From Adaptive Educational Hypermedia to Adaptive Information Access

Peter Brusilovsky
School of Information Sciences
University of Pittsburgh, USA
From Generation to Generation

UM → HT → ITS
WWW → 1G AEH
WBE → 2G AEH

1G AEH

Classic Adaptive Educational Hypermedia

2G AEH

Web-based Adaptive Educational Hypermedia

3G AEH

“Real World” Adaptive Educational Hypermedia
Personal View

- ELM-PE Ex, Trier (1994-1995)
- COCOA, CTE (1999-2000)
- WebEx Pitt (2000-2006)
- NavEx and QuizGuide (2004-2009)
- Knowledge Sea Pitt (2002-2008)
- ITEM/IP, MSU (1986-1994)
- InterBook, CMU (1996-1998)
- QuizPack Pitt (2002-2006)
- Adapt2 Pitt (2002-2008)
- CourseAgent Pitt (2003-2009)
- PittCult, ConfNavigator Pitt (2006-2009)
Adaptive systems

Classic loop “user modeling - adaptation” in adaptive systems
Generation 0

UM  →  WWW  →  WBE  →  3G AEH
HT  →  1G AEH
ITS  →  2G AEH

Classic Adaptive Educational Hypermedia
Web-based Adaptive Educational Hypermedia
“Real World” Adaptive Educational Hypermedia
Personal View: Generation 0

ITEM/IP, MSU (1986-1994)

- InterBook, CMU (1996-1998)
- COCOA, CTE (1999-2000)

- TALER Lab projects (2000-2004)

TALER Lab, University of Pittsburgh
ITEM/IP

- ILE for Introductory Programming
- Integrated system
  - Tutorial (presentation of optimal sequence of explanations, examples and problems)
  - Environment (playing with examples, design and debug problem solutions)
  - Manual (a manual for reference-style access to studied information, examples, solved problems)
Knowledge and learning material

Concepts

Concept 1
Concept 2
Concept 3
Concept 4
Concept N

Examples

Example 1
Example 2
Example M

Problems

Problem 1
Problem 2
Problem K
Weighted overlay model

Concept 1
Concept 2
Concept 3
Concept 4
Concept N
Concept 5

10
7
4
3
0
2
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

If switch is known and user_motivation is high

Fragment 1

Fragment 2

Fragment K
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

UM

HT

ITS

WWW

1G AEH

Classic Adaptive Educational Hypermedia

WBE

2G AEH

Web-based Adaptive Educational Hypermedia

3G AEH

“Real World” Adaptive Educational Hypermedia

TALER Lab, University of Pittsburgh
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)
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

ITEM/IP, MSU (1986-1994)

ISIS-Tutor, MSU (1992-1994)

ELM-ART, Trier (1994-1997)

InterBook, CMU (1996-1998)

ADAPTS, CMU (1998-1999)
COCOA, CTE (1999-2000)

TALER Lab, University of Pittsburgh
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 ‘+’)

TALER Lab, University of Pittsburgh
### Sample index page (annotation)

<table>
<thead>
<tr>
<th>Доступные темы</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 1 Общий вид формата</td>
<td>+ 2 Арифметические выражения</td>
</tr>
<tr>
<td>3 Удаление пустых строк</td>
<td>4 Безусловный переход на новую строку</td>
</tr>
<tr>
<td>+ 5 Переход на новую строку</td>
<td>6 Выбор позиции в строке</td>
</tr>
<tr>
<td>7 Печать пробелов</td>
<td>+ 8 Вывод поля</td>
</tr>
<tr>
<td>9 Понятие MFN</td>
<td>10 Безусловный литерал</td>
</tr>
<tr>
<td>11 Арифметическая функция L</td>
<td>12 Арифметическая функция Mn</td>
</tr>
<tr>
<td>13 Арифметическая функция Val</td>
<td>14 Арифметическая функция Rsum</td>
</tr>
<tr>
<td>15 Арифметическая функция Rmin</td>
<td>16 Арифметическая функция Rmax</td>
</tr>
<tr>
<td>17 Арифметическая функция Ravr</td>
<td>18 Совмещение % и #</td>
</tr>
<tr>
<td>19 Совмещение / и #</td>
<td>20 Условный литерал</td>
</tr>
<tr>
<td>21 Повторяющийся литерал</td>
<td>22 Вывод MFN</td>
</tr>
<tr>
<td>23 Строковые выражения</td>
<td>24 Префиксный условный литерал</td>
</tr>
<tr>
<td>25 Суффиксные литералы</td>
<td>26 Нуль-литерал</td>
</tr>
<tr>
<td>27 Повторяющийся литерал c +</td>
<td>28 Префиксный повторяющийся литерал</td>
</tr>
<tr>
<td>29 Установка режима вывода</td>
<td>30 Совмещение условных литералов и %</td>
</tr>
<tr>
<td>31 Совмещение условных литералов с #</td>
<td>32 Совмещение условных литералов с /</td>
</tr>
<tr>
<td>33 Совмещение условных литералов с С</td>
<td>34 Совмещение условных литералов с X</td>
</tr>
<tr>
<td>35 Совмещение условных литералов с M</td>
<td>36 Режимы L,U в команде M.</td>
</tr>
<tr>
<td>37 Режим H в команде M</td>
<td>38 Режим D в команде M</td>
</tr>
<tr>
<td>39 Режим P в команде M</td>
<td>40 Строковая функция F</td>
</tr>
<tr>
<td>41 Строковая функция Ref</td>
<td>42 Строковая функция S</td>
</tr>
<tr>
<td>43 Программы пользователя format</td>
<td>44 Выражения отношения</td>
</tr>
</tbody>
</table>

**Enter - изучить**  **F4-практ**  **F6-учи**  **F8-инд.в задача**  **F9-назад**  **PgDn-след.стр.**

**+ Хорошо изучен**  **Изучен**  **Можно изучать**  ** Не готов**
Sample index page (annotation and hiding)

<table>
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<td>27 Повторяющийся литерал с +</td>
<td>28 Префиксный повторяющийся литерал</td>
</tr>
<tr>
<td>29 Установка режима вывода</td>
<td>52 Размещение первой строки поля</td>
</tr>
<tr>
<td>53 Выбор длины фрагмента поля</td>
<td>54 Выбор смещения фрагмента поля</td>
</tr>
<tr>
<td>55 Вывод подполя</td>
<td>56 Повторяющиеся группы</td>
</tr>
</tbody>
</table>

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

- γπAdaptερ (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

- UM
- HT
- ITS

1G AEH

- WWW
- WBE

2G AEH

- Classic Adaptive Educational Hypermedia
- Web-based Adaptive Educational Hypermedia
- “Real World” Adaptive Educational Hypermedia

3G AEH
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

ITEM/IP, MSU (1986-1994)

ISIS-Tutor, MSU (1992-1994)

ELM-ART, Trier (1994-1997)

InterBook, CMU (1996-1998)

COCOA, CTE (1999-2000)
TALER Lab projects (2000-2004)

TALER Lab, University of Pittsburgh
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
Adaptive Diagnostics

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)
15
(RECTANGLE-AREA 4 2)
8
(RECTANGLE-AREA 6 10)
0

Type in your solution here:

(define RectArea
  (lambda (a b)
    (* a b)))

[Code for testing and diagnosis]
ELM-ART: Evaluation Results

- 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

- “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
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.
Glossary view

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
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)
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 $d_1$ and $d_2$ in a column and $d_1 + d_2 = d_3$
THEN set as a subgoal to write $d_3$ 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.
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

- 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)

Hypermedia structures and systems

author: Prof. dr. P.M.E. De Bra

Welcome to the hypermedia course at the Eindhoven University of Technology. This course contains the following, (not necessarily disjoint) parts:

- Introduction (it is advised to read this before the other items)
- Definition of hypertext and hypermedia
- The history of hypertext and hypermedia

You are advised to first study the three above sections. You are not yet prepared to study the more advanced topics described in the sections below.

- The architecture of hypertext systems
- Navigation (and browsing semantics) in hypertext
- Information Retrieval using hypertext
- Writing (or authoring) hypertext
- Distribution and Concurrency issues
- The Future of Hypertext and Hypermedia
- Assignment for this course. This item only becomes available when you have finished the other sections.

When desired you can always review the instructions for this course.

All rights reserved.
INSPIRE (Grigoriadou, Papanikolaou, Kornilakis, Magoulas)
Generation 3

- UM
- HT
- ITS
- WWW
- 1G AEH
- 2G AEH
- 3G AEH

Classic Adaptive Educational Hypermedia
Web-based Adaptive Educational Hypermedia
“Real World” Adaptive Educational Hypermedia
Practical E-Learning

- 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

ITEM/IP, MSU (1986-1994)


ELM-ART, Trier (1995-1997)

InterBook, CMU (1996-1998)

QuizPack Pitt (2002-2006)

Adapt2 Pitt (2002-2008)

Knowledge Sea Pitt (2002-2008)

CourseAgent Pitt (2003-2009)

PittCult, ConfNavigator Pitt (2006-2009)

TALER Lab, University of Pittsburgh
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
• 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
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

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
Question:

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

Task:
Show all the information contained in table "store".

Enter your answer here.

Table Name: Schema & Sample Data (click +/- to show/hide sample data)

<table>
<thead>
<tr>
<th>actor</th>
<th>actor_id</th>
<th>first_name</th>
<th>last_name</th>
<th>last_update</th>
</tr>
</thead>
<tbody>
<tr>
<td>PELOPE</td>
<td>1</td>
<td>PENELope</td>
<td>GUINNESS</td>
<td>2006-02-15 04:34:33.0</td>
</tr>
<tr>
<td>NICK</td>
<td>2</td>
<td>WAHLBERG</td>
<td></td>
<td>2006-02-15 04:34:33.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>address</th>
<th>address_id</th>
<th>address</th>
<th>address2</th>
<th>district</th>
<th>city_id</th>
<th>postal_code</th>
<th>phone</th>
<th>last_update</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>category</th>
<th>category_id</th>
<th>name</th>
<th>last_update</th>
</tr>
</thead>
</table>

Submit Answer

Go to SQL-Lab
Proactive: Metadata for ANS

Recommendation and navigation support based on available metadata indexing
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???
Conference Navigator

Considers user visits, scheduling, annotation
### Top Ten Annotated Papers

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adaptive Navigation Support</td>
<td>Jul 30 200</td>
<td>9</td>
</tr>
<tr>
<td>2. Towards Computerized Ad</td>
<td>Aug 1 2001</td>
<td>5</td>
</tr>
<tr>
<td>3. Adaptive Link Annotation</td>
<td>Aug 1 2001</td>
<td>3</td>
</tr>
<tr>
<td>4. Altruism, Selfishness, and</td>
<td>Jul 31 200</td>
<td>3</td>
</tr>
<tr>
<td>5. (Web Search)shared - a So</td>
<td>Jul 30 200</td>
<td>3</td>
</tr>
<tr>
<td>6. An Evidence-Based Appro</td>
<td>Jul 31 200</td>
<td>3</td>
</tr>
<tr>
<td>7. SemWeb: A Semantic Web</td>
<td>Jul 31 200</td>
<td>1</td>
</tr>
<tr>
<td>8. A Rule-Based Recommenc</td>
<td>Jul 31 200</td>
<td>1</td>
</tr>
<tr>
<td>9. A Scratchable User Modelling</td>
<td>Jul 31 200</td>
<td>1</td>
</tr>
<tr>
<td>10. Modelling Semantic Relati</td>
<td>Jul 30 200</td>
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</tbody>
</table>

### Top Ten Visited Papers

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<tr>
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<tbody>
<tr>
<td>1. Adaptive Navigation Support</td>
<td>Jul 30 200</td>
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<td>2. Towards Computerized Ad</td>
<td>Aug 1 2001</td>
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<td>3. Adaptive Link Annotation</td>
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<td>4. Altruism, Selfishness, and</td>
<td>Jul 31 200</td>
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<td>5. An Evidence-Based Appro</td>
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<td>6. LS-Plan: An Effective Com</td>
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<td>7. SemWeb: A Semantic Web</td>
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<td>8. A Scratchable User Modelling</td>
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<td>9. A Rule-Based Recommenc</td>
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<td>10. Adaptation of Elaborated f</td>
<td>Jul 31 200</td>
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### Tag Cloud

- adaptable
- adaptive
- adaptive-hypermedia
- adaptive-navigation
- support
- adaptive-web
- assessment
- e-learning
- interoperability
- jon-dron
- judith
- keynote
- mashoff
- open-corpus
- peter-brusilovsky
- portals
- recommender
- social-navigation
- social-search
- social-web
- structured
- systems
- tagging
- task
- web

### Contributors

#### Top Ten Active Communities

<table>
<thead>
<tr>
<th>Community</th>
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<tr>
<td>Social Web</td>
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<td>Adaptive Web</td>
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<td>User Modelling</td>
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<td>Personalized Web</td>
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CourseAgent

CourseAgent: Adaptive Online Course Recommendation System

Schedule of spring 2006

<table>
<thead>
<tr>
<th>CRN</th>
<th>Course No</th>
<th>Title</th>
<th>Day</th>
<th>Time</th>
<th>Location</th>
<th>Instructor</th>
<th>Degree of Relevance to Career Goals</th>
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<tr>
<td>2692</td>
<td>TELECOM 2240</td>
<td>PRACTICUM</td>
<td>Mon</td>
<td>6-8 PM</td>
<td>302 CL</td>
<td>Richard Thompson</td>
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<td>16048</td>
<td>INFS 1 2120</td>
<td>INFORMATION AND CODING THEORY</td>
<td>Tue</td>
<td>6-8 PM</td>
<td>411 IS</td>
<td>Paul Munro</td>
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<tr>
<td>16077</td>
<td>INFS 1 2120</td>
<td>DECISION ANALYSIS AND DECEPTION SUPPORT SYSTEMS</td>
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<td>6-8 PM</td>
<td>411 IS</td>
<td>Marc Druzdzel</td>
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<tr>
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<td>6-8 PM</td>
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<tr>
<td>16096</td>
<td>INFS 1 2470</td>
<td>INTERACTIVE SYSTEM DESIGN</td>
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<td>6-8 PM</td>
<td>409 IS</td>
<td>Peter Aulitzky</td>
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<td>16079</td>
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<td>INFORMATION SYSTEMS ANALYSIS</td>
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<td>6-8 PM</td>
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<td>Glenn Ray</td>
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<tr>
<td>16011</td>
<td>INFS 1 2610</td>
<td>DATA STRUCTURES</td>
<td>Thu</td>
<td>6-8 PM</td>
<td>501 IS</td>
<td>Roger Finn</td>
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<tr>
<td>16110</td>
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<td>ALGORITHM DESIGN</td>
<td>Tue</td>
<td>6-8 PM</td>
<td>409 IS</td>
<td>Hassan Karimi</td>
<td>Plan It</td>
</tr>
</tbody>
</table>

- **Planned to take (can be registered)**
- **Already taken (can be evaluated)**
- **Degree of relevance to students’ career goal**
  - Marginally relevant
  - Relevant
  - Very Relevant

Difficulty level of the course:
- Low
- Medium
- High
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
Personalized Information Access 2016

Adaptation Mechanisms

- Metadata-based mechanism
- Keyword-based mechanism
- Community-based mechanism

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Navigation

Adaptive Hypermedia

Search

Adaptive IR

Recommendation

Web Recommenders
Personalized Information Access 2016

- 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

☐ Read


☐ Explore

- Try our systems at PAWS Community portal: [http://www.sis.pitt.edu/~paws](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