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АНАЛИЗ ВАРИАНТОВ ИСПОЛЬЗОВАНИЯ НЕЙРОННЫХ СЕТЕЙ В ОБРАЗОВАНИИ
ANALYSIS OF VARIANTS FOR USING NEURAL NETWORKS IN EDUCATION

Аннотация: В статье рассматривается использование нейронных сетей в образовании. Анализируются методы использования нейронных сетей при обучении бакалавров и магистров, а также в образовательном процессе в качестве помощника преподавателя.
Abstract: The article discusses the use of neural networks in education. The methods of using neural networks in teaching bachelors and masters, as well as in the educational process as an helper for teachers, are analyzed.
Ключевые слова: нейронные сети, образовательный процесс, программирование, API, прокторинг.
Keywords: neural networks, educational process, programming, API, proctoring.

Neural networks have become a part of the life of a modern person, imperceptibly penetrating into almost every field of activity. Automatic translation of text, selection of music playlists, photo processing, generation of texts and images, voice assistants and advertising, parking and speeding tickets, optimization of business processes and many other things that we encounter almost daily use neural networks. The prediction that 47% of American jobs will be automated by 2033, made at Oxford Martin School ten years ago, does not seem unrealizable at the moment [1]. At the same time, there is an automation of not manual, but intellectual labor. Of course, we cannot talk about a complete replacement for the activities of a doctor, lawyer, psychologist or marketer, but we cannot deny the presence of high-quality neural network decision support systems for issues that require processing a large amount of information and performing routine tasks.

The field of education was no exception. Here we can distinguish the following ways to use neural networks:

− bachelors and masters in teaching programming and performing diploma and master's theses,

− teachers in preparation for classes and organization of the educational process,

− self-development and self-education outside the educational process.

When teaching bachelors and masters, an important factor is their ability to use all the latest technologies and trends. Thus, when developing software products for the defense of diplomas and master's theses, various libraries and programming languages are used, such as Python, R, C#, C ++, Go, Haskell, Swift, Java, JS. Great opportunities for studying neural networks and visualizing the process of their learning are provided by the Deep Learning Toolbox framework in Matlab [2], where you can not only learn how to create network architectures with different topologies, analyze, train networks, but also use ready-made pre-trained networks to solve custom problems in your applications, accelerate training using cloud and distributed computing, perform compression to save memory and improve performance, automatically optimize and generate code using GPU Coder.

It is convenient to explore the projected network in Matlab, and then program it in the language used to develop the software product. The result of the neural network is highly dependent on the quality of the input data. There are ready-made datasets that are allowed to be used and contain anonymized data for training the designed neural networks, as well as libraries for preparing your own data.

Many neural networks are provided in the public domain and this allows students to use their API for programming [3]. Python libraries provide ample opportunities in the field of machine learning and AI: TensorFlow [4], Keras [5], Theano[6], Scikit-learn[7], PyTorch[8], Pandas[9].

Examples of work using neural networks performed as part of the education of bachelors and masters are:

− "Pharmacological system for assessing the therapeutic activity of substances" to determine the therapeutic class of a chemical compound using machine learning methods and a special method of entering formulas, which uses Clustering by a self-organizing Kohonen map, Binary classification by LVQNET(Learning vector quantization neural network) network, Convolutional Neural Networks (ConvNet / CNN), optimization algorithm Adam, SMILES (Simplified Molecular Input Line Entry System), Ajax, Django;

− "Neural network support system for decision making on granting a loan" taking into account the complex relationships between customer data, his credit history and a loan application, where logistic regression, support vector method (SVM), random forest algorithm, fully connected neural network, Lvqnet (Learning vector quantization neural network) and pattern recognition network (patternnet) are used [10];

− "Neural networks application for the analysis of musical preferences", which uses a composite model of a neural network from a combination of convolutional and MaxPooling layers, additionally an LSTM(Long short-term memory networks) layer and a fully connected one as an output, provides automation of genre recognition for a given composition, and displays the distribution of probabilities of belonging to a composition to each genre in the form of a diagram [11];

− "Predicting the results of eSports competitions using neural networks" is an application based on the LSTM recurrent network, which provided automation of the forecasting system based on match data for further use in training analysts, competitors, developing more complex and intelligent strategies, as well as predicting the results of competitions [12];

− "On-screen text translator" provides optical character recognition, text translation, and text replacement in an image while maintaining the placement of text, fonts and colors in real time and is developed on the basis of Python, Django, C#, WPS library, Google Vision API, Windows Forms and Googletrans libraries, Visual Studio Code.When training, ready-made applications developed on a neural network basis can provide significant assistance to both teachers and students.

Neural networks in AI Code Mentor [13] can assist in learning programming, acting as a personal mentor who will explain the code in different programming languages, identify problems and errors, and perform refactoring. A choice of explanation quality is available: Robot, 5 years old, Novice programmer, Teacher, NASA programmer, etc. This product helps students to better understand the logic of programming, learn from a large number of examples to develop high-quality code.

It is easy to translate code from one programming language to another using the OpenAI API and GPT-Migrate [14], but experience has shown that so far the transition between python or javascript is carried out without any problems, and when trying to translate more complex ones, for example, C++ or Rust, you often need human help.

There are even applications that can turn ideas into code, such as AutoCode [15], but the configuration of the generated Chrome extensions, web applications and mobile applications is left to the programmer. Here, the risk remains the inaccuracy of the formation of the idea and the inevitability of improvements, since changes always accompany the development of a software product.

The Gliglish neural network [16] will help you learn foreign languages, which provides an opportunity for language practice in different languages, get feedback on pronunciation and grammar, choose a speed, ask a question in your native language about what you are studying, translate words and expressions. However, the free version is limited to one topic and 20 messages to talk about.

Artificial intelligence is also the basis for other language learning resources, for example, TWEE[17], which helps both teachers in creating lessons and trainees in selecting content in accordance with the level and interactive questions, training to expand vocabulary. At the moment, there is a free version of the software product.

Neural networks can be used to personalize recommendations for the choice of disciplines, lectures, and materials. Here, one of the solutions is to use the capabilities of CogBooks in the creation of individual programs, which has reduced the number of deductions to 10% and an increase in academic performance to 24% [18].

For success in learning, the emotional state of the student is also important, which can also be assessed using applications based on neural networks, for example, such as Emotimeter – Emotion detector [19] using photographs, and Sonde, which makes a conclusion about the risk of mental illness based on a short voice sample[20]. An attempt to use the available photo-based emotion recognition

applications showed their lack of accuracy and the ability to recognize only simple emotions: Happy, Neutral, Sad, Angry, and Surprise. Their use should only be considered for your own entertainment use and not for teacher screening of students as it is in our opinion a breach of ethics and private life.

With the advent of ChatGPT [21], it became possible for students and undergraduates to write texts and code with their help, however, when checking papers, such text is easily identified, since it is usually poorly structured and, when trying to increase the amount of writing, repeats the same idea in different words in several paragraphs in a hard-to-read language. It is no coincidence that the use of this resource by students is already prohibited in some countries. However, ChatGPT can be used to saving time when choosing the most important information from a large amount of information, books, training courses, analysis and search for patterns, etc. It is important to make the right request to the neural network, otherwise it will not be possible to achieve the result. Some content generation capabilities are offered by GPT-4, Bard, Claude.

When developing software using the capabilities of ChatGPT to generate content, images, speech-to-text, etc., you need to use API interaction via HTTP requests. Python and Node.js are recommended, but other options are also possible [22].

The following tools have been developed to detect that ChatGPT, GPT-4, Bard and Claude resources have been used: GPTZero [23], OpenAI AI Text Classifier [24], CopyLeaks [25], SciSpace Academic AI Detector[26], Hive Moderation[27], Content at Scale[28], Hello Simple AI [29], OpenAI HF Detector[30], Corrector.app[31], Writer.com [32].

Writer.com is less accurate and has a limit of 1500 characters. GPTZero and CopyLeaks have an extension for Chrome, SciSpace is focused on checking pdfs and is the most accurate, Hello Simple AI and OpenAI HF Detector are free tools.

Neural networks are also useful in studying the effectiveness of the educational process, so with the help of ready-made neural networks represented by the Python and Deep Learning Toolbox libraries in Matlab, it is useful to cluster trainees using learning outcomes and additional characteristics (gender, age, discipline, etc.) and predict learning outcomes when changing input parameters.

In distance learning, good results are demonstrated by the use of proctoring, when neural networks analyze the recording from a video camera and recognize attempts to cheat and clues on abnormal behavior, eye movement and suspicious environmental conditions. Based on the results of the analysis, a report is generated, where violations are recorded, and sent to the organizer along with the assessment.

Online proctoring software is constantly updated with new products [33]. According to G2.com [34], there are now at least 54 Online Proctoring Software, including: Honorlock, Proctorio, Examity, Talview, Mercer Mettl Online Examination and Proctoring Solutions, Respondus Monitor, ProctorU, Test Invite, ExamOnline.

For the development of such products Deep Learning techniques, Convolutional Neural Networks (ConvNet/CNN), Region-Based Convolutional Neural Networks (R-CNN), Multi-Task Cascaded Convolution Networks (MTCNN), Long short-term memory (LSTM) network, RNN (Recurrent Neural Network) [35-37] are often used.

Most applications allow you to block the use of other applications, browsers, search engines on the test taker's screen, track results in real time, get statistics on current and previous tests, and use a hybrid option when you can connect a teacher, not just Artificial Intelligence. Some of the products contain ready-to-use online tests that you can use, as well as your own question bank. An up-to-date option is an alert system for detecting content used for testing on the Internet, which may indicate that the test has been hacked.

The final selection of Online Proctoring Software should be made based on the criteria of dashboard convenience and test reporting, quality of identity verification, and user support.

In addition, github has ready-made open source Python applications that you can use, as an example, to build your own Online Proctoring system [38]

Neural networks can come to the rescue in building a new training course. Here, the opportunities are provided by LearningStudioAI, the next-gen online course creation tool [39]. To create a course, you need to enter its name that most accurately reflects the essence. The result is generated content, including text modules, images, videos, exercises, tests, which can be downloaded in pdf format and changed in the future. Experiment to create a course "Git" and "Docker" showed that

the created content turned out to be structured, very concise and can only be considered as a basis at the beginning of the development of the training course. The formed tests allow you to assess the basic level of mastering the discipline, but are not enough to assess the advanced level. The developers plan to add content generation in the form of HTML and xAPI, course allocation management, and tracking student actions.

In education, interactivity and gamification help to keep the student's attention and captivate him with the subject of study. This is where the organization of metaverses as a learning environment can come to the rescue. At the same time, the trend in the development of metaverses is the use of neural networks to generate three-dimensional objects, gesture recognition, eye tracking, natural language processing, and automation of smart contracts [40, 41].

The results of the study on the possibilities of using neural networks in training showed their undeniable benefits and effectiveness, however, in most cases, a neural network can be considered as a support for a person's decision-making and obtaining knowledge and skills, as well as an aid in performing routine operations.

Список литературы:

1. Carl Benedikt Frey, Michael A. Osborne. (2013). The future of employment: how susceptible are jobs to computerisation? Working paper. Published by the Oxford Martin Programme on Technology and Employment – https://www.oxfordmartin.ox.ac.uk/downloads/academic/future-of-employment.pdf

2. MathWorks. Deep Learning Toolbox. Design, train, and analyze deep learning networks. https://www.mathworks.com/products/deep-learning.html

3. Neural Networks API https://developer.android.com/ndk/guides/neuralnetworks

4. TensorFlow https://www.tensorflow.org/

5. Keras https://keras.io/

6. Theano https://github.com/Theano/

7. Scikit-learn https://scikit-learn.org/stable/

8. PyTorch https://pytorch.org/

9. Pandas https://pandas.pydata.org/

10. D. S. Senkovich, A. V. Zhvakina. Neural network system for supporting banking decision-making when issuing loans to furnaces. BIG DATA and Advanced Analytics = BIG DATA and high-level analysis: collection of materials of the VI International. scientific-practical conference, Minsk, May 20-21, 2020: at 3 p.m. Part 1 / red.: V. A. Bogush [and others]. – Minsk: Bestprint, 2020. – P. 358-366.

11. A.V. Zhvakina, V.I. Dektyarev. Neural network recognition of the genre of musical works of furnaces. BIG DATA and Advanced Analytics = BIG DATA and High-Level Analysis: Proceedings of the V International Scientific and Practical Conference, Minsk, March 13–14, 2019 At 2 p.m. Part 1 / Belarusian State University of Informatics and Radioelectronics; red.: V. A. Bogush [et al.]. – Minsk, 2019. – P. 206 – 217.

12. S. G. Minchuk, A. B. Zhvakina Predicting the results of esports competitions using neural networks // BIG DATA Advanced Analytics: collection of materials of the fourth international scientific and practical conference, Minsk, Belarus, May 3 – 4, 2018 / editorial board: M. Batura [etc.]. – Minsk, BSUIR, 2018. – R. 428 – 434.

13. AI Code Mentor https://code-mentor.ai/

14. GPT-Migrate https://github.com/0xpayne/gpt-migrate

15. AutoCode https://autocodepro.com/

16. Gliglish https://gliglish.com/

17. TWEE https://twee.com/

18. CogBooks https://www.cogbooks.com/

19. Emotimeter – Emotion detector https://emotimeter-emotion-detector.en.softonic.com/android

20. Sonde https://www.sondehealth.com/

21. ChatGPT OpenAI API Documentation https://platform.openai.com/docs/guides/gpt

22. API reference. https://platform.openai.com/docs/api-reference/introduction

23. GPTZero https://gptzero.me/,

24. OpenAI AI Text Classifier (https://platform.openai.com/ai-text-classifier),

25. CopyLeaks (https://copyleaks.com/ai-content-detector),

26. SciSpace Academic AI Detector (https://typeset.io/ai-detector),

27. Hive Moderation (https://hivemoderation.com/ai-generated-content-detection),

28. Content at Scale (https://contentatscale.ai/ai-content-detector/),

29. Hello Simple AI (https://hello-simpleai-chatgpt-detector-ling.hf.space/),

30. OpenAI HF Detector (https://openai-openai-detector.hf.space/),

31. Corrector.app (https://corrector.app/ai-content-detector/),

32. Writer.com (http://writer.com/)

33. Online Proctoring Software https://www.trustradius.com/online-proctoring-software

34. Best Online Proctoring Software https://www.g2.com/categories/online-proctoring

35. Potluri, T., S, V. & K, V.K.K. An automated online proctoring system using attentive-net to assess student mischievous behavior. *Multimed Tools Appl* (2023). https://link.springer.com/article/10.1007/s11042-023-14604-w#citeas https://doi.org/10.1007/s11042-023-14604-w

36. AI-based proctoring system for online tests. Vidhya SG, Hema GA, Jeevitha MG, Nischitha KB, Vandana. International Research Journal of Modernization in Engineering Technology and Science https://www.irjmets.com/uploadedfiles/paper//issue_7_july_2022/28574/final/fin_irjmets1659380322.pdf

37. Vardan Agarwal. Automating Online Proctoring Using AI. https://towardsdatascience.com/automating-online-proctoring-using-ai-e429086743c8

38. Proctoring-AI https://github.com/vardanagarwal/Proctoring-AI

39. LearningStudioAI https://learningstudioai.com/

40. Victor Dey. How deep learning will ignite the metaverse in 2023 and beyond https://venturebeat.com/virtual/how-deep-learning-will-ignite-the-metaverse-in-2023-and-beyond/

41. Guo Y, Yu T, Wu J, et al. Artificial Intelligence for Metaverse: A Framework. CAAI Artificial Intelligence Research, 2022, 1(1): 54-67. https://doi.org/10.26599/AIR.2022.9150004 https://www.sciopen.com/article/10.26599/AIR.2022.9150004