Enhancing Personalized Learning of students through Study Material Recommendation in an Adaptive Learning Environment.

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# Research Methodology

* Data
  + approval
  + evidence / sample
  + data processing
* Solution design
  + Architecture
  + Model assumptions
  + Scope
* Risk

# Data

This research uses a real-world data set from an International E-learning (courseware) platform that uses state of the art adaptive learning technology. This platform provides educational content targeting schools for Mathematics, Economy, Chemistry, Biology, Physics and Psychology. Based on the research question, identified data was already collected with the organization’s approval.

Subjected Adaptive Learning Platform (ADP) measures the learners' progress level ranging from 0 to 100. Teachers can assign assignments to the student related to a specific Learning Objective(LO). A student has to reach 100 progress to complete the assignment, then the student has achieved the ‘Mastery’ to that LO. Each LO has minimum 4 question, progress of a student for a given LO is

Progress = proficiency score x fraction of the minimum questions learner have tried

If student fail master a LO, student get to do more practice questions. If the student need further support, he or she get more instructions and direct back to the prerequisite LOs.

All the learning objectives, concepts, questions, and course materials are associated to knowledge graphs. These knowledge graphs and progress levels drive the students journey to master a given learning objective. But other characteristics of the student joinery are not considered. Such as time spent on a question, time spent on instructions, quality of the instruction materials, etc.

|  |  |  |
| --- | --- | --- |
| Data | Number of data points | Attributes |
| Student coursework performance | 3.3 million | * Learning objectives * coursework id * user id * progress * question id * correctness of the answer * time spent to answer * time spent for the question instruction * study material id referred |
| Student assignment | 140,000 | * Learning objectives * test id * user id * question id * correctness of the answer |
| Learning objective map (knowledge graph) | 1145 | * Source LO Id (prerequisite LO ID) * Destination LO Id * Source LO Title (prerequisite LO Name) * Destination LO Title |

# Solution design

## Selection of solution architecture

According to the literature authors have used different methods to solve knowledge tracing. There mainly two methods. First method is Traditional knowledge tracing which has two branches. They are ;

1. Bayesian knowledge tracing
2. Factor analysis models

Second method is Deep knowledge tracing. This is the latest knowledge tracing methodology, and it has outperformed Traditional knowledge tracing methods. Our dataset has already tested with modified item response theory which is one of the models under Factor analysis models. Hence Traditional knowledge tracing methods will not be used for this research. Instead, Deep knowledge tracing methods will be employed expecting better performance.

Under Deep knowledge tracing there are multiple models. All these models use Deep Neural Networks with different input types and different neural network architecture. Subjected data set has heterogenous data types and relationship between these data better explained by Graphs/Networks. Hence this study will use Graph based knowledge tracing methodology to predict students’ knowledge level. There are multiple graph based knowledge tracing methods in literature and this study will compare and contrast different model when building the model.

## Graph Neural Network (GNN)

## Risk

Hardware might not be enough - batch wise training.

Not getting the optimal results

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