

Exercises Recommendation System in AL

A Primitive Results

Ha Noi, Apr 28, 2021

Outline

Source code: <https://gitlab.ftech.ai/nlp/research/exercises-recommendation>

Documents: https://docs.google.com/document/d/1J11qjtteFJDZnR8BaAcA_ny6hT3wbt-ceO8G7hdKsk

Introduction

- Recommendation module is an important module in Adaptive learning systems.
- In order to consolidate the learning effect of students at certain stages, corresponding exercises are often provided to them appropriately.
- It's a challenge to recommend exercises with suitable difficulty levels for students as they have different learning status; variety of types; exercises bank is very large; knowledge concepts contained therein meet the requirements of the learning progress.

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Some approaches

- Content-based Filtering (CBF) ¹
- Collaborative Filtering (CF) ²
- Hybrid Filtering based on similar - good learner's recommendation ³
- Knowledge Concept Prediction - Exercises Recommendation (KCP-ER) ⁴

¹Michael J. Pazzani, Daniel Billsus, "Content-based Filtering" *In:* https://link.springer.com/chapter/10.1007%2F9783540720799_10

²G. Linden, "Amazon.com recommendations: item-to-item collaborative filtering" *In:* DOI: [10.1109/MIC.2003.1167344](https://doi.org/10.1109/MIC.2003.1167344).

³Dade Nurjanah, "Good and Similar Learners' Recommendation in Adaptive Learning Systems" *In: Conference: 8th International Conference on Computer Supported Education. DOI: [10.5220/0005864304340440](https://doi.org/10.5220/0005864304340440)*.

⁴ZhengyangWu, "Exercise recommendation based on knowledge concept prediction" *In:* <https://doi.org/10.1016/j.knosys.2020.106481>.

Some approaches

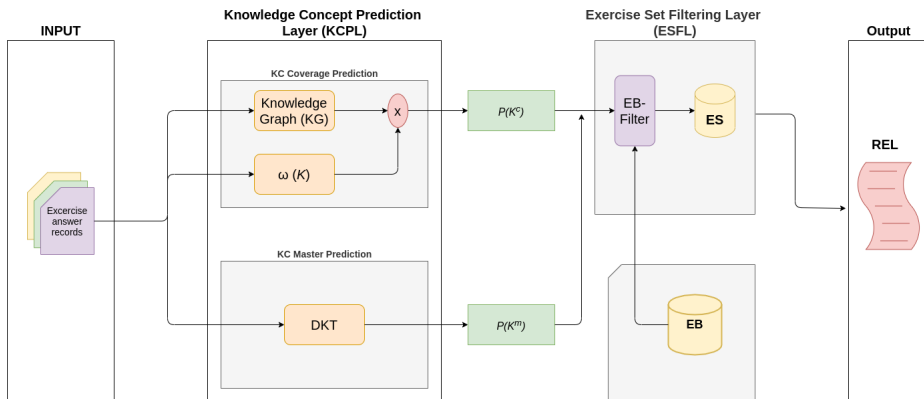
- Base on Knowledge Concept Prediction - Exercises Recommendation (KCP-ER)
- Pros and Cons:
 - This method takes advantage of the output of Knowledge Tracing module, provides an efficient modeling method of measuring the performance of each learner -> more effective recommendation ;
 - Allows configure the recommended exercises based on the desired difficulty level of the learner; or to diversify the difficulty level;
 - There are many complicated modules: KCCP, KCMP, Filter layers
 - Modules (KCCP, KCMP) using the DL model need enough data to train the model, leading to a cold-start problem.

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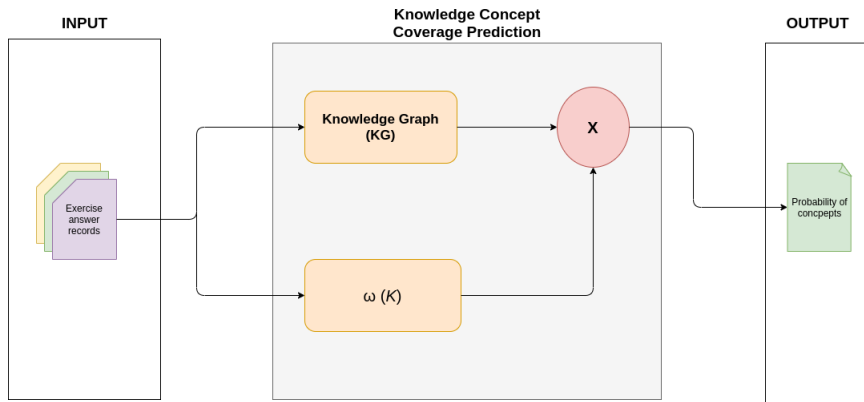
Documents: https://docs.google.com/document/d/1J11qjtteFJDZnR8BaAcA_ny6hT3wbt-ceO8G7hdKsk

The proposed approach



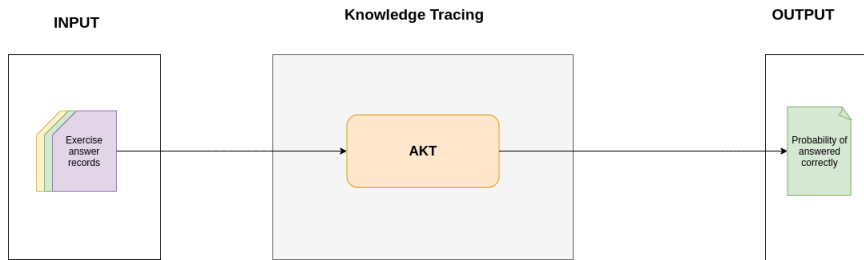
Hình 1: Pipeline the proposed System

KCCP module



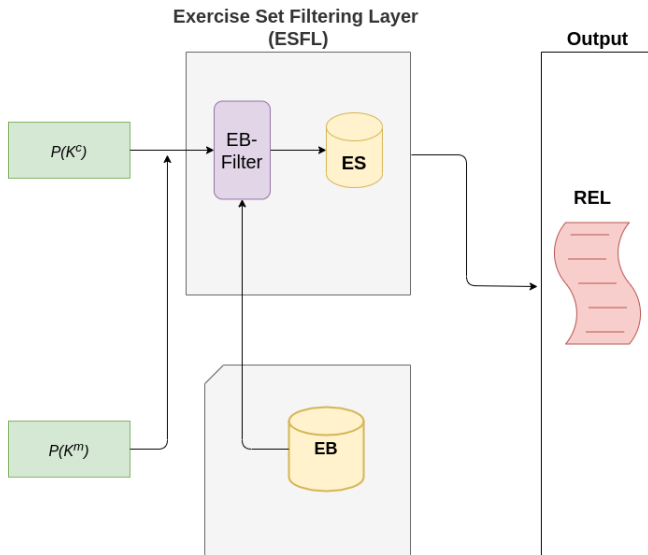
Hình 2: Knowledge concept coverage prediction (KCCP) module

KT module



Hình 3: Knowledge Tracing (KT) module

Filter layer



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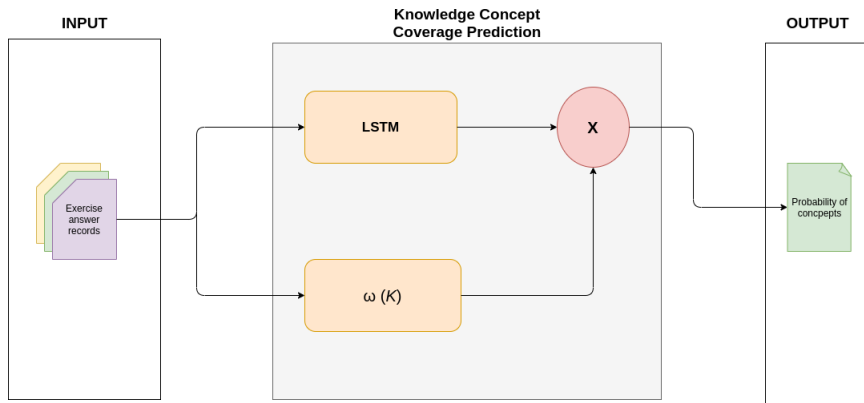
Experimental setup

- Kaggle dataset is a subset of EdNet ⁵, published by Riiid Labs;
- Uses the LSTM network in the KCCP module to replace the Knowledge Graph which gives a probability distribution across all of the concepts contained in the course.
- For KCCP module use LSTM, we use F1-score, Accuracy, Precision and Recall for evaluation, while for KT module, use Accuracy and AUC metrics. With Exercises recommendation system in AL, we use 3 metrics: Accuracy, Novelty, and Diversity. ⁶

⁵Youngduck Choi, "EdNet: A Large-Scale Hierarchical Dataset in Education" *In: arXiv:1912.03072*.

⁶, "Exercises Recommendation System" *In: Exercises Recommendation Literature Review* ↻ 🔍 🔗

KCCP module



Hình 5: KCCP module use LSTM

Sub-modules results

Since the KG module is not available yet, we use a simple LSTM model instead. The input is the history learner interaction and the output is a probability distribution over concepts.

Model	F1-Score	Accuracy	Precision	Recall
LSTM	0.4561	0.4865	0.5253	0.4865

Bảng 1: KCCP module result.

Model	AUC	Accuracy
AKT-NR	0.7754	0.7423

Bảng 2: KT module result.

System results

Model	Accuracy	Novelty	Diversity
KCP-ER	0.6548	-	0.3040

Bảng 3: Recommendation System result.

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Next plan

- Improve model exercises recommendation includes: KCCP module, KT module, and algorithm to generate a Exercises subset with high diversity;
- Optimize the speed of system processing
- Implement and experiment ER model in Fschoool dataset, analysis issues;
- Integrate into the production, running and waiting for the results !!!