



Athabasca University

FACULTY OF SCIENCE & TECHNOLOGY

School of Computing & Information Systems

Enhanced Learning and Teaching Support through Adaptive and Intelligent Systems

Dr. Sabine Graf
Associate Professor

<http://sgraf.athabascau.ca>
sabine.graf@athabascau.ca

Research Team:

Muhammad Anwar (PhD student)
Cecilia Ávila (PhD student)
Mohammad Belghis-Zadeh (RA)
Charles Jason Bernard (MSc student)
Edward da Cunha (MSc student)
Elinam Richmond Hini (MSc student & RA)
Darin Hobbs (MSc student & RA)
Hazra Imran (Postdoc)
Slobodan Jovicic (MSc student)
Jeff Kurcz (MSc student & RA)
Renan Henrique Lima (undergrad. student)
Paul Maguire (MSc student & RA)
Abiodun Ojo (MSc student)
Jeremie Seanosky (RA)
Júlia Marques Carvalho da Silva (Postdoc)
Richard Tortorella (PhD student)
Lanqin Zheng (Postdoc)

Adaptivity and Personalization in Learning Systems

How can we make learning systems more adaptive, intelligent and personalized



- In different settings such as desktop-based, mobile and ubiquitous settings
- Based on a rich student model that combines learner information and context information
- Supporting learners as well as teachers
- Using techniques from artificial intelligence, data mining, visualization, etc.
- Develop approaches, add-ons and mechanisms that extend existing learning systems

Research Topics

- **Adaptivity based on learning styles**
 - Automatic and dynamic identification of learning styles based on students' behaviour [Charles Jason Bernard]
 - Adaptive course provision based on learning styles [Collaboration with Leibniz University Hannover, Alberta Distance Learning Centre; Ting-Wen Chang, Jeff Kurcz]
 - Adaptive recommendations for teachers to make their courses better support students with different learning styles [Moushir El-Bishouty]

- Adaptivity based on cognitive abilities
 - Automatic and dynamic identification of cognitive abilities based on students' behaviour in an online course [Charles Jason Bernard]
 - Providing teachers with recommendations about how to consider students' cognitive abilities [Ting-Wen Chang]
 - Adaptive course provision based on students' cognitive abilities [Ting-Wen Chang, Jeff Kurcz]

Research Topics

- Adaptivity based on motivation [Paul Maguire]
 - Integrating techniques for motivating students in learning systems
 - Investigating effectiveness of motivational techniques for students with different characteristics, situations and contexts
 - Providing adaptive functionality for motivating students

- Adaptivity based on students' context
 - Identification of students' context through sensor technology [Dan Jovicic, Richard Tortorella]
 - Identification of device functionalities and their usage [Renan Lima, Moushir El-Bishouty]
 - Providing adaptivity based on students' context [Dan Jovicic, Richard Tortorella]

Research Topics

- Combining adaptivity based on students' context with adaptivity based on students' characteristics
 - Providing adaptivity based on learning styles and context information for mobile devices [Richard Tortorella]
 - Combine students' characteristics, context, and learning behaviour [Hazra Imran, Mohammad Belghis-Zadeh]
 - Providing adaptive recommendations based on pedagogical rules, student's history, and collaborative filtering [Hazra Imran, Mohammad Belghis-Zadeh]
 - Provide visualization of identified data

Research Topics

■ Learning Analytics

- Identification of at-risk students
 - What features are relevant for at-risk student identification and how to use them for at-risk identification [Darin Hobbs, Júlia Marques Carvalho da Silva]
 - Learning styles vs. course content support [Moushir El-Bishouty]
- Enhancing the Accessibility of Educational Log Data for Investigating Effective Course Design and Teaching Strategies [Jeremie Seanosky, Harza Imran]

Adaptive and Personalized Learning based on Students' Learning Styles

[Ting-Wen Chang, Jeff Kurcz]

Adaptive Course Provision based on Learning Styles

- Develop a mechanism that enables learning systems to automatically generate adaptive courses

- General goals:
 - Mechanism should be applicable for different learning systems
 - Mechanism should ask teachers for as little as possible additional effort

- Benefits:
 - Teachers can continue using their courses in existing learning systems
 - Students get personalized support with respect to their learning styles

Demo

Demo ...

Course: Introduction to Computing and Information Systems - Mozilla Firefox
http://adapt-dev.athabascau.ca/moodle19/course/view.php?id=5

Introduction to Computing and Information Systems

icore_moodle > COMP200

People
Participants

Activities
Assignments
Forums
Quizzes
Resources

Search Forums
Go
Advanced search

Administration
Turn editing on
Settings
Assign roles
Grades
Groups
Backup
Restore
Import
Reset
Reports
Questions
Files
Unenrol me from COMP200
Profile

Weekly outline

- News forum
- General Course Discussion
- Assignment 1
- Assignment 2
- Assignment 3

1 March - 7 March
Unit 1: Computer Basics

- Unit Commentary
- Section 1: Why Study Information Systems?
 - Commentary Area before content
 - Animation
 - Real-Life Application
 - Content Area after content
 - Self-Assessment Test
 - Exercise
 - Forum Activity
 - Example
 - Reflection Quiz
 - Additional Reading Material
 - Conclusion
 - Assignment
- Section 2: Information Processing Overview

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 - Conclusion

Adaptive and Personalized Learning based on Students' Working Memory Capacity

[Ting-Wen Chang, Jeff Kurcz]

Why Working Memory Capacity?

- There are several cognitive traits/abilities that are highly relevant for learning (e.g., working memory capacity, inductive reasoning ability, associate learning skills, information processing speed, etc.)
- Working memory capacity (WMC) is a very important trait for learning
- WMC enables humans to keep active a limited amount of information for a very brief period of time.
- Miller (1956) found that people can remember 7 ± 2 chunks of information.
- Learners with high WMC can remember almost double the amount of information than learners with low WMC

Automatic Recommendations based on Students' Cognitive Abilities

- However, typically learning systems do not consider this individual differences in WMC
- Research aim
 - Provide students with automatic recommendations to individually support their learning based on their WMC
- Adaptive mechanism
 - What recommendation shall the system show?
 - When shall the system provide a recommendation?
 - Which recommendation should be provided?
 - Do students follow recommendations?

What recommendations?

No.	Asking the student to
R1	take notes when he/she learns a learning object
R2	request help if he/she have any question by posting or asking teachers about this learning object
R3	post the ideas , thought, or reflection about what he/she learnt in this learning object
R4	summarize what he/she learnt about this learning object
R5	rehearsal by revisiting the content of this learning object
R6	use concept/mind maps to easier remember content of this learning object

When to show a recommendation?

- Show recommendation either before or after a learning object has been viewed
- Two methods for deciding on when to show a recommendation
 - Time-based (how much time has a student spent on a learning object)
 - Probability-based (based on students' WMC)

When to show a recommendation?

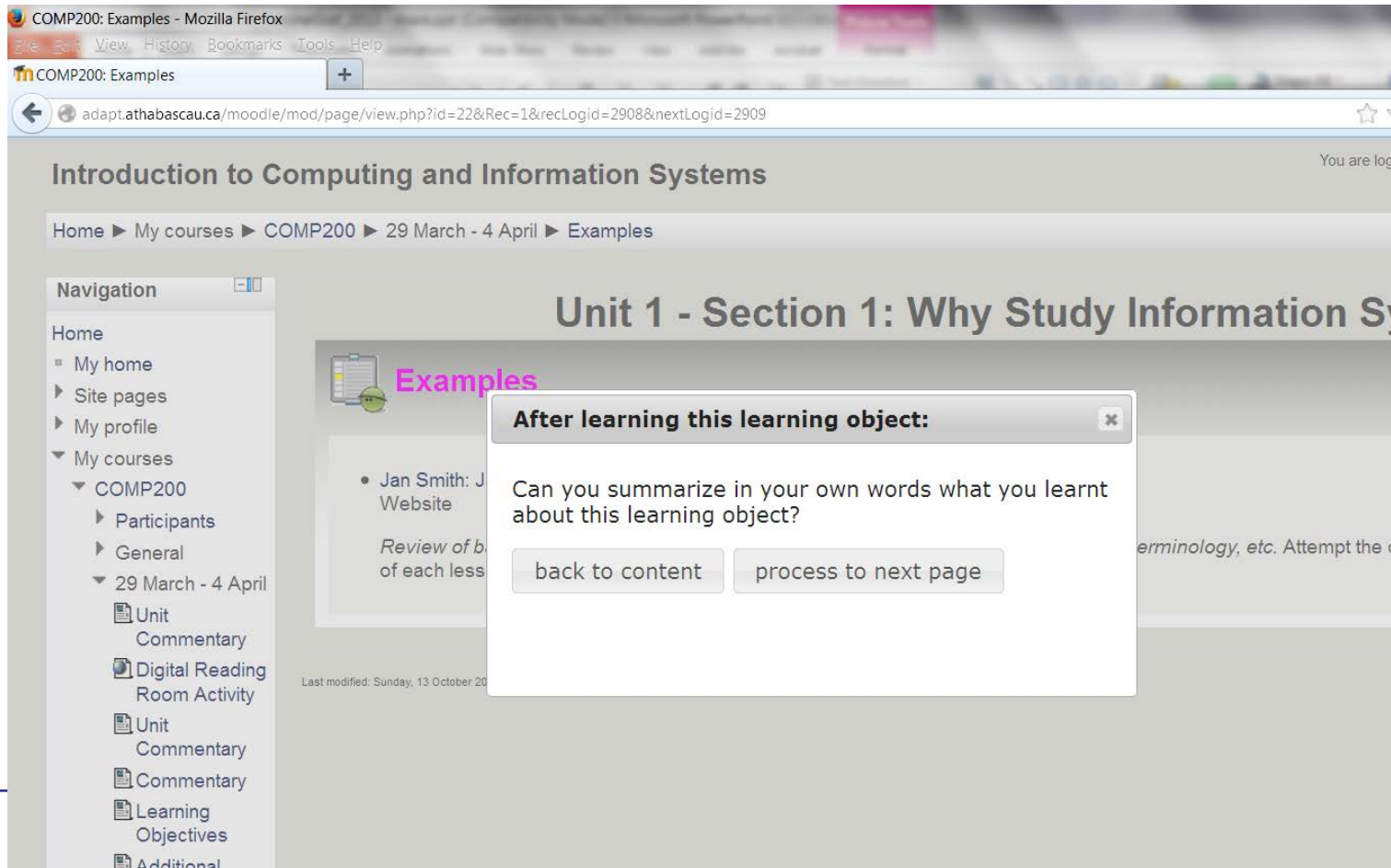
No.	Asking the student to	When (before/after learning)	Method
R1	take notes when he/she learns a learning object	before	probability-based
R2	request help if he/she have any question by posting or asking teachers about this learning object	after	probability-based time-based
R3	post the ideas , thought, or reflection about what he/she learnt in this learning object	after	probability-based
R4	summarize what he/she learnt about this learning object	after	probability-based time-based
R5	rehearsal by revisiting the content of this learning object	after	time-based
R6	use concept/mind maps to easier remember content of this learning object	after	probability-based

When to present which recommendations?

- For each type of learning object, it has been determined whether a recommendation makes sense or not
- For each type of learning object, recommendations are ranked based on how well they fit for a learning object
- Consider whether time-based or probability-based method is activated
- Consider whether a recommendation has been followed or not

Demo

Demo ...



COMP200: Examples - Mozilla Firefox

COMP200: Examples

adapt.athabasca.ca/moodle/mod/page/view.php?id=22&Rec=1&recLogId=2908&nextLogId=2909

Introduction to Computing and Information Systems

Home ▶ My courses ▶ COMP200 ▶ 29 March - 4 April ▶ Examples

Navigation

- Home
 - My home
 - Site pages
 - My profile
- My courses
 - COMP200
 - Participants
 - General
 - 29 March - 4 April
 - Unit
 - Commentary
 - Digital Reading Room Activity
 - Unit
 - Commentary
 - Commentary
 - Learning Objectives
 - Additional

Unit 1 - Section 1: Why Study Information Systems

Examples

- Jan Smith: J Website

Review of b
of each less

Last modified: Sunday, 13 October 20

terminology, etc. Attempt the c

You are log

After learning this learning object:

Can you summarize in your own words what you learnt about this learning object?

back to content process to next page

Academic Analytics

Enhancing the Accessibility of Educational Log Data

[Jeremie Seanosky, Harza Imran]

Academic Analytics

- What is academic analytics?
 - Analysis of data to support educational institutions, including faculty/teachers, learning designers, decision makers, etc.
 - Institution-wide and cross-course/cross-department analysis
 - Includes research related to
 - Effectiveness of teaching strategies
 - Effectiveness of course designs
 - Teacher Dashboards
 - Retention and at-risk identification
 - ...

Academic Analytics Tool (AAT)

- In online education, educators and learning designers typically don't get much feedback on whether or not their teaching strategies and course designs are successful/helpful for students.
- Learning Management Systems (LMSs) generate a lot of data
- But learning designers and educators don't have skills to use these data (e.g.: SQL)

General Aim of Research

How to provide support for users without computer science background to access complex LMS data?



General aim:

- Design, develop and evaluate a tool that provides users with easy access to complex educational log data
- Allow users to ask “questions” to the data
- Allow users to start with easy queries and then build upon them
- Work for different LMS
- Facilitate teachers’ learning about their teaching strategies and course designers’ learning about their learning designs

Procedure

Building a profile

- Select a learning system to connect to
- Create/Select a data set (courses)
- Create/Select a patterns (queries)

Demo

Demo ...

Active Database: OldMoodle
 Selected Datasets: COMP200, COMP301

What would you like to do?

- I want to create a new pattern from scratch.** Select this if you want to create an entirely new Pattern
- I want to create a new pattern from an existing pattern.** Select this if you want to create a new Pattern, but start with an existing Pattern
- I want to chain two existing patterns.** Select this if you want to create a new Pattern, but as a combination of two existing Patterns
- I want to perform an analysis on an existing pattern.** Select this if you want to see the SUM or Average or Count or Minimum value or Maximum value of an existing Pattern's results.

Additional callouts on the left side of the image:

- I want to create a new pattern from scratch.
- I want to create a new pattern from an existing pattern. Goes to select pattern screen then goes to Pattern Builder wizard with form prefilled.
- I want to join two existing patterns. Goes to select pattern screen then goes to Pattern Builder wizard with form prefilled.
- I want to perform an analysis on an existing pattern. Goes to select pattern screen then goes to perform analysis screen.

Active Database: OldMoodle
 Selected Datasets: COMP200, COMP301
 Choose Concepts > Choose Attributes > Add Limits > Define Sorting > Save

Do you want to define limits to the attributes?

Attribute	Limit Type	Limit
Course Name	<input type="radio"/> Exactly <input type="radio"/> Like	
Course Open Date	<input type="radio"/> Earlier Than <input type="radio"/> Later Than <input type="radio"/> Between <input checked="" type="radio"/> Equals	123
...	<input type="radio"/> Equals <input type="radio"/> Between	
Course Duration	<input type="radio"/> Exactly <input type="radio"/> Like	
Student Name	<input type="radio"/> Exactly <input type="radio"/> Like	

I want ALL of the limits I define to apply to this pattern (narrows results)
 OR
 I want AT LEAST ONE limit to apply to this pattern (expands results)

ALL At Least One

<< Choose Attributes Define Sorting >>

Pattern Result (top 10 rows only)

Course Name	Course Open Date	...	Course Duration	Student Name
COMP 200	Sept 1 2012	123	45	Stephen Kladich
COMP301	Oct 12, 2012	123	90	Kinshuk

SQL Pane [Copy](#)

```
SELECT blah, blah
FROM blah, blah
WHERE blah = 123
```

At this point the concepts are listed along with filter types based on the data type of the attribute text -> = OR LIKE (for wildcard match)
 date --> range where if only one value is entered then it is the lower or upper bound, also equals (but not to time level)
 number => range where if only one value is entered then it is the lower or upper bound

Filter options get set only when filter radio button selected... either 1 or 2 text boxes depending on data type and filter type
 Will have to validate data based on data type of attribute.