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For scientists, scientists, students, graduate students, representatives of business and public organizations and higher education institutions and a wide range of readers.

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PREDICTING THE RESULTS OF ESPORTS MATCHES BY MEANS OF MACHINE LEARNING

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The outbreak of COVID-19 pandemic impacted the growth of the global esports market. According to the latest research by SkyQuest Technology, the global esports market was valued at USD 1.08 billion in 2021, and it is expected to reach a value of USD 2.8 Billion by 2028. Machine learning technologies continuously change the esports market. They improve player performance, conversational assistants, discover new approaches to build game strategies. Nowadays esports analytics platforms provides coaching that can assess player statistics, and suggest better strategies in computer games like for League of Legends and Dota 2. Artificial intelligence (AI) coach advises players on how to attack and defend, and shows how alternative approaches can increase the odds of winning. Developers train AI agents by means of enforcement learning alghoritms to learn specific games.

The relevance of researches in the field of esports using machine learning technologies, is confirmed by a significant number of last scientific publications (Jadowski, R., Cunningham, S., 2022; Yadav J. et al., 2022; Bátfai N., Szabó, M., 2021; Hodge V. et al., 2021; Kuzmenko, O. et al., 2021; Lettieri E., Orsenigo, C., 2020; Melentev, N. et al., 2020; Ani, R et al., 2019; Vinyals, O. et al., 2019). For the query "computer gaming and machine learning" in the Scopus database were found 1802 documents published by 4766 scientists over the past five years. Computer games are the ultimate test lab for AI because we can observe the results. It is necessary to note the significant contribution to the study of practical aspects of socio-economic and culture phenomenas, which was carried out by such scientists as Oteh O. et al., 2021; Poghosyan K., Tovmasyan G., 2021; Zhuravka O. et al., 2021; Baranauskas G., 2020; Kasztelnik K., Brown D., 2020; Kasztelnik K., Brown E., 2020; Kasztelnik K. Frederick D., 2020; Letunovska N. et al., 2020; Miskiewicz R., 2020; Njegovanović A., 2020; Serpeninova Yu. et al., 2020; Skrynnyk O., 2020; Sotnyk I. et al., 2020; Tenytska T. et al., 2020; Yelnikova Ju., Barhaq A., 2020; Cosmulese C., 2019; Kirichenko L. et al., 2017; Logan W., Esmanov O., 2017; Zakutniaia A., Hayriyan A., 2017.

Our research was conducted on a dataset describing 7620 professional matches from the online computer game League of Legends (LoL), obtained from the analytical resource Kaggle (kaggle.com). We chose the SAS Enterprise Miner package, which is designed to detect in large data sets the information needed for decision-making. To build predictive models of esports matches results, we used the tools of decision trees, regression analysis and neural networks (Fig. 1).

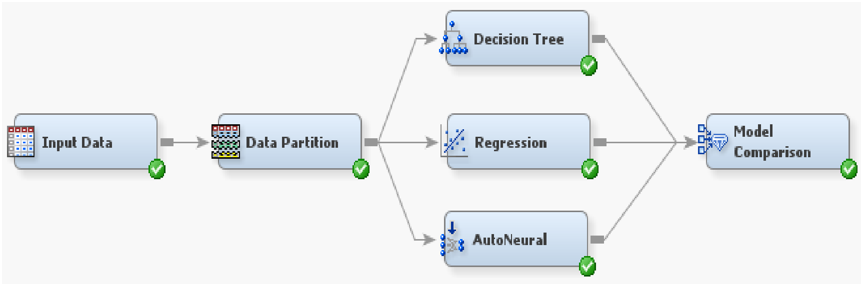

Fig. 1. ETL-diagram of the process of modeling the results of esports matches

Source: author's elaboration using SAS Enterprize Miner toolkit

The *Input Data* node of the ETL process diagram contains a set of input data consisting of 14 interval input variables (performance indicators of teams) and 1 binary output variable (number of the team that won the match). The *Data Partition* node of the ETL process diagram uses the tool Data Partition, with which the entire input data set (100% - 7620 matches) is randomly divided into two parts while maintaining the proportion of response distribution of the target variable (*winner*): 60% (4571) is the training data on which the model is based; 40% (3049) is the validation data, which checks the quality of possible variants of the model specification and selects the best of them. Then, using Model Comparison tool, a comparative analysis of the constructed models (decision tree, logistic regression, and neural network) was performed and the best one was selected. To optimize the model of logistic regression, the method of stepwise exclusion of insignificant factors was chosen, the significance of which was determined by the statistical criterion of Chi-Square.

The best model was selected on the basis of the Misclassification Rate, the Average Squared Error and the Gini Coefficient (Fig. 2). The lowest values of the Misclassification Rate, the Average Squared Error and the highest values of the Gini Coefficient are characterized by the neural network (*Auto Neural*). In second place is the logistic regression (*Reg*). The last place is occupied by the decision tree (*Tree*).

According to the presented results, it can be conclude that the neural networks is the best Machine Learning technology recommended for the practical implementation of the predictor of the esports matches results. The proposed approach to modeling the results of esports matches can be successfully used in other areas than esports. The main advantage of our approach is that it improves the forecast accuracy using chosen best machine learning model.

Statistics	Auto Neural	Reg	Tree
Valid: Kolmogorov-Smirnov Statistic	0.97	0.97	0.95
Valid: Average Squared Error	0.01	0.01	0.02
Valid: Roc Index	1.00	1.00	0.99
Valid: Average Error Function	0.04	0.04	.
Valid: Bin-Based Two-Way Kolmogorov-Smirnov Probability Cutoff	0.78	0.82	0.83
Valid: Cumulative Percent Captured Response	21.94	21.94	21.53
Valid: Percent Captured Response	10.94	10.94	10.80
Valid: Divisor for VASE	6098.00	6098.00	6098.00
Valid: Error Function	268.16	263.22	.
Valid: Gain	119.35	119.35	115.23
Valid: Gini Coefficient	1.00	1.00	0.98
Valid: Bin-Based Two-Way Kolmogorov-Smirnov Statistic	0.97	0.96	0.95
Valid: Kolmogorov-Smirnov Probability Cutoff	0.48	0.32	0.24
Valid: Cumulative Lift	2.19	2.19	2.15
Valid: Lift	2.19	2.19	2.17
Valid: Maximum Absolute Error	1.00	1.00	1.00
Valid: Misclassification Rate	0.01	0.02	0.02
Valid: Mean Squared Error	0.01	0.01	.
Valid: Sum of Frequencies	3049.00	3049.00	3049.00
Valid: Root Average Squared Error	0.11	0.11	0.14
Valid: Cumulative Percent Response	100.00	100.00	98.12
Valid: Percent Response	100.00	100.00	98.72
Valid: Root Mean Squared Error	0.11	0.11	.
Valid: Sum of Squared Errors	71.87	71.72	112.89
Valid: Sum of Case Weights Times Freq	6098.00	6098.00	.
Valid: Number of Wrong Classifications	42.00	.	.

Fig. 2. Results of quality assessment of constructed models

Source: author's elaboration using SAS Enterprize Miner toolkit

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