Knowledge Inference and Structure Discovery for Education

Syllabus

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Learning Objectives

Education is increasingly occurring online or in educational software, resulting in an explosion of data that can be used to improve educational effectiveness and support basic research on learning.

In this course, you will learn:

1. How and when to use key methods for knowledge inference and structure discovery,
2. About the methods being developed by researchers in the educational data mining, learning analytics, learning at scale, student modeling, and artificial intelligence in education communities, as well as standard data mining methods frequently applied to educational data,
3. How to apply these methods, and when to apply them, as well as their strengths and weaknesses for different applications.

The course will discuss how to use each method to answer education research questions and to drive intervention and improvement in educational software and systems. Methods will be covered both at a theoretical level, and in terms of how to apply and execute them using software tools like Python and RapidMiner.

Some knowledge of either statistics, data mining, mathematical modeling, or algorithms is recommended. Experience with programming is not required. This course is comparable in difficulty to the elective course "Core Methods in Educational Data Mining," offered at the Graduate School of Education at the University of Pennsylvania, but covers a briefer scope.

Modules from this iteration of the course offer experimental adaptive support through the Cognitive Tutor Authoring Tools (CTAT) and the Generalized Intelligent Framework for Tutoring (GIFT). Not all modules will have the same types of content and activities. Please let us know your thoughts and suggestions as we work to make this course a better experience!

Weekly Modules

Week 1: **Knowledge Inference and Knowledge Structures**

- Knowledge Inference
- Bayesian Knowledge Tracing (BKT)

- Performance Factor Analysis
- Item Response Theory
- Advanced BKT
- Recent Developments in Knowledge Inference
- Memory Algorithms

Week 2: **Structure Discovery**
- Clustering
- Validation and Selection
- Advanced Clustering Algorithm
- Factor Analysis
- Knowledge Inference Structures

Week 3: **Relationship Mining**
- Correlation Mining
- Causal Mining
- Association Rule Mining
- Sequential Pattern Mining
- Network Analysis

Grading Policy

Assignments – There will be one problem-solving assignments (in CTAT) each week. In the problem-solving assignments, you will conduct analysis on a data set provided to you, and answer questions about it. Additionally, in some weeks, additional recall and example activities will be provided through GIFT. To receive a certificate of completion, students will need to earn an overall grade of 90%, indicating completion or near-completion of all three activities.

Forum Etiquette & Structure

One of the most powerful and dynamic components of this edX course will be your contributions! It's your course, so openly discuss the material. Help each other!

Here are some things to consider to help make the discussion forums engaging and productive:
- **Tone** - Tone is a very important part of online communication. Before posting, read your message out loud. Ask yourself if you would say this to a fellow student in your class in a face-to-face discussion.
- **Peer support** - Make an effort to understand and support your peers. People have different perspectives - but everyone is here to learn! And the more we learn from each other, the better!
- **Disagree vs. attack** - Disagreeing with peers in debate and discussion is fine and welcome, but make sure to avoid challenges that may be interpreted as personal.
- **Check previous postings** - Take a minute to read read previous posts to ensure that the conversation you want to have is not happening elsewhere in he board.

- **Delete the extraneous** - When replying to another's post, be specific about the sentence, phrase, or comment that you are addressing. This will help to keep the thread focused, and it will make it easier for all of us to understand how the conversation is progressing.
- **Be open to challenges and confrontations**
- **Encourage others to share their ideas**

Here are four approaches to consider when engaging in our weekly discussions:

- **Agree/Disagree** - It is perfectly fine to agree or disagree with others in the discussions, but explain the "level" of your agreement or disagreement. Avoid posting short responses such as "Yes! I agree!", or "No! That is wrong!" Explain WHY you agree or disagree.
- **Critique** - Thoughtful and constructive criticism of each other's posts will help to keep the discussions positive, academic, and interesting.
- **Expand** - If you find a post interesting or thought provoking, use your reply to expand upon it.
- **Exemplify** - Bring in examples to support your ideas and comments.

Each video lecture and CTAT assignment has a discussion forum module attached to it or directly following it. If you have any questions about any of the topics discussed in these resources, please take advantage of these forum modules, as your input will enhance the overall experience of this course!

For more general discussions, you can take advantage of the Discussion section of the course by sharing any questions, answers, or additional helpful resources that can add to the learning that week. The instructor and TA will do their best to address all questions posted on the forums within a timely manner. Please keep all discussions in all forum modules within the context and content of this course.

Academic Policy

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