Generating Adaptive Learning Materials

SCHOOL OF IT

Background and Motivation

Traditional static forms of learning provide general information to learners who thrive on personalized content. This is what gives rise for the need of Adaptive Learning systems. Generating Adaptive Learning Materials (GALMAT) is an adaptive learning system that generates questions on a given domain, for a learner according to that learner's unique knowledge on the topic. GALMAT is an application that does not require a large amount of information to perform it's adaptivity functionalities, rather it is able to simply adapt to a learner's knowledge based on their answers to previously administered guizzes.



Research objectives

- Generate quality questions to test a learner's knowledge of a topic
- Identifying learners knowledge gaps by assessing their proficiency in subjects
- Creating detailed and more human-like learner notes

Output Examples

Standard Question	Ajoblanco has Vegetables as an Ingredient. True or False?	
Difficult Question	Bhaji is eaten in India and has Gram Flour as an Ingredient. True or False?	
This table shows examples of true or false questions generated by the AQG.		

This table shows examples of true or false questions generated by the AQG The difficult question contains more distractors (India and Gram Flour).

Subject	Predicate	Object	Subject Ability	Object Ability
			0.404	



The above diagram provides a high-level overview of the system design. When using the system, the user interacts with the AQG component, answering questions on the topic. The question answers and user score are then sent to the ALS component to approximate the learner's knowledge gaps and quantify them. This is stored in a knowledge graph. Finally, the NLGA component expresses the content of the knowledge graph in the form an informative document.

AjoblancohasIngredientGarlic0.164NoneBaconExplosionisEatenInRegionKansasCityMetropolita
nArea0.428None

This table shows examples of triples that are output by the ALS. The AQG and NLGA read in this output to perform their functionalities. The output consists of a Subject Ability which is the learner's level of understanding for that particular subject

Output Sentence 1	Ajoblanco is a chilled Spanish soup made with bread, garlic, oil, salt, and sometimes almonds. The dish contains an ingredient, garlic.
Output Sentence 2	The BaconExplosion is a popular dish consisting of a rolled bacon weave filled with a sausage and bacon mix. It is eaten in the Kansas City Metropolitan Area.

This table shows the prompt used to generate a detailed sentence for a given triple using the NLGA component which uses GPT-3 as its underlying model. A quick comparison of the output with the reference sentence shows how much triple-related context has been added.

5 Results

No. Grammaticallly Incorrect Questions No. Language Appropriate Questions

No. Incorrectly Adapted Questions



	Ajoblanco	Bacon Explosion	Bhaji
Results	11/20	11/20	17/20
Ability	0.164	0.428	0.679

Table showing the data obtained after the simulation's execution. In the Results row, the traditional method for calculating test



Graph showing how users rated the questions in terms of grammaticality, appropriateness, and adaptability.	results is depicted as the ratio of correct answers to the total number of questions. The Ability row displays the calculated learner abilities for each concept using Item Response Theory (IRT).	This bar chart is an extract of the result we obtained from a user evaluation done to verify the validity of the added details. This shows that the added details to describe 'Bacon Explosion' was appreciated by the human evaluators and was considered necessary.	
6 Conclusions			

The results concluded that the adaptive learning system accurately generated learning materials for a learner that were adapted to their knowledge of the course domain. High quality questions were generated that allowed the system to calculate their learning abilities. Furthermore, the system generated learning materials for a learner dependent on their abilities as well as on triples with detailed context on the topics addressed.



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