



PROCEEDINGS

of the
6th International Conference on

CONTROL AND OPTIMIZATION

WITH INDUSTRIAL APPLICATIONS



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with Industrial Applications (COIA 2018)**

PREFACE

This volume of Proceedings contains selected papers from the 6th International Conference on Control and Optimization with Industrial Applications (COIA 2018) held in Baku, Azerbaijan, on July 11-13, 2018. The conference, which was organized by the Ministry of Transport, Communications and High Technologies of the Republic of Azerbaijan, and the Institute of Applied Mathematics of Baku State University has received more than 300 abstracts. Following a review process, 222 of these were accepted for presentation at the conference. We thank all participants for their contributions to the Conference program and for their contributions to these Proceedings.

The topics that are covered in the conference include Control Theory, Optimization, Intelligent Systems, Fuzzy Control, Numerical and Computational Methods, Network and Telecommunications, Mathematical Modelling and Simulation, Applications in Industrial Processes and Economics, and Identification.

Reviewing and evaluating the submitted abstracts to COIA 2018 was a challenging undertaking that relied on the goodwill of many researchers who are experts in the topical areas covered by the conference. More than 65 researchers were involved in that process, and we thank them for their time and effort in reviewing the submissions and in providing useful feedback to the authors, which the final versions of the papers included in these Proceedings have benefited from.

We would like to express our deep appreciation to the conference sponsor, Ministry of Transport, Communications and High Technologies of the Republic of Azerbaijan for their financial support.

As this conference is being closed, we look forward to the next one in the series, the 7th International Conference on Control and Optimization with Industrial Applications, which will be held in 2020.

**Aliev Fikret
Tamer Başar**

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APPLICATION OF METHODS OF DATA MINING IN THE EDUCATIONAL PROCESS

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1. INTRODUCTION

As information technologies become more widespread, the volumes of information stored in databases increase. Traditional approaches are becoming ineffective, and that leads to the development of modern methods of Intelligent Data Analysis (IDA), as these methods are promising solutions for increasing the efficiency of analysis of large volumes of poorly structured information. The goal in this paper is to show the advantage of methods of data analysis with the help of economic and physical models of analogies.

Recently, in modern organizations, continuous development requires an increasingly effective and efficient organizational and production environment and the availability of tools for modeling business processes, analyzing their implementation, monitoring and documentation tools. Modeling a business process is a complex task that requires a thorough knowledge of the process. Modeling this type of problem, the analyst is provided with means for testing hypotheses in the analysis of data. Further, the analyst generates hypotheses based on his knowledge and experience. However, knowledge is not only in man, but also in the accumulated data that are analyzed. Such knowledge is often called "hidden", as they are contained in gigabytes and terabytes of information that a person is not able to investigate on his own. That is why in modern science there is an increasing interest in discovering hidden knowledge mostly by means of IDA, which is given special attention in this work. The purpose of this technology is to study the process of finding new, valid and potentially useful knowledge in the database and finding them necessary for making optimal decisions in various areas of human activity - in science, business and telecommunications, banking, industrial production and so on.

From various aspects of the problem of analyzing the data of the educational process were considered in the works of Baker R. [1], Grigoriev L.I. [2]. In this paper, the methods and technologies of experimental and theoretical studies of the regularities of the development of the system of higher professional education are studied, and an approach is proposed for quality management in the education process with the use of IDA tools.

2. THE APPLICATION OF THE METHOD OF DATA ANALYSIS IN THE FIELD OF EDUCATION

Data Analysis plays an important role regardless of the type of industry, and in the sense of the education system. Conducting effective policy and support for the adoption of reforms in the field of education requires the use of new methods of analysis to prepare organizational and management solutions that are adequate to modern tasks. In this situation, information and analytical support becomes one of the main "services" in solving the problem of modernizing the

quality management of education. Education - one of the key links in the socio-economic system. In the conditions of formation of the economy based on knowledge, educational institutions of higher professional education should play a major role. But their missions, structures and management systems need to change in order to meet the current requirements of the economy and the future requirements of a knowledge-based economy. In accordance with the former (before the 90-ies) norms, the education system was supposed to prepare specialists for orders, centrally formed by the state. Under the conditions of the fundamentally new structure of the country's economy, the practical disappearance of individual enterprises and entire industries, the growth of medium and small businesses, this system ceased to exist.

The question now needs to be put as follows. What should be done in conditions when some of the graduates do not seek or can't work in their specialty, and some in general plan or are forced to leave the country; most employers do not want or can't train them; some professors can't provide the knowledge that is in demand now, since they have never worked in modern organizations and modern industries, or simply they do not have the time and desire for it? Is it not worth the question now that the previously existing system of higher professional education should radically change, because, at present, different categories of participants in the educational process and the education system as a whole have different goals and interests.

Building an IA model is an integral part of a larger process, starting with the definition of the basic problem that the model will solve, and ending with the deployment of this model in the production environment. Despite the fact that this process is cyclical, each step does not necessarily lead directly to the next step. With insufficient data, additional data are needed to create the required IA models. At present, the credit technology of education is widely used in Azerbaijan's universities. Information systems of Azerbaijani universities accumulate large volumes of information about students' learning activities, students' academic achievements are fixed during the semester with the help of control points, and the final grade is calculated. Existing information systems in higher education institutions (if they exist) are used only as information support systems for the educational process and the accounting system, but not as a management system. They lack the components necessary for analysis, modeling and forecasting the behavior of the elements of the university system and the university system as a whole. This does not allow real control over processes, resources and, ultimately, the educational system.

It is necessary to use intelligent algorithms for processing information that could provide clear and understandable results for making decisions in order to improve the learning process. However, the problems of applying the methods of "Data Mining" for the analysis of data and decision-making in the sphere of education remain unresolved, taking into account various criteria. The purpose of the study is to analyze the learning outcomes and activities of students to make management and organizational decisions using the methodology of operational and IDA.

To control the quality of the educational process, the authors proposed an approach that includes methods of OLAP technologies and "Data Mining", which allows:

- Identify the patterns and trends that exist in education data systems;
- form clusters containing objects of education with similar characteristics;
- find dependencies in large data sets;
- identify the indicators of education that best allow you to predict the results of the educational process;
- build models for predicting the results of educational activities;
- identify the weak and strong points of educational policy;
- generate recommendations for making managerial decisions [3].

To implement the proposed approach, primary data were processed and analyzed with numerous indicators of the educational statistics of a higher education institution for a certain period of time. The algorithm for implementing the proposed approach in the following order:

1. Collection and cleaning of the educational process data.

2. The study of data, which will allow us to understand how adequately the prepared set represents the educational process of the university.

3. Select the kind of analysis: OLAP analysis or Data Mining.

4. OLAP-based solution allows implementing fast aggregation / detailed data operations on summary set of indicators, thus providing the analyst with detailed or generalized operational information on the indicators of the educational process that interest him. For our analysis, as measurements in which the data will be analyzed, the following can act:

— indicators of the educational process (grades for the exam, the final score, colloquiums 1 and 2, etc.);

— period, depending on the degree of detailing year, semester, rating period, week);

— faculty;

— aggregation level (department, specialty, group). A multidimensional model is visually represented using a cube.

5. Intelligent analysis, which consists of the following stages: analysis of the influence of factors, factor analysis, cluster analysis.

The proposed approach is implemented in a Microsoft Power BI environment using an intelligent environment to create and operate this mining model. An analysis of the influence of various makes it possible to determine how the result of the educational process depends on other parameters (learning factors). In this study, an analysis was made of the influence of factors on the examination score on disciplines. This stage allows you to assess the degree of influence of different parameters of the educational process on each other, while completely independent and, conversely, completely dependent factors should be removed from consideration. Thus, the analysis of the problem shows that the task of managing the quality of education in modern conditions is complex and diverse requires the simultaneous use of several approaches to management, accounting for many factors. The existing approach to the management of the quality of education in higher education has a number of such drawbacks as the low level of processing of the educational process data, therefore, a new approach to the management of the quality of the educational system using the methods of operational and intellectual analysis was proposed, and the architecture of the information and analytical system for management was designed quality of the educational process. The results of operational and intellectual analysis make it possible to improve managerial activity in the sphere of education and can be used in decision support systems.

Keywords: Intelligent data analysis, OLAP, factor analysis, cluster analysis.

Subject Classification: 62-07, 68U35.

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