

Mapping of COs to POs using NLP

Srinivasa K

Department of Computer Science and Engineering, Siddaganga Institute of Technology, Tumkur, India
Email: srinivasa@sit.ac.in

Abstract— In the context of educational programs, aligning course outcomes with program outcomes is crucial for ensuring the attainment of educational objectives. This study presents a methodology for mapping course outcomes to program outcomes using Natural Language Processing (NLP) technique. The proposed NLP approach utilizes computational methods like Cosine similarity to calculate the similarity between outcomes based on their semantic content. Cosine similarity is employed as a measure of textual similarity, considering the vector representation of outcomes. By comparing the results with the manual approach, this work proves the efficiency of NLP technique in automating the mapping process. The findings of this research contribute to the field of education by offering a quantitative evaluation of the NLP-based approach for mapping course outcomes to program outcomes.

Keywords— Natural Language Processing, Program Outcomes, Course Outcomes.

I. INTRODUCTION

Mapping course outcomes to program outcomes is a critical task in education, ensuring that individual courses align with the objectives of an educational program. Traditionally, this mapping process has been performed manually, relying on the expertise of educators to assess the alignment between outcomes. However, with the advancements in NLP, there is an opportunity to automate and enhance this process.

In this work, we explore the use of NLP techniques, specifically cosine similarity, for mapping course outcomes to program outcomes. Cosine similarity measures the similarity between two vectors based on the angle between them, providing a quantitative measure of how closely related two sets of outcomes are in terms of their semantic content.

The main objectives of this work are twofold: first, to automate the mapping using NLP technique, and second, to assign grades 0, 1, and 2 to the matches based on the level of matching Low, Medium and High respectively.

II. BACKGROUND AND RELATED WORK

The comparative analysis between manual mapping and the NLP-based technique reveals the distinct advantages of computational methods. Even though mapping of COs with POs is a common work in academics now a days, in most of the institutions it is done manually and very few works tried till the date to automate the process. [1] focuses on the use of curriculum mapping as a tool for assessing and evaluating N educational programs in the field of pharmaceutical education. It discusses the process of curriculum mapping, its benefits, and its application in program assessment to ensure alignment with desired educational outcomes. The work [2] discusses the importance of quality assurance in work placements within higher education.

It explores the challenges and opportunities associated with assessing and ensuring the quality of work placements, proposing a framework for effective quality assurance measures. [3] explores how rules can be used to streamline the evaluation process and improve efficiency in curriculum mapping. In the work [4] authors explored the application of Natural Language Processing (NLP) techniques for quality assurance in higher education. [5] proposed a methodology for student outcomes assessment for ABET Accreditation by considering Computer Science and Computer Information Systems Programs as a case study. The recent work [6] automated the process of mapping COs to POs using NLP but without considering the level at which each COs maps to the respective POs like Low, Medium or High.

III. PROBLEM DESCRIPTION AND OBJECTIVES

To develop a system that can automatically map course outcomes to program outcomes using Natural Language Processing (NLP). The system will analyze both the course and program outcomes, identify the most relevant keywords and concepts finally use this information to map the course outcomes to the program outcomes.

This work has the following specific objectives:

- Develop an NLP model that can accurately map course outcomes to program outcomes.
- Assign grades 0, 1, and 2 to the mappings based on the level of matching Low, Medium and High respectively.

IV. METHODOLOGY

The methodology used to develop the system is as shown in figure 1 and steps involved in developing the system are explained in brief as follows:

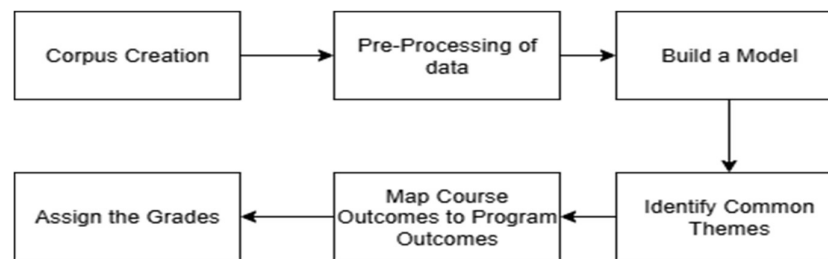


Figure 1: Overview of the Proposed System

A. Corpus creation and Pre-processing of data

The set of course outcomes and program outcomes required for experiment are collected from diverse sources such as textbooks, articles, and educational materials. The collected data is then cleaned, standardized, and transformed using natural language processing techniques such as tokenization, stemming, and lemmatization.

B. Build a model

The dataset created in previous step is used to train a supervised learning model, typically based on NLP techniques like text classification or sequence labeling. Through an iterative optimization process, the model adjusts its internal parameters by minimizing the error between predicted and actual outcomes. This training process entails feeding the dataset into the model, updating parameters using optimization algorithms, and repeating until the model achieves satisfactory performance. Once trained, the model can effectively predict program outcomes based on course outcomes, facilitating the mapping process and providing valuable insights for curriculum evaluation and enhancement.

C. Identify common themes

In the process of mapping course outcomes to program outcomes using NLP, a crucial step is identifying common themes. This involves analyzing the text data associated with course and program outcomes to discover recurring topics, concepts, or keywords that are shared across multiple outcomes. Techniques such as topic modeling, keyword extraction, or clustering algorithms are applied to uncover these common themes. By identifying the shared elements, educators and curriculum developers gain insights into the areas of focus that align course-level achievements with program-level goals. This step enables a deeper understanding of the relationships between outcomes, helps ensure consistency and coherence in the curriculum, and aids in making informed decisions for curriculum design and improvement.

D. Map course outcomes to program outcomes and assigning the grades/levels

Mapping course outcomes to program outcomes is a crucial step which identifies the connections and relationships between course outcomes and program outcomes, ensuring that the knowledge, skills, and competencies acquired in each course contribute to the broader objectives of the program. This mapping enables curriculum designers to evaluate the effectiveness of individual courses in achieving program-level goals, identify any gaps or redundancies, and make informed decisions for curriculum development, improvement, and overall educational quality assurance. This is achieved through cosine semantic similarity measure. The sentiment analysis technique is used to assign levels for semantically similar outcomes. The outcomes whose similarity is more than a threshold value, will be assigned with a grade of 2 which indicates a level High for the most similar outcomes.

V. EXPERIMENTAL ANALYSIS

A sample of mapping obtained between the COs and POs for the corpus developed using cosine similarity and sentiment analysis is as shown in Figure 2.

	P1	P2	P3	P4	P5	P6	acc
0	0	0	0	0	0	0	0.833333
1	0	0	0	0	0	2	0.166667
2	0	0	0	0	0	0	0.166667
3	0	0	0	0	0	0	0.000000
4	0	0	0	0	0	0	0.000000
...	...	...	...	...	...	...	...
116	0	0	0	0	0	0	0.000000
117	0	2	0	0	0	2	0.333333
118	0	0	0	0	0	2	0.500000
119	0	0	0	0	0	2	0.333333
120	0	0	0	0	2	0	0.333333

121 rows × 7 columns

Figure 2: Final COs to POs mapped table with accuracy

VI. CONCLUSIONS AND FUTURE WORKS

This work considers the promising application of NLP in mapping course outcomes to program outcomes within the realm of education. Through the utilization of cosine similarity as a measure of textual resemblance, the NLP-based approach offers an automated and efficient means of aligning educational objectives.

The comparative analysis between manual mapping and the NLP-based technique reveals the distinct advantages of computational methods. The NLP approach provides a scalable and objective process, eliminating the inherent subjectivity involved in manual mapping. By assigning grades of 0, 1, or 2 the sentiment analysis enables a systematic evaluation of outcomes.

The results demonstrate that NLP-based mapping can substantially reduce the time and effort required for outcome alignment. Leveraging the power of machine learning, it empowers educators and curriculum developers to streamline the design and evaluation of educational programs. Additionally, it highlights the potential of NLP techniques in enhancing the quality of education by ensuring improved coherence and alignment of curricula.

In summary, this research provides valuable insights into the efficacy of NLP for mapping course outcomes to program outcomes. It emphasizes the transformative potential of automated techniques, such as NLP, in education. As institutions strive for continual improvement in curriculum development and assessment, the integration of NLP-based approaches can greatly enhance efficiency, accuracy, and standardization. This study lays the foundation for the adoption of NLP as a powerful tool to drive more effective and targeted learning experiences, ultimately advancing educational practices.

REFERENCES

- [1] C. Plaza, J. Draugalis, M. Slack, G. Skrepnek, K. Sauer, Curriculum mapping in program assessment and evaluation, *American journal of pharmaceutical education* 71 (2007) 20. doi:10.5688/aj710220.
- [2] R. Immerstein, H. Hasleberg, G. Eri, Quality assurance for work placement in higher education, 2020, pp. 1096–1101. doi:10.1109/EDUCON45650.2020.9125156.
- [3] A. Alshantiti, T. Alam, M. Benaida, A. Namoun, A. Taleb, A rule-based approach toward automating the assessments of academic curriculum mapping, *International Journal of Advanced Computer Science and Applications* 11 (2020) 747–754. doi:10.14569/IJACSA.2020.0111285.
- [4] B. Ujkani, D. Minkovska, L. Stoyanova, Using natural language processing for quality assurance purposes in higher education, in: 2021 IV International Conference on High Technology for Sustainable Development (HiTech), 2021, pp. 01–04. doi:10.1109/HiTech53072.2021.9614206.
- [5] A. Shafi, S. Saeed, Y. Bamarouf, S. Iqbal, N. Min Allah, M. Alq, Student outcomes assessment methodology for abet accreditation: A case study of computer science and computer information systems programs, *IEEE Access* PP (2019) 1–1. doi:10.1109/ACCESS.2019.2894066.
- [6] N. Zaki, S. Turaev, K. Shuaib, A. Baby, E. Mohamed, Automating the mapping of course learning outcomes to program learning outcomes using natural language processing for accurate educational program evaluation (10 2022). doi:10.21203/rs.3.rs-2196467/v1.