

An Automated Question Paper Generation Tool based on Course Outcomes and Bloom's Taxonomy Using Natural Language Processing

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Abstract

The Outcome Based Education (OBE) system is rapidly emerging nowadays. To meet the needs of OBE, it is necessary to design the Question papers of engineering students that fulfills all the course outcomes and all levels of Bloom's Taxonomy, from remembering to creating. To design a question paper that fulfills all these criteria is a tedious task. Hence, the proposed system uses a natural language processing algorithm to extract keywords from the question bank. A pattern matching algorithm is used to identify the Course Outcome and Bloom's Taxonomy level.

Index Terms - *Natural Language Processing (NLP), Bloom's Taxonomy, Pattern Matching, Outcome Based Education.*

I. INTRODUCTION

Outcome Based Education is goal centric learning methodology that helps to measure the goals by a student at the end of a programme or course. And Bloom's Taxonomy is a prominent tool to measure the goals achieved by a student. Nowadays, new assessment methods are emerging rapidly, and to formulate a question paper for undergraduate students that fulfills all the criteria is very time consuming and tedious. To have an automation of question paper generation that satisfies all the levels of *Bloom's Taxonomy* and covers all the desired course outcomes will ease the task and save a lot of valuable time.

II. NATURAL LANGUAGE PROCESSING

NLP helps analyzing, understanding and deriving meaning out of human language, which can be organized and structured further processing. Few of the common uses of NLP are[1]:

- Summarization of text keeping relevant information while neglecting the irrelevant information.
- Automatically generate keyword tags to identify keywords in the body of text.
- Identify the type of entity extracted, such as it being a person, place, or organization
- Sentiment Analysis
- Reduce words to their root

There are numerous open source libraries to provide NLP for real time applications such as Apache OpenNLP, Natural Language Toolkit (NLTK), MALLET, etc

III. WHAT IS BLOOM'S TAXONOMY?

In 1956, Benjamin Bloom who was a head of a group of educational psychologists, developed different levels of classification of intellectual behavior important in learning. They were as follows:

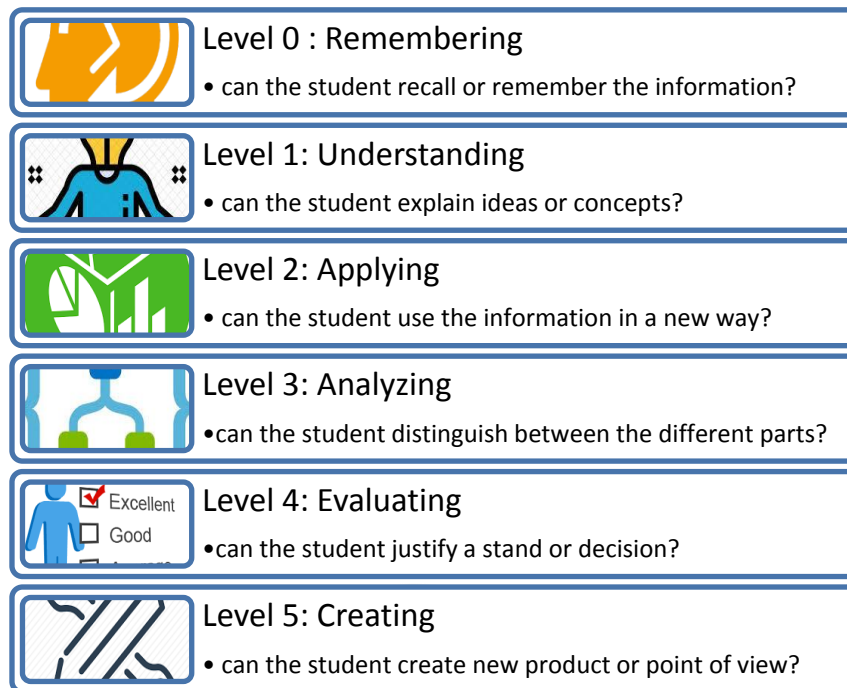


Fig.2.1: Bloom's Taxonomy

IV. LITERATURE REVIEW

Conventionally, the question papers are set manually, looking at the frequency of occurrence of questions in examinations. But, today's need is outcome based learning and the outcomes need to be measurable. A pupil is expected to achieve the higher levels of Bloom's Taxonomy. So whenever a teacher sets a question paper, he needs to check the respective course outcome, Bloom's level and frequency of occurrence of question in prior examinations. Then he needs to check that all the required course outcomes are covered and proper Bloom's levels are attained or not. The teacher also needs to check that all the COs are balanced or not. And this method is very time consuming and tedious.

Many automated tools for question paper generation are available, but none of these tools comply with the OBE methodologies and Bloom's Taxonomy. In the paper entitled "Automated Question Paper Generation System" by RohanBhirangiet. al. [2], an automated process of Question Paper Generation is proposed which is fast, streamlined, randomized and secure. The system implements a newly proposed algorithm for randomization of questions.

Another paper on "Automatic Test Paper Generation Based on Ant Colony Algorithm" has implemented a complex but highly efficient Ant Colony Algorithm [3]. It requires building of a mathematical model of constraint according to the requirements of the paper [3].

Mr. Amit Sanjay Khairnar et.al. [4] has proposed an automatic question paper generator designed for small and medium scale institutes.

All these systems use efficient randomization techniques for generating random questions from question bank, but they do not take into consideration the Course Outcomes and Bloom's Levels.

V. PROPOSED SYSTEM

This is a newly proposed system that has not been implemented yet. Input to the proposed system is a question bank with marks, course outcomes, syllabus, keywords of the Bloom's level.

The proposed system consists of the following modules:

- Question Base:** It is a question bank that stores questions related to a particular subject with marks.
- Natural Language Processing (NLP) module:** The NLP module is used to extract keywords with respect to Bloom's levels and course outcomes. These keywords will further act as an input to the Semantic Analysis Module and Text Mapping module.
- Semantic Analysis:** The keywords extracted through the NLP will help to identify the Bloom's Level. For example, if the question is "Define an assembler" Keyword extracted will be: Define, assembler. And through semantic analysis "define" will be mapped with one of the Bloom's Level. Whereas, assembler is not the content of Bloom's taxonomy keywords, so it will be directed to text mapping module. The requirement of Semantic Analysis Module is because of same keywords in two different Bloom's Levels. For example: "Solve" is a keyword in third level as well as fifth level. So, to identify the Bloom's Level accurately, we need to extract its meaning, and that is possible through semantic analysis.
- Text mapping:** Through text mapping, a question will be mapped to a course outcome. For example: In the above question, "assembler" is directed towards text mapping module. If any CO specifically contains the word "Assembler", then that CO will be mapped to the given question. But if none of the COs match with the given keyword, then the text

mapping module identifies to which part of the syllabus, the question belongs. It also identifies which CO can be mapped to that particular part of syllabus.

5. After determining the Bloom's level and the CO, the question bank will be updated.
6. **Paper Pattern logic:** this module will have a pre-defined paper pattern. The generated question papers will be in the same pre-defined pattern. This module consists of a **randomization algorithm**, which will randomize the questions from the question bank.

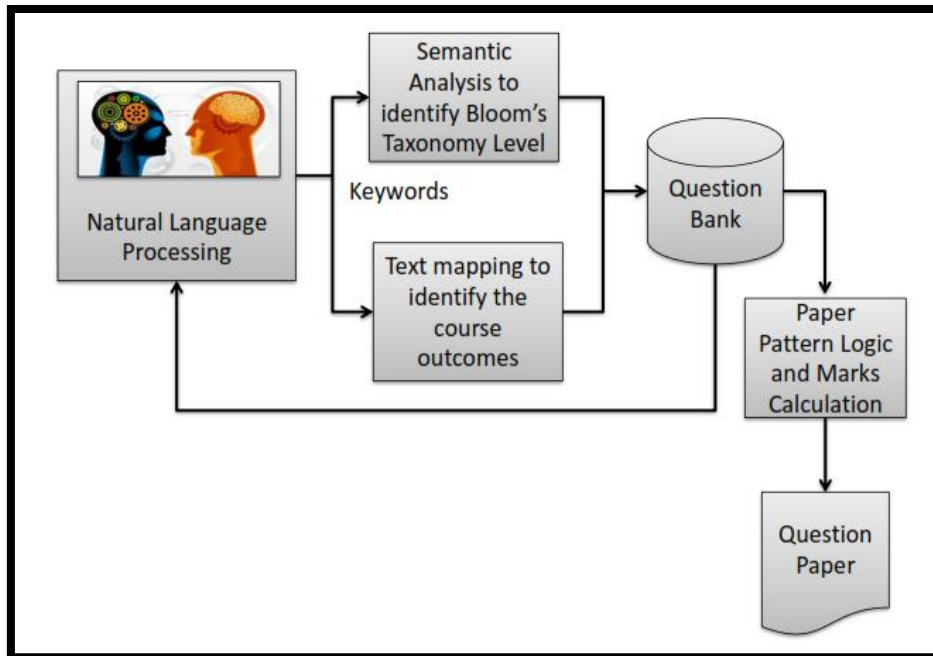


Fig 5.1 Proposed System

V. FUTURE SCOPE

The proposed system can be extended to generate a Question Paper for all subjects. It can also be extended to perform different analytics on the question paper to check if all the course outcomes and Bloom's levels are satisfactorily attended or not. Further if we add a module of marks entry and analysis, it can automatically give us a detailed report of Course attainment. And the teacher does not need to formulate assignments. For example, if a pupil is not achieving a certain CO, he should get assignments only for that CO. And the proposed system can find out those questions from its question bank and automatically assign the questions to that pupil. The system can also be extended to provide security related to question paper distribution, if we add an encryption module for security.

VI. CONCLUSION

Hence, we can conclude that the proposed system is useful for the colleges who have a strong desire to achieve the aim of Outcome Based Education. This system is highly useful for the colleges who appear for various accreditations such as NAAC and NBA. This system can save a lot of labor work for staff members as question papers are to be generated not only for internal tests, but also for university examinations.

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