

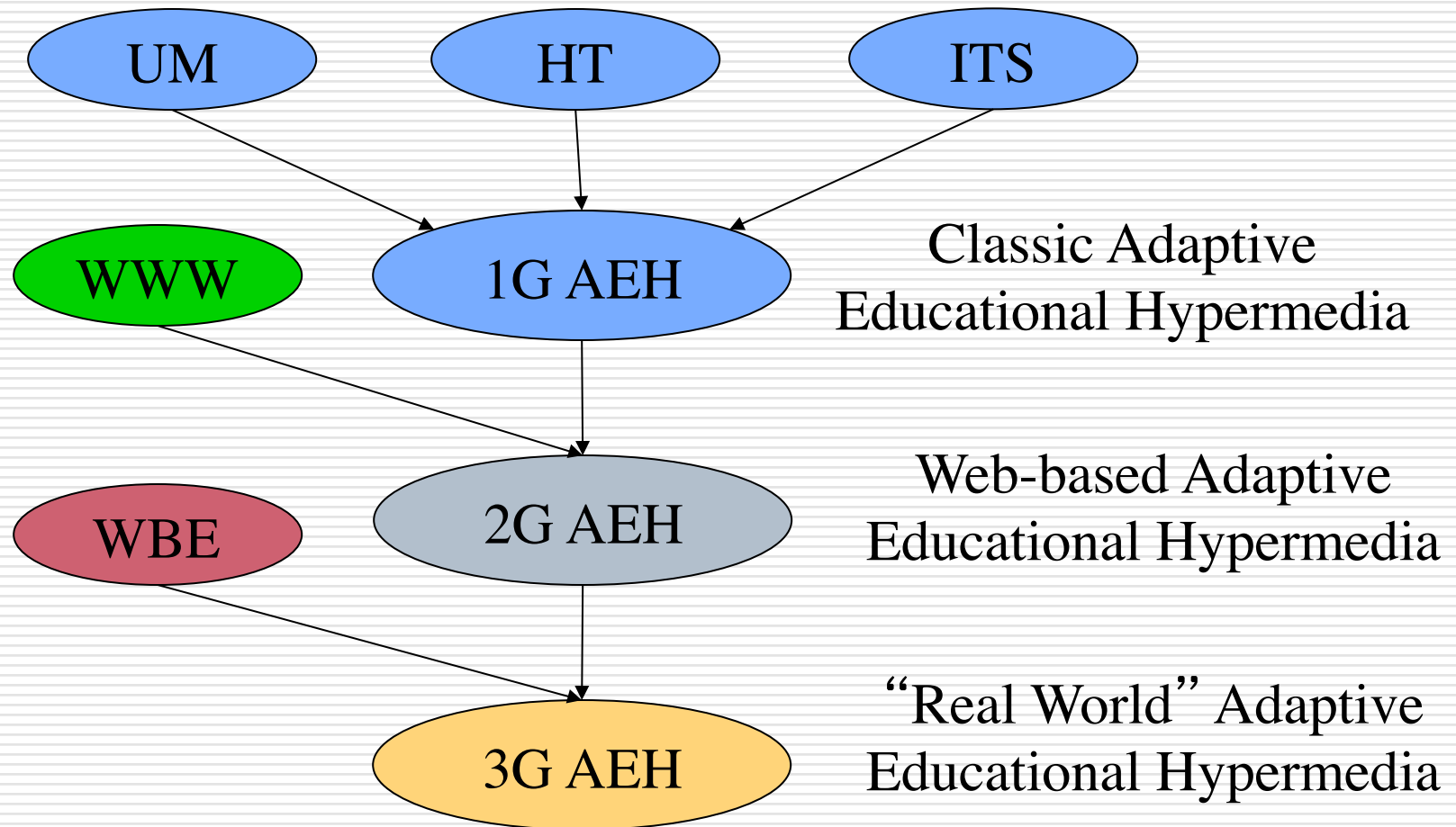
# From Adaptive Educational Hypermedia to Adaptive Information Access

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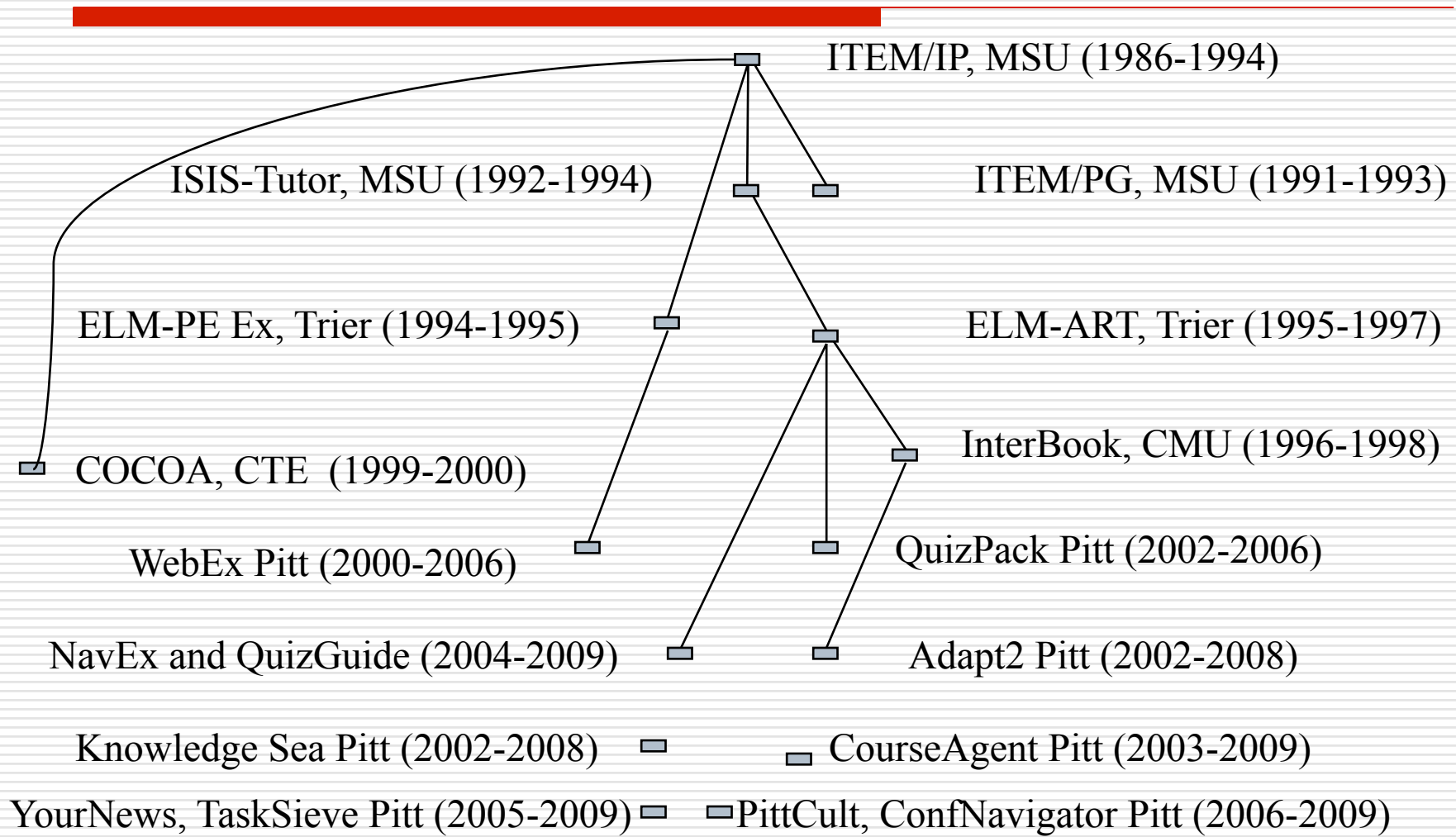
Peter Brusilovsky  
School of Information Sciences  
University of Pittsburgh, USA

# From Generation to Generation

---

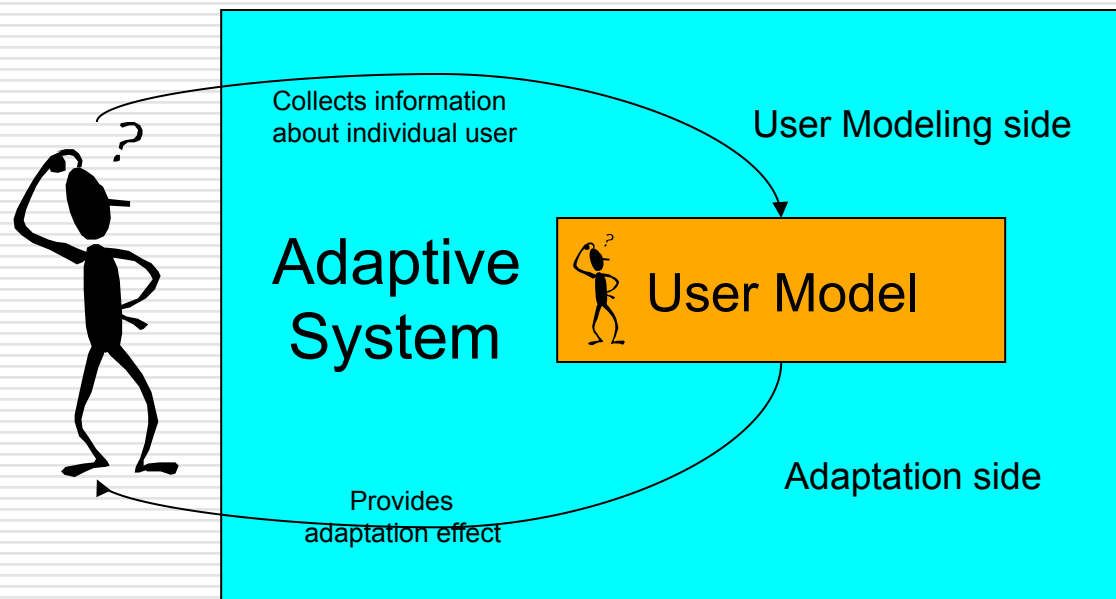


# Personal View



# Adaptive systems

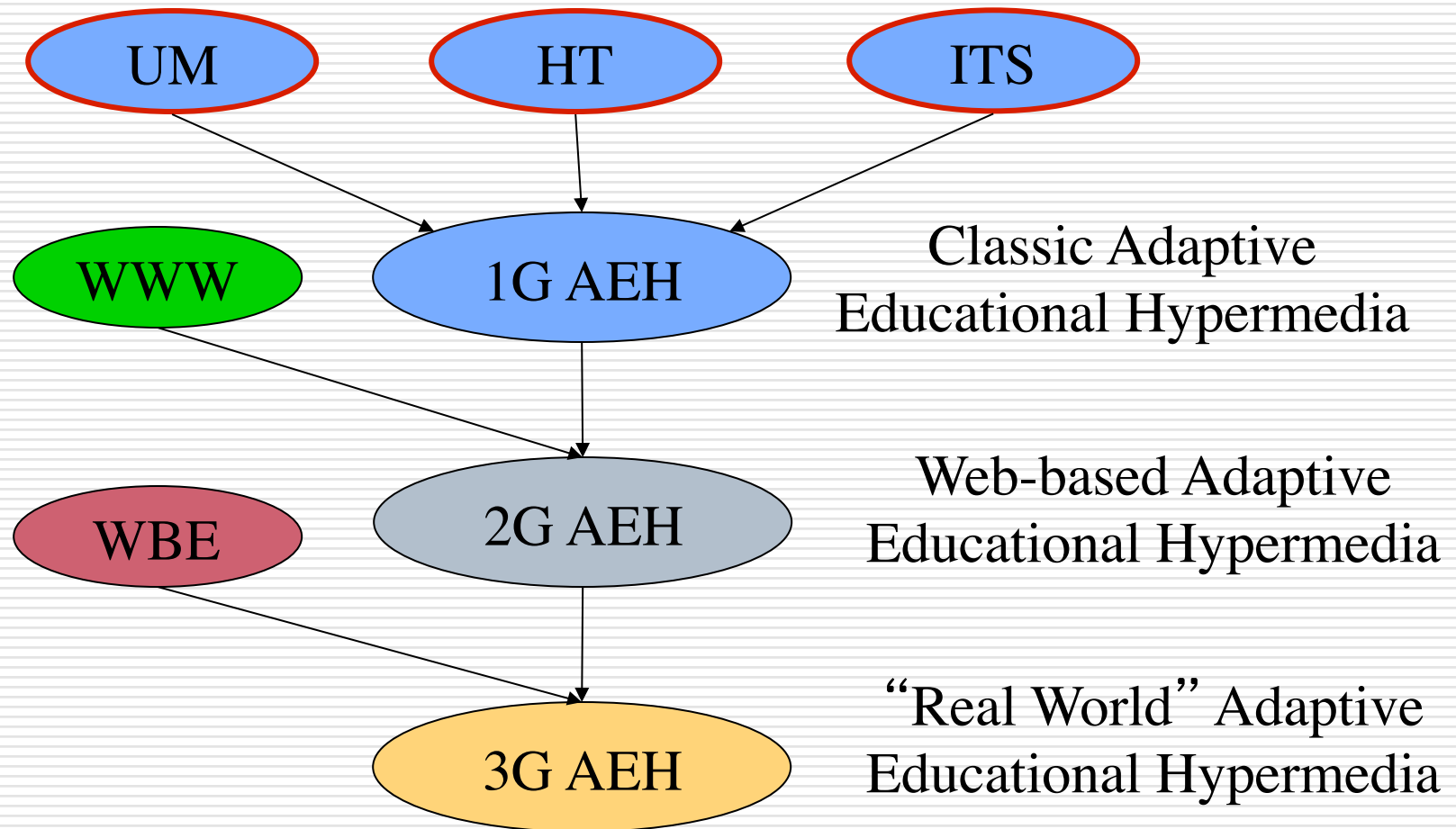
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Classic loop “user modeling - adaptation” in adaptive systems

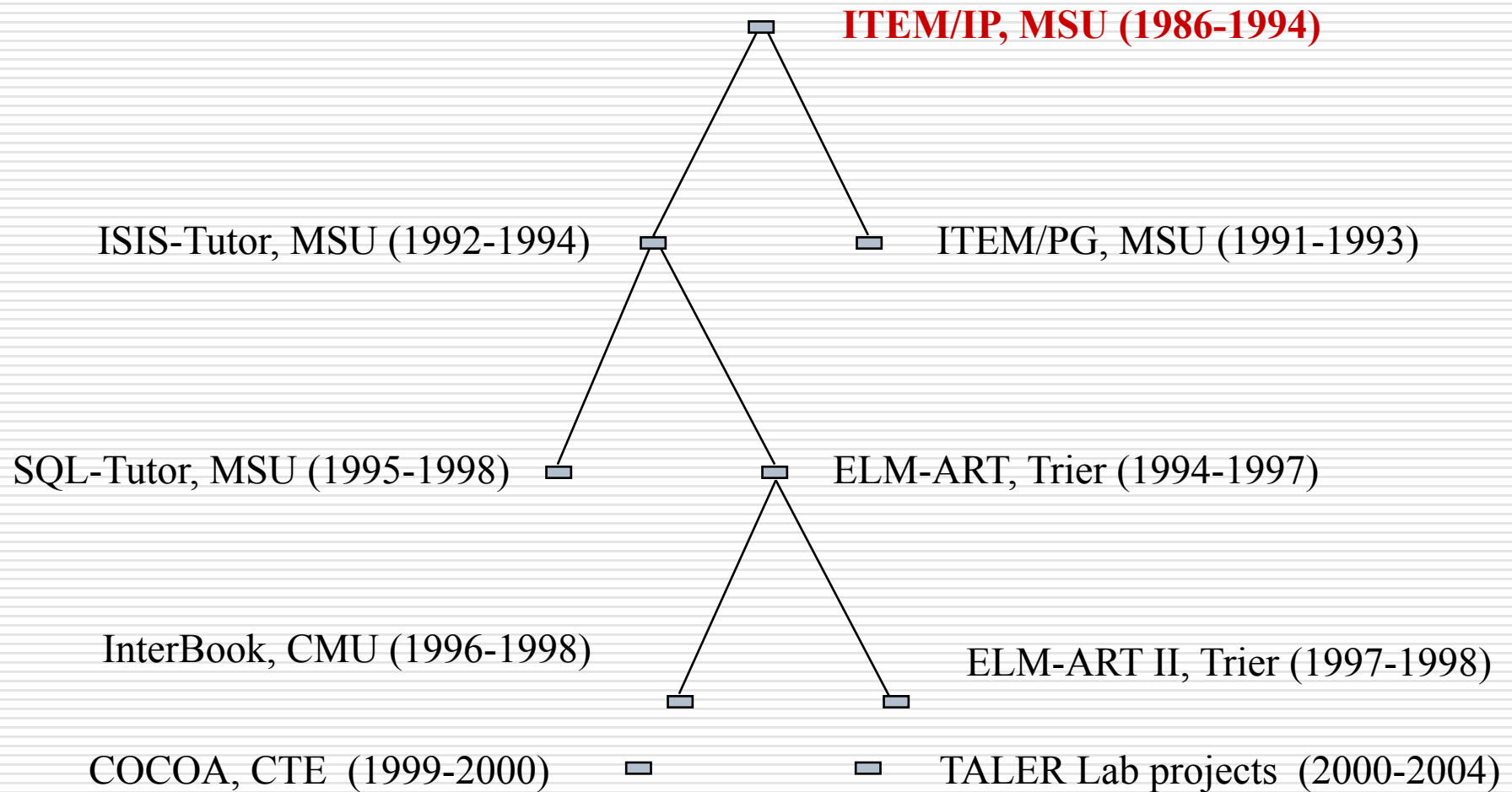
# Generation 0

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# Personal View: Generation 0

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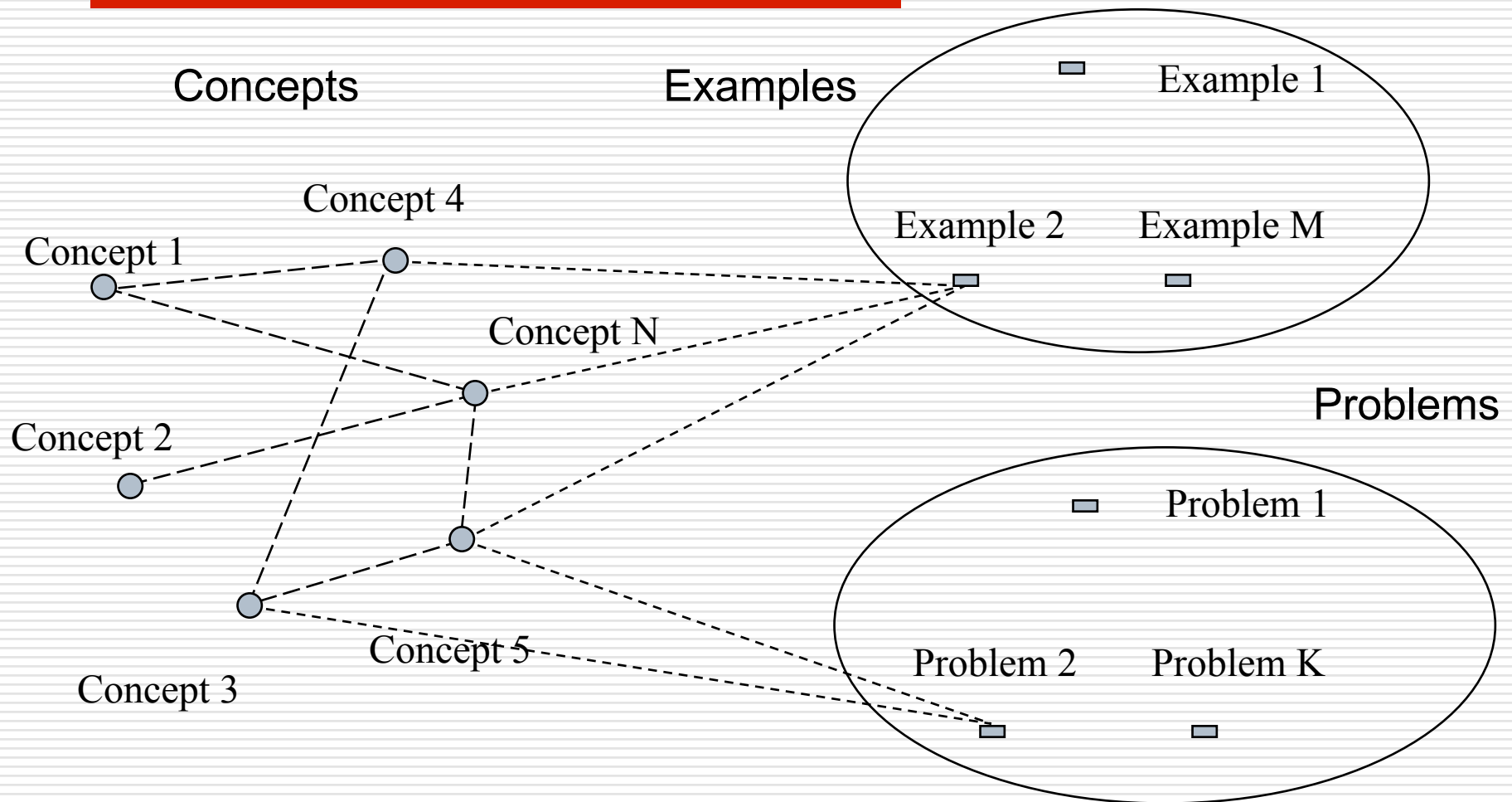
# ITEM/IP

---

- ILE for **I**ntrductory **P**rogramming
- **I**ntegrated system
  - **T**utorial (presentation of optimal sequence of explanations, examples and problems)
  - **E**nvironment (playing with examples, design and debug problem solutions)
  - **M**anual (a manual for reference-style access to studied information, examples, solved problems)

# Knowledge and learning material

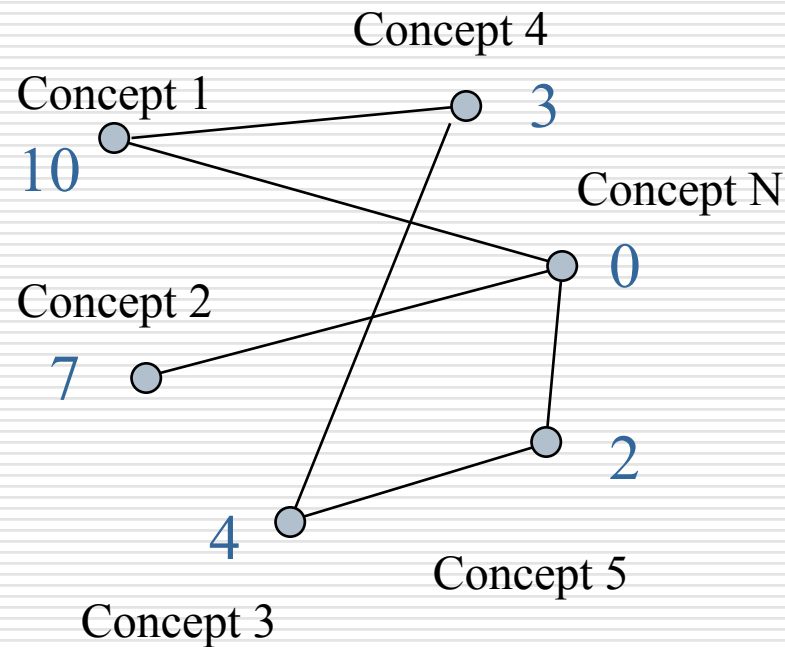
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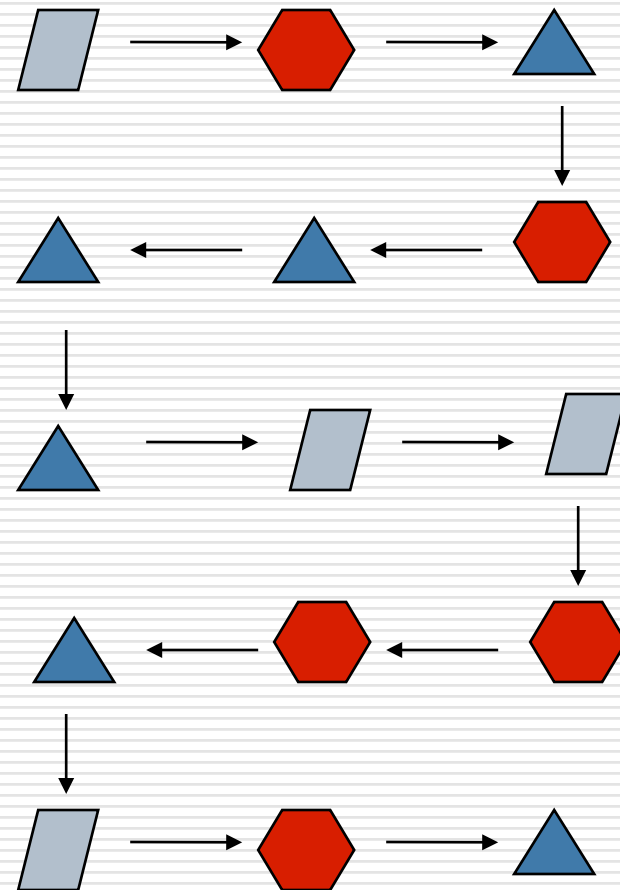
# Weighted overlay model

---



# Course Sequencing

- ❑ Oldest ITS technology
  - SCHOLAR, BIP, GCAI...
- ❑ Goal: individualized “best” sequence of educational activities
- ❑ ITEM/IP: multi-type
  - information to read
  - examples to explore
  - problems to solve ...



# Adaptive presentation

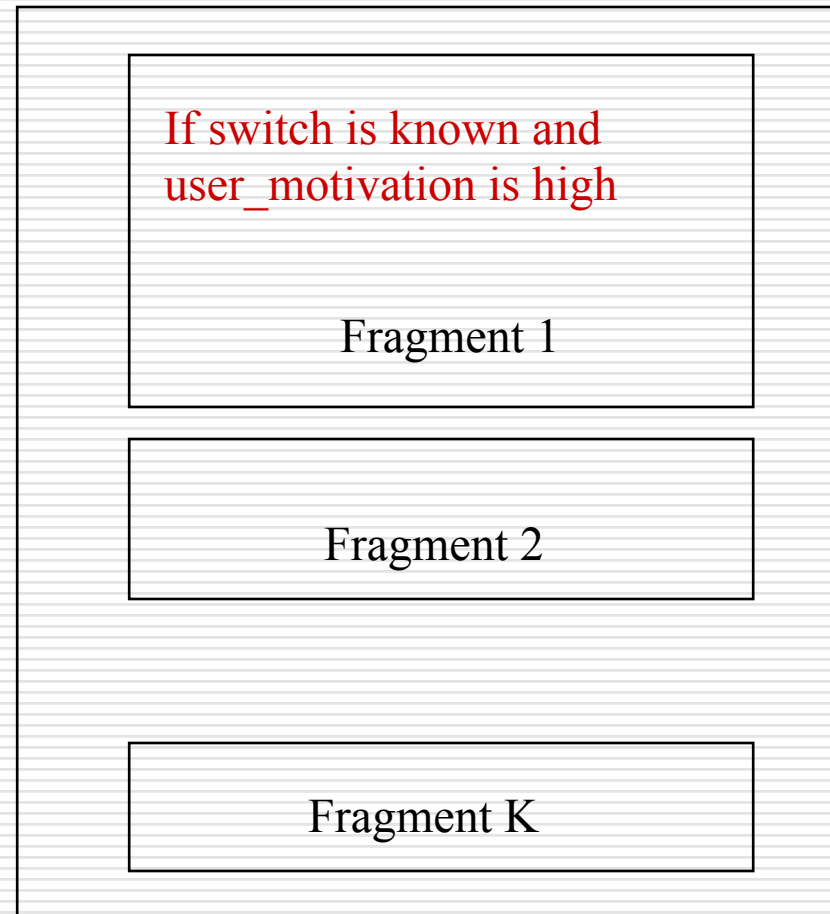
---

- Goal: make the same “page” suitable for students with different knowledge
  - beginners (in tutorial mode)
  - advanced (in manual mode)
  - smooth transition
- Methods to achieve the goals
  - comparisons of several concepts
  - extra explanations for beginners
  - more complete information for advanced

# Conditional text filtering

---

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



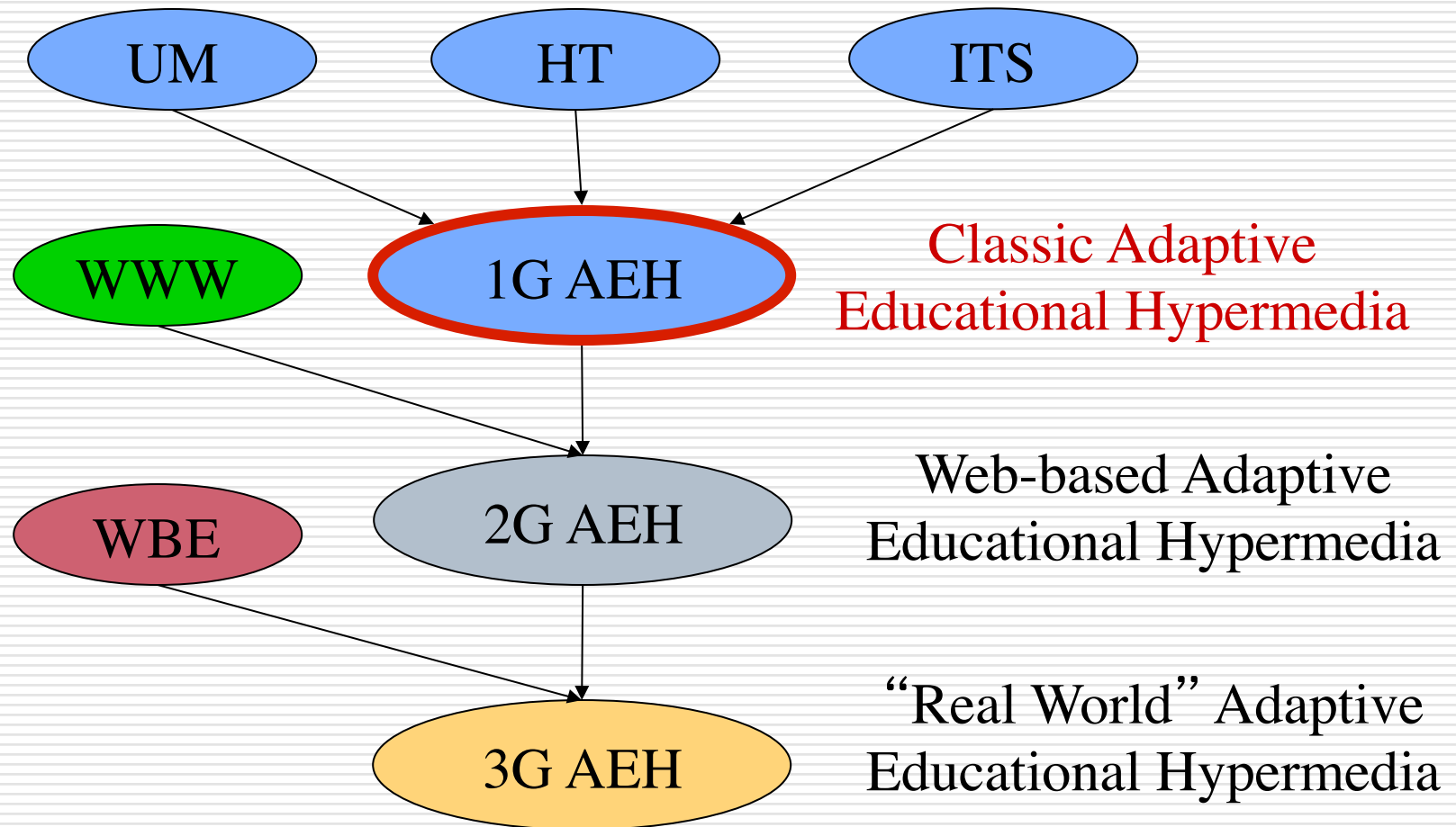
# Problems

---

- ❑ A category of students wanted to make the choice of next thing to do themselves
- ❑ Combining guidance and freedom?
- ❑ Added menu-based access to new material
- ❑ Two information spaces with separate access...
  - Explored material (past)
  - New material (future)
- ❑ And in 1991 we have found hypertext...

# Generation 1

---



# 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...

# What Can Be Adapted?

---

- Hypermedia = 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

# Example: Stretchtext (ADAPTS)

Interactive Maintenance Assistant - (Less Detail) - Microsoft Internet Explorer

File Edit View Go Favorites Help

Address

H60 Helicopter - Sonar System Troubleshooting

Warnings Task Component Reference

Sonar System Troubleshooting

External Electrical Power Connection

- Connecting External Electrical Power
  - To troubleshoot the sonar, you must first connect External Electrical Power. Before you start the Connect Procedure, please review all Warnings.
  - AC External Power Access Location
  - Connect Power
  - Additional Information

Activity Contents

- Connecting External Electrical Power
  - External power access
  - Plug in electrical power cable
  - Hearing protection
  - Acoustic measurements

My Computer

# 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

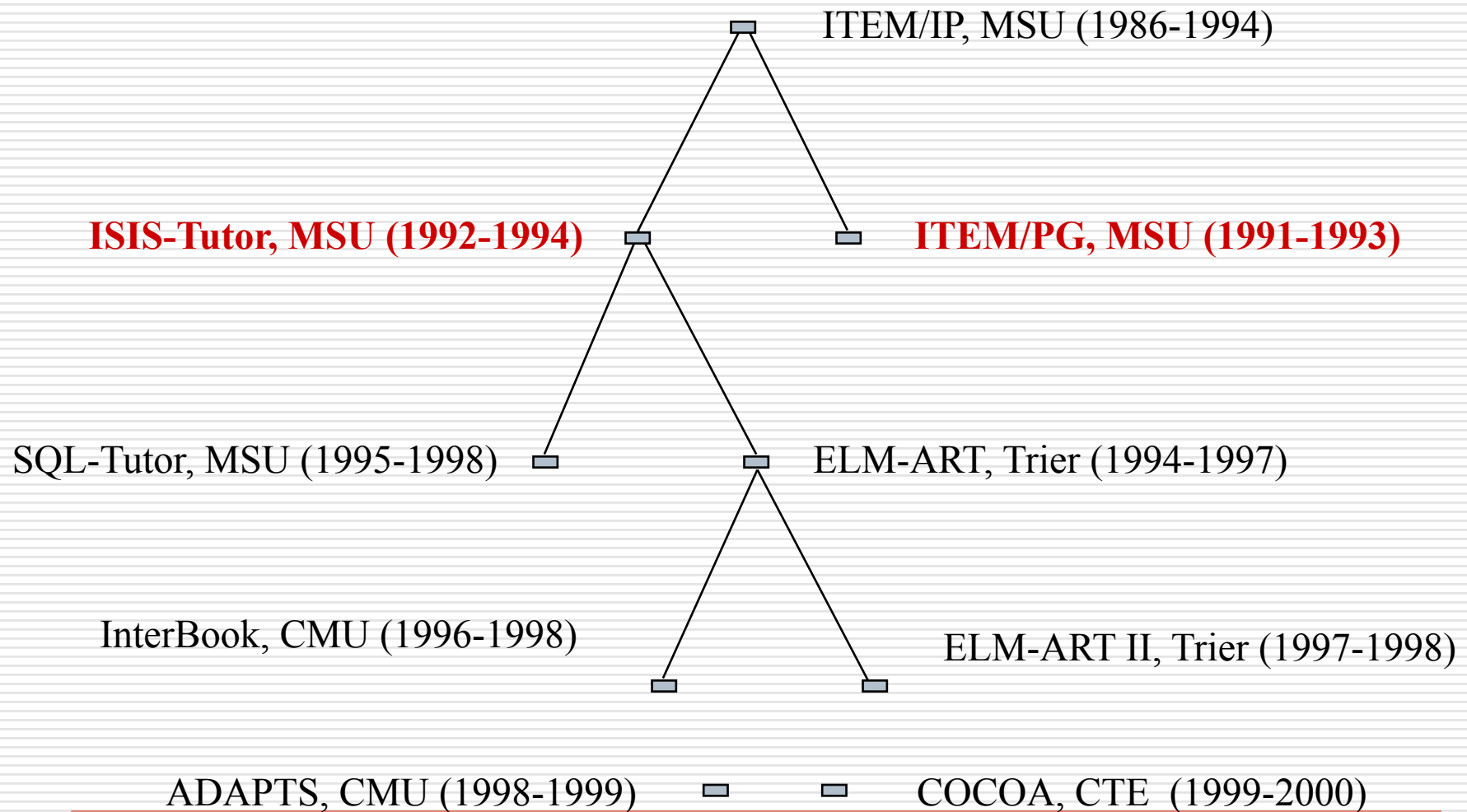
# Adaptive Navigation Support: Techniques

---

- ❑ Direct guidance
- ❑ Restricting access
  - Removing, disabling, hiding
- ❑ Sorting
- ❑ Annotation
- ❑ Generation
  - Similarity-based, interest-based
- ❑ Map adaptation techniques

# Personal View: Generation 1

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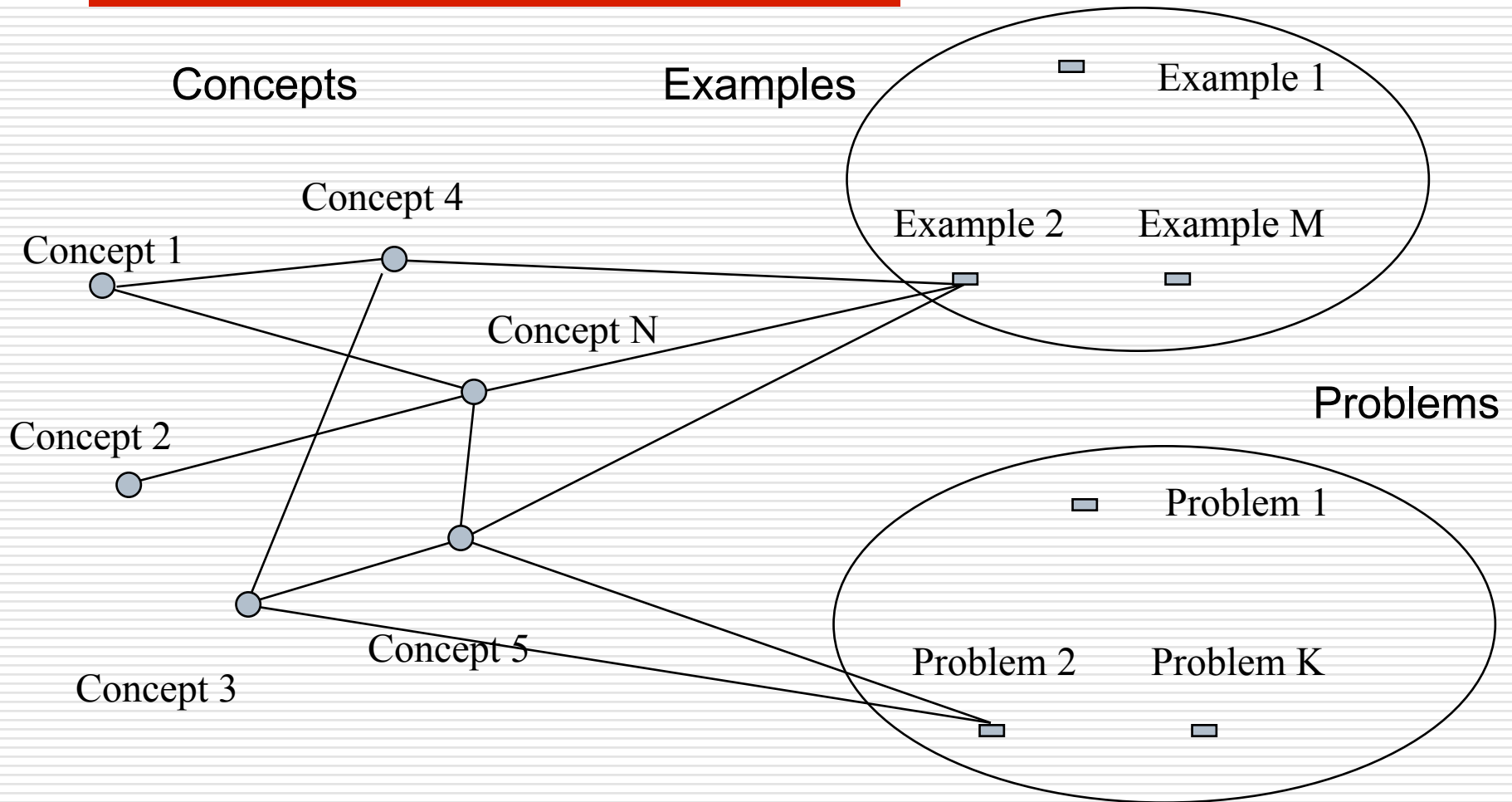
# ISIS-Tutor: ILE + hypertext

---

- ❑ An adaptive tutorial for CDS/ISIS/M users
- ❑ Domain knowledge: concepts and constructs
- ❑ Hypertext - a way to access learning material:
  - Description of concepts and constructs
  - Examples and problems indexed with concepts (could be used in an *exploratory environment*)
- ❑ Educational status of explanations, examples and problems is shown with link annotation

# Knowledge and learning material

---





# Student modeling and adaptation

---

- States for concepts:
  - not ready (may be hidden)
  - ready (red)
  - known (green)
  - learned (green and ‘+’)
- State for problems/examples:
  - not ready (may be hidden)
  - ready (red)
  - solved (green and ‘+’)

# Sample index page (annotation)

Доступные темы	
+ 1 Общий вид формата	2 Арифметические выражения
3 Удаление пустых строк	4 Безусловный переход на новую строку
+ 5 Переход на новую строку	6 Выбор позиции в строке
7 Печать пробелов	+ 8 Вывод поля
9 Понятие MFN	10 Безусловный литерал
11 Арифметическая функция L	12 Арифметическая функция Mfn
13 Арифметическая функция Val	14 Арифметическая функция Rsum
15 Арифметическая функция Rmin	16 Арифметическая функция Rmax
17 Арифметическая функция Ravr	18 Совмещение % и #
19 Совмещение / и #	20 Условный литерал
21 Повторяющийся литерал	22 Вывод MFN
23 Строковые выражения	24 Префиксный условный литерал
25 Суффиксные литералы	26 Нуль-литералы
27 Повторяющийся литерал с +	28 Префиксный повторяющийся литерал
29 Установка режима вывода	30 Совмещение условных литералов и %
31 Совмещение условных литералов с #	32 Совмещение условных литералов с /
33 Совмещение условных литералов с C	34 Совмещение условных литералов с X
35 Совмещение условных литералов с M	36 Режимы L,U в команде M.
37 Режим H в команде M	38 Режим D в команде M
39 Режим P в команде M	40 Строковая функция F
41 Строковая функция Ref	42 Строковая функция S
43 Программы пользователя format	44 Выражения отношения
Enter – изучить F4-практ F6-учи F8-инд.задач F9-назад PgDn-след.стр.	
+ Хорошо изучен	Изучен
Можно изучать	Не готов

# Sample index page (annotation and hiding)

Доступные темы		
+ 1 Общий вид формата	2 Арифметические выражения	
3 Удаление пустых строк	4 Безусловный переход на новую строку	
+ 5 Переход на новую строку	6 Выбор позиции в строке	
7 Печать пробелов	+ 8 Вывод поля	
9 Понятие MFN	10 Безусловный литерал	
13 Арифметическая функция Val	20 Условный литерал	
21 Повторяющийся литерал	22 Вывод MFN	
27 Повторяющийся литерал с +	28 Префиксный повторяющийся литерал	
29 Установка режима вывода	52 Размещение первой строки поля	
53 Выбор длины фрагмента поля	54 Выбор смещения фрагмента поля	
55 Вывод подполя	56 Повторяющиеся группы	
Enter - изучить F4-практ F6-учи F8-инд.задач F9-назад		
+ Хорошо изучен	Изучен	Можно изучать

# ISIS-Tutor: Evaluation

---

- 26 first year CS students of MSU
- 3 groups:
  - control (no adaptation)
  - adaptive annotation
  - adaptive annotation + hiding
- Goal: 10 concepts (of 64), 10 problems, all examples

# ISIS-Tutor: Evaluation Results

---

- ❑ 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)

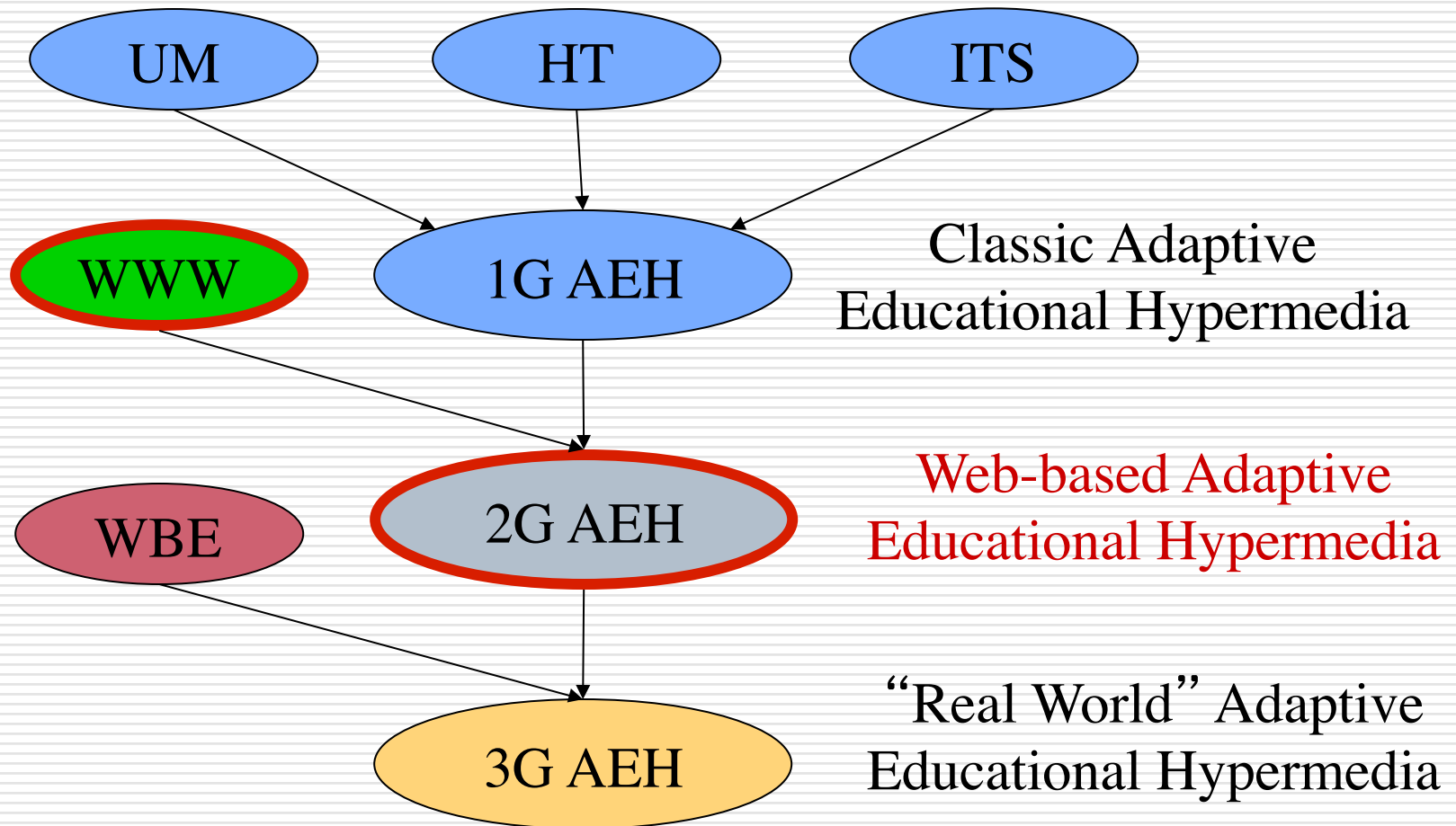
# Similar works 1991-1994

---

- $\gamma\pi$ Adaptερ (Hohl, Böker, Gunzenhauser, 1991)
  - Sorting page fragments and links by relevance
- Manuel Excel (de La Passardiere, Dufresne, 1992)
  - Adaptive link annotation with icons
- ANATOM-Tutor (Beaumont, 1994)
  - Adaptive presentation, hypertext + ITS
- MetaDoc (Boyle, Encarnacion, 1994)
  - Adaptive stretchtext

# Generation 2

---



# Generation 2 vs Generation 1

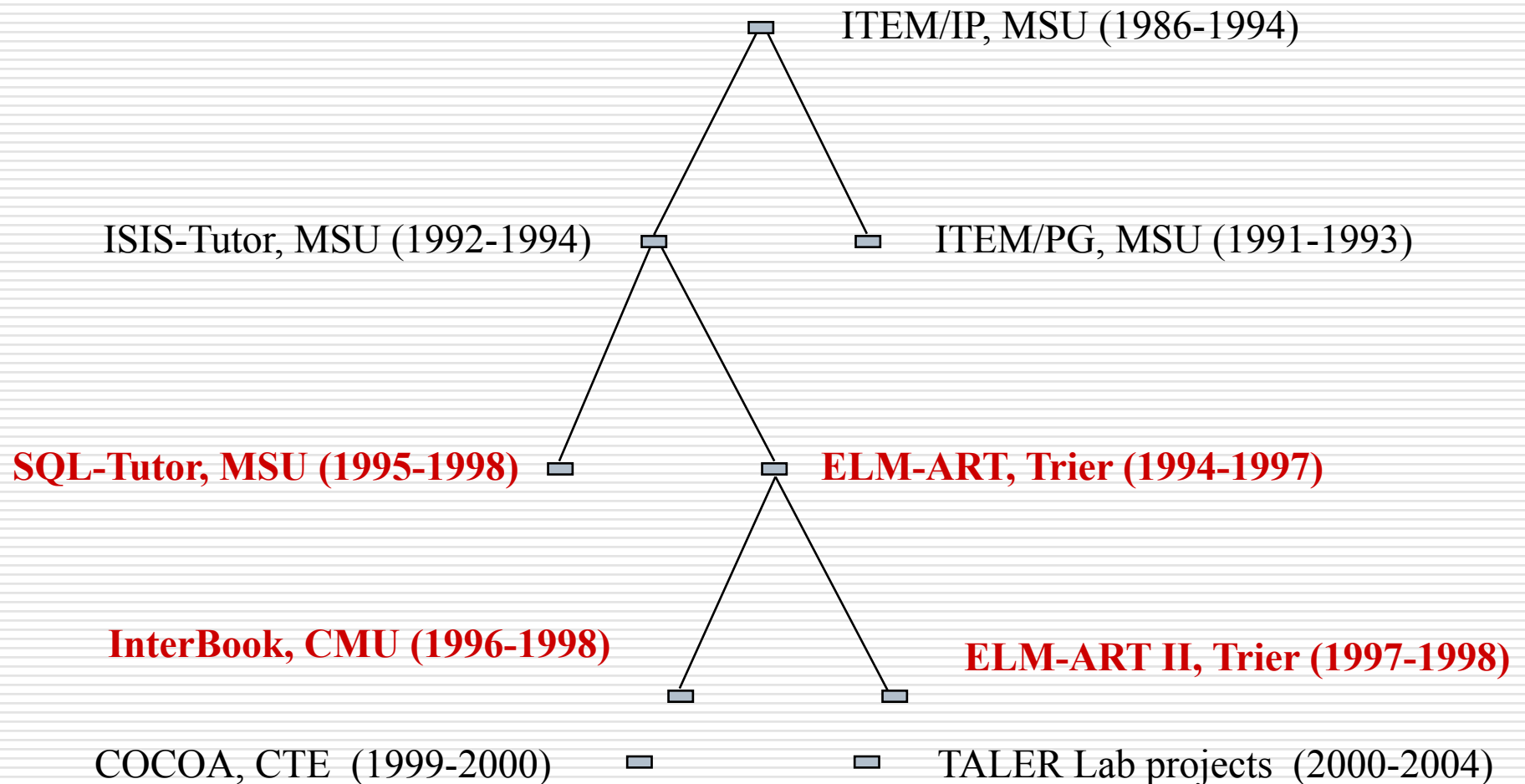
---

- Generation 1 systems:
  - Research oriented
  - Traditional hypertext/hypermedia
  - Developed independently
- Generation 2 systems
  - Practically oriented
  - Web-based hypermedia
  - Influenced by earlier research
  - Less value on evaluation



# Personal View: Generation 2

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# ELM-ART: Lisp ITS on WWW

---

## □ ELM-ART:

- ELM-PE (ILE with problem solving support)
- Adaptive Hypermedia (all educational material)

## □ Model: adaptive electronic textbook

- tests
- examples
- problems

# Knowledge representation

---

- Domain knowledge
  - conceptual network for Lisp
  - problem solving plans
  - debugging knowledge
- Student model
  - Overlay model for Lisp concepts
  - Episodic model for problem-solving knowledge

# ELM-ART: Adaptive Textbook

---

- ❑ Electronic Textbook
  - Intelligent, adaptive, interactive
- ❑ Adaptive navigation support
- ❑ Adaptive sequencing (pages and questions)
- ❑ Adaptive similarity-based navigation
- ❑ Adaptive selection of relevant examples
- ❑ Intelligent program diagnosis
- ❑ Open student modeling

# Adaptive navigation support

The screenshot shows a Netscape browser window titled "Netscape: ELM-ART: Lisp-Course". The browser's toolbar includes icons for "elm", "TUTOR", "HELP", "MODEL", "BACK", "NEXT", "PREFS", "CONTENT", "SEARCH", "EVAL", and "EXERCISE".

The main content area displays a navigation tree:

- LISP Course
  - Lesson 1
    - Datatypes
      - Atoms (exercises solved) ...
      - S-Atom (exercises solved) ...
      - Numbers (with exercises) ...**
      - Lists (exercises solved) ...
      - Nested Lists (exercises solved) ...
      - Empty List, NIL, and T (with exercises) ...
      - Tests on Data Types ...

All tasks in the last exercises were solved correctly. However, you should work at some more tasks.

## Exercises



Is the character string a *number*?

-0,4e+4  
 Yes  
 No



Is the character string a *number*?

1  
 Yes  
 No



submit



Chat Room

LISP Constructs

Private Notes  
on this Page

store

# Adaptive Diagnostics

The screenshot shows a Netscape browser window titled "Netscape: ELM-ART: Lisp-Course". The page has a dark blue background and contains several sections:

- Navigation Bar:** A row of icons for "eim", "TUTOR", "HELP", "MODEL", "BACK", "NEXT", "PREFS", "CONTENT", "SEARCH", and "EVAL".
- Course Menu:** A tree view showing "LISP Course" > "Lesson 1" > "Self-defined Functions" > "Further Tasks". Under "Further Tasks", there are four items: "AREA-OF-SQUARE (programming task solved)", "RECTANGLE-AREA (programming task)", "CUBOID-VOLUME-NEW (programming task)", and "WEIGHT-OF-PURCHASE (programming task)".
- Chat Room:** A section with a cartoon illustration of people at a table and a "Chat Room" link.
- LISP Constructs:** A list of constructs including "DEFUN", "FIRST", and "REST".
- New Functions:** A list of functions including "SQUARE", "WEIGHT-OF-PURCHASE 311SL", "MY-THIRD", and "MY-SECOND".
- Private Notes on this Page:** A scrollable text area with a "store" button below it.
- Main Content Area:**
  - RECTANGLE-AREA**
  - Define a function RECTANGLE-AREA, that takes as input the side lengths of a rectangle and calculates its area.
  - Examples:
    - `(RECTANGLE-AREA 3 5)` returns 15
    - `(RECTANGLE-AREA 4 2)` returns 8
    - `(RECTANGLE-AREA 0 10)` returns 0
  - Type in your solution here:** A text input field containing the LISP code:

```
(defun r-a (num1 num2)
  (* num1 num2))
```
  - Buttons for "define" and "diagnosis".
  - Return formatted code
  - [show example](#) (with a mouse cursor pointing to it)

At the bottom of the browser window, a status bar shows a small icon and the text "Shows an example that may help to solve the problem." The browser's address bar is empty.

# ELM-ART: Evaluation Results

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- ❑ Users with no previous programming and Web experience worked twice as longer if adaptive guidance was provided. No effect of adaptive annotation
- ❑ Users with starting programming and Web experience worked twice as longer if adaptive annotation was provided. No effect of adaptive guidance.

# InterBook: a Shell for AET

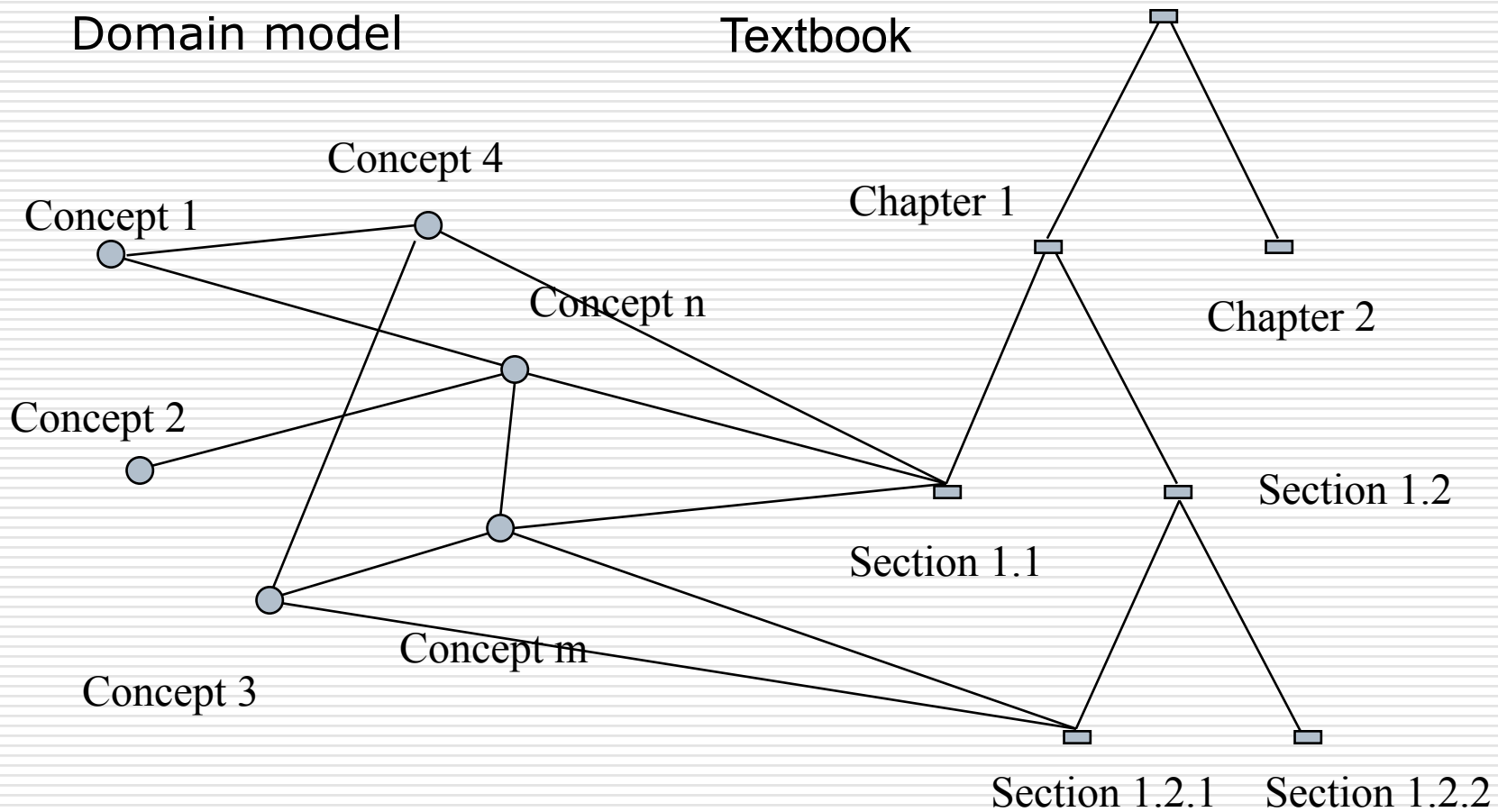
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- “Knowledge behind pages”
- Structured electronic textbook  
(a tree of “sections”)
- Sections indexed by domain concepts
  - Outcome concepts
  - Background concepts
- Concepts are externalized as glossary entries
- Shows educational status of concepts and pages



# Knowledge and hyperspace

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**Netscape: InterBook User and Author Manual**

Back Forward Home Reload Images Open Print Find Stop

[InterBook User and Author Manual](#)

- [3. Interbooks: InterBook-served electronic textbooks](#)
  - [3.1 Content structuring](#)
    - [3.1.3 The annotated textbook](#)

**3.1.3 The annotated textbook**

To make the [textbook](#) → "more intelligent" and to connect it to the [glossary](#) →, we have to let the system know what about each [section](#) → of the textbook is. It is done by indexing the textbook sections by [domain model](#) → [concepts](#) →. For each unit, a list of concepts related with this unit is provided (we call this list [spectrum](#) → of the unit). For each involved concept, the spectrum of the unit can represent also the role of the concept in the unit. Currently we support two roles: each concept can be either an *outcome* concept or a *background* concept. A concept is included in the spectrum as an [outcome concept](#) → if some part of this page presents the piece of knowledge designated by the concept. A concept is included into the spectrum as a prerequisite concept if a student has to know this concept to understand the content of the page. Indexing is a relatively simple but powerful mechanism, because it provides the system with knowledge about the content of its pages: the system knows which concepts are presented on each page and which concepts have to be learned before starting to learn each page. It opens a way for several adaptation techniques.

Continue Teach me

**Content**

Glossary

Help

Search

Hint

**Background:**

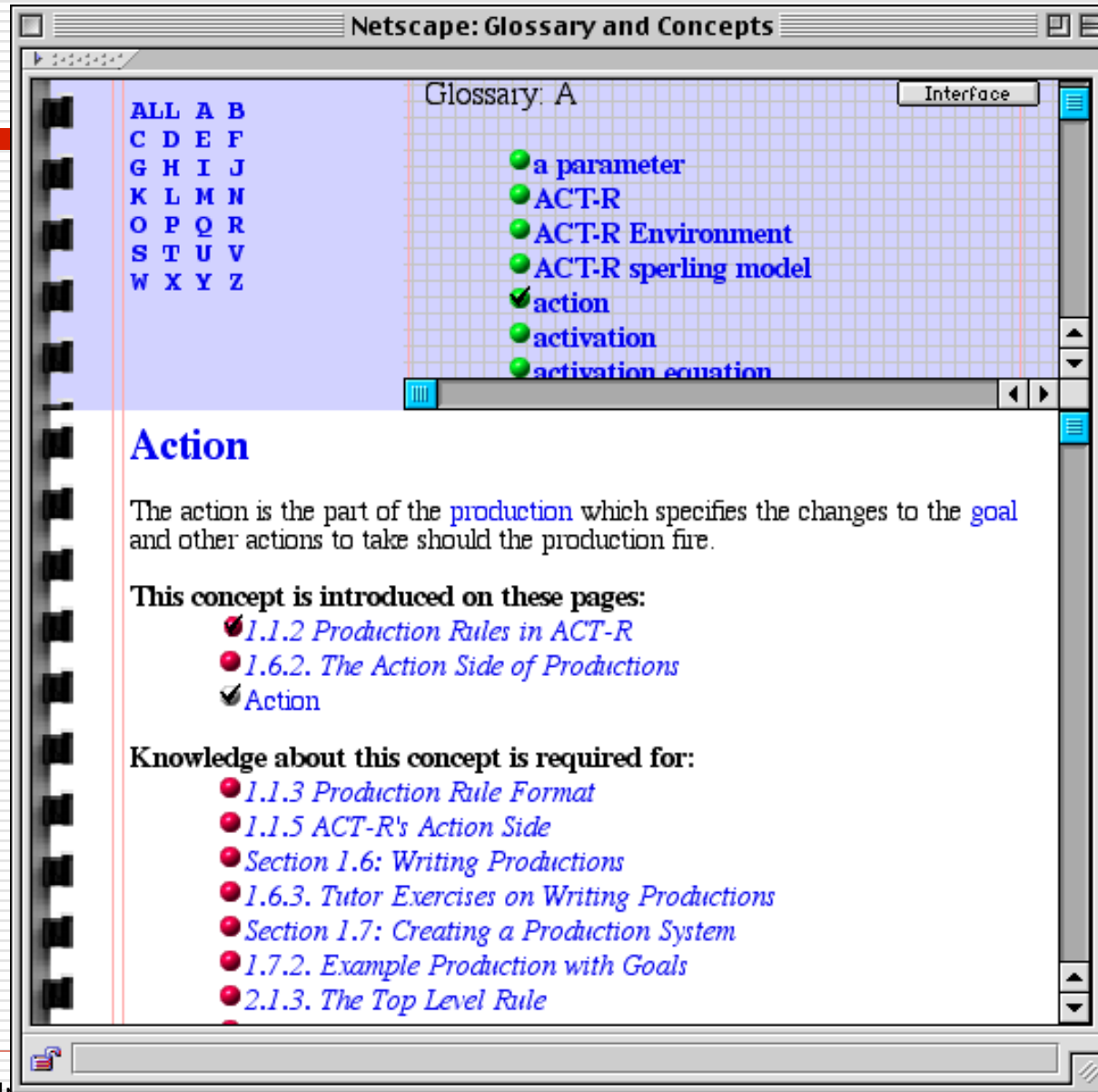
- [concept](#) ✓
- [domain model](#) ✓
- [glossary](#)
- [section](#)

**Outcome:**

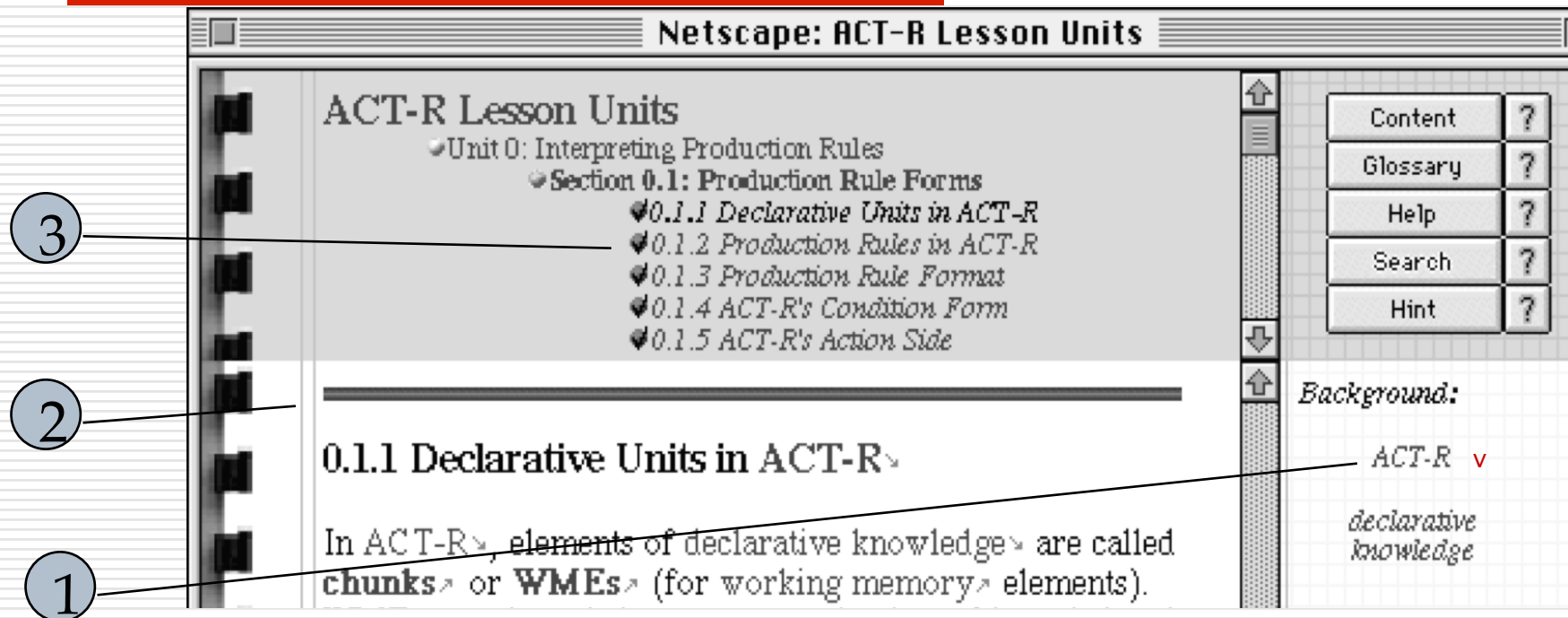
- [background concept](#)
- [outcome concept](#)
- [spectrum](#)

WEEK Lab, University of Pittsburgh

# Glossary view



# 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

**ACT-R Lesson Units**

- Unit 1: Understanding Production Systems
  - Section 1.1: The ACT-R Production System
    - 1.1.1 Declarative Units in ACT-R
    - 1.1.2 Production Rules in ACT-R
    - 1.1.3 Production Rule Format
    - 1.1.4 ACT-R's Condition Form
    - 1.1.5 ACT-R's Action Side

Back

Teach this Page

## 1.1.2 Production Rules in ACT-R

A **production** rule is a statement of a particular contingency that controls behavior. Examples might be

IF the **goal** is to classify a person  
and he is unmarried  
THEN classify him as a bachelor

IF the goal is to add two digits d1 and d2 in a column  
and  $d1 + d2 = d3$   
THEN set as a **subgoal** to write d3 in the column

The **condition** of a production rule (the IF part) consists of a specification of a goal and a number of **chunks** while the **action** of a production rule (the THEN part) basically involves the creation or modifications of some chunks. The above is an informal English specification of production rules. You will learn the syntax for their precise specification within the ACT-R system.

A production rule specifies an  to be taken when a  is met.

Continue Teach me

Content  
Glossary  
Help  
Search  
Interface

Background:  
*procedural knowledge*

Outcome:  
action  
condition  
procedural memory  
production  
production rule

# InterBook Evaluation Results

---

- ❑ No performance difference between groups
- ❑ About 90% of clicks were made with sequential navigation buttons
- ❑ Adaptive annotation encourages non-sequential navigation
- ❑ Adaptive annotation benefits those who use it as expected

# Adaptive annotation can:

---

- ❑ Reduce navigation efforts
- ❑ Reduce repetitive visits to learning items
- ❑ Encourage non-sequential navigation
- ❑ Make system more attractive for students
- ❑ But we still need to understand better
  - When it is helpful
  - How to match functionality to students

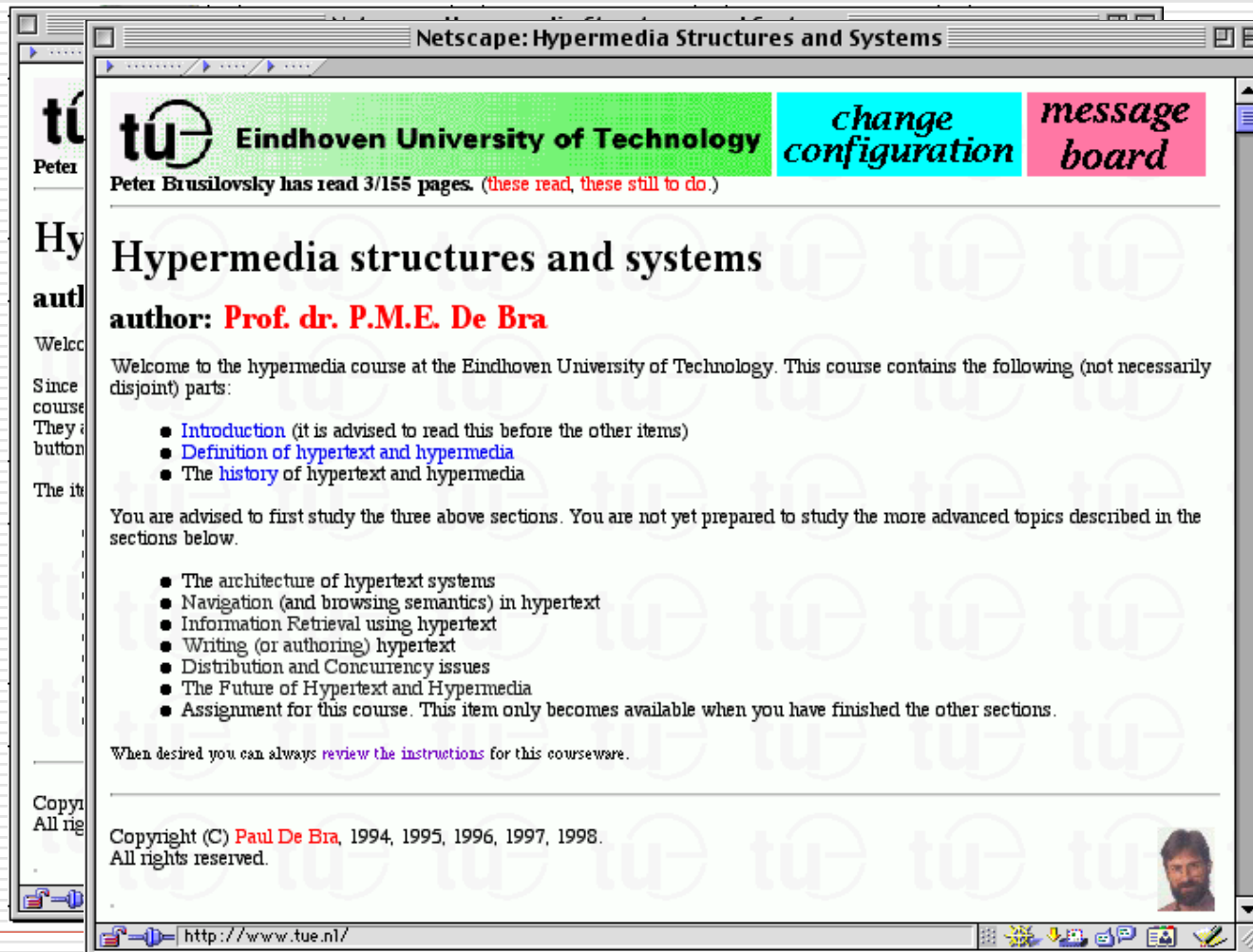
# Other Generation 2 AEHS

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- ELM-ART stream: Exploring new approaches and techniques
  - AHA!, INSPIRE, MetaLinks, MANIC
- InterBook stream: Creating authoring frameworks and tools
  - Frameworks:
    - KBS-HyperBook, Multibook
  - Authoring Tools:
    - AHA!, NetCoach, MetaLinks



# AHA! (De Bra)



# INSPIRE (Grigoriadou, Papanikolaou, Kornilakis, Magoulas)

INSPIRE - Βασικές Λειτουργίες - Microsoft Internet Explorer

File Edit View Favorites Tools Help

INSPIRE

Γλωσσάρι Σημειώσεις Αναπληρώματα E-mail Εορτήρια Μοντέλο Μάθημα

Κρυφή Μνήμη

Επόμενη

Οργάνωση Κρυφής Μνήμης Layer 1

Τεχνικές Αντιστοίχισης

Βασικές Λειτουργίες Layer 2

Εισαγωγή

Ασκήσεις Αξιολόγησης

Μεταφορές Δεδομένων

Ασκήσεις Αξιολόγησης

Κέντρο μπλοκ

Ανακεφαλαίωση

Τοποθέτηση

Εντοπισμός

Αντικατάσταση

Εγγραφή στην Κρυφή Μνήμη

## Βασικές Λειτουργίες Κρυφής Μνήμης

### Εκκός

Θα αναφερθούμε στο ρόλο της κρυφής μνήμης και θα ορίσουμε τη μικρότερη μονάδα πληροφορίας της. Θα αναφερθούμε στις έννοιες της επιτυχίας, της αποτυχίας και της ποιής αποτυχίας. Θα διακρίνουμε τις τέσσερις βασικές λειτουργίες της κρυφής μνήμης και θα περιγράψουμε τη σχέση που έχουν με τη λειτουργία ανάγνωσης ή εγγραφής του επεξεργαστή.

Όταν θα έχετε μελετήσει τις βασικές λειτουργίες της κρυφής μνήμης, θα μπορείτε να:

- ▶ να προσδιορίζετε το ρόλο της κρυφής μνήμης σε ένα υπολογιστικό σύστημα
- ▶ να ορίζετε τη μικρότερη μονάδα προσπέλασης στην κρυφή μνήμη
- ▶ να περιγράψετε τη σχέση που έχει η λειτουργία της κρυφής μνήμης με τη λειτουργία της ανάγνωσης ή της εγγραφής του επεξεργαστή
- ▶ να ορίζετε τις έννοιες επιτυχία, αποτυχία και ποιή αποτυχίας στην κρυφή μνήμη
- ▶ διακρίνετε τις βασικές λειτουργίες της κρυφής μνήμης

### Προσλαμβόμενες Έννοιες

[Οργάνωση κύριας μνήμης](#)

### Σχετικές Έννοιες

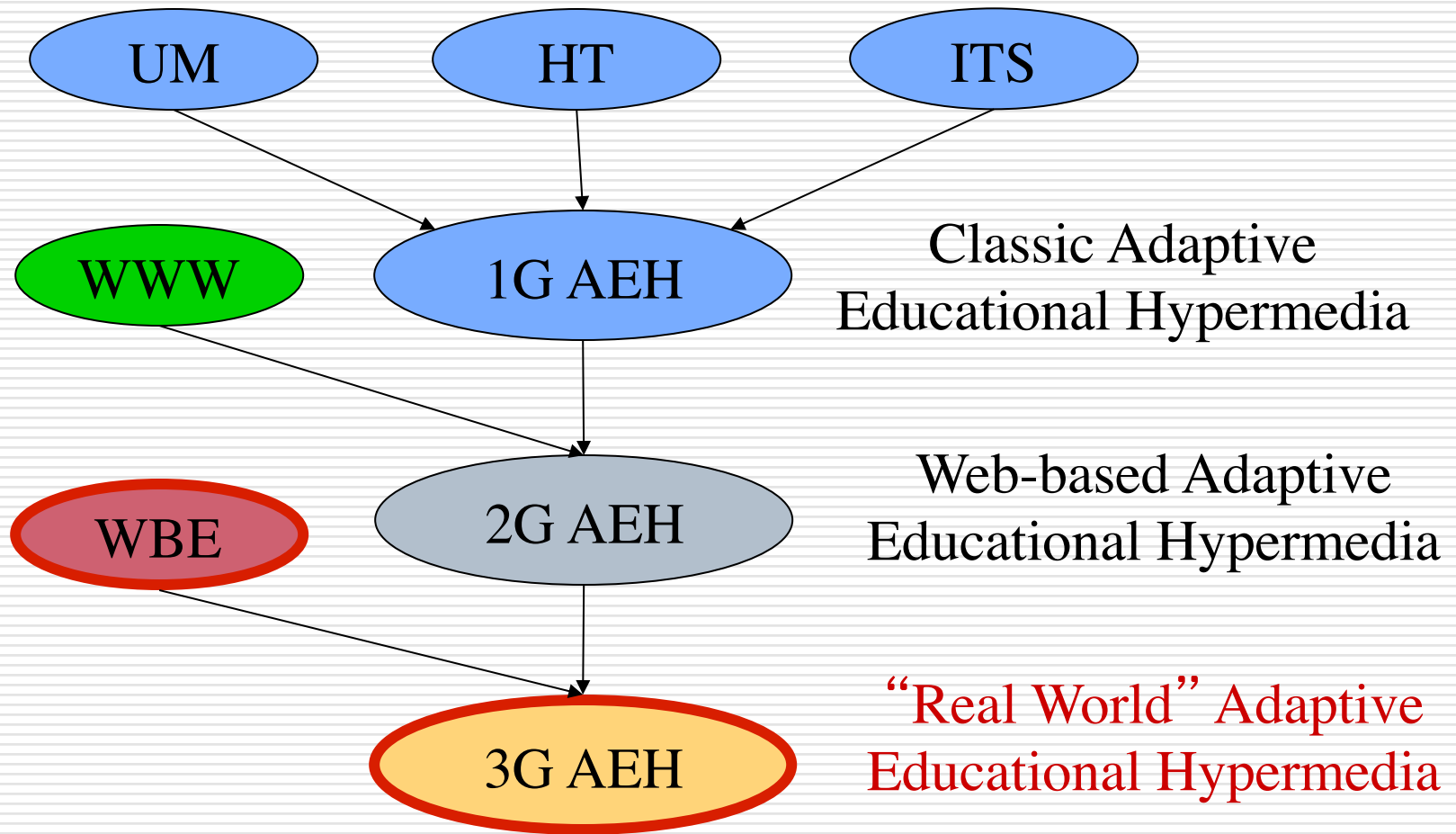
[Επεξεργαστής](#), [Δέξη](#), [Κβντε](#), [Βντε](#), [Αλγόριθμος](#), [Διευθυνσιοδοτημένη Μνήμη](#), [Κύρια Μνήμη](#)

Επιστροφή στην Αρχή

Επόμενη

# Generation 3

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# Practical E-Learning

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- Integrated Course Management Systems
  - Blackboard, WebCT, ...
- Support almost all aspects of E-Learning
  - Course material presentation
  - Assessment with quizzes
  - Threaded discussions
  - Student management and grading
- “MS Word”-style all-in-one tool for WBE

# Adaptive E-Learning?

---

- Adaptive E-Learning systems can provide a more advanced support for most functions
  - Course material presentation - InterBook, AHA
  - Assessment with quizzes - SIETTE
  - Threaded discussions - help agents
  - Student management - intelligent monitoring
- Why they are rarely used in practical E-Learning?

# Practical Adaptive E-Learning

---

- ❑ Model 1: Adapting to current E-Learning Paradigm - CMS
- ❑ More versatile adaptive systems
- ❑ An ability to integrate open corpus content
- ❑ Improving CMS content
- ❑ Giving more power to the teacher
  - Customize the system to specific course and material

# Emerging E-Learning

---

- Interoperability and standards
  - IEEE CMI, SCORM
- Semantics and metadata
  - LOM
- Component-based architectures
  - OKI, uPortal
- Resource reusability
- Distributed learning content
- Semantic Web

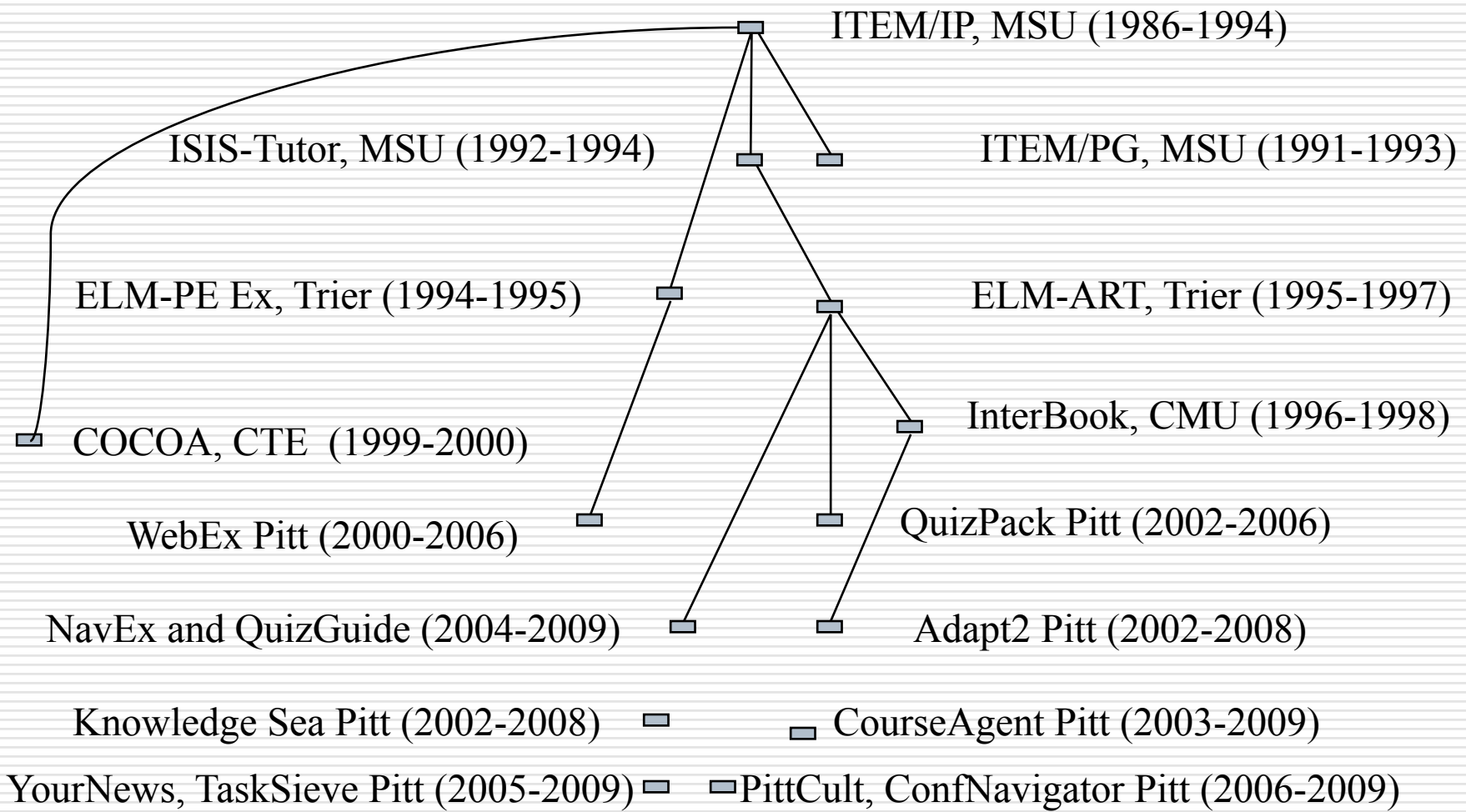
# Practical Adaptive E-Learning

---

- ❑ Model 2: Embedding adaptivity into emerging E-Learning
- ❑ Use of current interoperability standards (SCORM, LOM)
- ❑ Developing new interoperability architectures
- ❑ Resource discovery
- ❑ The use of Semantic Web



# Personal View: Generation 3



# CoCoA - Static Sequencing

---

- ❑ Many contributors for a single course
- ❑ Almost impossible to keep the course consistent without special tool
- ❑ Courseware engineering: From course authoring in small to course authoring in large
- ❑ CoCoA - Static sequencing
  - Prerequisite checking
  - Goal focusing
  - Learning activity balance

Problem report - Microsoft Internet Explorer

File Edit Links Address Back Forward Stop R

- This section requires concept **setcolor**, but it was not presented yet
- This section requires concept **fillrect**, but it was not presented yet
- No problems with question applet parameters

**Checking 2.2.2 Types, variables and identifiers.**

- Checking internal page structure
  - No problems with subsection Types and variables
  - No problems with subsection Primitive Types
  - Found a problem with subsection Declaring and using variables
    - This section requires an introduction to concept **identifier**, but it was neither introduced, nor presented yet
  - Found 2 problems with subsection Example of using types and variables: Relative positions
    - Concept **variable** is introduced here, but it was already presented
    - Concept **graphics coordinates** is introduced here, but it was already introduced
  - No problems with subsection Using Variables in Arithmetic Expressions
  - Found a problem with subsection Assigning values to variables
    - Concept **drawstring** is presented here, but it was

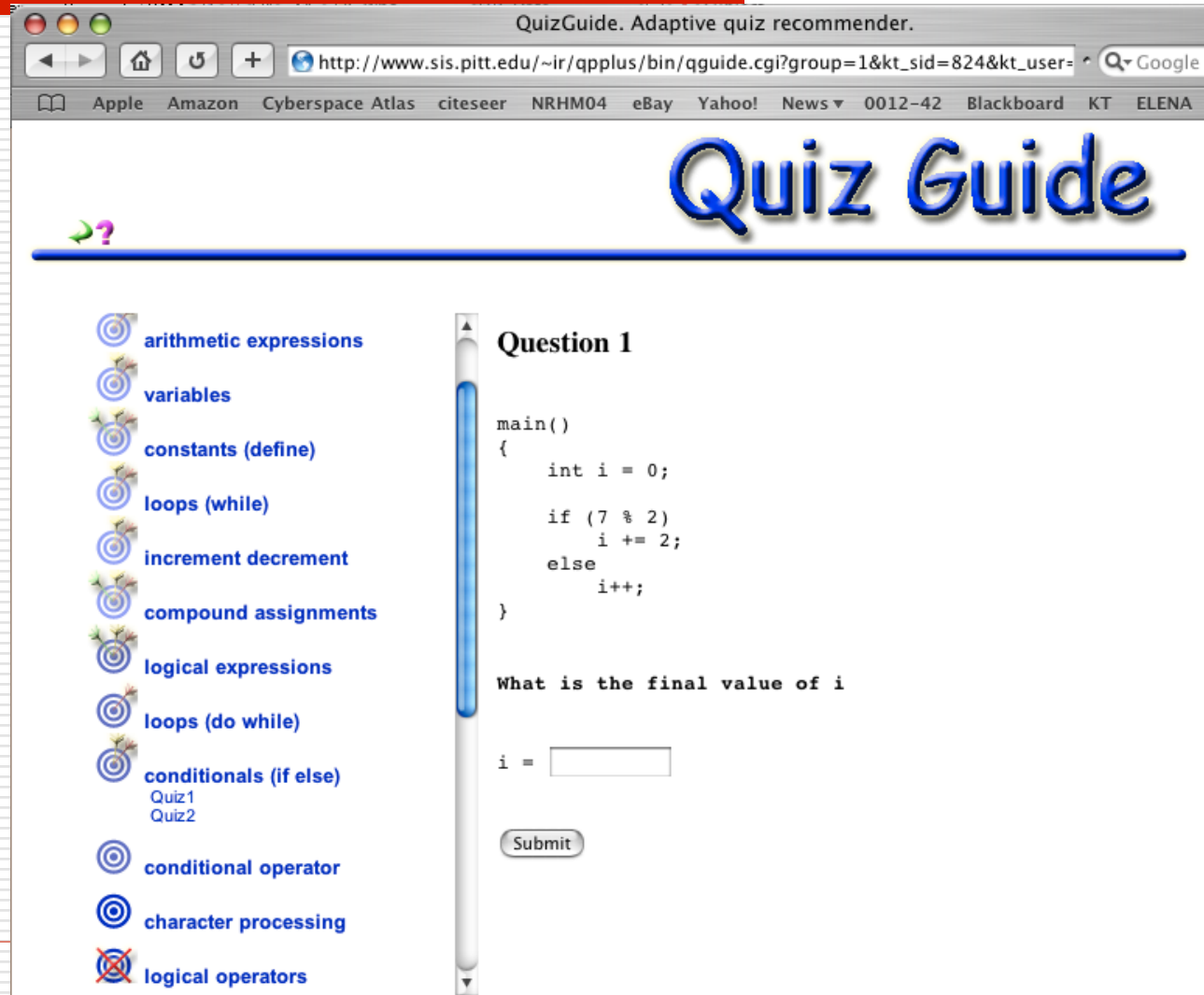
My Computer

# Open Corpus Adaptive Hypermedia

---

- ❑ Classic AH - Closed Corpus of pre-processed content
- ❑ Integrate Open Corpus content
- ❑ Bringing open corpus content in by indexing
  - KBS-HyperBook, SIGUE
- ❑ Processing open corpus content without manual indexing
  - Knowledge Sea

# QuizGuide: Topic-Based AH



The screenshot shows a web browser window with the title "QuizGuide. Adaptive quiz recommender." and the URL "http://www.sis.pitt.edu/~ir/qplus/bin/qguide.cgi?group=1&kt\_sid=824&kt\_user=...". The browser's address bar also shows a search engine icon and the text "Google". Below the address bar, there are several search engines listed: Apple, Amazon, Cyberspace Atlas, citeseer, NRHM04, eBay, Yahoo!, News, 0012-42, Blackboard, KT, and ELENA.

## Quiz Guide

→ ?

- arithmetic expressions
- variables
- constants (define)
- loops (while)
- increment decrement
- compound assignments
- logical expressions
- loops (do while)
- conditionals (if else)  
Quiz1  
Quiz2
- conditional operator
- character processing
- ~~logical operators~~

### Question 1

```
main()
{
    int i = 0;

    if (7 % 2)
        i += 2;
    else
        i++;
}
```

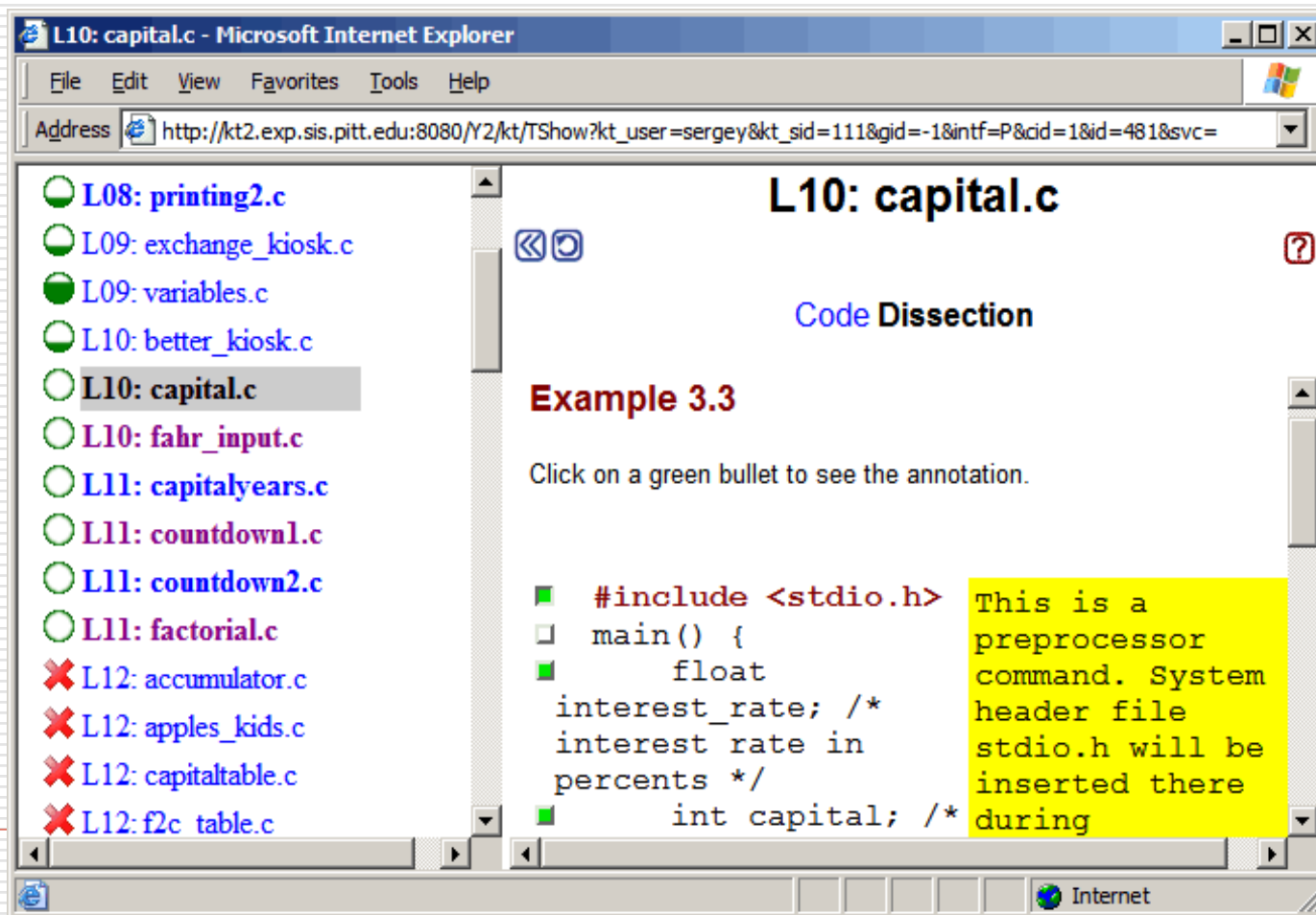
What is the final value of i

i =

Submit

# NavEx: Automatic Indexing

Classic “traffic light” prerequisite-based mechanism based on automatic indexing



The screenshot shows a Microsoft Internet Explorer window with the title "L10: capital.c - Microsoft Internet Explorer". The address bar contains the URL: `http://kt2.exp.sis.pitt.edu:8080/Y2/kt/TShow?kt_user=sergey&kt_sid=111&gid=-1&intf=P&cid=1&id=481&svc=`. The main content area is titled "L10: capital.c" and features a "Code Dissection" section. On the left, a sidebar lists various files with green circles indicating prerequisites and red X's indicating non-prerequisites. The "Code Dissection" section includes "Example 3.3" and a code snippet with a yellow annotation box.

**L10: capital.c**

Code Dissection

**Example 3.3**

Click on a green bullet to see the annotation.

```
■ #include <stdio.h>
□ main() {
■     float
       interest_rate; /*
       interest rate in
       percents */
■     int capital; /*
```

This is a preprocessor command. System header file `stdio.h` will be inserted there during

# Concept-Based QuizGuide

QuizGuide: Topic-based Adaptive Navigation for Quizzes - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Little progress is made for this material. You have answered this question correctly.

QuizGuide  
Adaptive Navigation for Self-Assessment Quizzes

**SELECT-FROM**

Arithmetic Expressions

SELECT-FROM-WHERE

Pattern Matching

Multiple Table Queries

ORDER-BY

Set Operations

Aggregate Functions

GROUP-BY and HAVING

Sub-Queries

**Question:**

Based on the tables below, write the required SQL expression.

**Task:**

Show all the information contained in table "store".

Enter your answer here.

Submit Answer

Go to SQL-Lab

Table Name	Schema & Sample Data (click +/- to show/hide sample data)							
actor(-)	actor_id first_name last_name last_update							
	actor_id	first_name	last_name	last_update				
	1	PENELOPE	GUINNESS	2006-02-15 04:34:33.0				
	2	NICK	WAHLBERG	2006-02-15 04:34:33.0				
address(+)	address_id	address	address2	district	city_id	postal_code	phone last_update	
category(+)	category_id	name					last_update	

# Proactive: Metadata for ANS

Recommendation and navigation support based on available metadata indexing

Proactive

[Preference] [Feedback] [Help] [Logout]

Welcome to Proactive, danielle

[Most Recent Jobs]

[Matched to Preference]

[Recommended Jobs]

[My Saved Jobs]

[Advanced Search]

:: Job recommendation based on your saved jobs ::

Total: 50(1/3)

Matched to Preference Visualize this list

1 2 3

Job Category	Title	Company	City	State	Position Type	Salary	Experience	Education	Post Date	Relevance
Help Desk Analyst	Help Desk Support Analyst [SAVE]	Cost Plus World Market	Oakland	CA	Full-Time, Employee	Unspecified	1-2 Years Experience	Associates	12-15-07	*****
E-Commerce Director	Director/VP of Applications-Wireless [SAVE]	Terran Systems	San Jose	CA	Full-Time, Employee	Unspecified	10-15 Years Experience	Master of Science	12-15-07	*****
Java Server Engineer	Java Server Engineer [SAVE]	Cross Creek Systems	San Jose	CA	Full-Time, Employee	unspecified	5-10 Years Experience	Bachelor of Science	12-15-07	****
Information Services Consultant	Financial Services Consultant [SAVE]	IBM	Boston	MA	Full-Time, Employee	unspecified	0-1 Years Experience	unspecified	12-15-07	****
Information Services Consultant	Oracle Service Consultant [SAVE]	IBM	Boston	MA	Full-Time, Employee	unspecified	Unspecified	unspecified	12-15-07	****
Java Server Engineer	QA Engineer - Web UI Automation (Selenium/Java) [SAVE]	Yahoo! Inc	Santa Clara	CA	Full-Time, Employee	unspecified	2-5 Years Experience	unspecified	12-15-07	****
Help Desk Analyst	HELP DESK ANALYST - BOSTON [SAVE]	SuccessFactors.com	Boston	MA	Full-Time, Employee	Unspecified	2-5 Years Experience	Bachelor of Science	12-15-07	****
Java Server Engineer	Principal SW Engineer - Ad Server [SAVE]	Yahoo! Inc	Santa Clara	CA	Full-Time, Employee	unspecified	5-10 Years Experience	unspecified	12-15-07	****
Java Server Engineer	Java Developer Server Side [SAVE]	Informative People Inc	San Francisco	CA	Full-Time, Employee	Unspecified	1-2 Years Experience	unspecified	12-15-07	***
E-Commerce Director	Director of Software [SAVE]	Terran Systems	San Francisco	CA	Full-Time, Employee	\$140K - \$190K	10-15 Years Experience	unspecified	12-15-07	***
E-Commerce Director	Director of Categorization [SAVE]	Yahoo! Inc	Sunnyvale	CA	Full-Time, Employee	unspecified	Unspecified	unspecified	12-15-07	***
Information Services Consultant	Financial Services Consultant [SAVE]	IBM	San Francisco	CA	Full-Time, Employee	unspecified	0-1 Years Experience	unspecified	12-15-07	***
Java Server Engineer	Senior Java Server Engineer [SAVE]	ArcSight	Cupertino	CA	Full-Time, Employee	Unspecified	5-10 Years Experience	Bachelor of Science	12-15-07	***
Information Services	Oracle Service Consultant [SAVE]	IBM	San Francisco	CA	Full-Time, Employee	unspecified	Unspecified	unspecified	12-15-07	***



# Community-based OCAH

---

- Footprint-based social navigation
    - Footprints, CoWeb, Knowledge Sea II, ASSIST
  - Action-based social navigation (annotation, scheduling...)
    - Knowledge Sea II, Conference Navigator
  - Direct feedback for navigation support
    - CourseAgent, PittCult
  - Tag-based social navigation
    - Any example???
-

# Knowledge Sea II

The screenshot displays the Knowledge Sea v2.0 interface. The main window shows a grid of knowledge cells, each containing a list of related terms and a small icon. The grid is organized into columns and rows, with each cell representing a specific concept or topic. The interface includes a navigation bar at the top with buttons for Back, Forward, Stop, Refresh, Home, and AutoFill. The address bar shows the URL: [http://kt1.exp.sis.pitt.edu:8080/ksea/default.jsp?it\\_slid=156&...](http://kt1.exp.sis.pitt.edu:8080/ksea/default.jsp?it_slid=156&...). The main content area is titled "Know" and contains a grid of cells. Each cell contains a list of related terms and a small icon. The interface also includes a navigation bar at the bottom with buttons for Internet zone, Home, and AutoFill.

Two detailed views of cell contents are shown in the foreground:

- Knowledge Sea v2.0: Cell Contents - Girish C...**
  - Location on map: [Grid]
  - Keywords: string, character, print, space, array.
  - Content:
    - [R. Milas : Strings](#)
    - [R. Milas : How long is a piece ...](#)
    - [R. Milas : strcpy](#)
    - [R. Milas : strcmp](#)
    - [R. Milas : strlen](#)
    - [S. Summit : 6.1 printf](#)
    - [S. Summit : Chapter 8: Strings](#)
    - [P. Burden : Introduction to C Pr...](#)
    - [P. Burden : Addresses , Pointers, ...](#)
    - [P. Burden : Addresses , Pointers, ...](#)
    - [P. Burden : Addresses , Pointers, ...](#)
    - [P. Burden : Addresses , Pointers, ...](#)
    - [P. Burden : Functions and storag ...](#)
    - [D. Marshall : Integer Functions , R ...](#)
    - [D. Marshall : String Conversion](#)
    - [D. Marshall : Basic String Handlin ...](#)
    - [D. Marshall : Exercises](#)
    - [D. Marshall : Strings](#)
    - [D. Marshall : Exercises](#)
    - [C.Fag : Question 10.12](#)
    - [C.Fag : Question 10.22](#)
- Knowledge Sea v2.0: Cell Contents - Girish C...**
  - Location on map: [Grid]
  - Keywords: array, pointer, string, element, memory.
  - Content:
    - [R. Milas : Arrays](#)
    - [R. Milas : Why We Need Arrays](#)
    - [R. Milas : Array Types and Size ...](#)
    - [R. Milas : More Than One Dimens ...](#)
    - [S. Summit : 10.5 ``Equivalence'' ...](#)
    - [S. Summit : 10.6 Arrays and Poin ...](#)
    - [S. Summit : 4.1 Arrays](#)
    - [S. Summit : 4.1.1 Array Initiali ...](#)
    - [S. Summit : 4.1.2 Arrays of Arra ...](#)
    - [P. Burden : Addresses , Pointers, ...](#)
    - [D. Marshall : Pointers and Arrays...](#)
    - [D. Marshall : Multidimensional arr ...](#)
    - [D. Marshall : Static Initialisatio ...](#)
    - [D. Marshall : Searching and Sortin ...](#)
    - [D. Marshall : Initializinga Sema ...](#)
    - [D. Marshall : Controlling Semaphor ...](#)
    - [D. Marshall : Semaphore Operations ...](#)
    - [D. Marshall : Arrays and Strings](#)
    - [D. Marshall : Single and Multi-dim ...](#)
    - [D. Marshall : Functions and Arrays ...](#)
    - [C.Fag : Question 1.31](#)
    - [C.Fag : Question 15.13](#)

# Conference Navigator

The screenshot shows the AACE E-Learn Conference website in a Mozilla Firefox browser. The page title is "AACE - E-Learn Conference - Mozilla Firefox". The address bar shows the URL: [http://www.aace.org/conf/elearn/sessions/index.cfm/fuseaction/PresentationSearch?cfid=38123751&cfToken=692352&search\\_field=Author&search\\_string=&day=&topic\\_sear](http://www.aace.org/conf/elearn/sessions/index.cfm/fuseaction/PresentationSearch?cfid=38123751&cfToken=692352&search_field=Author&search_string=&day=&topic_sear). The navigation menu includes: AACE Home, Conferences, Membership, Publications, Digital Library, Store, Contact. The user is logged in as Rosta Farzan. The main heading is "E-Learn 2006" with the subtitle "World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education". A search bar is present with the text "Search Author matching" and a "Search" button. Below the search bar, it says "Searches for United States or United Kingdom, use 'USA' or 'UK'". The date filter is set to "Saturday, Oct. 14, 2006". The topic filter is set to "Tools & Systems". A "Next Page" link is visible. Below the search results, it says "Presentations Matching Search: 77" and "Sat, Oct. 14". A table of presentations is displayed with columns: Time, Room, Title, Type, Topic, and Proceedings Starting Page #.

**E-Learn 2006**  
World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education

**E-Learn 2006 Presentation Schedule/Search**

Search

Searches for United States or United Kingdom, use "USA" or "UK".

Date:  All Days  Saturday, Oct. 14, 2006  Monday, Oct. 16, 2006  
 Sunday, Oct. 15, 2006  Tuesday, Oct. 17, 2006

Topic:

[Next Page](#)

Presentations Matching Search: 77

Sat, Oct. 14

Time	Room	Title	Type	Topic	Proceedings Starting Page #
10:00 AM	3	<a href="#">AnnotatEd: A Social Navigation and Annotation Service for Web-based Educational Resources</a> <small>Rosta Farzan, University of Pittsburgh, USA; Peter Brusilovsky, University of Pittsburgh, USA</small> <a href="#">View Details</a> <a href="#">View PowerPoint Presentation</a>	Full Paper	Tools & Systems	2794
10:30 AM	9	<a href="#">Using iPods to Support Content Area Learning in a Japanese College Lecture Course</a> <small>Douglas Scott, Waseda University, Japan; Shoji Nishimura, Waseda University, Japan; Shogo Kato, Waseda University, Japan</small> <a href="#">View Details</a>	Full Paper	Tools & Systems	3014
11:15 AM	3	<a href="#">Enabling the collective to assist the individual: CoREAD, a self-organising reading environment</a> <small>Andrew Chiarella, McGill, Canada; Susanne Lajoie, McGill University, Canada</small> <a href="#">View Details</a> <a href="#">View PowerPoint Presentation</a>	Brief Paper	Tools & Systems	2753
11:35 AM	3	<a href="#">Drag and Drop Streaming: an Inexpensive Method for Recording and Delivering Lectures is Becoming the Next Revolution in E-Learning</a> <small>Salvador Baez-Franceschi, University of Houston, USA; Afshad Dinshaw, University of Houston, USA; Ian Evans, University of Houston, USA; Donald Nieuwenhuise, University of Houston, USA</small> <a href="#">View Details</a>	Brief Paper	Tools & Systems	2715
11:55 AM	3	<a href="#">Supporting Diagnostic Problem Solving in Medical Education Using an Integrated Classroom - E-Learning Model</a> <small>Sonia Faremo, McGill University, Canada; Susanne Lajoie, McGill University, Canada; Genevieve Gauthier, McGill University, Canada; Jeffrey Wiseman, McGill University, Canada</small> <a href="#">View Details</a>	Brief Paper	Tools & Systems	2788
1:30 PM	8	<a href="#">Finding Out Clues of Understanding with Learner's Contexts in C-Language Programming</a>	Full Paper	Tools & Systems	3040

Considers user visits, scheduling, annotation



# Conference Navigator 2.0 *Beta*

Welcome Guest

Login

Signup

## Adaptive Hypermedia 2008

Summary

Program

## Top Ten Annotated Papers

	Title	Date	#
1	<b>Adaptive Navigation Support</b> Peter Brusilovsky	Jul 30 2008	9
2	<b>Towards Computerized Adaptive Learning</b> Jozef Tvarozek, Milos Kravcik, Maria Bielikova	Aug 1 2008	5
3	<b>Adaptive Link Annotation</b> Michael Yudelson, Peter Brusilovsky	Aug 1 2008	3
4	<b>Altruism, Selfishness, and Social Navigation</b> John Riedl	Jul 31 2008	3
5	<b>(Web Search)shared - a Social Search Framework</b> Maurice Coyle, Barry Smyth	Jul 30 2008	3
6	<b>An Evidence-Based Approach to Adaptive Learning</b> Francesca Carmagnola, Vania Dimitrova	Jul 31 2008	1
7	<b>SemWeB: A Semantic Web Recommendation System</b> Melike Sah, Wendy Hall, David C. De Roure	Jul 31 2008	1
8	<b>A Rule-Based Recommendation System for Adaptive Learning</b> Fabian Abel, Ig Ibert Bittencourt, Nicola Henze, Daniel Krause, Julita Vassileva	Jul 31 2008	1
9	<b>A Scrutable User Modelling System</b> Demetris Kyriacou	Jul 31 2008	1
10	<b>Modelling Semantic Relationships in Adaptive Learning</b> Styliani Kleanthous, Vania Dimitrova	Jul 30 2008	1

## Top Ten Visited Papers

	Title	Date	#
1	<b>Adaptive Navigation Support</b> Peter Brusilovsky	Jul 30 2008	12
2	<b>Towards Computerized Adaptive Learning</b> Jozef Tvarozek, Milos Kravcik, Maria Bielikova	Aug 1 2008	8
3	<b>Adaptive Link Annotation</b> Michael Yudelson, Peter Brusilovsky	Aug 1 2008	7
4	<b>Altruism, Selfishness, and Social Navigation</b> John Riedl	Jul 31 2008	5
5	<b>An Evidence-Based Approach to Adaptive Learning</b> Francesca Carmagnola, Vania Dimitrova	Jul 31 2008	4
6	<b>LS-Plan: An Effective Comprehension Planning System</b> Carla Limongelli, Filippo Sciarone, Giulia Vaste	Aug 1 2008	2
7	<b>SemWeB: A Semantic Web Recommendation System</b> Melike Sah, Wendy Hall, David C. De Roure	Jul 31 2008	2
8	<b>A Scrutable User Modelling System</b> Demetris Kyriacou	Jul 31 2008	2
9	<b>A Rule-Based Recommendation System for Adaptive Learning</b> Fabian Abel, Ig Ibert Bittencourt, Nicola Henze, Daniel Krause, Julita Vassileva	Jul 31 2008	1
10	<b>Adaptation of Elaborated Feedback in Adaptive Learning</b> Ekaterina Vasilyeva, Mykola Pechenizkiy, Paul De Bra	Jul 31 2008	1

## Tag Cloud

[adaptability](#)
[adaptive](#)
[adaptive-hypermedia-systems](#)
[adaptive-navigation-support](#)
[adaptive-web](#)
[assessment](#)
[e-learning](#)
[framework](#)
[hypermedia](#)
[information-retrieval](#)
[interoperability](#)
[jon-dron](#)
[judith](#)
[keynote](#)
[masthoff](#)
[open-corpus](#)
[peter-brusilovsky](#)
[portals](#)
[recommender](#)
[social-navigation](#)
[social-search](#)
[social-web](#)
[structured](#)
[systems](#)
[tagging](#)
[task](#)
[web](#)

## Contributors

## Top Ten Active Communities

	Community	#
1	Social Web	19
2	Adaptive Web	17
3	User Modelling	13
4	Personalized Web	8



# CourseAgent

Spring 2006 List

Click to see the schedule

CourseAgent  
Adaptive Online Course Recommendation System




Control Panel Schedules Career Scope Course Catalog Faculty Register




Rosta's CourseAgent Help Log off

Schedule of spring 2006

Taken Courses, Planned Courses, Currently Taken Courses, Recommend by Advisor, Degree of Relevance to Career Goals

CRN	Course No	Title	Day	Time	Location	Instructor	Workload	Relevance	Action
2692	TELCOM 2240	PRACTICUM	sept			Richard Thompson			Plan It
16084	INFSCI 2120	INFORMATION AND CODING THEORY	tue	6:00-8:50 P	302 CL	Paul Munro	YY	☺☺☺	Plan It
16077	INFSCI 2130	DECISION ANALYSIS AND DECISION SUPPORT SYSTEMS	wed	6:00-8:50	411 IS	Marek Crutdzal	YY	☺☺☺	Plan It
16088	LIS 2194	ETHICS IN THE INFORMATION SOCIETY	mon	3:00-5:50 P	403 IS	Toni Carbo			Plan It
16099	INFSCI 2350	HUMAN FACTORS IN SYSTEMS	thu	6:00-8:50 P	411 IS	Michael Lewis	YY	☺☺☺	Register It
16056	INFSCI 2470	INTERACTIVE SYSTEM DESIGN	wed	6:00-8:50 P	405 IS	Peter Rouslovsky	YY	☺☺☺	Evaluate It
16079	INFSCI 2511	INFORMATION SYSTEMS ANALYSIS, DESIGN, AND EVALUATION	tue	6:00-8:50 P	411 IS	Glenn Bay	Y		Plan It
16011	INFSCI 2610	DATA STRUCTURES	thu	3:00-5:50 P	501 IS	Booster Flynn	YY	☺☺☺	Plan It
16118	INFSCI 2611	ALGORITHM DESIGN	tue	3:00-5:50 P	406 IS	Hassan Kaomi	YY	☺☺☺	Plan It
16065	INFSCI 2720	GEOGRAPHIC INFORMATION SYSTEMS	thu	6:00-8:50 P	405 IS	Hassan Kaomi	YY	☺☺☺	Plan It

Difficulty level of the course  
Low , Medium , High 

Degree of relevance to students' career goal  
Marginally relevant   
Relevant   
Very Relevant 

Planned to take (can be registered)

Already taken (can be evaluated)

# PittCult

UNIVERSITY OF PITTSBURGH SCHOOL OF INFORMATION SCIENCES

## PITTCULT

| home | recommendation | my events | **profile & friends**  | logout | help |

---

<< July / 2008 >>						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

**Show All Events**

**Kind**

- Exhibitions (10)
- Film/Video Arts (8)
- Literary Programs (1)
- Music Concerts (32)
- Opera/Musical (5)
- << More

**Organization**

- Carnegie Museum of Art (1)
- Carnegie Museum of Natural History (4)
- Carnegie Science Center (1)
- Frick Art & Historical Center (2)

**Most Recent Events** Welcome to PITTCULT, peterb

**[CINEMA IN THE PARKS] The Spiderwick Chronicles**  
**Date:** 2008-07-30 20:00 | **Venue:** Schenley Park [\[map\]](#) | **Kind:** Film/Video Arts  
Grab a blanket and head out for an unforgettable evening of cinema under the stars. The 2008 "Citiparks Cinema in the Park" schedule will include Spider-Man 3, Ocean's T ...

**Last Days Cafe Monthly Creative Resource Meet and Chat for Pittsburgh's Creatives**  
**Date:** 2008-07-31 17:30 | **Venue:** New Hazlett Theater [\[map\]](#) | **Kind:** Others  
Join us for a monthly gathering of artists and creative professionals, known as "Last Days Cafe This FREE happy hour, casual "salon" is held the last day of every month ( ... 

**Annie Get Your Gun**  
**Date:** 2008-07-30 20:00 | **Venue:** Benedum Center [\[map\]](#) | **Kind:** Opera/Musical  
Music and Lyrics by Irving Berlin  
Book by Herbert & Dorothy Fields  
As revised by Peter Stone 

**[ Random Users ]**

- Nimisha
- radamanthis
- celery
- st3313rsfan
- chirayukong

**[ Most Trusted Users ]**

- lpb
- peterb
- danielle

**[ Most Popular Event ]**

- In Harmony with...
- Great British A...
- Marvin & Chris
- ...
- Fiddler on the ...
- Sideburns
- (Bake...

Social networks for contextual recommendation

# Keyword-based OCAH

---

- Siskill and Webert
    - Link ordering and annotation
  - ML-Tutor
    - Link ordering and generation
  - ScentTrails
    - Link annotation
  - YourNews/TaskSieve
    - Link ordering and generation
-

# YourNews: Open Keyword-Level User Models

Keyword-level user model is visible and editable

The screenshot shows a Mozilla Firefox browser window displaying the YourNews website. The page title is "YourNews" and the URL is "http://ir.exp.sis.pitt.edu/gale/news-study/personalize". The user "jahn" is logged in. The page features a navigation menu with categories: All, Headlines, National, World, Business, Technology, Sports, Entertainment, and Health. Below the menu, there are options to "Show all duplicate articles", "Short term", "Long term", "Recent News", and "Recommended News".

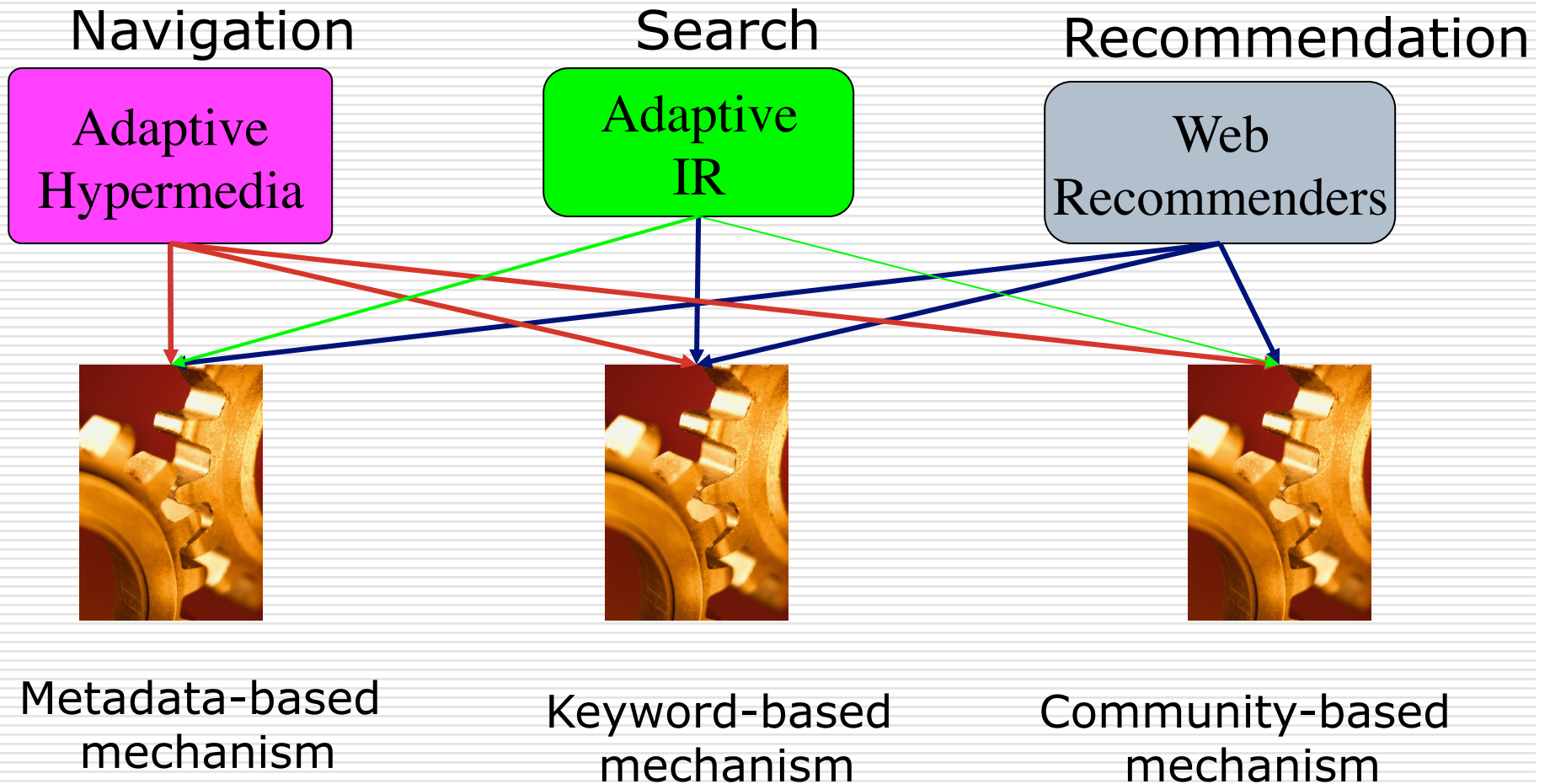
The main content area displays a list of news articles. The top article is "Spinach Plants Probed; E. Coli Kills Boy (10 hours ago)" with a 5-star rating. The article text reads: "Officials launch criminal probe into 2 spinach plants; Idaho boy's death blamed on E. coli". Below this is another article: "Idaho blames toddler's death on E. coli (AP) (10 hours ago)" with a 5-star rating. The article text reads: "AP - A 2-year-old boy who died from kidney failure last month had been infected with the same strain of E. coli bacteria that prompted a nationwide consumer warning on fresh spinach and sickened at least 192 people." Other articles include "Report Ties Cancers to 1959 Lab Meltdown (11 hours ago)", "Breast-Feeding, Intelligence Link Probed (11 hours ago)", and "Study: Drug Prevents Postpartum Bleeding (11 hours ago)".

Overlaid on the right side of the page is a dialog box titled "jahn's Keywords for Health News [Hide]". The dialog box contains a list of keywords: COLI, SPINACH, BOY, IDAHO, PLANT, BOISE, PROBE, KIDNEY, INFECT, DEATH, BACTERIA, TODDLER, NATIONWIDE, STRAIN, OFFICIAL, FAILURE, OUTBREAK, CRIMINAL, FRESH, PROMPT, BLAME, WARNING, CONSUMER, LINK, HEALTH, LAUNCH, DIE, OLD, MONTH, THURSDAY, KILL. Below the list is a text input field with the word "CONTAMINATION" and an "OK" button. The dialog box also includes the text "Add your custom keywords" and a small "CC" icon.



# Personalized Information Access 2016

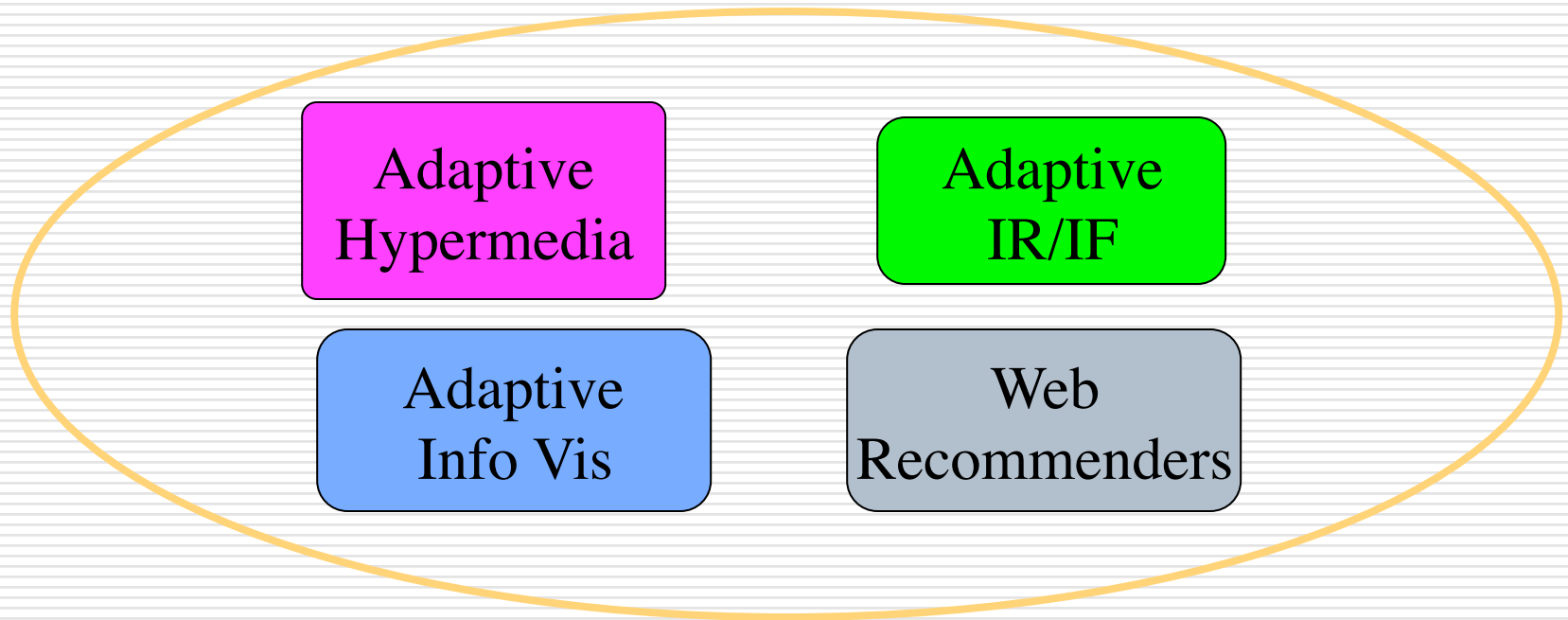
---



**Adaptation Mechanisms**

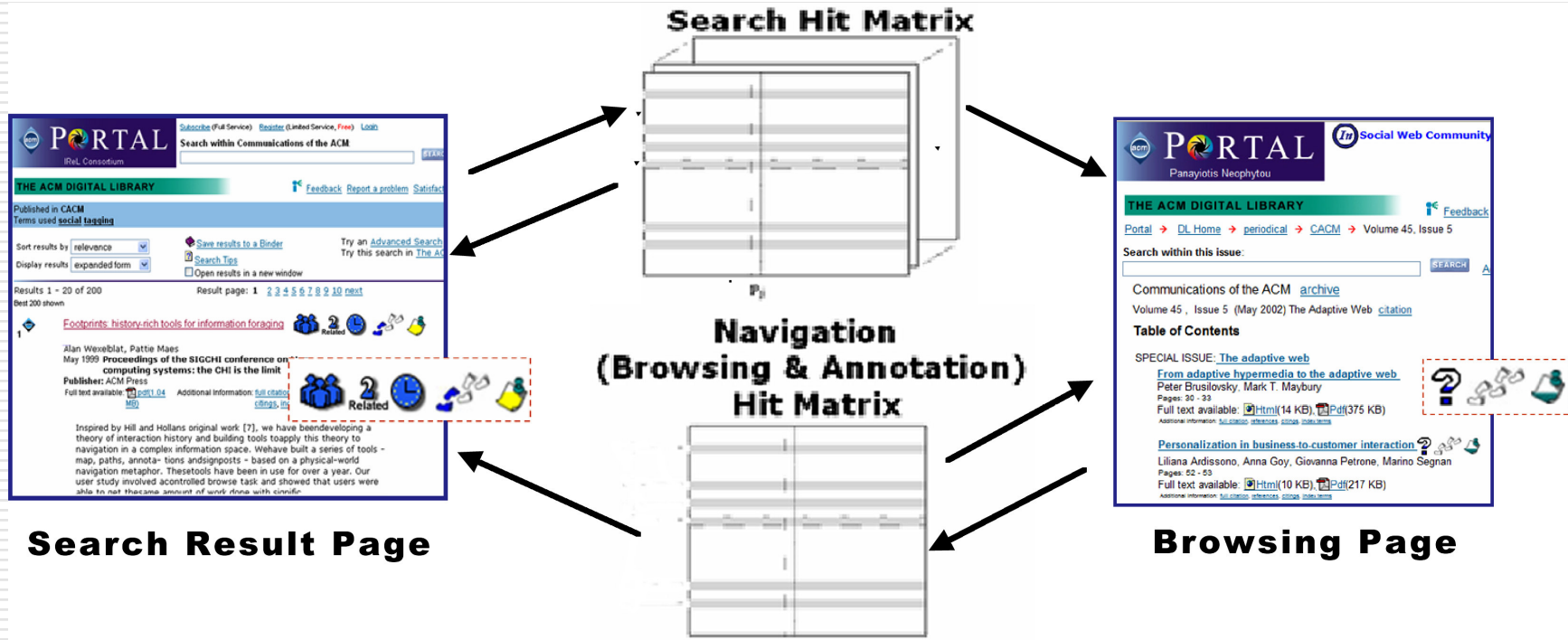
# Personalized Information Access 2016

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- With and without domain models
- Keyword- and concept-based UM
- Use of any AI techniques that fit
- Use many forms of information access
- Use a range of adaptation techniques
- Adapt to more than just interests

# ASSIST-ACM



Re-ranking result-list based on search and browsing history information

Augmenting the links based on search and browsing history information

# More Information

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## □ Read

- Brusilovsky, P. (1996) Methods and techniques of adaptive hypermedia. *User Modeling and User-Adapted Interaction* 6 (2-3), 87-129
- Brusilovsky, P. and Henze, N. (2007) Open corpus adaptive educational hypermedia. *The Adaptive Web: Methods and Strategies of Web Personalization*. Lecture Notes in Computer Science, Vol. 4321, Springer-Verlag, pp. 671-696.

## □ Explore

- Try our systems at PAWS Community portal:  
<http://www.sis.pitt.edu/~paws>
  - [http://adapt2.sis.pitt.edu/wiki/Main\\_Page](http://adapt2.sis.pitt.edu/wiki/Main_Page)
  - Use Eventur, CoMeT, CourseAgent
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