Better Course Management System

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July 2023

1 Abstract

This document is part of a bigger vision, which consists in the creation of an AI-based tool that guides individual students through the course, and also helps the teacher to know more precisely how their students are doing academically. As mentioned above, this document is a part of the bigger picture, in which we propose and implement a tool that allows students to access information about courses available for specific degrees or careers. The tool incorporates two visualizations: one that shows all possible courses within a program, and another that provides information about the learning objectives associated with each course. Thanks to these visualizations, students can better understand the courses offered and make informed decisions about their academic activities.

2 Introduction

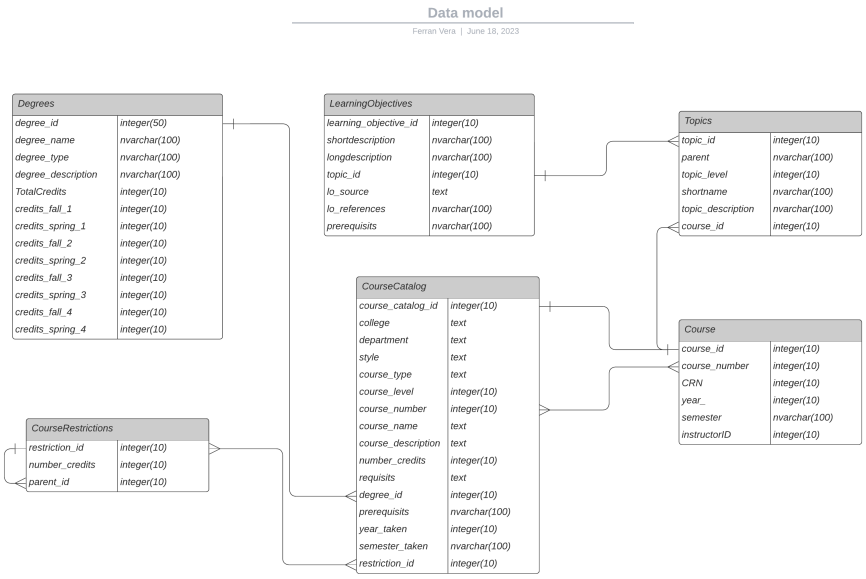
Currently in all schools, universities or any place where classes are taught, we find a situation where there is a 1-n relationship, this means that we have a single teacher for n students. This leads to the situation where sometimes the teacher cannot do his task in the best possible way because not all students learn at the same time. In recent years many youtube channels have appeared that explain any kind of subject matter, but in this case the relationship is one-way, since the student does not receive feedback from youtube and therefore does not know if he has grasped the basic concepts needed. Thanks to the bigger picture of this project this situation can change drastically in favor of both students and teachers, since the creation of a tool based on artificial intelligence that serves as a kind of teacher assitant for students will help them a lot when learning, assimilate concepts, see what is the roadmap that best suits their abilities, what are the learning objectives to learn ... As for the teacher it will also be a very useful tool because he will know how well or badly his students are doing in each of the topics of each subject, so he can know which topics should be improved and which students need more help. Specifically in this project we are going to talk about the creation of visualizations to see the different roadmaps that the students can choose and the different learning objectives that they will learn. To carry out this project we have used python as a programming language,

mysql as a database to store the data pyplot for the visualization of data that are stored in dynamic html to be included in web pages and that students can consult them.

3 Data Model

In analyzing the relationship between the courses offered and how they relate to each other we have chosen to use a rational data model, using mysql as the database and using CSV files to store the data. By using a CSV (comma separated values) format to store the data, the aim is to establish a structured and organized representation of the courses and their attributes. This allows for efficient storage, retrieval and manipulation of the data.
The CSV format is commonly used to store tabular data, where each row represents a specific record and the columns represent different attributes or properties. In this context, the CSV file contains information about courses, programs, learning objectives, topics, descriptions, prerequisites. By keeping this relationship structured within the CSV file, it is easier to extract and analyze the data to generate meaningful visualizations and insights.
Capturing and utilizing this relationship is crucial for students because it allows them to make informed decisions about their academic path. By having access to a high-level overview of all possible courses available for a particular degree or major, students can effectively plan their course selection and ensure they meet the necessary requirements.
Furthermore, understanding the relationships between courses enables students to identify dependencies and prerequisites. This knowledge helps them sequence their courses appropriately, ensuring they acquire the necessary foundational knowledge before advancing to more advanced topics.

The following will show the data model used for the creation of the database.



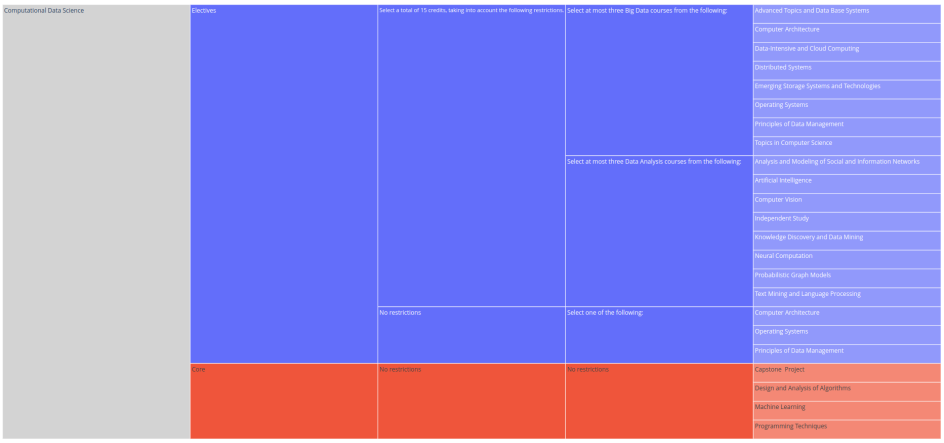
Data model

The use of CSV as explained above has many advantages, but it also has some disadvantages that would be solved with the implementation of a non-relational database using json to store the data for example. One of the disadvantages is that when a course has multiple constraints using CSV you have to create a row for each constraint, while using json is only adding a field with a list, this makes the storage using CSV is greater than using json.
Another disadvantage is for the visualization of the learning objectives, which will be explained in more detail later, when using a relational data model, i.e. static, makes it more difficult to visualize the data, especially if it is hierarchical, while the use of non-relational data, i.e. dynamic, is very comfortable when visualizing hierarchical data.

4 Data Visualization

As mentioned above, the visualization of the different courses of a given degree is done using python, pyplot and dash. The objective of this visualization is that the student has an interactive tool to see and understand how the degree he/she wants to take works. The student will have a drop-down list with all the different degrees that can be chosen, once the degree is chosen the icon cycle graph will be shown with all the different subjects and their respective restrictions. When we say restrictions we mean that sometimes the student must

choose, for example, one subject among 3, that is a restriction for the degree. The icycle graph has been chosen because we believe it is the most appropriate for the visualization we want to develop, since it allows us to see very clearly the hierarchical relationship obtained from the courses. Other options such as treemap, radial tree, etc. were considered, but due to their way of displaying the data, the hierarchical relationship we wanted to observe could not be fully appreciated. The following image shows the result obtained. At the top you can see the drop-down button to choose the degree, once chosen the different courses and restrictions appear. If the degree chosen is a bachelor's degree, you can see that the subjects are divided according to the year and semester that can be taken.



Roadmap for Computational Data Science programm

The second visualization in this capstone project is a pyplot graph sunburst which shows all the learning objectives for a selected program. The graph is very good for understanding the relationships between the learning objectives in a clear way. It is interactive and easy to use, making it helpful for students and others to explore the program's educational outcomes. This visualization aims to make it easier to see how different courses connect to their respective learning objectives.
Moreover, to add it to web pages and let users access it easily, we save the output in an HTML file dynamically. This way, people can view and interact with the sunburst graph without any trouble on different web-based platforms, such as educational websites or department pages. This will help students, teachers, and others to make better decisions about courses and understand the program's learning objectives more effectively. The HTML file gets updated automatically whenever there are changes in the learning objectives, ensuring the information on the web pages remains correct and up-to-date.

Learning objectives for Computational Data Science programm

5 Future work

The present project lays the foundation for a valuable AI-based tool that enhances the educational experience for students and provides relevant information to teachers. As explained during this work, the implementation of the database, the visualization of the different combinations of courses that can be chosen for each program and the learning objectives of each program have been achieved. However, there are several opportunities for expansion and future work to improve and extend the capabilities of the tool. Such as implementing a non-relational database which as mentioned in the data model section, although the use of CSV for data storage offers simplicity and structure, transitioning to a non-relational database, such as JSON-based storage, could provide additional advantages. This change would streamline the representation of courses with multiple constraints, minimize data redundancy, and facilitate hierarchical data

visualization.

To fully achieve the bigger picture's goal of guiding students through their courses and for teachers to have more information about students in order to best suit their needs, future work could include implementing features to track and monitor students' academic progress. Incorporating data on student performance and learning outcomes would enable the AI-based tool to provide personalized recommendations.

Other future work could focus on extending the tool to facilitate feedback and real-time communication between students and educators would increase its effectiveness. Incorporating chatbots or discussion forums would allow students to request clarification, receive immediate feedback on their performance, and engage in interactive learning experiences.

Through the power of AI and data analytics, the tool could be extended to predict students who may require additional support or intervention. Early identification of students at risk of academic difficulties would allow teachers and academic advisors to proactively intervene and provide personalized assistance to improve overall student success rates.

6 References

Tree map: https://towardsdatascience.com/make-a-treemap-in-python-426cee6ee9b8
Radial tree: https://github.com/koonimaru/radialtree Icicle Chart: https://plotly.com/python/icicle-charts/ Dash: https://dash.plotly.com/installation