

INFSCI 2480: Adaptive Information Systems

# Adaptive Navigation Support

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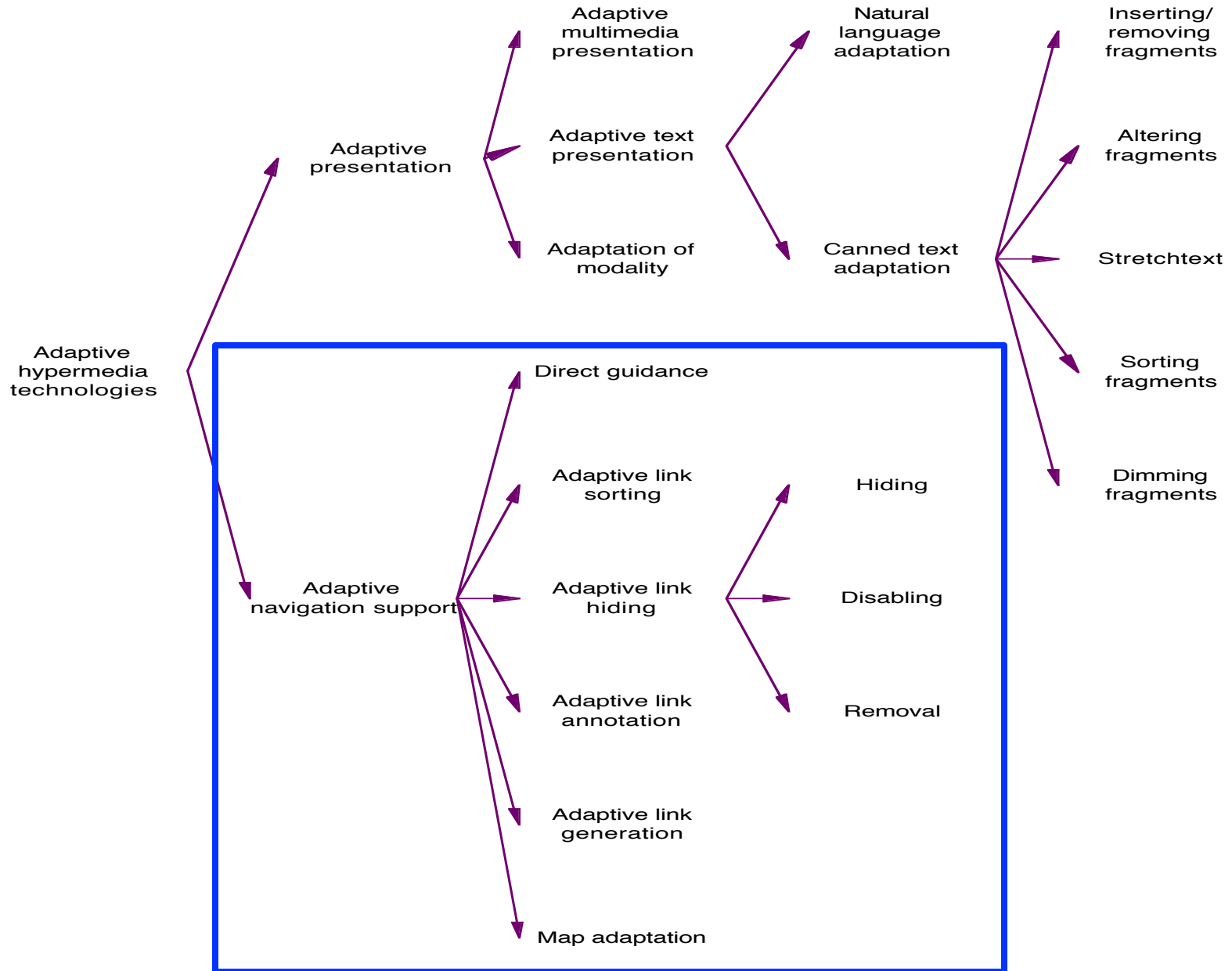
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# A Part of Adaptive Hypermedia

- Hypermedia = Pages + Links
- Adaptive presentation
  - content adaptation
- Adaptive navigation support
  - link adaptation



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

# Example: Adaptive annotation

**4**

**3**

**2**

**1**

Netscape: ACT-R Lesson Units

ACT-R Lesson Units

- Unit 0: Interpreting Production Rules
  - Section 0.1: Production Rule Forms
    - 0.1.1 Declarative Units in ACT-R
    - 0.1.2 Production Rules in ACT-R
    - 0.1.3 Production Rule Format
    - 0.1.4 ACT-R's Condition Form
    - 0.1.5 ACT-R's Action Side

0.1.1 Declarative Units in ACT-R

In ACT-R, elements of declarative knowledge are called **chunks** or **WMEs** (for working memory elements).

Background:

ACT-R ✓

declarative knowledge

Content	?
Glossary	?
Help	?
Search	?
Hint	?

1. Concept role

2. Current concept state

3. Current section state

4. Linked sections state

# What can be adapted: links

- Contextual links (“real hypertext”)
- Local non-contextual links
- Index pages
- Table of contents
- Links on local map
- Links on global map

# Link types and technologies

	Direct guidance	Sorting	Hiding	Annotation	Map adaptation
Contextual links	OK		(disabling)	OK	
Non-contextual links	OK	OK	?	OK	
Table of contents	OK		?	OK	
Index	OK		?	OK	
Local map	OK		OK	OK	OK
Global map	OK		OK	OK	OK



# Some Popular ANS Mechanisms

- Relevance-based navigation support
  - Expresses link relevance to user interests
  - Mechanism is similar to adaptive search, but interface is different
- Prerequisite-based navigation support
- Progress-based navigation support
- *A mechanism is different from an interface*
  - Same mechanism, different presentation

# Relevance-based navigation support

- Sorting
  - HYPERFLEX, 1993
- Annotation (icons)
  - Siskill & Webert 1996
- Annotation (font)
  - ScentTrails 2003
- Annotation (icons) + Sorting
  - YourNews, 2007

# Evaluation of Relevance-based AND using 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

# Syskill & Webert vs. ScentTrails

Syskill & Webert - Lycos Search

Lycos search: GRANTS CONTROL WUSTL DATA  
GENOME CDC INFECTIOUS UNIVERSITY  
RESEARCH PHARMACY HEALTH JOURNAL  
BIOLOGY MEDICAL

Lycos Nov 15, 1995 catalog, 11646653 unique URLs

1) .008 [Research & Data](#) [1.0000, 5 of 14 terms, adj 1.0]

**Abstract:** **Research & Data** HHS makes a substantial investment in improving understanding of **health** and social services. An increasing amount of the information generated by HHS organizations will be made available on the Internet and through this page. Program evaluation and policy **research** \* Abstracts of HHS program evaluation studies \* The 1994 Green Book: **Data** and information on selected social welfare programs \* Office of the Assistant Secretary for Planning and Evaluation **Biomedical research** \* National Institutes of **Health** (NIH) \* National Library of  
<http://www.as.dhhs.gov/resdata.html> (3k)

2) 1.0 [Online Journals](#) [0.9902, 6 of 14 terms]

**Abstract:** American Chemical Society Publications DOE Whitepaper on Bio-Informatics Emerging **Infectious** Diseases (EID) - CDC European Molecular **Biology** Network Newsletter Human **Genome** Newsletter GCG Transcript **Journal** of Biological Chemistry **Journal** of Clinical Monitoring **Journal** of Computer-Aided Molecular Design Mathematics and **Biology** Protein Science Recombinant DNA/Protein Resource Facility News Report: NCHGR GESTEC Director's Meeting on **Genome** Informatics Informatics Center, Vanderbilt **University Medical** Center Last Modified: Wednesday, 04 October 1995  
webmaster@www.mc.vanderbilt.edu  
<http://vumclib.mc.vanderbilt.edu/resources/interests/journal.html> (3k)

3) .996 [Selected Internet Resources Starting Points Subject Specific](#)  
[Star Institution](#) [0.0250, 5 of 14 terms, adj 1.0]

## Departmental and Production Copiers

(60 & up Copies per Minute; Volume above 75,000 Copies per Month)

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# Content-Based Link Annotation in YourNews

YourNews - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://ir.exp.sis.pitt.edu/gale/news-study/personalize

Google

User "jahn" logged in | Logout | Preference green Session 1

## YourNews

All | **Headlines** | National | World | Business | Technology | Sports | Entertainment | Health

Show all duplicate articles > Short term | Long term > Recent News | Recommended News

- Spinach Plants Probed; E. Coli Kills Boy (10 hours ago) ★★★★★  
Officials launch criminal probe into 2 spinach plants; Idaho boy's death blamed on E. coli
- ★ ★ ★ ★ ★ 12 hours ago - Fri, 06 Oct 2006 00:22:35 EDT  
**Idaho blames toddler's death on E. coli (AP)**  
(10 hours ago) ★★★★★  
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.
- ★ ★ ★ ★ ★ 14 hours ago - Thu, 05 Oct 2006 22:12:28 EDT  
**Report Ties Cancers to 1959 Lab Meltdown** (11 hours ago)  
Report says nuclear reactor meltdown at Calif. lab may have caused cancers in surrounding area.
- ★ ★ ★ ★ ★ (11 hours ago)  
**Breast-Feeding, Intelligence Link Probed** (11 hours ago)  
Study says genetic and environmental factors, not breast-feeding, affect child's intelligence
- ★ ★ ★ ★ ★ (11 hours ago)  
**Study: Drug Prevents Postpartum Bleeding** (11 hours ago)  
Study finds drug used to treat ulcers is effective in preventing excessive postpartum bleeding

jahn's Keywords for Health News [Hide]

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

**CONTAMINATION**

Add your custom keywords

Done

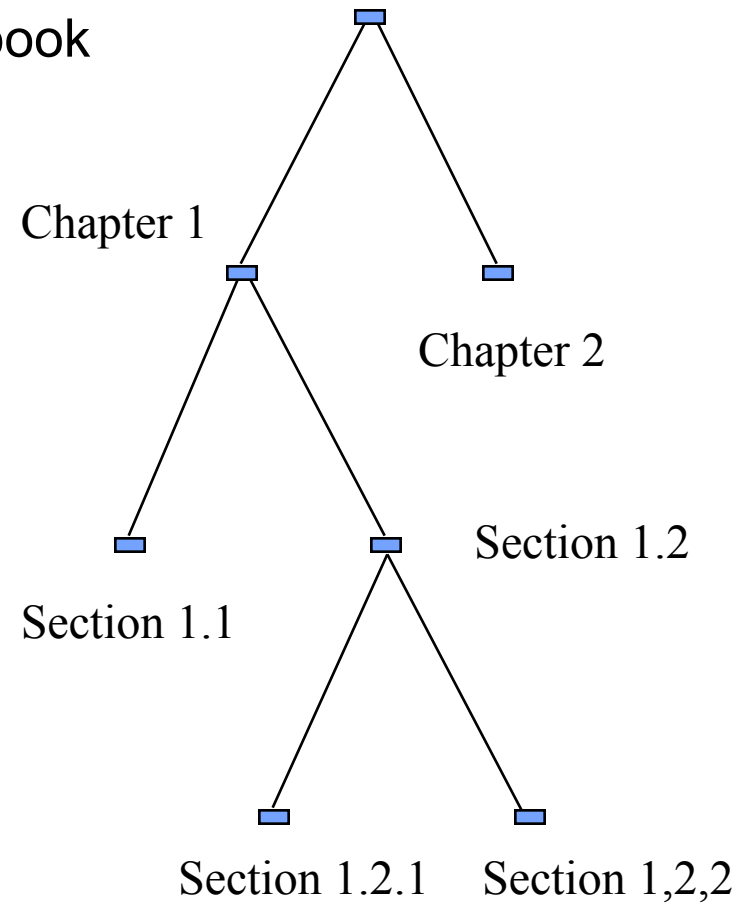
Open Notebook

# InterBook: Prerequisite-based navigation in ET

- “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

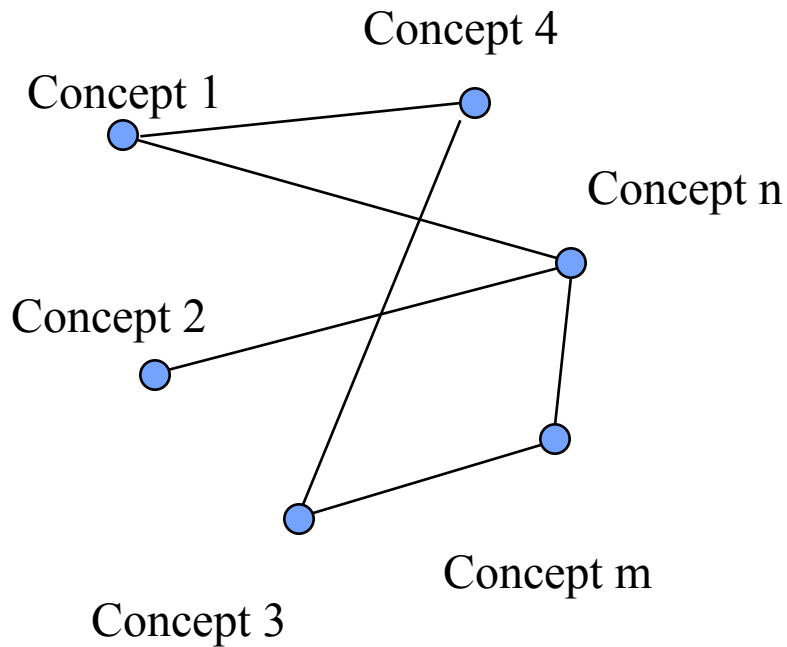
# Sections and concepts

Textbook

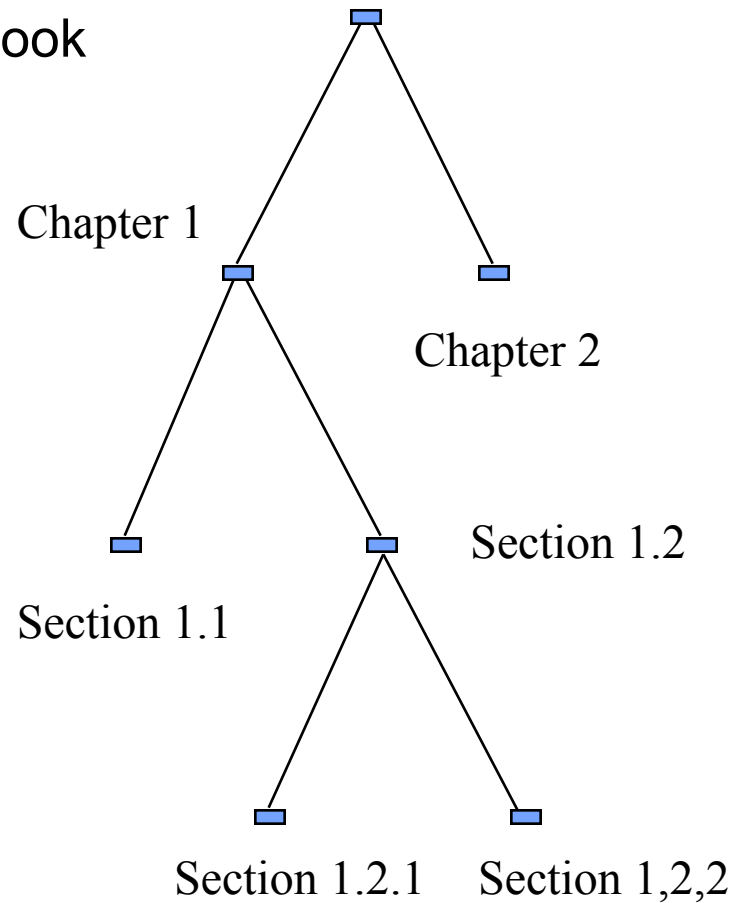


# Sections and concepts

Domain model

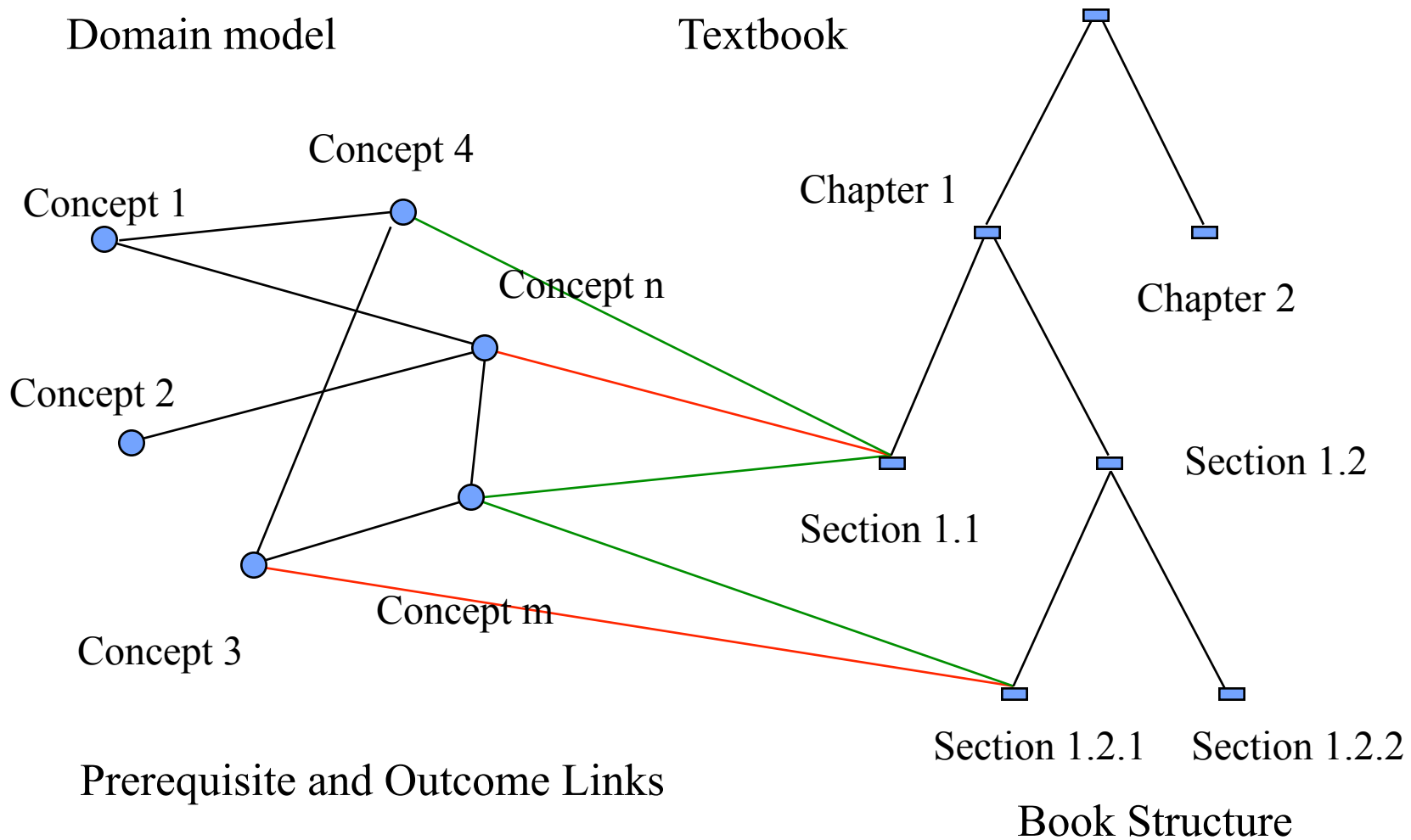


Textbook





# Indexing and navigation



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](#)

- Content
- Glossary
- Help
- Search
- Hint

### [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.

Background:

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

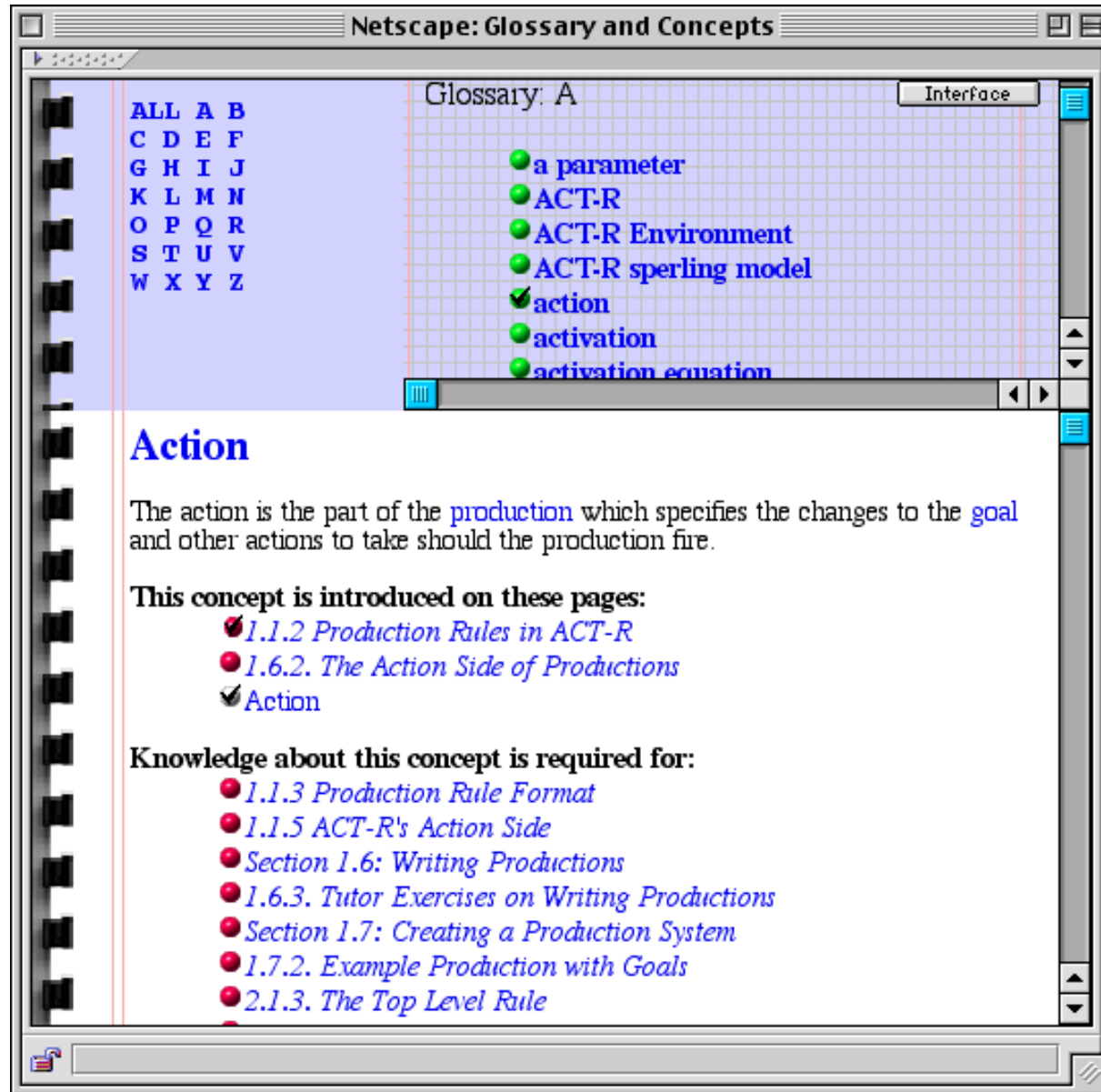
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Outcome:

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

Continue Teach me

# Glossary view



The screenshot shows a Netscape browser window titled "Netscape: Glossary and Concepts". The address bar is empty. The main content area is divided into two sections. The top section, titled "Glossary: A", contains a list of terms with green circular icons next to them: "a parameter", "ACT-R", "ACT-R Environment", "ACT-R sperling model", "action" (with a checked checkbox), "activation", and "activation equation". To the left of this list is a vertical navigation menu with letters from "ALL" to "Z". The bottom section, titled "Action", contains a definition: "The action is the part of the production which specifies the changes to the goal and other actions to take should the production fire." Below the definition are two sections: "This concept is introduced on these pages:" and "Knowledge about this concept is required for:". The first section lists three items, with the third, "Action", having a checked checkbox. The second section lists seven items, each with a red circular icon.

Netscape: Glossary and Concepts

Glossary: A

Interface

ALL A B  
C D E F  
G H I J  
K L M N  
O P Q R  
S T U V  
W X Y Z

- a parameter
- ACT-R
- ACT-R Environment
- ACT-R sperling model
- action
- activation
- activation equation

## Action

The action is the part of the [production](#) which specifies the changes to the [goal](#) and other actions to take should the production fire.

**This concept is introduced on these pages:**

- [1.1.2 Production Rules in ACT-R](#)
- [1.6.2. The Action Side of Productions](#)
- [Action](#)

**Knowledge about this concept is required for:**

- [1.1.3 Production Rule Format](#)
- [1.1.5 ACT-R's Action Side](#)
- [Section 1.6: Writing Productions](#)
- [1.6.3. Tutor Exercises on Writing Productions](#)
- [Section 1.7: Creating a Production System](#)
- [1.7.2. Example Production with Goals](#)
- [2.1.3. The Top Level Rule](#)

# Navigation in InterBook

- Regular navigation
  - Linear (Continue/Back)
  - Tree navigation (Ancestors/Brothers)
  - Table of contents
- Concept-based navigation
  - Glossary (concept -> section)
  - Concept bar (section -> concept)
  - Hypertext links (section -> concept)

# Adaptive navigation support

- Adaptive annotations
  - Links to sections
  - Links to concepts
  - Pages
- Adaptive sorting
  - Background help
- Direct guidance (course sequencing)
  - Teach Me

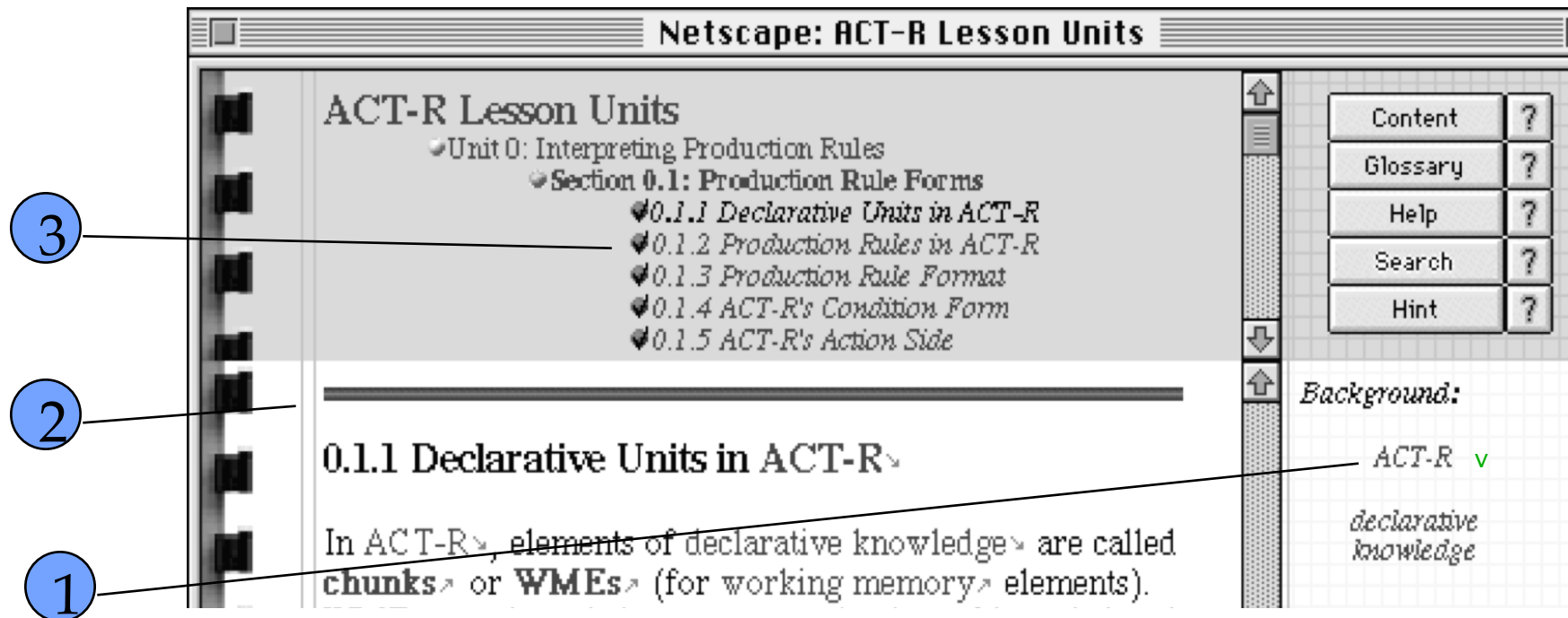
# User modeling

- Overlay student model for domain concepts
- Knowledge states for each concept
  - unknown (never seen)
  - known (visited some page)
  - learned (passed a test)
- Information for sections
  - visited/not visited
  - time spent
- Information for tests: last answers

# Adaptive annotation

- Educational status for concept
  - unknown
  - ✓ known
  - ✓ learned
- Educational status for sections
  - not ready to be learned
  - ready to be learned
  - suggested

# 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)



# Backward learning: “help” and “teach this”

The screenshot shows a Netscape browser window titled "Netscape: ACT-R Lesson Units". The main content area has a light blue header with the text "ACT-R Lesson Units" and a tree view of the lesson structure:

- Unit 2: Knowledge Representation in ACT-R
  - Section 2.2: Designing Chunk Types
    - 2.2.1 Goals as Sources of Chunk Types
    - 2.2.2 Paper Exercises on Chunk Types
    - 2.2.3 Answer to Chunk Type Exercise

Below the header, there is a "Back" button and a "Teach this Page" button. A red horizontal line is drawn across the page, passing through the "Teach this Page" button.

On the right side of the page, there is a vertical menu with buttons for "Content", "Glossary", "Help", "Search", and "Interface". Below this menu, there is a "Background:" section with a list of terms: "chunk type", "goal", "initial goal", "ISA slot", and "slot". Below that is an "Outcome:" section with a list of terms: "chunk creation", "Designing Chunk Types" (with a green checkmark), "goal", and "chunk".

An overlapping help window titled "Netscape: Help on '2.2.1 Goals as Sources of Chunk Types'" is open in the foreground. It contains the following text:

These pages could help you understanding '2.2.1 Goals as Sources of Chunk Types':

- 1.1.4 ACT-R's Condition Form
- Goal
- 1.5.2. Creating Declarative Chunks
- ISA
- 1.1.1 Declarative Units in ACT-R
- Section 1.7: Creating a Production System
- 1.6.1. Condition Form
- Chunk type
- Slot
- Defining Chunk Types
- 1.3.1 The Initialize-Addition Production

The help window also shows a list of related pages, including "the following addition fact", "which was perhaps solved by a repeated", "s a set of arguments (ARG1 and ARG2)", "ng of objects from the environment.", "f a line of symbols into a left and right", "t and right hand side would be the result.", and "be".

# ELM-ART: Lisp ITS on WWW

- Model: adaptive electronic textbook
  - hierarchical textbook
  - tests
  - examples
  - problems
  - programming laboratory
- Navigation Support
  - Uses both progress-based and prerequisite-based navigation support

# ELM-ART: Navigation Support

The screenshot shows a Netscape browser window titled "Netscape: ELM-ART: Lisp-Course". The interface features a dark blue header with a navigation toolbar containing icons for elm, TUTOR, HELP, MODEL, BACK, NEXT, Prefs, CONTENT, SEARCH, EVAL, and EXERCISE. Below the toolbar, a tree view on the left shows the course structure: "LISP Course" > "Lesson 1" > "Datatypes". Under "Datatypes", several topics are listed with progress bars: "Atoms (exercises solved) ...", "S-Atom (exercises solved) ...", "Numbers (with exercises) ...", "Lists (exercises solved) ...", "Nested Lists (exercises solved) ...", "Empty List, NIL, and T (with exercises) ...", and "Tests on Data Types ...". A central light blue box contains the message: "All tasks in the last exercises were solved correctly. However, you should work at some more tasks." Below this, the "Exercises" section is titled in red. It contains two questions, each with radio buttons for "Yes" and "No" and a "HELP" button. The first question is "Is the character string a *number*?" with the example "-0,4e+4". The second question is "Is the character string a *number*?" with the example "1". A "submit" button is located at the bottom of the exercise section. On the right side of the page, there is a "Chat Room" icon, a "LISP Constructs" link, and a "Private Notes on this Page" section with a "store" button. The browser's status bar at the bottom indicates "Working at this page is not yet recommended."



## Learner Model:

Page	Link-Status	% learned	User Modification
<a href="#">Datatypes</a>	The system suggests to work at this section.		<input type="checkbox"/> already known (Modification will be inherited to all subordinated pages)
<a href="#">Atoms</a> (exercises solved)	You successfully worked at this page.	100 %	<input type="checkbox"/> already known
<a href="#">S-Atom</a> (with exercises)	The system assumes the content of this page is known to you already.	10 %	<input type="checkbox"/> already known
<a href="#">Numbers (with exercises)</a>	The system suggests to work at this page.	17 %	<input type="checkbox"/> already known
<a href="#">Lists</a> (exercises solved)	You successfully worked at this page.	100 %	<input type="checkbox"/> already known
<a href="#">Nested Lists</a> (exercises solved)	You successfully worked at this page.	100 %	<input type="checkbox"/> already known
<a href="#">Empty List, NIL, and T (with exercises)</a>	The system suggests to work at this page.	0 %	<input type="checkbox"/> already known
<a href="#">Tests on Data Types</a>	Working at this page is not yet recommended.	0 %	<input type="checkbox"/> already known

Change Model

[Back to current page \(Datatypes\)](#)



# Effects of Prerequisite ANS

- Reduces navigation efforts
- Reduces repetitive visits to presentation and problem pages
- Educational goal achieved faster
- Increases learning outcome
- Adaptive annotation encourage non-sequential navigation
- Make system more attractive for students

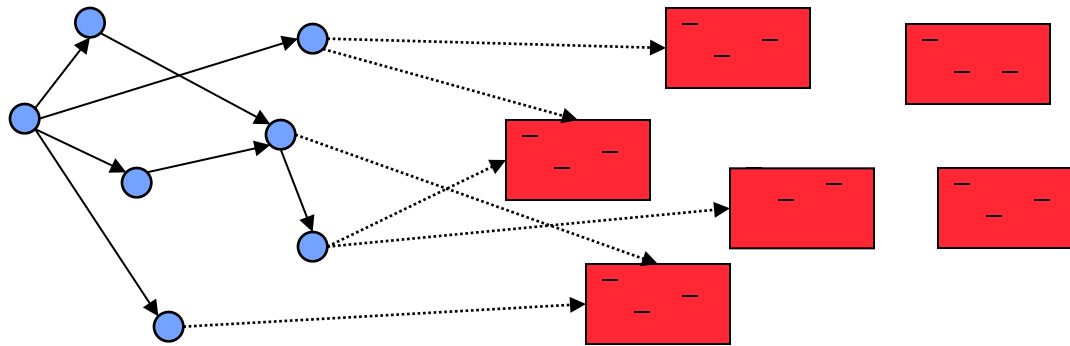
# Where is the Magic?

- No magic: Knowledge behind material
- Knowledge about domain (subject)
- Knowledge about documents
  - Simple concept indexing
- Knowledge about students
  - Learning goal model
  - Overlay student model
- Straightforward techniques of user modeling and adaptation

# Adaptive Hypertext: The Secret

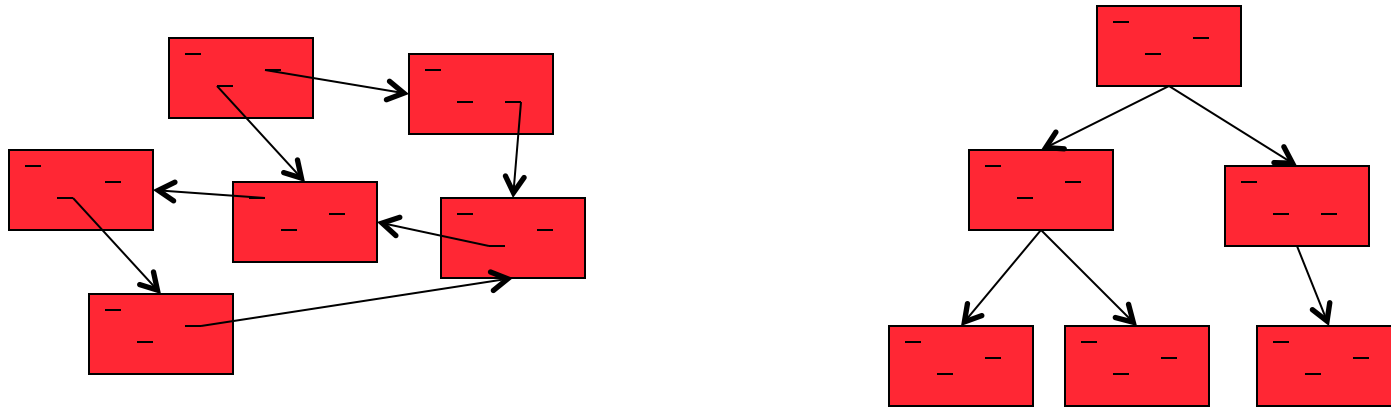
Domain Model

Pool of Learning Items



- Adaptive hypertext has knowledge “behind” the pages
- A network of pages like a regular hypertext plus a network of concepts connected to pages

# Hyperspace structuring



- Concept-based hyperspace
- No imposed structure
- Hierarchy
- ASK approach - conversational relationships



# Progress-Based Mechanism

- The idea of the mechanism to express the progress of user knowledge/experience
  - With domain concepts
  - With content pages
- Possible interfaces
  - Removing links to well-known concepts (AHA)
  - Annotating links to concepts and pages (InterBook, Inspire, QuizGuide, NavEx)

# Progress-Based Hiding

- Adaptive course on Hypertext (De Bra)
- Hiding “not ready” links
- Hiding obsolete links to support content
- Small-scale evaluation
- No significant differences
- Students are not comfortable with disappearing links

# Progress-Based Annotation

The screenshot shows a web browser window titled "INSPIRE - Βασικές Λειτουργίες - Microsoft Internet Explorer". The browser's address bar and menu bar are visible. The website's header features the "INSPIRE" logo and several navigation icons with labels: Γλωσσάρι, Σημειώσεις, Αποηρημένα, E-mail, Βοήθεια, Μοντέλο, and Μάθημα. The main content area is titled "Βασικές Λειτουργίες Κρυφής Μήμης" (Basic Functions of the Hidden Message). On the left, there is a sidebar with a search icon and the text "Κρυφή Μήμη". Below this, there are two layers of content: "Layer 1" containing "Οργάνωση Κρυφής Μήμης" and "Τεχνικές Αντιστοίχησης", and "Layer 2" containing "Βασικές Λειτουργίες". Under "Βασικές Λειτουργίες", there is a list of sub-topics: Εισαγωγή, Ασκήσεις Αξιολόγησης, Μεταφορές Δεδομένων, Ασκήσεις Αξιολόγησης, Κέντρος μηδός, and Ανακεφαλαίωση. Below this list are icons for "Τοποθέτηση", "Εντοπισμός", "Ανακατάσταση", and "Εγγραφή στην Κρυφή Μήμη". The main content area starts with a "Επόμενη" link. The title "Βασικές Λειτουργίες Κρυφής Μήμης" is followed by a section titled "Εκκοός" (Ecclesiastes) with a paragraph of text. Below this is a section titled "Όταν θα έχετε μελετήσει τις βασικές λειτουργίες της κρυφής μήμης, θα μπορείτε να:" followed by a list of five bullet points. The next section is "Προσπαιτούμενες Έννοιες" (Concepts to be taught) with a link "Οργάνωση κύριας μήμης". The final section is "Σχετικές Έννοιες" (Related concepts) with a link "Επεξεργαστής, Λέξη, Kbyte, Byte, Αλγόριθμος, Διευθυνοδοτημένη Μήμη, Κύρια Μήμη". At the bottom, there are links for "Επιστροφή στην Αρχή" and "Επόμενη".

INSPIRE

Γλωσσάρι Σημειώσεις Αποηρημένα E-mail Βοήθεια Μοντέλο Μάθημα

Κρυφή Μήμη

Επόμενη

Layer 1

Οργάνωση Κρυφής Μήμης

Τεχνικές Αντιστοίχησης

Layer 2

Βασικές Λειτουργίες

Εισαγωγή

Ασκήσεις Αξιολόγησης

Μεταφορές Δεδομένων

Ασκήσεις Αξιολόγησης

Κέντρος μηδός

Ανακεφαλαίωση

Τοποθέτηση

Εντοπισμός

Ανακατάσταση

Εγγραφή στην Κρυφή Μήμη

Βασικές Λειτουργίες Κρυφής Μήμης

Εκκοός

Θα αναφερθούμε στο ρόλο της κρυφής μήμης 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 μήμης και θα περιγράψουμε τη σχέση που έχουν με τη λειτουργία ανάγνωσης ή εγγραφής του επεξεργαστή.

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

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

Προσπαιτούμενες Έννοιες

[Οργάνωση κύριας μήμης](#)

Σχετικές Έννοιες

[Επεξεργαστής](#), [Λέξη](#), [Kbyte](#), [Byte](#), [Αλγόριθμος](#), [Διευθυνοδοτημένη Μήμη](#), [Κύρια Μήμη](#)

Επιστροφή στην Αρχή

Επόμενη

# What Size of “concept”?

- How much domain knowledge should a concept cover?
- Two practical approaches
- Topic-based student modeling
  - Large topics, one per ULM/page
- Concept-based student modeling
  - Small concepts, many per ULM/page

# Topic-based Student Modeling

- Benefits
  - Easier for students and teachers to grasp
  - Easier for teachers to index content
  - Clear interface for presentation of progress
- Shortcomings
  - The user model is too coarse-grained
  - Precision of user modeling is low

# Topic-Based ANS: QuizGuide

The screenshot shows a web browser window titled "QuizGuide. Adaptive quiz recommender." with the URL `http://www.sis.pitt.edu/~ir/qplus/bin/qguide.cgi?group=1&kt_sid=824&kt_user=`. The browser's address bar includes a search engine icon and the text "Google". Below the address bar is a navigation bar with various links: Apple, Amazon, Cyberspace Atlas, citeseer, NRHM04, eBay, Yahoo!, News, 0012-42, Blackboard, KT, and ELENA. The main content area features a large blue "Quiz Guide" title with a question mark icon to its left. A vertical sidebar on the left lists various programming topics, each with a target icon: arithmetic expressions, variables, constants (define), loops (while), increment decrement, compound assignments, logical expressions, loops (do while), conditionals (if else) (with sub-items Quiz1 and Quiz2), conditional operator, character processing, and logical operators (with a red 'X' over the icon). The main content area displays "Question 1" with a code block:

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

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

Below the code, the text "What is the final value of i" is followed by an input field containing "i =". A "Submit" button is located below the input field.







# QuizGuide: Topic-level Adaptive Annotations

- Target-arrow abstraction:
  - Number of arrows – level of knowledge for the specific topic (from 0 to 3). *Individual, event-based adaptation.*



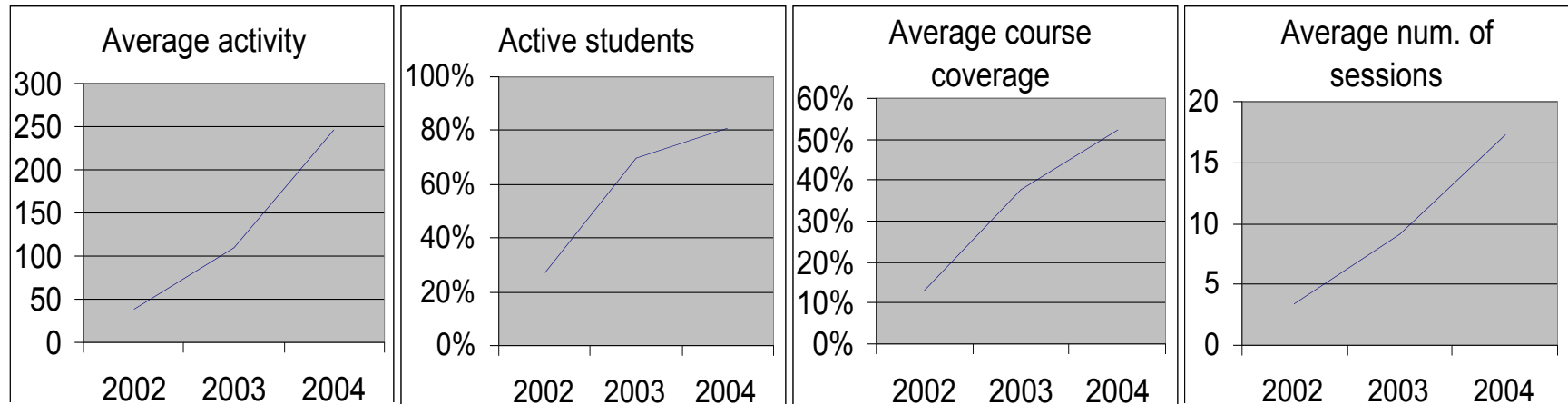
- Color Intensity – learning goal (current, prerequisite for current, not-relevant, not-ready). *Group, time-based adaptation.*



	loops (while) Quiz1 Quiz2
	increment decrement
	compound assignments Quiz1
	logical expressions Quiz1
	<b>loops (do while)</b> Quiz1 <b>Quiz2</b>
	conditionals (if else)

# QuizGuide: Influence on Motivation

- Adaptive navigation support increased student's activity and persistence of using the system

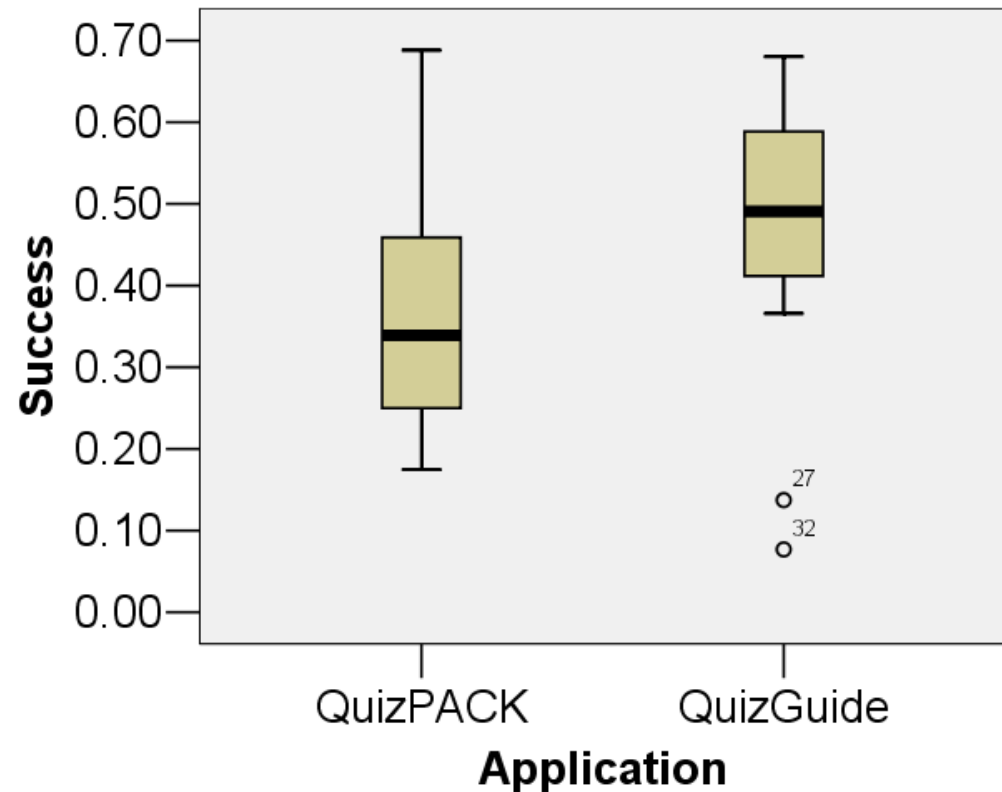


- Within the same class QuizGuide sessions were much longer than QuizPACK sessions: 24 vs. 14 question attempts at average.
- Average Knowledge Gain for the class rose from 5.1 to 6.5

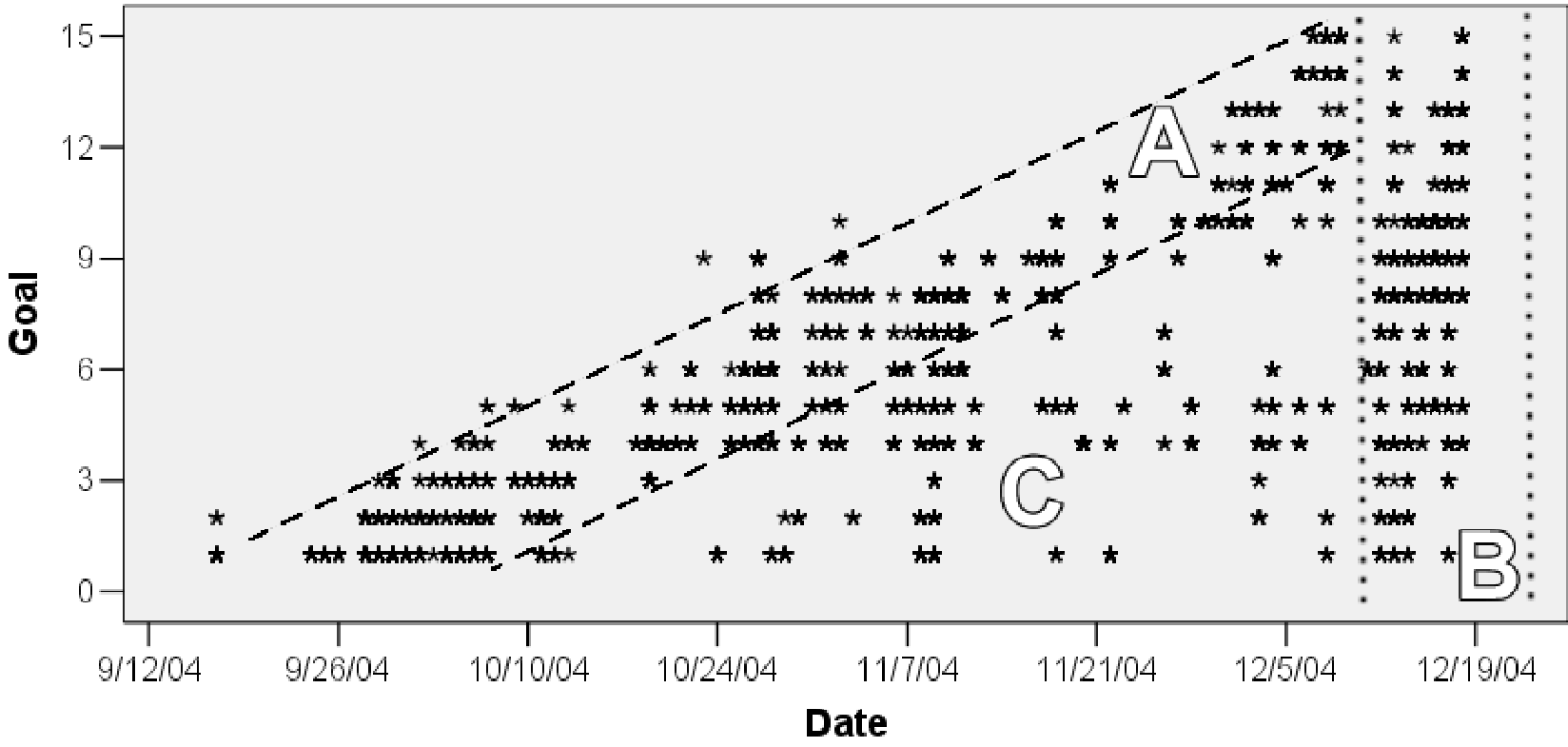


# QuizGuide: Success Rate Increase

- One-way ANOVA shows that mean success value for QuizGuide with ANS is significantly larger than:  
 $F(1, 43) = 5.07$   
(p-value = 0.03).



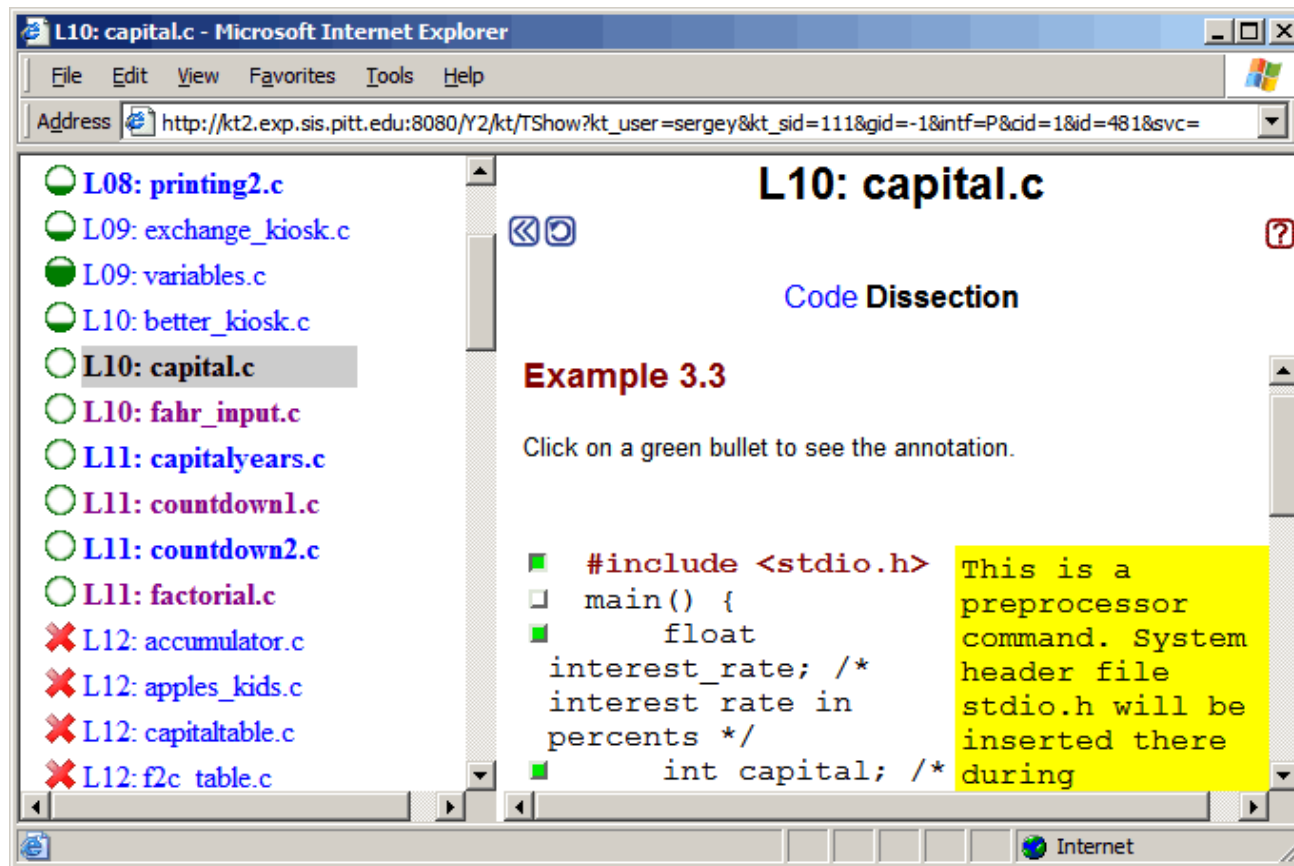
# A Deeper Look



# Concept-based Student Modeling

- Benefits
  - The user model is fine-grained
  - Precision of user modeling is good
- Shortcomings
  - Harder for students and teachers to grasp
  - Harder for teachers to index content
  - Presentation of progress is harder to integrate into the system interface

# Concept-Based ANS: NavEx

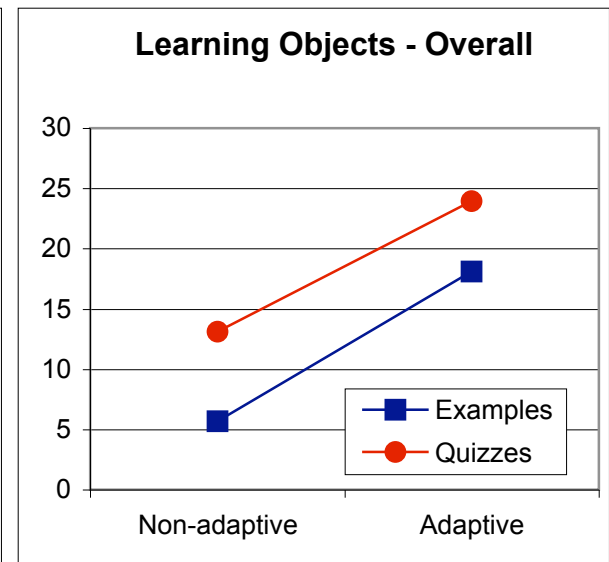
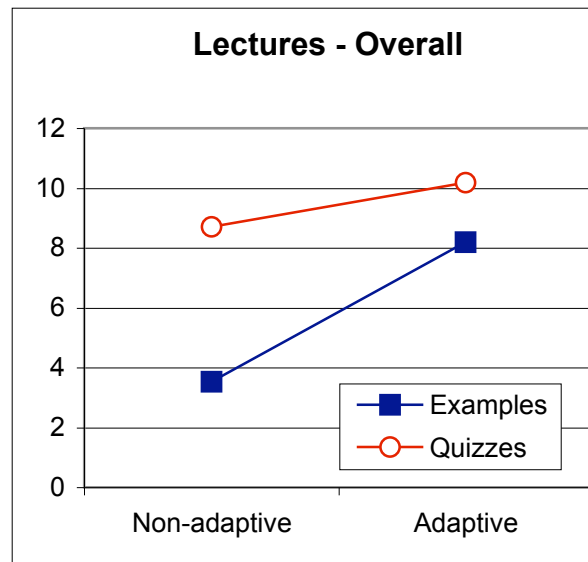
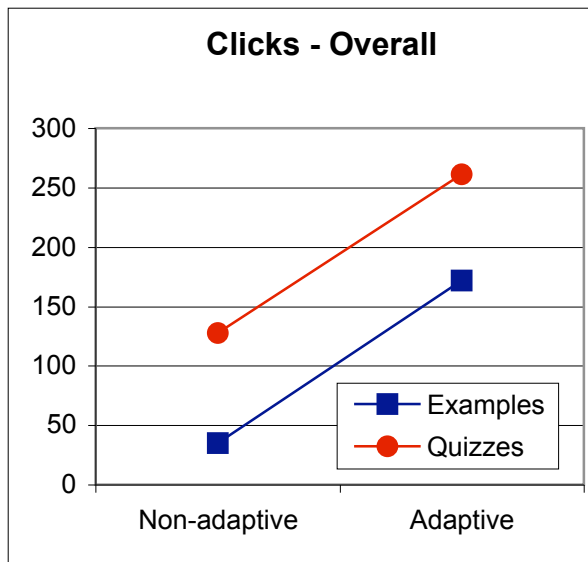


# Indexing Examples in NavEx

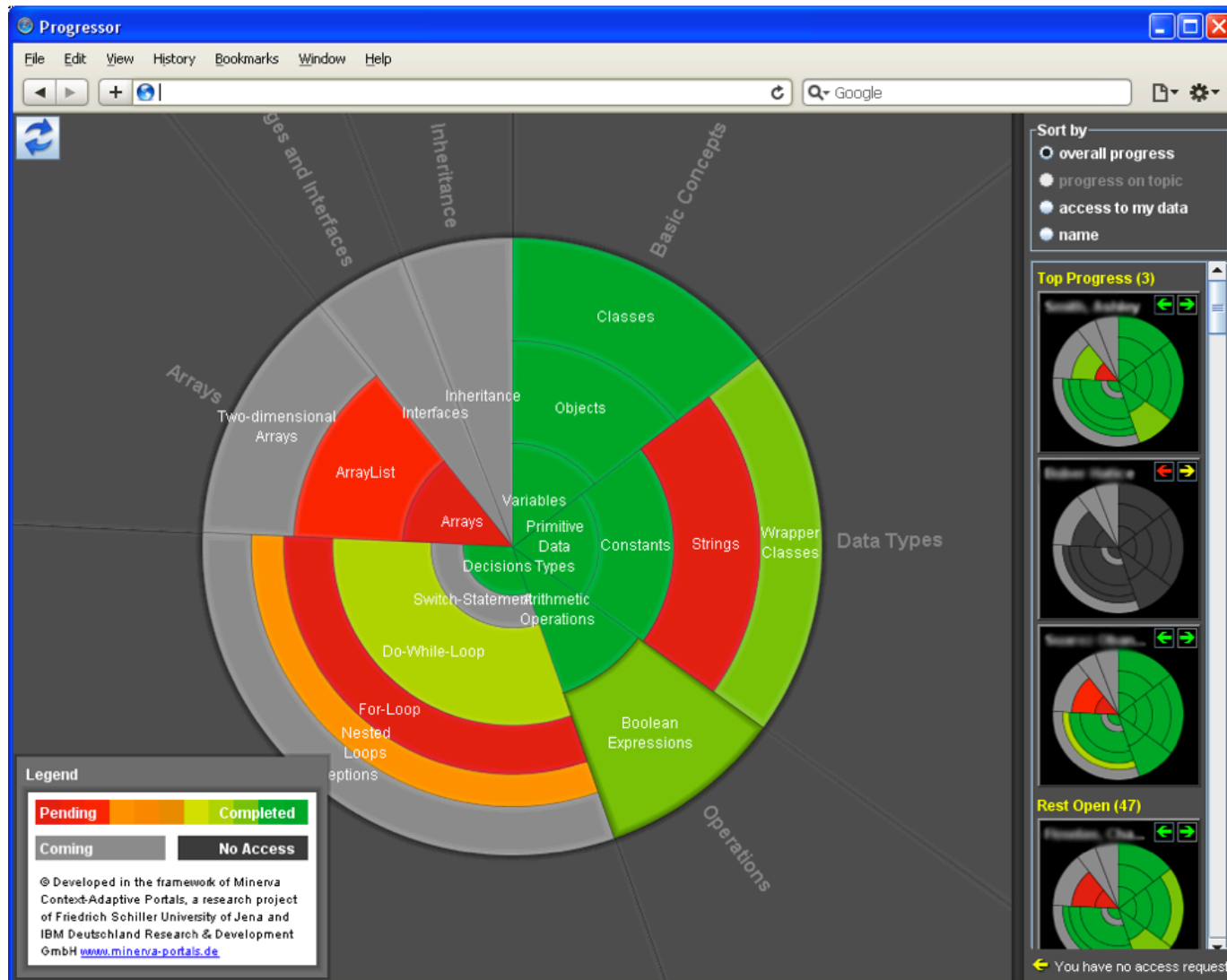
- Concepts derived from language constructs
  - C-code parser (based on UNIX lex & yacc)
  - 51 concepts totally (include, void, main\_func, decl\_var, etc)
- Ask teacher to assign examples to lectures
  - Use a subsetting approach to divide extracted concepts into prerequisite and outcome concepts

# Increased Motivation

- The increase of the amount of work for the course



# Next Step? Social Progress-based ANS in Progressor



# ANS vs Recommendations

- Relevance-based ANS vs. recommendations
  - Same engine, different interface
  - In-context guidance vs. ranked list
- More sophisticated ANS vs. recommendations
  - ANS can display simultaneously *several* aspects of importance/interest/relevance
  - Ranking used in recommendation approaches can only display only one dimension