Supervised Learning Techniques for Virtual Military Training

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Abstract

Development of some applications that would provide the officer-students and the teachers with a real time feedback based on the existing data from the virtual training system is imposed in order to realise a student-centred training. In this regard, we will use supervised training techniques so as to identify the patterns/ models from the data sets of the system. According to them, we can generate, organize and disseminate the knowledge necessary for a good training of the future officers. The conclusions presented at the end can be successfully used to develop an intelligent tutoring system that would allow monitoring and predicting the students' performances.

Keywords: Supervised Learning, Decision Tree, Neural Networks

Introduction

Development and expansion of e-learning systems, the progress regarding the processing power, the capacity of data storage and the diversity of the digital formats that present the educational contents have all had an important impact upon the military educational system.

The advantages offered by the e-learning technologies are by default admitted, as it can be noticed in the present tendency regarding the officer-student training using on-line courses. These advantages (GAO, 2004) include: better facilitation of student and faculty interaction, increased flexibility in modifying course material; reductions in time required to complete programs, better leveraging of resources for administrative support, and establishment of learning management systems that monitor student progress and produce management reports.

By using e-learning systems for officer-student training, the tendency is to move from a classroom-centric delivery of instruction to a learner-centric model, in which the officer-students assume greater responsibility for learning facts, procedures, and complex skills as well as teamwork skills.

The process of implementing and using the modern military technologies will have major consequences not only for the military ”concepts and doctrines but also for the military training and education, which implies full consistence of the educational programs with those from NATO and EU countries” (www.presidency.ro).

Therefore, it is compulsory that higher military education redefine its functions, development strategies, managing system, also its general and specific functioning principles. Reorganizing the military training system, restructuring the educational programs, restating the educational objectives and including the new technologies in the educational processes are all key elements that will provide the military personnel with the possibility of training the skills and capacities necessary not only to fulfil the military profession but also to be able to integrate within the civilian life.

These changes have important consequences also upon the e-learning system leading to a big collection of digital data. By diversifying the digital formats of presenting the educational contents and by increasing the number of enlisted students it is more and more difficult to exploit the data stored in an e-learning system using the traditional methods. This is the reason that the data analyse using certain automatic techniques assisted by the computer is required.

Supervised learning techniques such as decision trees and artificial neural networks are used more and more frequently in analysing the data collected by the educational system(□u□nea, 2009a) as they allow creating new explicit models and can be validated, modified, learned from, or used for training novices in a given domain(Krzysztof et al, 2007).

In this context our goal is to use the data representing the students' preferences regarding the most relevant traits of the e-learning environment so as to generate models that would be the fundamental base for developing an intelligent system for officer-student training.

Background and Literature

As we gain more experience regarding e-learning system, we can notice that essential is not only accessing the content regardless the time or space, but also the quick accessing of the relevant, focused and directly usable content.

In the recent years we can notice an increased interest regarding the use of techniques from the artificial intelligence domain in processing the data specific to the educational area mainly e-learning. Models as components can generate intelligent information that would support the students' training activity, although using the computational models within the training processes may turn out to be more important for teachers rather than for learners (Baker, 2000).

Supervised learning techniques have been successfully used by higher educational institutions in all academic processes.

An important and long-term objective of each higher educational institution is represented by student retention, due to the inferences that it has upon the students, the teachers and the administrative personnel. Therefore, a series of models has been developed by using the decisional trees and the artificial neural networks so as to identify the relevant factors for student retention (Herzog, 2006, Delen, 2010).

Also the predictable mechanisms have been developed which analyse the students' failure/success according to certain factors such as family, social status, financial status (Pinninghoff Junemann et al., 2007).

Within the e-learning educational systems, a special attention has been given to developing some models for an intelligent tutoring system that would adapt contents to students'profile (Hall and Ko, 2008). Certain researches have been conducted so as to analyse the way in which the educational resources are used with different learning characteristics(Kelly and Tangney, 2006). Neural networks have been used in order to develop certain agents (Wang et Mitrovic, 2002) that would allow predicting the scores achieved by the students and choosing certain items appropriate to the knowledge level. A special attention has been given to data analyzing and predicting student graduation outcomes (Herzog, 2004; Karamouzis and Vrettos, 2008; Lykourentzou, 2009,).

Supervised learning techniques have been useful in solving those tasks that recurrently appear when designing systems to support teaching-learning processes (Salcedo et al, 2009).

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The use of e-learning platforms in training the military has many advantages. Besides the facilities offered to resident/ on-resident students regarding the flexibility of choosing the place and moment for learning, we can add the advantages obtained by the educational institution such as decreasing the number of instructors, re-use of the educational contents and use of several forms of media.

The formats used to present the educational contents influence directly the achievement of the performance objectives specific to military training. This is why we have conducted a research based on which we have identified the students' preferences for the most relevant e-learning characteristics. The answers representing the students' personal choices have been stored in a dataset. The fields that are important for our research can be visualised in Table 1. The dataset consists of 140 recordings.

Table 1. Dataset description

Field	Description
Changes	The students' perception regarding the effects of using e-learning technologies upon the military training.
Browsing	The most efficient way the students can cover the studying (training) materials as far as the learning guidance process is concerned.
Multimedia	The multimedia format of presenting the educational contents which helps develop certain relevant skills necessary for future activity.
Communication	The most efficient communication means used to send the information.
Organization	The organizing form that maximizes the efficiency of the e-learning training process.
Feedback	The useful role of the feedback provided by the e-learning platform regarding the scores on the tests.
Interaction	Existence of a strong influence of the interaction factor upon knowledge gaining.
Mark	The score achieved by each student at the end of the course.

We will use decision trees to predict the belonging of the instances to certain distinct classes defined by dependent variable Changes, starting from categorical variables Browsing, Multimedia, Communication, Organization, Feedback, and Interaction. This technique is often used due to the advantage provided by the decision tree that allows a very suggestive visual point of the classes. The objective is to discover certain relations between class variable and the attribute variable.

The decision tree has been induced based on the CART algorithm. To achieve an optimal level, the k-fold technique has been used for k-10. This can be visualised in Figure 1. As it can be noticed, 62,14% of the students consider that e-learning technologies have brought positive changes to specific military training. About 60% of them consider that the use of simulating programs, the text and video formats in the training activity and an increased degree of interaction are all essential elements that help achieve the specific objectives of the military training.

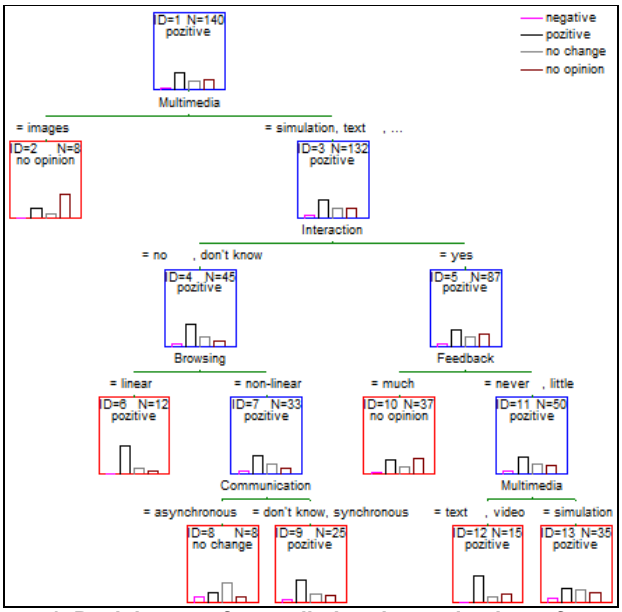

Figure 1. Decision tree for predicting the student's preferences with regard to the most important e-learning characteristics

32% of the students are not decided regarding the changes provoked by e-learning technologies, as they are interested in the learning materials presented as simulations, video and textual, a high degree of interaction and a positive feedback provided by the platform.

Next, we will use artificial neural networks (ANN) to create a model based on which we can predict the scores achieved by the students at the end of the course according to the preferences that they have regarding e-learning. We have used ANNs, the type Multilayer Perceptron (MLP), Radial Basis Function (RBF) and Linear for which we have calculated the performances and the errors recorded by each network. The networks can be visualised in Table 2.

Table 2. Details regarding configuration, performances and errors recorded by each ANN type

Type ANN	Performance of ANN			Error of ANN			Numbers of input variables	Numbers of hidden neurons
	Train	Select	Test	Train	Select	Test		
MLP	0,900	0,343	0,429	0,423	3,909	3,206	6	10
Linear	0,486	0,229	0,314	0,453	0,519	0,487	5	0
Linear	0,471	0,314	0,429	0,461	0,509	0,496	4	0
RBF	0,543	0,343	0,429	0,430	0,495	0,483	6	6
RBF	0,514	0,371	0,486	0,449	0,484	0,470	6	3

It can be noticed that the best values have been achieved for RBF network which has 6 input variables, 3 hidden neurons, and 1 output variable (Mark).

Conclusions

The e-learning characteristics have a powerful impact upon the military training. In this regard, we have studied the preferences of the student-officers for the most relevant characteristics of the e-learning environment. For the analyse we have used decision trees and ANNs, types MLP, RBF and Linear.

To induce the decision tree we have used the CART algorithm. Taking into account the big percentage of students considering that including the e-learning technologies in the training process has brought positive changes to the specific military training, we conclude by stating that they occurred due to a synchronic communication and to the use of simulations and video materials. Next, we have developed the ANNs models to predict the students' scores having as entry variables the e-learning characteristics.

For projecting an intelligent system of training, the use of decision trees allows identifying the student classes with the same preferences regarding the characteristics of the e-learning environment, and ANN RBF type will allow predicting their performances.

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