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ARTIFICIAL INTELLIGENCE AS A BASIS FOR INNOVATION MANAGEMENT IN TOURISM

Abstract. *The paper overviews theoretical researches and practical applications related to implementation of artificial intelligence (AI) in tourism. Recently, much attention is given to the machine learning algorithms, neural networks and computer visions as promising tools of the digital transformation of tourist industry. Prognostic and classification models build by means of them allow all stakeholders of tourist industry to move to a new level of decision-making process and thus to improve the quality of the service. In particularly, AI-based software enables local authorities not only to measure anthropogenic load in some area, to perform ecologic monitoring of recreation territories and to model their sustainable development, but also to increase safety level for tourists. Transport companies could optimize tourist itineraries and study behavior models of the clients at the moment of buying tickets and hotel and restaurant owners would get more efficient tools for determining preferences of the consumers, the degree of their satisfaction and that would lead to constructing much more efficient relations with them. Another important issue is that neural networks are capable to resolve the problem of fake reviews. Undoubtedly, that will rise the credibility of the information available on internet. Summarizing, AI is becoming a new technological paradigm on the basis of which an innovative management processes in tourism will be designed soon.*

Keywords: *innovation, neural network, machine learning, tourism, computer vision, big data analysis*

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ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ КАК ОСНОВА ИННОВАЦИОННОГО УПРАВЛЕНИЯ В ТУРИЗМЕ

В статье рассматриваются теоретические исследования и практические разработки, затрагивающие вопросы внедрения технологии искусственного интеллекта (ИИ) в туризм. В последнее время все больше внимания уделяется алгоритмам машинного обучения, нейросетям и компьютерному зрению как перспективным инструментам цифровой трансформации туриндустрии. Построенные с помощью этих инструментов прогностические и классификационные модели, позволят всем участникам туриндустрии выйти на новый уровень в принятии решений и тем самым улучшить качество сервиса. В частности, внедрение ИИ позволит органам государственной власти не только измерять антропогенную нагрузку, проводить экологический мониторинг рекреационных территорий и моделировать их устойчивое развитие, но также повышать уровень безопасности туристов. Транспортные компании смогут оптимизировать туристические маршруты и изучать поведенческие модели клиентов при покупке билетов, а отельеры и рестораторы получат более эффективные средства изучения предпочтений потребителей, степень их удовлетворенности услугами, а значит выстраивать более эффективные взаимоотношения с ними. Что немаловажно – нейросети способны решить проблему ложных отзывов, что положительно скажется на качестве информации, доступной пользователям интернета. Таким образом, ИИ оформляется в новую технологическую парадигму, лежащую в основе процессов управления в том числе и туризма.

Ключевые слова: *инновации, нейронная сеть, машинное обучение, туризм, компьютерное зрение, анализ больших данных*

Introduction

The use of artificial intelligence (AI) and related technologies is gradually becoming common practice for many companies over the last decade. The same period is marked by emerging of new research area: Data Science, that is aimed at studying the object by means of data. The schematic figure 1 shows the technologies which are the part of the general term "artificial intelligence".
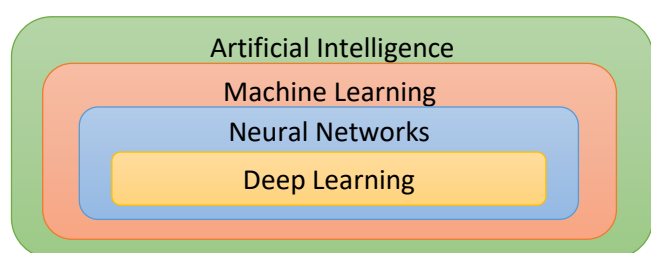

Fig. 1 – Technologies of Artificial Intelligence

At present, telecommunication companies, banks and retailers are the absolute leaders in implementing AI in their processes. Tourist companies are still going behind, but there are some preconditions to launch digitalization and intellectualization development of this area [1]. The triggers for that, on the one hand, are the tasks and problems which are imposed on the tourist industry in general and on each of stakeholders, and on the other hand, availability of results obtained of performed researches. Practical implementation of them will make it possible to find efficient solutions for existing problems. This paper reviews some ways of applying AI in tourist industry.

The examples of applying AI in tourism

First of all, one should note, that tourism as an economic activity is under the control of the federal or local government. State administration bodies provide management, regulation and planning of tourism development strategy for each region. At present, *models of machine learning* are becoming helpful tools in these processes. For example, in China machine learning is used to forecast tourist demand [2], to model economic development of tourist industry [3], to analyze visitors' reviews concerning tourist attractions [4]

and to forecast their daily tourist flows [5] to design and make efficient management decisions. Combined with convolutional neural networks such models of machine learning possess high accuracy. In the study [6] the method of self-organizing maps (it is a version of Kohonen neural network) and specialized software were used to determine correlated classes of indicators of sustainable development. That obtained results are the basis for future studies in this area and it is possible to forecast sustainable tourism in the observed (specified) region.

One should emphasize the role machine learning in processing data derived from social networks and websites with reviews, since nowadays it is these websites that are the key factor for the consumers' decision-making process. TripAdvisor, one of the most famous websites containing millions of reviews about tourist attractions around the world, is a convenient (open and actual) source of data, on the basis of which the researches often build various models of machine learning [7, 8].

However, there are also some drawbacks of online-reviews: fraud reviews that misrepresent objective profile and can cause serious reputational loss and, as a result, financial losses in case if their aim is to downgrade real consumer value of the service or product delivered by the supplier. Fraud reviews can be regarded as a method of unfair competitions. Data scientists counteract them by building algorithms aimed at revealing such reviews in Internet [9, 10].

Computer vision technology can potentially become additional tool in state and municipal administration, as stored volumes of visual information could improve the quality of monitoring of tourist sources. That is illustrated by the Spanish researches who developed three models of machine learning to evaluate concentration of chlorophyll A in sea water of Mar-Menor Bay based on satellite images. Actually, it can be considered as a new approach to evaluation of water quality [11]. Moreover, the study [12] employs computer vision to classify behavior models of tourists from

three regions (Asia, Europe and North America), that allows taking into account cultural specificity when developing tourist attractions and destinations. Another example of computer vision application is a quantitative estimation of visual culture in one of the most visited places in Peru – Cusco – through the photographs taken by the visitors. This allowed tracking routes within the cultural and historical tourism [13]. This technology may be used as a mean to evaluate tourist load, that is of great importance when we talk about saving natural reserves [14]. All tourism – overseen by local authorities – has as its top priority: the safety of the tourists. For example, event tourism often gathers thousands of visitors on the limited territory and any emergency situation may cause human victims. Computer vision can help to reveal potential dangerous situations [15] and, thus, to decrease the risk of negative scenario. Mass and event tourism can also employ aerial images and GPS-data of participants to determine their space-time activities. This makes it possible to perform clustering of visitors for the purpose of market segmentation [16].

A special role in tourism belongs to HORECA, i.e. to hotels, restaurants and casino, as they are important suppliers of tourist services and, hence, the quality of their works directly impacts on the attractiveness of the region for travelers.

Speaking of independent tourists, the leaders among the IDS (internet distribution systems) used by them for searching accommodation are Booking and Airbnb. Machine learning methods bring some benefits to the analytics of such systems. For example, the work [17] offers deep learning algorithm which classifies photographs made by the owner to understand how host facial characteristics influence on Airbnb pricing. And the model of negative binominal regression was used to identify the factors rising probability of successful booking in the study [18].

The efficiency of hotel business also depends on the amount of sold rooms (accom-modations). In other words, the less booking cancellations, the higher profit is. The cancellation of

booking is a risk to fail realization of the room (accommodation), especially if the date of cancellation is close to the date of tourist's arriving. Such loss is often called as "missed profit". Therefore, it is an urgent task to manage such risks in order to minimize lost profits caused by unsold rooms. For this, the authors of [19] developed a neural network on the basis of genetic algorithms, it contains only 13 variables. There are also some neural network solutions aimed at revenue management [20]. The deep learning models are able to forecast hotel daily demand, room prices or guests' reviews [21-23]. A decision-making model designed specially to prioritize the improving impacts on the hotel services can become a valuable source for managers [24]. At present, the problem of improving energy efficiency is of great importance for all types of buildings, including hotels. Norwegian engineers found the key to solution in AI: a prognostic model of hot-water heating in hotel was built [25].

Food and restaurant industries can be regarded as an integral part of tourist infrastructure. The caterers face the tasks which are very similar to those the hoteliers face, but there are some specific features. For example, storage life of the products restricts the time for their utilization, hence, a problem of optimization of food production arises. The main scope of optimization is to minimize the losses of unsold food. Japan data scientists created a regression model of random forest by means of which one can forecast number of orders made by the guests [26].

Without overstating it, tourism development depends largely on transport infrastructure and transport companies. Aero-, railway or bus communication favors transport accessibility of the single region or the whole country. Carriers also needs the latest achievements of artificial intelligence to find effective solutions for business and to improve their services and logistics. The example of that is the study, in which the algorithm of deep learning demonstrated the best results by accuracy in modeling uncertainties when a passenger chooses transfer airport [27]. In fact, the behavior strategies of the users of internet ticket

sales services identified with this algorithm allow us to uncover factors, impacting on the decision-making process. The most tackled problems in this area are as follows: elaboration of prognostic models for air passenger flow [28], calculation of flight delay probability [29] or flight time [30], classification of passenger behavior models and their satisfaction with the services [31].

Some features of AI implementation

Thus, the technology of AI can be considered as an innovation tool for decision-making process in management. But one should remember that application of radical innovation is always accompanied with some difficulties, one of which is a human factor. To process correctly big data and to build adequate models new professional skills and competences of IT-specialists are required. At this, different combinations of these competences generate new professions. In particularly, there are positions of data analyst, data engineer and data scientist at the up-to-date labor market. Each employer has his own requirements to these positions. General differences in duties and work functions are shown on fig. 2.

As it can be seen on the figure 2, a team of data specialists is often needed to deal with big data at the enterprise. It is a professional background of team member that affects on the

quality (accuracy, adequacy) of the final model of machine learning. For example, data scientist should prevent from model training on fraud dependencies and should not allow model over-training. Another issue is data preparation. That is, undoubtedly, the most labor consuming stage that may require 70-80% of total time spent on model development. The data preparation process comprises not only data «cleaning» but also filling missing values by means of approximation.
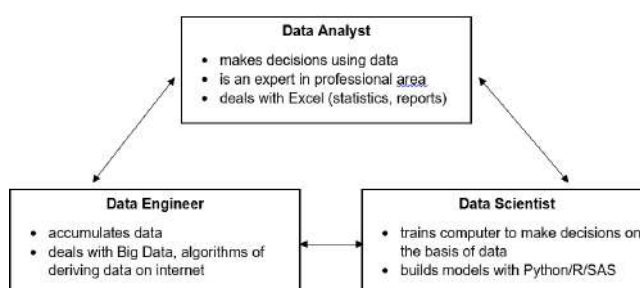
Fig. 2 – Professional skills and competences of digital specialists

In view of this, transfer to implementation of AI into business processes make state bodies and municipal administration (for example, regional ministry for tourism) or tour operators change organizational structure and solve the problems concerning staff training to process data.
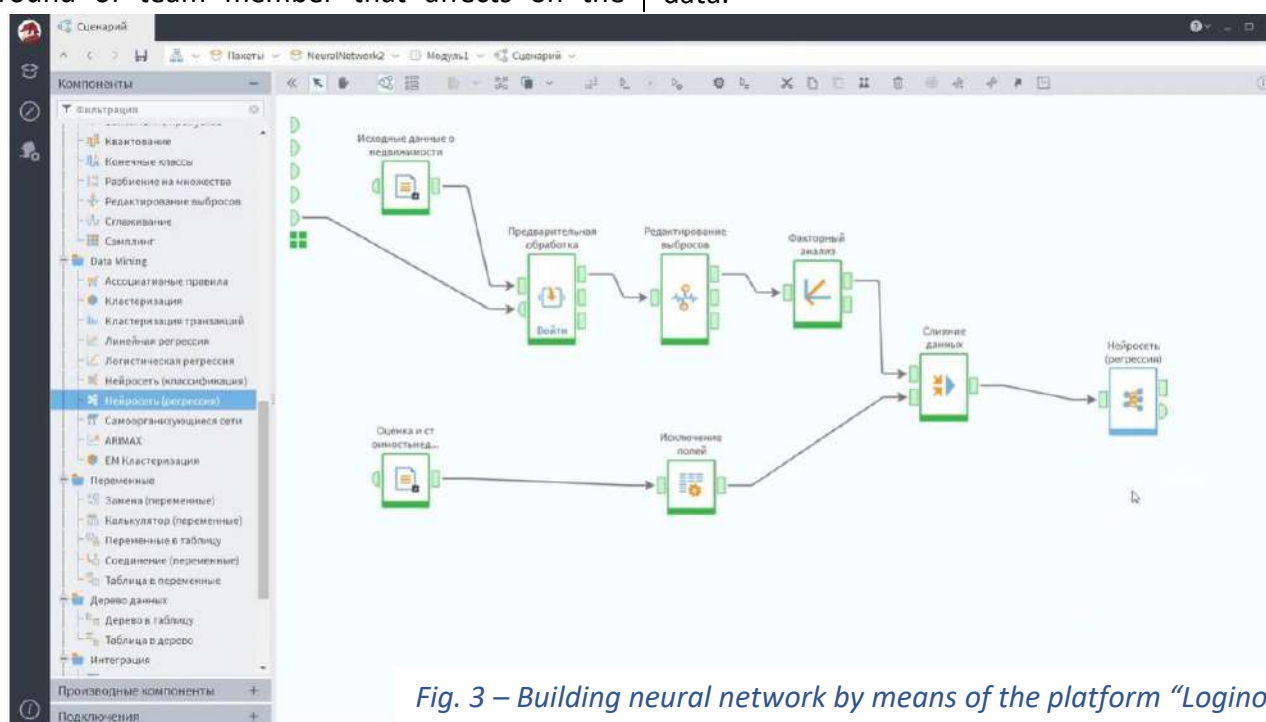
Fig. 3 – Building neural network by means of the platform "Loginom"

At this, machine learning technologies are not always expensive as it can be supposed. Firstly, some software is available in free access. For example, Russian company Loginom offers free version Community Edition along with commercial product. This product is based on "low-code" concept, i.e. on the visualized building of models with minimum coding, that is a strong advantage for those, whose coding skills are not at high level (Fig. 3).

Secondly, a special crowdsourcing service Kaggle is available for building and interpretation of the models of machine learning. It works as follows: a company publishes its dataset in free access, describes the problem and evaluation criteria, and data scientists create the models to solve it for remuneration.

Conclusion

The review of studies conducted in the area of AI showed that results of machine learning, neural networks and computer vision applied in real business processes of tourist companies or government bodies could reveal nontrivial trends that become a source for efficient decisions and innovation management procedures.

One can summarize that the near future will witness how results of researches and developments concerning AI are employed by large tour operators [32] to provide stability of business processes in dramatically changing economic and geopolitical conditions.

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