INTELLIGENT CURRICULUM ASSISTANT

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Abstract

More than 50% of the master curriculum in Graz Technical University consists of elective courses. All the elective courses are provided with a more or less standard description that includes a number of ECTS, a content of the course, knowledge and skills that students are supposed to get after successfully accomplishing the course. The elective courses are combined into a number of catalogues and can be freely selected by the student to form the particular study curriculum. Defining such a particular curriculum is a challenging task since too many factors must be taken into account.

To help students with building a certain master curriculum, the special software application – so-called curriculum assistant can be used. The curriculum assistant is a special component of the campus management system that provides students with automatically generated variants of the curriculum. The assistant randomly select courses from different catalogues until the desired number of ECTS is reached. If the student is satisfied, the list of courses can be fixed and printed out, otherwise, the process can be repeated as many times as needed. Obviously, the random process of the curriculum generation must be sufficiently amended to get acceptable results.

Deep learning is the latest technology that considerably extends the opportunities for the machine computing. Deep learning is successfully used in many areas such as image recognition and others. Deep learning is expected to allow machines to solve problems in a manner similar to the human way of thinking.

In this paper we describe an innovative application utilizing the deep learning technologies to facilitate the curriculum assistant with a number of artificial intelligent features. Specifically, we introduce to the curriculum assistant an evaluation of perspectives to get a particular type of job after the university. Thus, the intelligent assistant infers the particular curriculum not only taking into account total number of ECTS and necessary courses diversity but also - skills provided by the courses and current demand for such skill on the recruitment market.

1 INTRODUCTION

The term curriculum refers to the lessons and academic content taught in a specific study program. Pragmatically, we can understand the curriculum as simply a list of training courses for the students of the particular program [1, 2, 3].

More than 50% of the courses of a master curriculum in Graz Technical University are elective courses. The elective courses are combined into a number of catalogues and can be freely selected by the student to form the particular study curriculum. All the elective courses are provided with a more or less standard description that includes a number of ECTS, contents of the course, knowledge and skills that students are supposed to get after successfully accomplishing the course. Defining such a particular curriculum is a challenging task since too many factors must be taken into account.

To help students with building a certain master curriculum, the special software application – so-called curriculum assistant can be used. The curriculum assistant is a special component of the campus management system that provides students with automatically generated variants of the curriculum. The assistant randomly selects courses from different catalogues until the desired number of ECTS is reached. If the student is satisfied, the list of courses can be fixed and printed out, otherwise, the process can be repeated as many times as needed. Obviously, the random process of the curriculum generation must be sufficiently amended to get acceptable results. There are two methods that were applied to improve the results:

- Since all the courses are evaluated by students, the curriculum may be generated to optimize the total evaluation results of all the selected courses;
- Students may first select a few courses, and generate only the rest of the curriculum.
Unfortunately, the amendments above had not provided visible improvements to the algorithm and were not accepted by end users [4, 5].

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This project is intended to develop an application that gathers the recruitment data from announcements, analyze the data using principles of machine learning, and infer study curriculums using different criteria. Thus, the application is able to infer

- the most demanded study curriculum,
- the best study curriculum for a particular job,
- the most well-paid study curriculum, etc.

Additionally, the system provides some visual analytics like distribution of job offers over some geographical area [5].

2 ARCHITECTURE AND IMPLEMENTATION

The project is being implemented on the base of Azure Machine Learning (see Fig.1). The central part of the application is the Description of Courses taught in the TU Graz [6, 7]. This component can be seen as a database containing information on all the courses in TU Graz. The information on a particular course includes a textual description associated with information on ECTS and the study program where the course can be selected.

![Figure 1. Architecture of the Application](image)

The repository is parsed to build a so-called Knowledge/Skills list. The list keeps a unified description of all the knowledge and skills that can be obtained by during study in the TU Graz. The functionality of the parser is essentially based on machine learning principles. The parser accesses an individual course description and infers all the knowledge/skills that are supposed to be provided by this particular course. Initially, the system is trained by providing a list of knowledge/skills manually for some courses. At the run-time, the parser is periodically checked whether the results are sufficient or new skills must be introduced into the repository manually. As the result of the parsing the course repository, the course descriptions are prefixed with references to all the relevant entries in the Knowledge/skill list and stored into the special course repository.

Internet crawler scans all known websites with job announcements, parses the documents using the same deep learning principles as above. Thus, the knowledge/skills that are required by the particular working position are identified and converted into the unified notation from the Knowledge/Skills list.
Additionally, all the job announcements are provided with such parameters as the salary offer and geographic location of the working place and stored into the special announcements repository.

The Intelligent Backend component gets access to the list of knowledge skills, course repository and announcements repository, and implements basic algorithms for the system functionality.

Some basic algorithms are also based on deep learning principles. Thus, for example, the system is trained using such parameters of job announcements as a list of required knowledge/skills and the salary offer. After the training, the resulting algorithm is capable of predicting the salary offer on the base of the list of knowledge/skills. In a similar way, the system is trained using the list of skills and the geographical position where these skills are in demand.

End-Users communicate to the system by means of the special GUI client. The GUI client communicates to the back-end via a number of web services. The WEB services are built as combinations of the data from the repositories and the basic algorithms.

3 BASIC ALGORITHMS

The system functionality is based on the following basic algorithms.

An expected salary offer can be inferred on the base of the list of knowledge/skills. This algorithm is the primary functionality of the neural net trained by a big number of examples during parsing the job announcements.

The announcements matches a certain list of knowledge/skills can be retrieved from the database. The list of knowledge/skills required by the particular job announcement can be retrieved from the database. These algorithms is the primary functionality of the database management system serving the announcements repository (see Fig.1).

All the courses that provides a particular knowledge/skill can be retrieved from the database. The list of knowledge/skills provided by the particular course can be retrieved from the database. These algorithms is the primary functionality of the database management system serving the course repository (see Fig.1).

The functionality available for end-users is built as the superposition of the basic algorithms.

4 APPLICATION OF THE SYSTEM

The system is used as a semi-automatic assistant for making the final decision by the student. Any particular curriculum can be automatically provided:

- with the expected salary (max and average figures);
- with the assessment of relative demand (percent of job offers for the given qualification);
- geographical locations with the highest demand for the qualification.

The system may select job announcements matching a certain qualification for the particular geographical location and period of time. The students may select an existing job announcement or issue a job description that is expected to be popular in the future, and the system automatically infers the relevant curriculum.

The functionality above is important from the perspective of individual students. The analytical information can be also provided for the teachers and the university authorities. Thus, the system may find individual courses that provide most demanded knowledge and skills. In a similar way, the system may automatically identify new knowledge and skills that are in demand on the job market but not provided by university courses.

5 CONCLUSIONS

We have described a functionality of the intelligent assistant application. From one side, the application can be used by the individual students to build the master study curriculum [7, 9]. From another side, the application can be used as source of important analytical information for the university authorities. We see the practical value of this paper in possible reproduction and further development of the knowledge-based systems in universities.
REFERENCES


