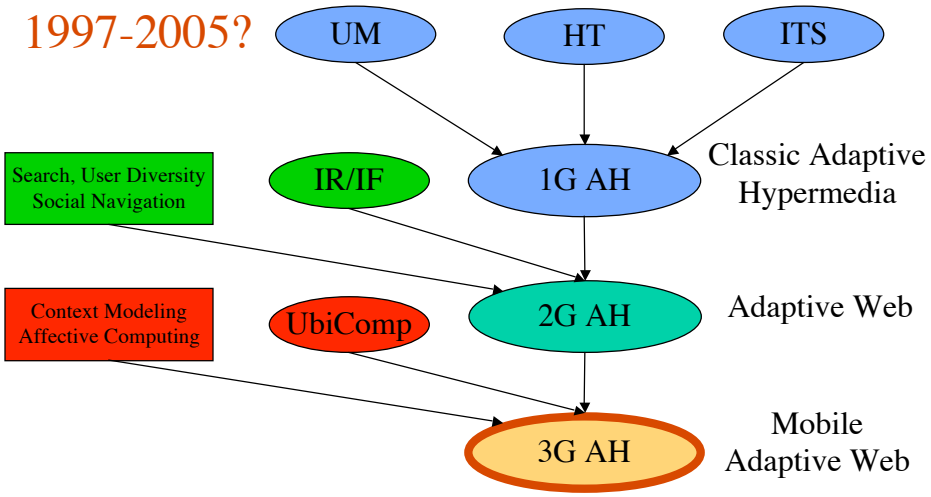
# Integrated interface




# THM5: Not all areas are ready for the Adaptive Web

- An attempt to implement adaptive Web-based education in Carnegie Technology Education
- What is the difference between the success in ADAPTS and the failure at Carnegie Technology Education?
- An application area should be ready for it
  - Adaptivity offers benefits
  - Adaptivity has it cost
  - Users should be ready and costs should be justified

# Mobile Adaptive Web



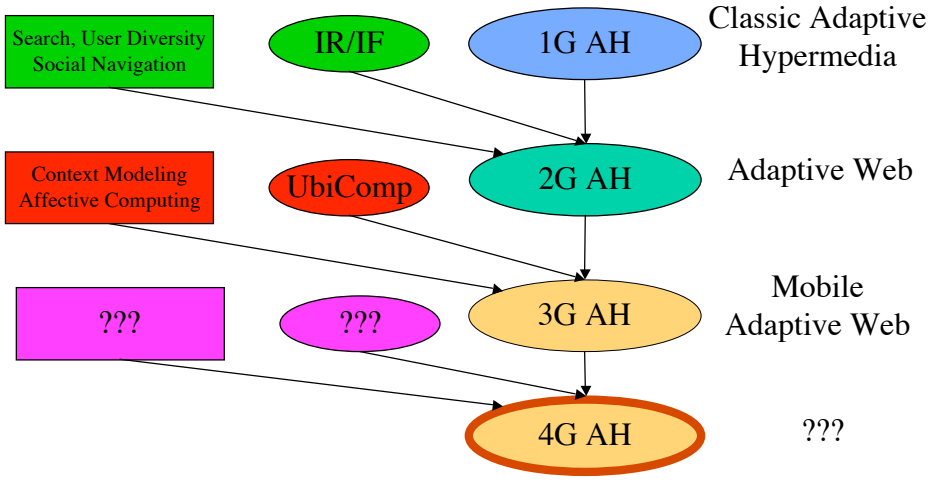

# The Need to Be Mobile

- Background
  - Technology: wearables, mobiles, handhelds…
  - GIS and GPS work
  - HCI: Ubiquitous Computing
- Need to adapt to the platform
  - Screen, computational power, bandwidth
- New opportunities
  - Taking into account location/time/other context
  - Sensors and affective computing

# New Application Areas

- Mobile handheld guides
  - Museum guides: HYPERAUDIO, HIPS
  - City guides: GUIDE
- Mobile recommenders
  - News and entertainment recommender
    - http://www.adaptiveinfo.com
- Adaptive mobile information sites
  - ClixSmart Navigator
    - http://www.changingworlds.com/

# 4th Generation?



# 3D Web

- Web is not 2D anymore - it includes a good amount of VR content
- 3D offers more power and supports some unique ways to access information
- 3D Web as the future of the Web?
- The dream of an immersive Web:
  - Neal Stephenson: Metaverse (Snow Crash)
  - Victor Lukyanenko: The Depth (Mirrors)

# Adaptive 3D Web?

- Motivated by a pioneer work…
  - Luca Chittaro and Roberto Ranon *Adding adaptive features to virtual reality interfaces for ecommerce*, in *Proc. Adaptive Hypermedia and Adaptive Web-based Systems, AH2000*, p. 86-91.
- VR as "another" virtual space with user-directed navigation
- Same ideas of adaptive presentation and adaptive navigation support can be explored
- Support is more important (UI problems)!

# Adaptive Navigation Support in 3D

- Joint work with Stephen Hughes, Michael Lewis, Jeffrey Jacobson, SIS Usability Lab
- How to guide the user to the appropriate information in a 3D space?
- Possible applications:
  - VR Museum, E-commerce, E-learning
- Guidance for 3D "Attentive navigation"
  - Direct guidance with different levels of control
  - Annotation - combination of freedom and guidance

# More information...

- *Adaptive Hypertext and Hypermedia Home Page:* http://wwwis.win.tue.nl/ah/
- Brusilovsky, P., Kobsa, A., and Vassileva, J. (eds.) (1998), *Adaptive Hypertext and Hypermedia*. Dordrecht: Kluwer Academic Publishers
- Special Issue of Communications of the ACM on Adaptive Web: May 2002, vol. 45, Number 5
- Adaptive Hypermedia and User Modeling Conference Series (look for proc. in Springer-Verlag's LNCS/LNAI)
- Most recent Adaptive Hypermedia 2004 in Eindhoven