A Prototype Expert System for Academic Orientation and Student Major Selection

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Abstract— the present paper has for purpose to introduce a computerized approach for academic advising process in Moroccan universities in particular we discuss the case of university AbdelMalek Essaadi. This study proposes a prototype of an advisory expert system dedicated to new and incoming students to assist them select the most suitable majors they can apply to and the most convenient institutions they can attend. The expert system proposed uses an Object-Oriented approach to represent the data in the knowledge-base and a profiling phase to simplify the rule-base.

Index Terms— Advisory Expert systems, Rule-base expert systems, Object-Oriented modeling, orientation systems

1 Introduction

The most important decision for freshman year students is selecting the proper major and the university to attend. The choices they make define their future careers and determine the nature of their further specialization in a specific academic domain. Students usually tend to base their career decisions on their preferences and interest not considering their abilities and the faculties required for a particular major witch sometimes leads to critical consequences and affects the student's performances, psychology and personal life. Universities often provide orientation services for new incoming students in order to deliver information, to assist and help them understand and make the right decisions and choices. However, such services are not fully efficient especially when the rate of incoming students is in constant increase each year and guidance services is both time and staff consuming. Consequently, the need for an alternative and computerized advising and guiding process becomes a necessity within universities that seek the improvement of student service quality.

Expert systems [1] are extensively used as advisory systems in many fields; they provide fast and accurate expert advice based on the knowledge contained in the knowledge base. They are efficient, time-saving and they simulate a human expert in both reasoning and questioning approach, which make their use convenient for student guidance process.

The purpose of this paper is to present a prototype of an advisory expert system we called SAGES (Student Advisory & Guidance Expert System) using academic criteria, majors and institutions as offered in University AbdelMalek Essaadi to assist new students and guide them through selecting the adequate major and convenient institutions they could attend.

2 Related work

The use of expert systems in academic advising and career guidance has known a large amount of interest, some of these advisory systems are disposable online, like the case of MyMajors[2], such systems have the inconvenient of being generic, therefore they don't offer a specific and accurate advice adapted for a particular student. "The purpose of academic advising is student learning and personal development"as cited in [3], from this perspective, advising should be a personalized process that focuses on both elements the student and the learning environment (academic majors and institutions) in order to provide each student with the convenient learning situation. Another study [4] uses an object-oriented database modelling in advisory expert system that helps students in selecting the courses of each semester.

In this paper we use an object-oriented expert system to generate a profile for each student, the advising rules and suggestions will be based on the student profile.

3 Rule-based Expert Systems

Expert systems are computer programs that emulate the reasoning of a human expert in the decision-making process related to a specific domain. Rule-based expert systems as detailed in [5] capture the human knowledge represented primarily as conditional relations IF-TEN in the knowledge base component. Regardless of the problem's nature, the knowledge is structured gradually forming as a chain of satisfied rules conducting to the final decision.

Expert systems are used for different types of problems: diagnosis [6], evaluation, prediction [7], advising [8], etc. The challenge is to convert a real life problem into a computerized model of facts, rules and chaining strategy. Most expert systems' knowledge can be represented by a decision tree, easy for humans to understand and conceive, especially for problems whose parameters and criteria are priority ranked.

An academic advisory expert system can be modeled as a decision tree, where the critical factors such as (Current degree, degree classification, placement tests,etc.) are hierarchically positioned in the top of the tree, leaving less influencing fac-

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tors as (student' preference, city,job interest…) in the last levels of the tree. But in this study we seek to personalize the process of advising, therefore we are using an Object-Oriented expert system modelling approach that we discuss further in the present paper.

4 IDENTIFYING THE PROBLEM

The purpose of the advisory expert system proposed is first to select the appropriate major for the student and then to suggest one or more institutions respecting for both tasks the student preferences and the academic norms required for a specific major and institution.

To facilitate the process of student guidance, we propose a profiling phase where a student is associated to a specific category and where academic rules are applied to the profile.

Therefore, we need to consider two entities:

- ***Student profile:*** a category in which a student is associated, it regroups all information strictly proper to a student such as (Current degree, degree classification, courses preferences...).
- ***Academic model:*** contains information about the institutions and majors in the university, the pre-requisites for each major, the maximum and minimum score in placement tests, etc…

In this study, the knowledge specification and representation along with the expert system development are represented in fig1.

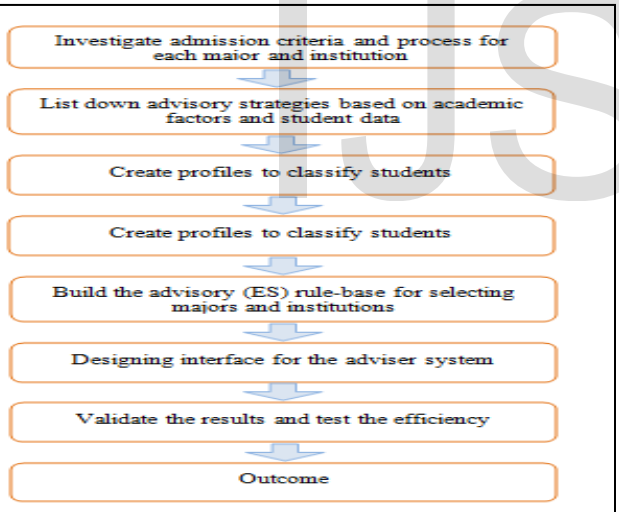

Fig1. Task analysis and representation

5 ADVISORY EXPERT SYSTEM PROPOSED

5.1 Knowledge base modeling

The advisory system proposed in this paper uses an object oriented database structure that facilitates the access, storage and modification of the data. Using the OO modeling also allows the system to consider and construct the student profile, the majors and the institutions as different objects, each with its proper attributes and values which simplifies the relations and rules between these entities.

The advisory expert system (SAGES) was modeled and developed with Kappa-pc expert system shell [9] that offers an object-oriented approach and graphical user interface.

The knowledge base modelling is certainly the most important task in building an expert system, the structure of the knowledge is determined by the process and elements of student advising. Fig2 presents the object hierarchy of SAGES using Kappa-pc's object browser. The object oriented database was divided into sections only for better visibility purposes.

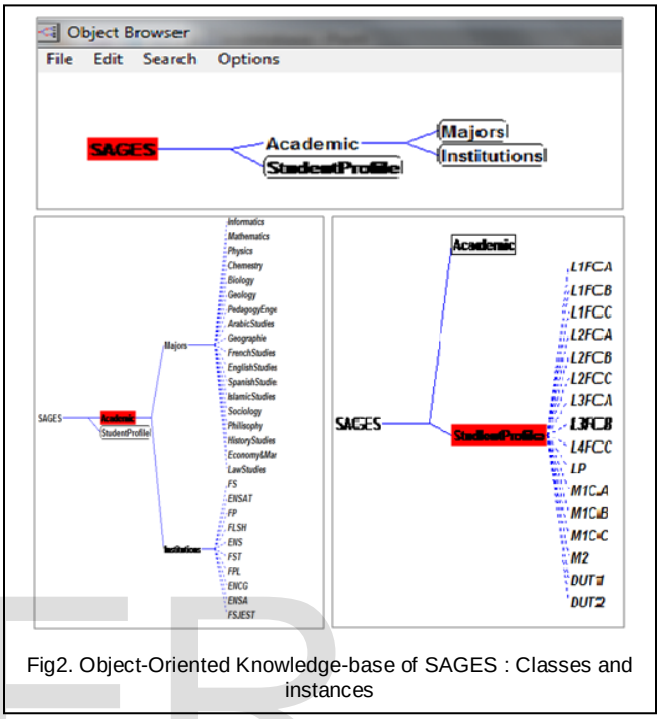

Fig2. Object-Oriented Knowledge-base of SAGES : Classes and instances

Each student is classified into a category we call a profile, the student profile is a class and each profile constitutes a different object and has for attributes (current degree, degree classification (score), current branch, age, major preference, city preference…). The class Academic regroups 2 subclasses: Majors and Institutions, each subclass contains several objects.

The modeling approach used considers each student profile as a single object that can be associated separately with the convenient majors and institutions given the values of attributes of the specific profile.

5.2 Expert systems'rules

Another important component of an expert system is the rule-base, in this paper the student profile is used to determine the majors and institutions proposed to a particular student based on academic rules and for those whom profile entitle them to different choices we use student-preference rules.

Basically we have 3 types of rules; profiling rules, academic rules and preferences rules.

We mention below examples of rules expressed in human language English:

- ***Profiling Rules:***

  Rule1:

  If (Student level is Bac+1) And (Student classification

is Honor)
Then(Student profile is L1CA)

Rule2:
If (Student level is Bac) And (Student age is 30)
Then (Student needs Continuing Education)

- ***Academic Rules:***

Rule3:
If (Student profile is L1FCA) And (Student orientation is Informatics)
Then (Student Major is Informatics And Institution is [FS, FST, ENSA])

Rule4:
If (Student profile is L3FCC) And (Student orientation is Arabic Language) And (Student preference is Mathematics)
Then (Proposed_Major is Arabic Language And Proposed_Institution is [FLSH,FSJES])

- ***Preference Rules:***

Rule5:
If (Student orientation is well-suited with student preference)
Then (Proposed Major is Student preference)

Rule6:
If (Proposed Institution is [FLSH, FSJES] And Student city is Tangier)
Then (Only Institutions of Tangier are sustained)

5.3 Advising process and inference engine

The characteristic of an expert system is the use an inference engine to run the rules and produce new facts following a specific chaining reasoning. The academic guidance proposed by our expert system is a process that consists on 3 main phases; Fig3 illustrates the procedure of student orientation adopted by SAGES.

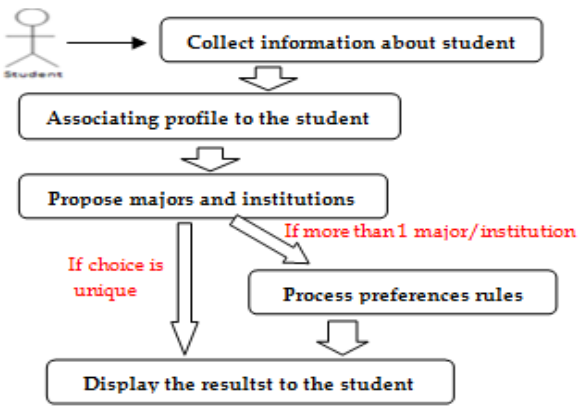

Fig3. The process of academic guidance and student orientation of SAGES

According to fig3, the student provides the system with basic information about his current degree, orientation and degree classification, using these informations, the system produces a profile of the student (eg. Profile SMI1CA means the student is in first year, major mathematics and informatics and his total score is higher than 14). Once the student is classified in a particular profile the system runs the academic rules to construct possible orientation concerning the majors and institutions proposed based only on the student profile generated. The last phase focuses on the student preferences if the system presents more than one major or more than one institution, the system will run the preferences rules based on student preferences previously entered (major preference, subjects of interest, city…), some students are not entitled to preferences because their profile only allows them a particular major in a specific institution.

The expert system shell used to develop SAGES supports both forward and backward chaining. In this study, we used forward chaining to produce student academic advising. The inference engine fired rules whom conditions where satisfied by order of priority as shown in the process presented in fig3.

5.4 User interface of SAGES

The communication between the student and the expert system proposed is held through a graphical user interface to facilitate the student-system interaction. We present some snapshots of the main screen, multiple choice form, message display windows of SAGES respectively in fig4,fig5 and fig6.

The menu, the messages and choices in the forms and questionnaire presented to the students are expressed in frensh, as the system is dedicated to Moroccan students in University Abdelmalek Essaadi. Only the welcoming message is in English.

Fig4. The main screen of SAGES

Fig4 presents the main window of SAGES that basically contains the welcoming message, a menu of buttons in witch students could display generic information about the institutions, the majors, the study levels and degrees that could be proposed by the system. The button Start triggers the advisory expert system and takes the student to the phase of data collecting via some questionnaires like shown in fig5 below.

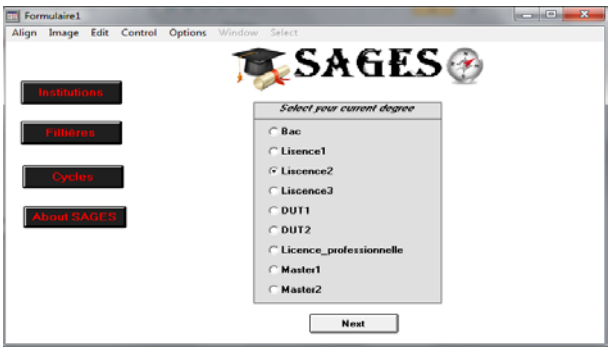

Fig5 and fig6 show 3 forms to be filled by the student; the questions concern the current level/degree, current specialisation and degree classification. These forms are crucial to construct the profile of the student. The system does not require any regestration, which means that any student with access to SAGEM can use it anonymously.

Fig7. Window that displays the profile generet by SAGES

Fig7 shows the window that displays to the student the profile generated by the system with a button of confirmation to continue the major/institution selection, whom results are displayed the same way in a similar window.

6 Discussion and Conclusion

The aim of this paper was to introduce and discuss a prototype of an advisory expert system for student academic guidance that helps them select the appropriate major and institution to attend. This prototype we named SAGES was concieved to be specifically used for incoming students to University AbdelMalek Essaadi. The system proposed was only tested on fabricated cases, but we plan to compare the results generated to real student advising performed by human experts in academic guidance.

As perspective to our work, we seek to improve this prototype in a way to be able to use it as an online application easy to be accessed via the university website.

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