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INFORMATION TECHNOLOGY AND EDUCATION DEVELOPMENT

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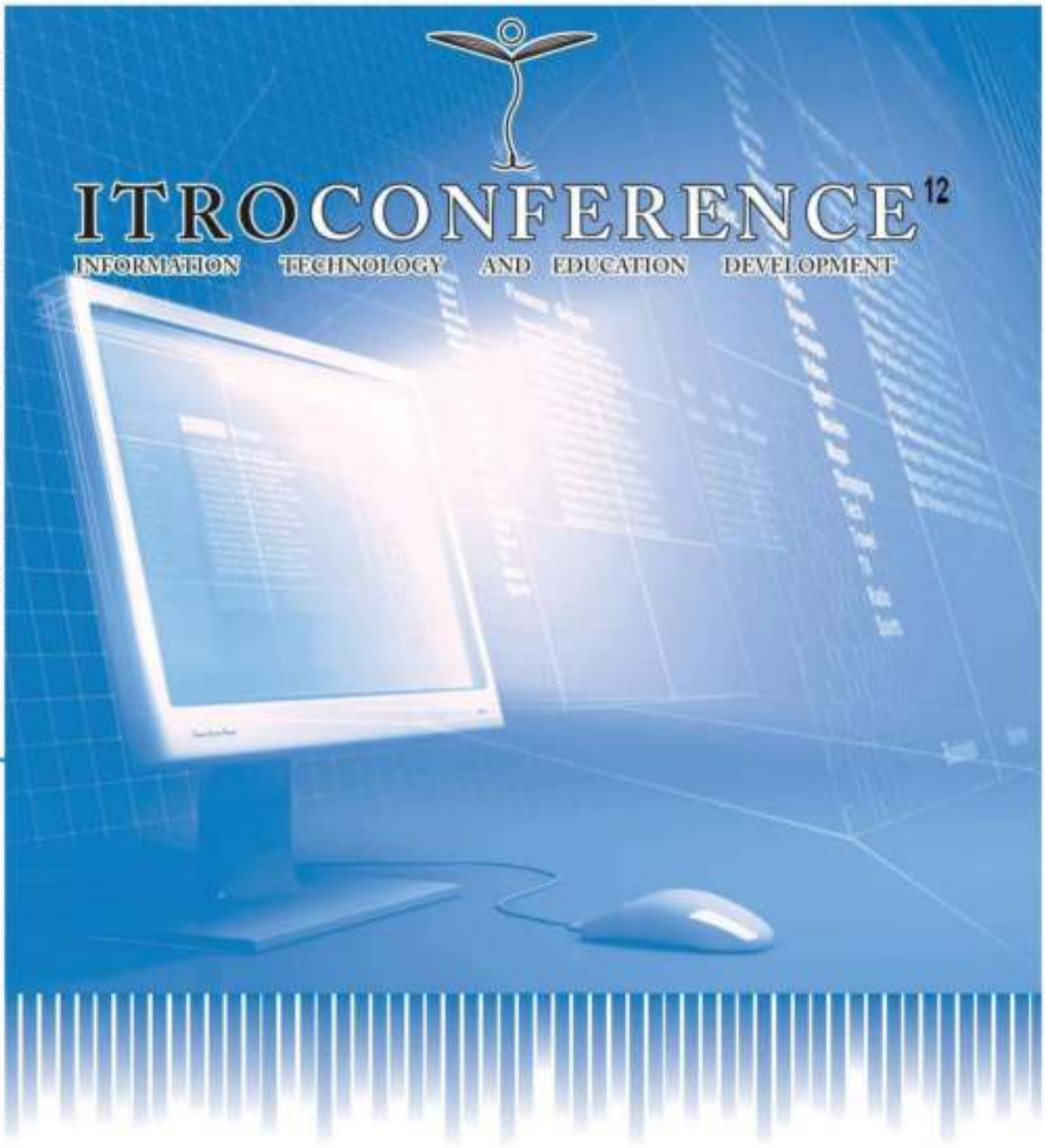

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TECHNICAL FACULTY "MIHAJLO PUPIN"
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PROCEEDINGS OF PAPERS

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THE ORGANIZING COMMITTEE:

With this publication, the CD with all papers from the International Conference on Information Technology and Development of Education, ITRO 2020 is also published.

INTRODUCTION

This Proceedings of papers consists from full papers from the International conference "Information technology and development of education" - ITRO 2021, that was held at the Technical Faculty "Mihajlo Pupin" in Zrenjanin on November 26th 2021.

The International conference on Information technology and development of education has had a goal to contribute to the development of education in Serbia and the Region, as well as, to gather experts from natural and technical sciences' teaching fields.

The expected scientific-skilled analysis of the accomplishment in the field of the contemporary information and communication technologies, as well as analysis of state, needs and tendencies in education all around the world and in our country has been realized.

The authors and the participants of the Conference have dealt with the following thematic areas:

- Education in crisis situations
- Educational challenges
- Theoretic and methodology questions of contemporary pedagogy
- Digital didactics of media
- Modern communication in teaching
- Curriculum of contemporary teaching
- E-learning
- Education management
- Methodic questions of natural and technical sciences subject teaching
- Information and communication technologies

All submitted papers have been reviewed by at least two independent members of the Science Committee. There were total of 94 authors that took part at the Conference from 12 countries, 3 continents: 52 from the Republic of Serbia and 42 from foreign countries such as: Macedonia, Bosnia and Herzegovina, Hungary, Slovakia, India, Bulgaria, Rumania, Albania, USA, Canada, Malaysia. They were presented 49 scientific papers.

The papers presented at the Conference and published in Proceedings can be useful for teachers while learning and teaching in the fields of informatics, technics and other teaching subjects and activities. Contribution to the science and teaching development in this Region and wider has been achieved in this way.

The ITRO Organizing Committee would like to thank the authors of papers, reviewers and participants in the Conference who have contributed to its tradition and successful realization.

Chairman of the Organizing Committee

Snežana Jokić, Ph.D, Ass. Professor

CONTENTS

INVITED LECTURE

SCIENTIFIC PAPERS

Using WEKA for Finding Output for Given Function

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Abstract - The aim of this paper is to explain what a machine learning is and to describe a decision tree as a kind of implementation of machine learning. Also, in the paper will be shown the practical application of Waikato Environment for Knowledge Analysis (WEKA) through a concrete example. WEKA is one of the most used software for machine learning. The example consists of a function of three input data giving the appropriate output. The function is shown with two types of decision trees: M5P and PERTree. In the conclusion is presented the appropriate and best output for our function.

I. INTRODUCTION

Machine learning is a branch of artificial intelligence and scientific discipline that deals with the design and creation of algorithms that allow computer systems to improve their work with the help of empirical data, i.e., data obtained through mechanical sensors, database, etc., through experiments and observation [1], [2]. Machine learning is the science of making computers work without being explicitly programmed. Over the past decade, machine learning has given us self-driving cars, practical speech recognition, web browsing, and significantly improved understanding of the human genome.

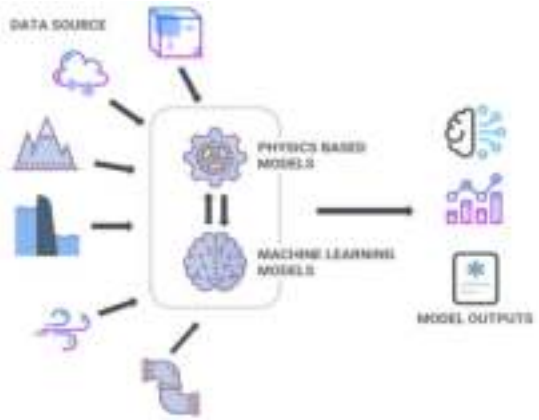

Figure 1. Machine learning model [8]

Machine learning is so prevalent today that everyone probably uses it dozens of times a day without knowing it. Many researchers also think that this is the best way to make progress on AI at the human level [9]. The field of machine learning requires an answer to how to create a computer system that improves its work from the experiences gained during its existence and operation, as well as to what are the fundamental laws that characterize the learning processes. These questions cover a wide range of learning tasks that contribute to many areas of real life, for example: the design of an autonomous mobile robot that learns to maneuver in the space in which it is located with the help of its experience, data mining of medical records of diseased patients in aim to study diagnoses for newly - ill patients, a search engine that automatically adapts to the needs of its users [3], [4].

There are several algorithms of machine learning implementation [5], [6] and they are listed below:

1. Decision tree - This way of learning uses a decision tree as a predicate model. It is one of the predictive modeling approaches used in statistics, data mining and machine learning. More descriptive names for the models are classification trees or regression trees. In these tree structures, the leaves represent class labels and the branches are the connectors of the functions that lead to those class labels.
2. Rule of association - It is used as a learning method to discover the relationships between parameters in large databases.
3. Artificial neural networks - Artificial neural networks are a learning algorithm that is inspired by the structure and functional aspect of the biological neural network. The calculations are structured in relation to interconnected groups of artificial neurons that are divided into layers and each layer makes a certain change in the input parameters. There are three major groups of neurons: input neurons, hidden neurons, and output neurons.

4. Genetic programming - Genetic programming is an algorithmically based evolutionary methodology inspired by biological evolution to find computer programs that perform user-defined tasks. It specializes in genetic algorithms where each individua is a computer program. This technique is used to optimize the population of computer programs according to the rule of suitability determined by the ability of the program to perform a given task.
5. Inductive logic programming - Inductive logic programming is a way of learning that uses logical programming as a uniform representation of examples, basic knowledge, and hypotheses. By applying a basic knowledge of a particular problem and a set of examples presented as a logical database of facts, this way of learning tries to derive a hypothesis in the form of a logical program that includes all positive but not negative examples.
6. Support vector machine - Support vector machines are a set of related supervised learning methods that used classification and regression. For a given set of training examples, each of the examples is marked as belonging to one of two categories. With the help of support vector machines, a model which predicts whether a given input example belongs to one or another category is made.
7. Clusters - Cluster analysis or also called clustering (grouping) is the division of a set of data into subsets called clusters so that all the observed data in a particular group is in some way similar in nature. Clustering is a method of unsupervised learning and a frequently used method for statistical data analysis.
8. Bayes networks - The Baes network, also called the belief network, is a probabilistic graphical model representing a set of random variables and their conditional independences using a directional acyclic graph (DAG). For example, the Bayes network may represent the link between certain diseases and symptoms. If the symptoms are known, the network can be used to calculate the likelihood of the presence of one of the various diseases. There are efficient algorithms that use the Bayes network to extract knowledge about certain problems.

II. DECISION TREE

This way of learning uses a decision tree as a predicate model. It is one of the predictive modelling approaches used in statistics, data mining and machine learning. More descriptive names for the tree models are classification trees or regression trees. In these tree structures, the leaves represent class labels, and the branches are the connectors of the functions that lead to those class labels.

The decision tree is a method for approximation of discrete - value target functions, in which the function is represented by a decision tree.

Trees can also be represented as sets of if-then rules to improve human readability. Decision trees consist of deciding nodes, where each deciding node is double or multiple branched, with each branch representing the value of the attribute being tested. The leaves are no longer branched, and they are generators of a uniform (final) conclusion.

Each decision tree starts with a node that represents the so-called initial decision, from where the branching of the tree begins. In Figure 2, the node representing the initial decision is presented by a square. The leaves generate the result if a specific path is followed along the stem.

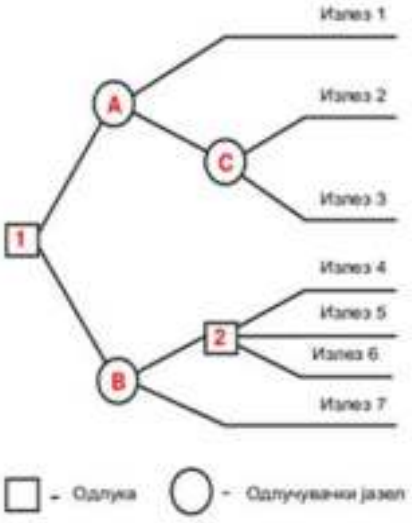

Figure 2. Decision three

III. DECISION TREES TECHNIQUES

Specific decision tree methods include Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID). CART and CHAID are decision tree techniques used for database classification. They provide a set of rules that can be applied to new (non-classified) databases to predict which records will have a given outcome. CART usually requires less data preparation than CHAID.

The decision tree is a method similar to the learning concepts that use a system and an ID3 algorithm that generates a rule, i.e. a classification tree for a given concept with its attributes and their values. Its inductive bias is an advantage over most small trees, and it is able to classify disjunctive concepts as well. This method may be far more effective than other inductive learning systems, but it is also not applicable in some complicated domains.

Decision tree learning is a type of function for approximating (discrete values) attributes and their discrete values. The decision tree classifies samples by accepting attributes from the root to the leaf of a branch, and can also be seen as a list of if-then rules (each branch is a conjunctive relation of attributes, and the whole tree is a disjunction). Example [7] tree for the PlayTennis concept (Figure 3):

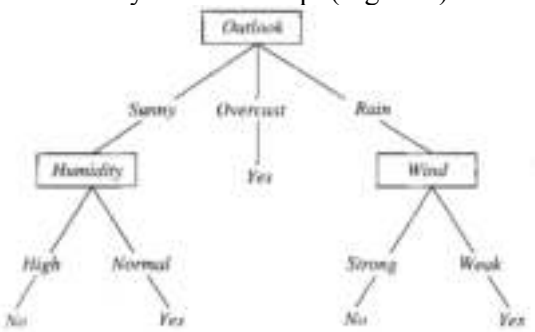

Figure 3. Decision tree for the PlayTennis concept

which represents the expression:

(Outlook = Sunny) ^ (Humidity = Normal)

V (Outlook = Overcast)

V (Outlook = Rain ^ Wind = Weak)

As can be seen, the samples are represented by a list of attribute-value pairs, the target function in the example is Boolean, but can be extended to a discrete or even real function. The instances in the example may contain errors (either in the attribute values or in the classification) or undefined attribute values.

IV. PROBLEM IMPLEMENTATION IN WEKA

WEKA is a machine learning / data mining software written in Java used for research, education, and applications. Its main features are:

- Comprehensive data set on processing tools, learning algorithms, and evaluation methods (Figure 4).
- Graphical user interfaces (including data visualization).
- Environment for comparing learning algorithms.

Figure 4. How WEKA work (Data processing in WEKA)

The following methods are implemented in Weka:

- Bayes
- Decision trees and rules
- Neural networks
- Functions
- Meta, lazy classifiers …

With the following test options:

- Use a training set
- Cross validation
- Percentage split.

WEKA works with files in ARFF format (Attribute-Relation File Format) which is an ASCII text file that describes a list of instances that share a common set of attributes (Figure 5).

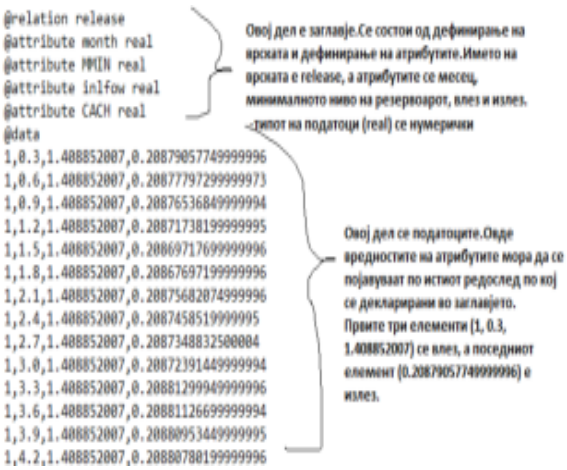

Figure 5. An Attribute-Relation File Format

Input parameters

The input data has the following structure:

@relation release
@attribute month real
@attribute MMIN real
@attribute inflow real
@attribute CACH real
@data

jan,0.3,1.408852007,0.20879057749999996

jan,0.6,1.408852007,0.20877797299999973
jan,0.9,1.408852007,0.20876536849999994

Our task and main goal were to examine which of the methods in WEKA is the best for presenting the function:

$$release = f(month, MMIN, inflow)$$

- We performed the tests using the test option "Use a training set"
- We examined with M5P and REPTree decision trees

M5P is reconstruction of Quinlan M5 algorithm to encourage tree models for regression. M5P combines conventional decision trees with the possibility of linear node regression functions. All attributes are converted to binary variables, so all partitions in M5P are binary. M5P generate models that are compact and relatively understandable.

REPTree makes reduced-errors and counts all attributes. Builds a decision / tree of regression with the help of entropy as a measure of uncertainty and using information obtained with the criterion of separation. REPTree is a fast decision tree and sort values for numeric attributes only.

Results from examination with decision trees are given in the table below (Table 1):

Table 1. Decision tree results

Decision tree		
	M5P	PERTree
Size of the tree	1194	3675
Number of Rules	598 (3588 lines code)	
Correlation coefficient	0.9609	0.983
=== Summary ===		
Mean absolute error	0.2339	0.1076
Root mean squared error	0.518	0.3422
Relative absolute error	16.4167 %	7.5535 %
Root relative squared error	27.792 %	18.3613 %
Total Number of Instances		**36960**

V. CONCLUSION AND DISSCUSION

According to the results given in the table above, we conclude that with REPTree we have a lower relative absolute error than with M5P. And that relative absolute error is 7.5535%. So, REPTree gave us the best output for this function, despite the size of the tree.

Our next aim is to compare decision threes with artificial neural networks algorithm and to see which technique will give us a better result.

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