Machine learning algorithms applied to post-bac academic guidance

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Abstract*— Educational guidance is the set of social and individual processes and factors that help students to choose the different courses of study that suit them according to their interests, skills and personality. This is a crucial stage in their educational journey, particularly for post-baccalaureate students, and has a significant influence on their success and personal development. However, traditional approaches to guidance can be limited in their ability to accurately predict students' future academic trajectories. And by introducing AI and machine learning algorithms into school guidance, the traditional school guidance process has been revolutionized.**[1] ***The advanced capabilities of machine learning offer innovative perspectives, with the aim of enhancing the effectiveness of school guidance advice and helping students to successfully navigate their academic and career paths. By analyzing students' academic and personal data, machine learning algorithms can detect patterns and trends that are difficult to detect manually. This information is used to offer personalised recommendations on the courses and career paths that best match the student's interests, skills and goals.

Keywords— Academic guidance, machine learning, Smart guidance, prediction, guidance decision

I. INTRODUCTION

Prior to the mid-twentieth century, career guidance focused primarily on adapting individuals to occupations. Students' career choices were more influenced by their socio-economic background and cultural heritage.
Even today, guidance counsellors often limit themselves to providing information on career paths, without really looking at the reasons for choice. Yet, in order to promote individual freedom, career guidance should offer appropriate support to students throughout their school career, providing them with reliable and relevant information to help them reflect on their personal and professional project. This applies from elementary school through to the end of secondary education. This requires the integration of technological solutions such as machine learning, in order to identify this growing demand and variety of criteria.

We will approach this topic in three parts: the first will cover the history and challenges of school guidance; the second will summarize the use of artificial intelligence to facilitate the choice of school guidance. The third section will be devoted to machine learning.

II. ACADEMIC GUIDANCE: ISSUES AND REALITY?

A. Academic guidance : the example of the French-speaking-world

Before the mid-twentieth century, there was no school-based guidance in the true sense of the term[2]. Guidance thinking was limited to the adaptation of individuals to occupations: it was a question of aptitude and ability to enter the job market (Guichard, 2006). Guidance therefore reflects a choice of occupation, influenced by socio-economic factors and the family's cultural level. According to Léon, in his book entitled "Psychopédagogie de l'orientation professionnelle", the aptitude diagnoses adopted in careers guidance are of little relevance and have little influence on students' career choices, which are instead influenced by factors such as socio-economic background or the family's cultural heritage. At careers interviews, students often arrive with their choices already made, without having access to complete and reliable information. Guidance counsellors generally confine themselves to giving information about career paths, without really looking into the reasons for the choice. Career guidance should promote individual freedom by encouraging work on career choices. To achieve this, it is vital to provide appropriate support for pupils throughout their school career, from primary school through to the end of secondary school, while giving them reliable and relevant information to help them think about their personal and career plans. The aim is to enable pupils to play an active role in building their plans and to combat external factors, such as the socio-economic and cultural context, which can have an impact on their choices. As Léon (1957) emphasises in his book, the school must lead the pupil towards a career while encouraging personal development. By encouraging students to express themselves freely and autonomously, schools can effectively guide them towards an activity that matches their preferences and aptitudes.

B. Vocational Guidance in the English-speaking world

In the English-speaking world, Vocational Guidance aims to help individuals choose a profession. It differs from educational guidance, which focuses on academic choices. The term vocational guidance covers both terms and focuses on the relationship between learning and work. Brewer and Landy (1943) and Kitson (1954) are researchers who suggest guidance practices similar to those suggested by Léon, involving the construction of a vocation through practical experience, the exploration of different ways of living and working, and social interaction. Career guidance, which focuses on matching individuals with the careers that suit them, emerged in the early 20th century, but gained momentum after the Second World War[3], and became widespread in schools from the 1970s

onwards (Pelletier, 2004). During this phase, schools began to suggest advice to support students in their choice of studies and profession (Danvers, 2009). School counselling gradually evolved in line with changes in education systems, with the aim of reducing selectivity and facilitating migration between school and the labour market.

C. Academic guidance in the Moroccan education system

According to Ali Boulahcen, there is no real guidance policy in Morocco, but rather a summative process based on marks and academic merit. This means that Moroccan schools are based on selection criteria rather than guidance.[4]

D. Approaches to educational guidance

1) Individual interviews:

The traditional method of meeting consultants individually and assessing their interests, strengths and weaknesses can be used to choose a career path. However, this method has a number of limitations, including the fact that it is not available to everyone, is time-consuming and is based on subjective and sometimes erroneous data.

2) Psychometric and personality tests:

In order to obtain a clearer picture of the personal characteristics that influence career choice, specialists have chosen to use psychometric and personality tests. However, these tests are not exhaustive, as other factors such as demography, culture and environment must also be taken into account.

III. Artificial intelligence (AI) at the service of academic guidance

Over the last ten years, the use of artificial intelligence in education has developed considerably[5], with a number of studies being carried out to implement intelligent systems to help students make a useful decision for their guidance. AI-based solutions offer new opportunities to support and guide students, while improving the effectiveness of school counsellors; who are under increasing pressure to meet students' academic, social and emotional needs. AI can help advisers identify students' interests, as well as freeing them up by automating certain repetitive tasks and allowing them to focus on more complex issues.

A concrete example of the use of AI in school guidance is the use of "chatbots", a computer programme that simulates a conversation with a person, whether written or spoken[6]. these programmes mimic human conversations and can provide students with information on school planning, applications, career exploration, mental health, etc. This allows counsellors to focus on the issues that require their expertise. This allows counsellors to focus on the issues that require their expertise. In addition, AI-based platforms can help identify students who may be experiencing academic, social or emotional difficulties by analyzing data such as attendance records, grades, etc. This early support is crucial to improving student success and well-being.

In addition, AI can also enhance the professional development of school counselors by evaluating the effectiveness of different interventions and providing best practice. This allows counselors to hone their skills and improve outcomes. However, it is important to recognize the challenges and limitations of AI, such as privacy and security issues, as well as the potential for algorithms to perpetuate existing biases and inequalities.

A. Machine learning:

Machine Learning is a sub-discipline of artificial intelligence, enabling computers to learn without having been programmed to carry out particular tasks, by means of algorithms capable of learning and making predictions from data[7]. These algorithms build a model from input samples and are used in a variety of computing tasks where it is difficult to design and program efficient explicit algorithms. Machine learning is related to computational statistics, which also focuses on using computers to make predictions. In the field of data analysis, machine learning is used to design complex models and algorithms to predict, analyse and make reliable decisions. Classifying machine learning algorithms is possible based on their learning mode :

1) Supervised learning:

Supervised learning is a method in which the computer is given examples of inputs and outputs. The computer must find solutions to obtain outputs based on the input data[8]. The aim is to teach the machine the correspondence between inputs and outputs. In this method, the data is generally labelled to indicate the patterns that the machine should search for. Supervised learning is used to classify new data based on previously labelled data. Learning algorithms identify relationships between predefined patterns and apply them to unlabelled datasets to designate them into similar groups. Frequently used algorithms include: logistic regression, KNN, decision trees, Naïve Bayes classifier, neural network models and support vector machines (SVM).

2) Unsupervised learning:

Consists of having only input data and no corresponding output variables. The aim of unsupervised learning is to model the structure or distribution of the results in order to learn more about the data.[8]

3) Semi-supervised learning :

Which lies between supervised and unsupervised learning, makes it possible to take advantage of the large quantities of unlabelled data that exist in many use cases, in combination with generally smaller sets of labelled data.[9]

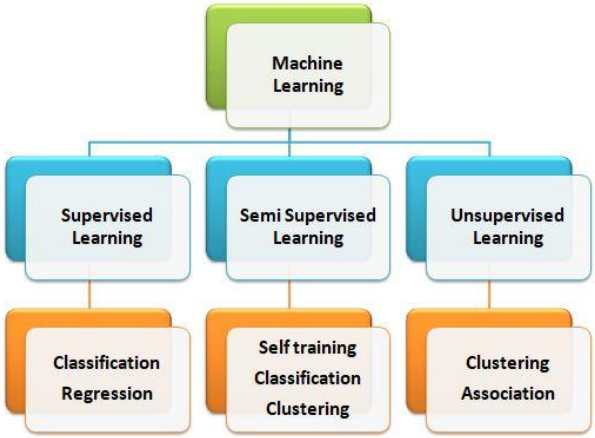

Fig. 1 Machine Learning types

a) Logistic regression :

Logistic regression is a machine learning technique used to analyse historical data and predict unknown values. It determines the relationship between two different data factors, in order to estimate the value of one as a function of the other. This technique enables more accurate and informed decisions to be made, by helping to solve regression and classification problems.

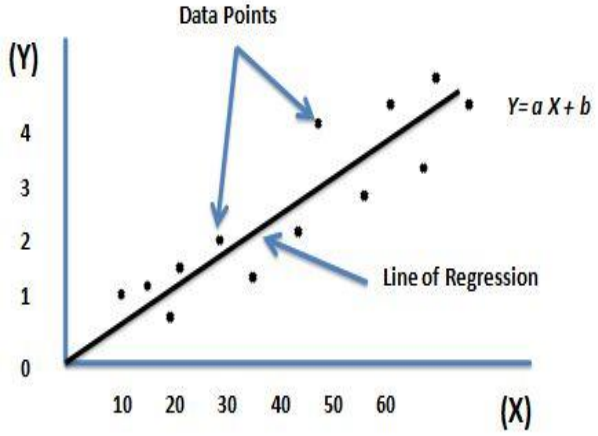

Fig. 2 Example of logistic regression line

b) The k-nearest neighbors (KNN) :

The K-nearest neighbour (KNN) algorithm is a commonly used machine learning method for classifying and clustering similar points in a multi-dimensional space. The algorithm works by examining the K nearest observations.

The main steps of the KNN algorithm are: data collection, choice of the number of neighbours (K), calculation of the distance, identification of the K nearest neighbours, classification and prediction.

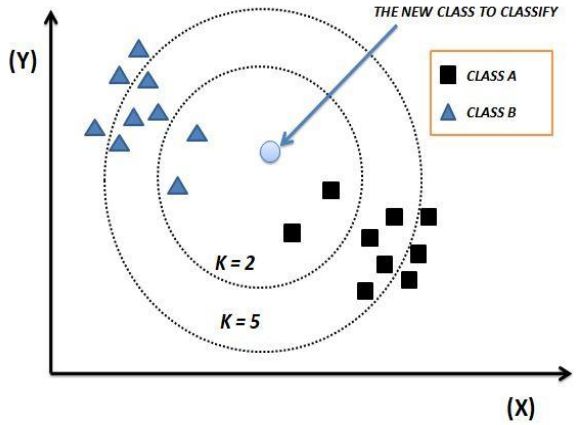

Fig. 3 Example of K-NN model

c) The decision tree algorithm :

The decision tree algorithm is used to solve classification and regression problems by segmenting data into subsets based on the characteristics of the data. The steps in the algorithm include data collection, selection, data partitioning, tree construction and using the tree to make predictions. Decision trees are simple to interpret and to represent graphically.

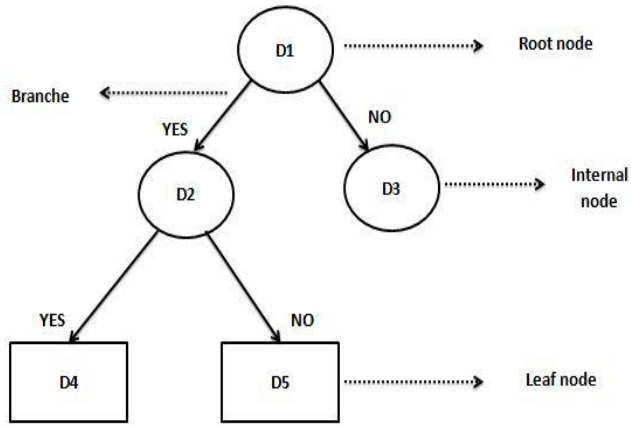

Fig. 4 Example of decision tree representation

d) The naive Bayes classifier :

This is a machine learning algorithm used for classification, based on Bayes' theorem, a classic principle of probability theory based on the use of conditional probabilities.

e) The SVM (Support Vector Machine)

The objective of the (SVM) algorithm is to find an optimal hyperplane for separating different classes in a multidimensional space. The key stages of the algorithm are the collection of labelled data, the choice of a kernel and the pre-processing of the data, in particular through normalisation.

B. The role of machine learning algorithms in academic guidance:

Machine learning algorithms have an important role to play in educational guidance, offering personalized and relevant recommendations to students. These algorithms use AI technologies to analyze large data sets, including students' prior learning, interests, aptitudes and goals, with the aim of producing tailored recommendations. Using supervised learning, unsupervised learning and natural language processing, these algorithms can predict the likely outcomes of academic choices. Based on individual skills, preferences and labor market trends, for example, they can suggest suitable study programs or careers, enabling students to make informed decisions about their academic and career paths. In addition, machine learning algorithms are able to detect early signs of academic difficulties, enabling counselors to intervene more quickly with additional support and appropriate resources [10]

IV. CONCLUSION

This article explores the issues and realities of academic guidance, as well as the growing role of machine learning algorithms and artificial intelligence (AI) in this field.

First, we examined the challenges facing school guidance approaches, including the limitations of traditional methods, the difficulty of providing personalized advice and the inability to predict school choices. We then discussed the important role of machine learning algorithms in school guidance, as well as the uses of artificial intelligence in school guidance. In conclusion, the growing use of machine learning algorithms offers opportunities to improve the effectiveness, relevance and accessibility of guidance services. By deepening our research and collaborating with guidance and career guidance specialists, we will be able to harness the full power of machine learning algorithms and artificial intelligence to develop school guidance and help students succeed in their academic and professional careers.

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