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MODERN PRACTICE OF MACHINE LEARNING IN THE AVIATION TRANSPORT INDUSTRY

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The fast-paced life of the present produces huge amounts of data every minute [1]. Timetables, scheduled aircraft maintenance, consumables, loyalty programs and personalized offers for passengers are data that can increase profits and reduce costs [2]. However, analysts are interested in information hidden in the data, which, without proper storage and processing, will remain just a lot of lines and will not be able to bring the expected benefits [3].

Machine learning has made a big breakthrough in knowledge processing [4]. Most of the routine operations are algorithmized and transferred to machines; a person, as a rule, acts as a teacher and controller. The indisputable advantage of machining is speed and the minimum probability of making mistakes. For example, in 2019, the average cost of an aircraft delay for a US passenger airline was \$ 74.25 per minute.

Machine learning is used in the field of airline revenue management: personalized discounts, optimal routes, dynamic formation of air ticket prices, and the like [5]. Correctly laid routes are a very important factor in the success of an airline. A striking example is the presence of direct flights between Krakow (Poland) and Chicago (Illinois, USA), which, at first glance, does not make sense. However, it is enough to analyze the ethnic composition of Chicago to find that 1,500,000 Poles live in the diaspora. Another important factor is dynamic pricing for air tickets. This is not a trivial task, since the airline wants to sell at a higher price, and the passenger wants to buy at a lower price. After all, the price of an air ticket is influenced by many factors: the time of booking, the day of the month, the day of the week, the availability of events at the destination, the cost of fuel, etc. All this data is difficult to process manually, but a properly designed system can handle it easily. Therefore, each airline has its own closed dynamic pricing system, and scientists develop frameworks and train neural networks to accurately predict the cost of air tickets.

The development of the aviation industry leads to an increase in the number of flights, which creates more carbon dioxide emissions. In 2018, all commercial air travel caused 2.4% of global CO₂ emissions. Although this value may seem insignificant, in 2013-2018 the amount of emissions increased by 32%. Machine

learning algorithms can help reduce CO2 production by improving the way engines work or shortening the running time of engines while the aircraft is on the ground. Another example is the experience of the American airline Southwest Airlines, which was able to optimize its fuel costs . The company's fuel consumption pilot project used Alteryx Designer and the R language to build eight different prediction models, which included time series regression modeling and neural networks. After the completion of the project, the trained system can produce 9.6 thousand forecasts for each airport of the airline on a monthly basis. Another important outcome was the decision to purchase fuel from a single supplier in southern California, which accelerated the procurement process.

The amount of fuel for each flight is influenced by the workload of the aircraft, since a lighter aircraft requires less fuel. One relief option is to reduce the amount of food on board. 20% of onboard food is wasted annually. It follows from this that a properly formed menu for each flight can save the airline significant funds. However, without artificial intelligence, this problem is difficult to solve, as it is necessary to take into account such factors of the flight as: time and duration, season and day of the week, ethnic and age of passengers, and the like. A successful example of the use of artificial intelligence is the experience of the British low-cost airline easyJet, which has significantly reduced its costs for passenger meals.

An airline's prestige plays a significant role, directly influencing its profit. Better reputation means more customers, that is why airlines pay attention to passenger reviews and respond instantly to comments on social media. PureStrategy company has developed an automated system with artificial intelligence (Automated Neural Intelligence Engine, ANIE). The functionality of this system provides the ability to review data, categorize, visualize and analyze customer sentiment. Optimizing so many routine manual labor-intensive tasks allows people to concentrate on more complex tasks.

Thus, the use of artificial intelligence and machine learning covers all areas of aviation activity: from the formation of optimal flights to the analysis of passenger reviews, from the aircraft health analysis to runway delays monitoring. The implementation and training of artificial intelligence systems is costly, but the results of the work become noticeable immediately and quickly start to make a profit.

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