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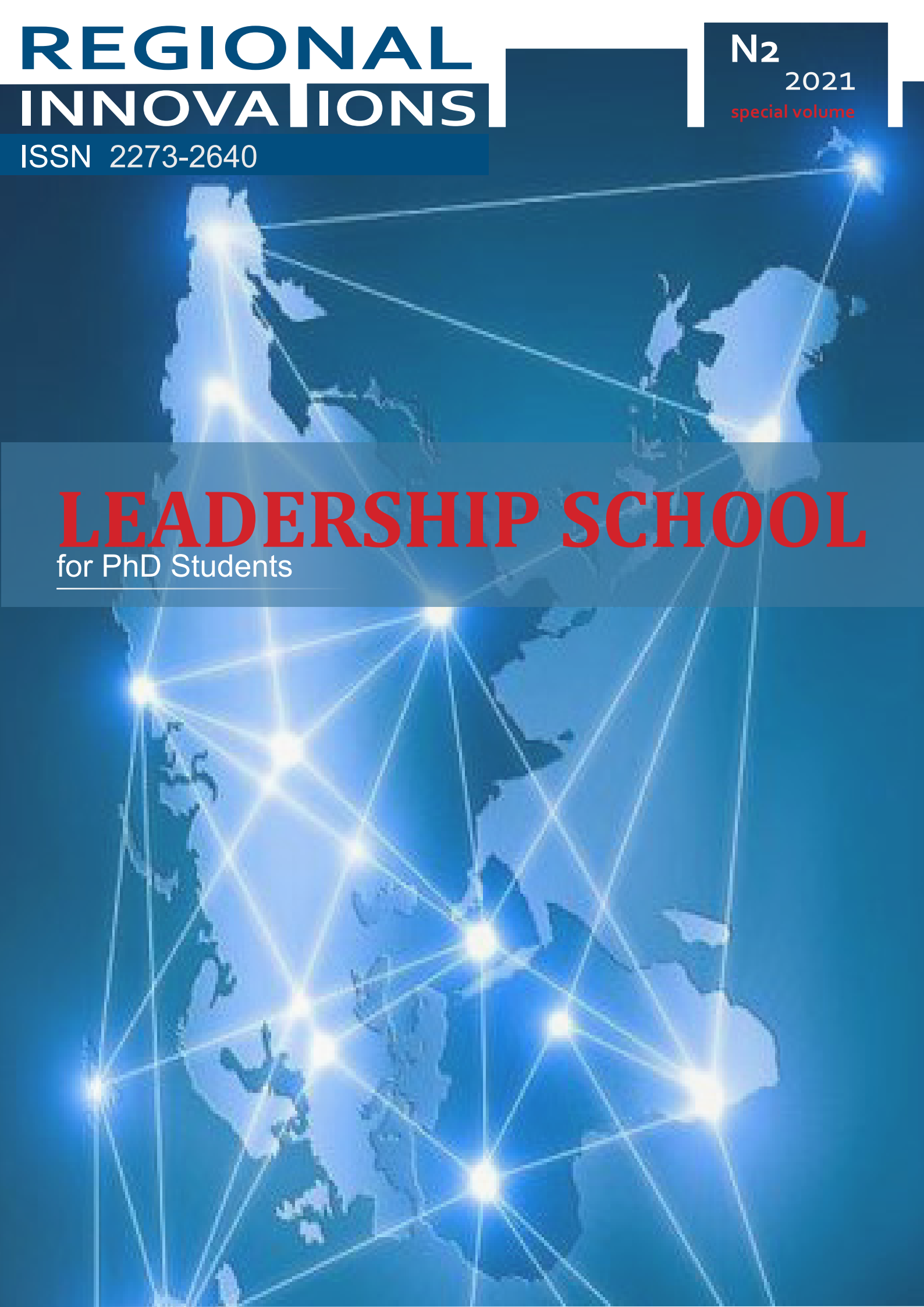

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This is a policy and research association that brings together all knowledge transfer professionals who are interested in delivering efficient, flexible, innovative and cost-effective services across the private and public sectors. We work closely with business, research and educational institutions, government agencies, policy makers, NGOs, media, individuals and other stakeholders to promote the interests of their industries.

Our members understand the changing needs of the transfer and exchange of knowledge and innovations and through continuous professional development, marketing and networking opportunities offered in this association, we keep current with the latest knowledge trends and issues that challenge people in their work and life journey. We also offer expansive opportunities for partner connection through our networks.

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www.irn.center

Contacts:

E-mail: info@irn.center
Address: 16, rue de la Roche,
Crégy-lès-Meaux, 77124, France
Tel. : +33 6 48 18 86 95

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Olga Sukhanova
Senior Lecturer,
Department of Medical Informatics,
Shupyk National Healthcare University of Ukraine,
Kyiv, Ukraine
olgasukhan@gmail.com

LOGICS AND BASIC PRINCIPLES FOR EVALUATION OF QUALITY OF DOCTORS' CONTINUING PROFESSIONAL DEVELOPMENT USING THE ELECTRONIC PORTFOLIO

Nowadays, during the multi-scale digitalization of society, special attention is paid to the use of modern innovative methods in all areas of development, including both graduate and postgraduate education. Information technologies have changed the world, revolutionized education and changed it for the better [6, 8]. The quantity, quality and variety of information technologies currently offered for education is impressive [2]. And during the COVID-19 pandemic these technologies brought the mechanisms of electronic and remote education in graduate and postgraduate medical education [4, 5]. In this case, there is a need to improve the accounting mechanism, especially the evaluation mechanism of the quality of knowledge in continuing medical education in general. However, the use of electronic portfolio technology has become more relevant nowadays [9] both for formalizing knowledge and competencies, monitoring them and for integral evaluation of the quality of education in continuing medical education.

Now a portfolio is often understood as a web technology that allows a doctor to register all the evidence of their experience, competence and professional success throughout the entire period of professional development.

However, the logics of an average approach to evaluation of the labour efforts of obtaining knowledge for different medical professions, the same approach in measuring related competencies in different medical specializations negates the features of professional activity.

The portfolio is considered as a personal professional-oriented technology, a form of authentic evaluation of the educational results of a doctor's education, an effective means of quantifying educational and professional growth in their continuing professional development.

The portfolio can be used to show the competencies in interdisciplinary and transdisciplinary areas of medicine, as well as the acquisition of non-clinical skills [12]. In many countries a portfolio is mandatory to qualify as a doctor [3]. The portfolio promotes lifelong learning, it allows storing all the evidence of learning for further analysis and correlation with your knowledge and needs for it.

The purpose of the work is to justify the background for creating a new type of portfolio by using methods of data mining of multidimensional information, which is entered into the portfolio.

There are hundreds of characteristics that reliably describe the doctor's work. Therefore, it is quite difficult to give an integral description of the specialist's work. Technically, each characteristic of the doctor's work can be represented by an n-dimensional arithmetic vector, which is an ordered set of n real values of specific measures. They will be the coordinates of a vector. The number of coordinates of a vector will be its dimension. Thus, we have a multi-dimensional, disordered data matrix. These data can also still be

burdened with weight factors of measures that describe the doctor's proficiency, and in addition to the huge dimension, the quantitative evaluation of training procedures is complicated because evaluated content is unstructured and changes rapidly. Uncertainty in a choice of training, training providers certification, quality control systems for training etc. are also the problem. Therefore, there is a need for informal complex measurement, it is necessary to use various evaluation tools, methods of multidimensional analysis, and special methods for integration of scores from different quantitative and qualitative scales simultaneously [11].

But in the modern "Big Data" world a large database is normal. To solve this problem, there are many methods of information processing i.e. data mining methods.

Data mining is a process in which the original data are structured using mathematical and computational algorithms and various data patterns are formed or identified [10]. Taking into account that today any algorithm can provide a valid evaluation of the professional growth of a specialist, we suggest ensemble learning, which is a combination of several algorithms that learn simultaneously and correct each other's mistakes. We think that this approach can provide the most accurate results. Among the many algorithms we consider the most important ones to include in the ensemble are the following:

Algorithm C4.5 builds a classifier as a decision tree. C4.5 was developed by Ross Quinlan. It is used to create a classifier as a decision tree from a classified dataset. A classifier refers to a data analysis tool that takes the data needed for classification and tries to predict the class of a new data. Each data point will have its own attributes, which fully corresponds to our problem. C4.5 builds a decision tree, asks questions about the attribute value and classifies new data according to these values. Decision trees are always easy to interpret and explain.

K-means method creates k-groups from a set of objects so that the group members are as homogeneous as possible. It is not guaranteed that the group members will be exactly the same, but they will be more similar compared to the other group. The k-means method refers to multivariate and multidimensional analysis algorithms. This mechanism can help us to divide the characteristics of a doctor's training and work into homogeneous clusters and then compare them with references.

Apriori Algorithm searches for association rules and applies to databases with a huge number of transactions. Learning association rules is a technique to study relations between database variables.

EM algorithm: the expectation-maximization (EM) algorithm is usually used as a cluster algorithm for identifying knowledge. In mathematical statistics, the EM algorithm is iterative and is used to estimate maximum likelihood when calculating the characteristics of a statistical model with hidden variables.

NaiveBayes algorithm is a collection of classification algorithms. The assumption used by the algorithm family is that each feature of the classified data is independent of all other class features. Naive Bayes is a simple but surprisingly efficient algorithm. The model consists of two types of probabilities that are calculated using training data: the probability of each class. Conditional probability for each class for each value of X. After calculating the chance model, it can be used for prediction using new data using Bayes' theorem.

There are a lot of such algorithms [7,12], but we need to choose an analysis mechanism that will allow us to make the most objective conclusion about the proficiency of the specialist they describe in a short time and take into account all the features of each data set. For this purpose, it is proposed to use both classification and probabilistic estimation methods. The scheme of the machine learning process is shown in fig. 1. This integrati on will allow us to use probabilistic estimates in selected homogeneous clusters to create a complete picture of significant educational outcomes in general.

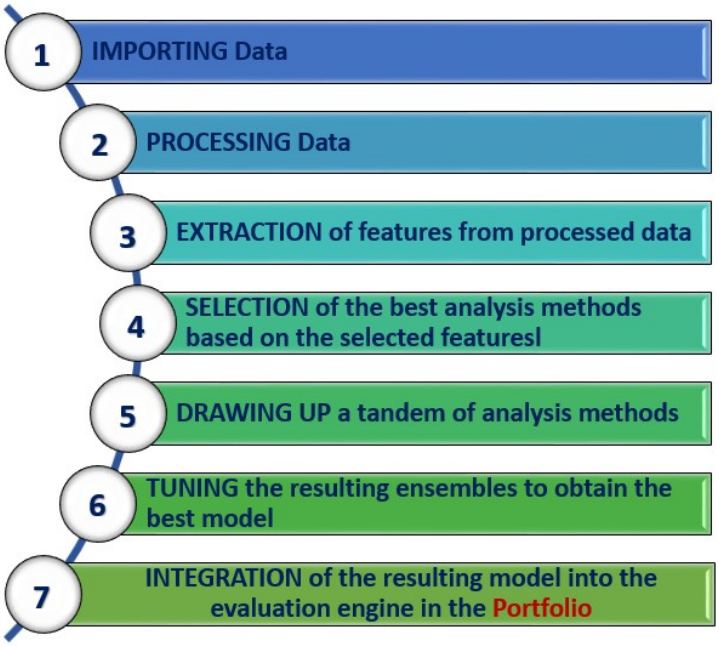

Fig. 1. Scheme of the machine learning process.

Conclusions

1. A portfolio can become an effective means of objectifying and quantifying educational and professional growth both in training and in the continuing professional development of a doctor when using a fundamentally new data analysis mechanism i.e an ensemble of algorithms for data mining.

2. Taking into account that nowadays any algorithm can provide a valid evaluation of the professional growth of a specialist, we suggest an ensemble learning, which is a combination of several algorithms that learn simultaneously and correct each other's mistakes. We think that this approach can provide the most accurate results.

3. The portfolio has a high potential, but its full implementation requires new approaches, as well as a significant effort and time. Therefore, solving the problem of creating an e-portfolio and its evaluation is an extremely modern and urgent problem.

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