WEP Warwick Evans Publishing

International Journal of Computer Science and Information Technology

ISSN: 3005-9682 (Print), ISSN: 3005-7140 (Online) | Volume 1, Number 1, Year 2023
DOI: https://doi.org/10.62051/ijcsit.v1n1.20
Journal homepage: https://wepub.org/index.php/IJCSIT/index

Unveiling the Future Navigating Next-Generation AI Frontiers and Innovations in Application

Guanghui Wang[1], Yulu Gong[2], Mingwei Zhu[3], Jiaqiang Yuan[4], Kuo Wei[5]

[1] Computer Science, Independent Contributor, Shanghai, China
[2] Computer & Information Technology, Northern Arizona University, Flagstaff, AZ, USA
[3] Computer Information System, Colorado State University, Fort Collins, CO, USA
[4] Information Studies, Trine University, Phoenix, AZ, USA
[5] Computer Science, Individual Contributor, Shenzhen, China

ABSTRACT

As a representative of the information revolution, the Internet began in the 1960s when ARPANET was born, and after decades of development and evolution, today it has formed a global information connection and interaction network. The greatest value of the Internet is that everyone can communicate and cooperate in real time across the limitations of time and space, which greatly improves the efficiency of group communication and collaboration, and then changes the organization and operation mode of people's work, business and social activities, and ultimately promotes the advancement of human social productivity. Therefore, the major research program of interpretable and universal next generation artificial intelligence methods faces the major strategic needs of the country in the development of artificial intelligence, takes the basic science issues of artificial intelligence as the core, develops the new method system of artificial intelligence, promotes the basic research and personnel training of artificial intelligence in China, and supports China's leading position in the new round of international scientific and technological competition. In this paper, the next generation of artificial intelligence innovation and application space are summarized, and the application of advanced algorithms is analyzed.

KEYWORDS

Advanced algorithm; Next generation AI; Intelligent innovation; Application scenario.

1. INTRODUCTION

Looking back at the development history of the Internet, the biggest feature is the massive digital application innovation. The scale and speed of this innovation far exceeds our experience in the industrial age, and it also forms wave after wave of digitization. From Web1.0 to Web2.0, from desktop Internet to mobile Internet, from the Internet of people to the Internet of things, Internet innovation has shown a large-scale, intergenerational accelerated change situation, which has constantly stimulated the imagination of the market and promoted the economy to continue to move upward. In recent years, with the emergence of new digital technologies and breakthroughs, the space for exploration, innovation and imagination of the next generation of artificial intelligence has been opened. In combination with recent hot issues and the current boundaries of the Internet, there are three key technologies that may take the lead and build the development framework of the next generation of the Internet through mutual combination and innovation.

The first type is holographic interconnection, which is represented by 3D engine and XR technology. In the future, if the Internet wants to break through the limited information transmission limitations

of two-dimensional plane and audio-visual, it will inevitably need technical support that can more comprehensively reproduce the physical world and fully convey the full sensory interaction information of human beings. In recent years, the 3D engine technology and XR technology promoted by games have made rapid progress, and Meta's VR equipment Ouest2, Unreal Engine UE5, and Nvidia 0mniverse platform have been launched together, which once triggered the wave of the "meta-universe" in the industry. Today, although XR devices have not completely broken through the limitations of experience to achieve true popularity, audio-visual and somatosensory simulation and interaction have entered a more realistic 3D development stage. Recently, for example, Apple just launched the Vision Pro, which may accelerate the development of XR again. Relatively speaking, there are more sensory information interaction technologies are still in a more preliminary stage of development, including taste, smell and brain computer interface, we are still a long way toward a truly holographic connected world.

The second category is intelligent interconnection, which is typically the AGI technology breakthrough led by GPT. The development and popularization of the Internet has promoted the explosive growth of online data and information. Faced with massive data and information, the efficiency of manual methods to learn and extract knowledge is very limited. The emergence of a generative pretrained converter model, GPT, makes it possible for AI to generalize, deduce, and assist human learning to greatly improve efficiency. In particular, GPT-3 began to enter the stage of 175 billion parameters of the super-scale model, and integrated unsupervised learning, supervised learning and reinforcement learning technology, efficient generation of question and answer content generally reached the high level of human beings. At present, GPT has triggered the emergence of AI generated applications in many fields around the world, from text and pictures to music, video, games, and other accelerated expansion and deepening. Comprehensive industry mainstream inference, the next three to five years, the high probability of this technology will reach the level of general artificial intelligence AGI, all mainstream applications will be integrated AI, the Internet has entered a new stage of "intelligence" everywhere.

2. RELATED WORK

"Next-generation AI" usually refers to a new round of innovation and development based on current AI technologies, with the goal of further improving the performance, adaptability, and creativity of intelligent systems. This may involve more advanced algorithms, more efficient computational models, more powerful learning methods, etc. The exact definition and application may vary depending on the context, but here are some possible features and applications:

2.1. Machine learning algorithm

Arthur Samuel, the founder of the field of Machine Learning, defined machine learning (ML) as early as 1959: machine learning is a field of research that enables computers to learn independently without relying on certain coding instructions. Arthur Samuel didn't just define ML, he developed a machine-learning system that learned to improve the machine's own checkers by playing them against a human. After thousands of learning sessions, Arthur Samuel's ML machine was able to match Arthur Samuel's chess skills.

Therefore, on the basis of machine learning, there are many new technical models and algorithm models.

First: linear regression model, linear regression is a basic predictive method in machine learning. It is based on the assumption that there is a linear relationship between inputs (features) and outputs (goals). The core principle of linear regression is to find a set of weights (coefficients) such that the linear combination of these weights and features is as close as possible to the target value. These

weights are determined during training by minimizing the difference between the predicted value and the actual value (usually the sum of squares of error).

Among the machine learning problems that linear regression is suitable for dealing with are,

Prediction problems: Linear regression is a powerful prediction tool in situations where there is a clear linear relationship between the feature and the target variable. For example, housing price forecast, stock price forecast and so on.

$$a = \frac{\sum_{i=1}^{m}(x^{(i)} - \bar{x})(y^{(i)} - \bar{y})}{\sum_{i=1}^{m}(x^{(i)} - \bar{x})^2} \qquad b = \bar{y} - a\bar{x} \tag{1}$$

Causal analysis: Linear regression can be used to analyze the effects of different characteristics on target variables, such as the effects of different factors on results in economics and social sciences.

Time series analysis: Although there are specialized time series models, linear regression can also be used to analyze time series data in some cases, especially when the data exhibits a linear trend. Although linear regression is useful in many situations, it may not perform as well when dealing with non-linear relationships, highly complex data sets, or data with a lot of noise. Therefore, it is very, very important to understand the nature and requirements of the data before choosing a linear regression model.

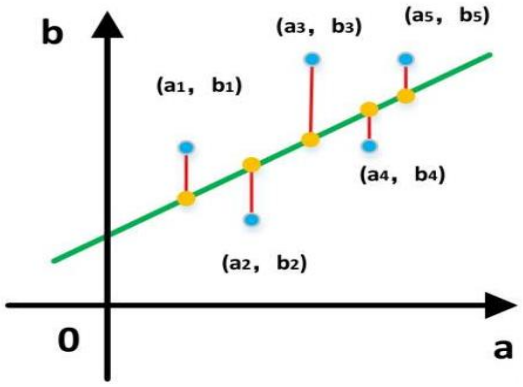

Figure 1. Linear regression parameter model

The quest for precise robot positioning within logistics automation has been a focal point in recent research endeavors. A multitude of techniques and methodologies have been explored to address this critical challenge.

2.2. Learn using network models

Natural language processing is a technology that uses computer as a tool to process and process written or oral forms. It is a discipline that studies actors in interpersonal communication and human-computer communication, and is the main content of artificial intelligence. It is also the model of studying language ability and language application, establishing computer (algorithm) framework to realize such language model, and improving, evaluating, and finally designing various practical systems.

In natural language processing technology, the first is digital features and classification features, text data has digital features and classification features, machine learning can only understand digital features, but can not understand classification features, in order to allow the computer to process the information with classification features of the text, it must talk about its classification features into digital features. Here's an example:

Age	Gender	Nationality
35	1	US
31	1	China
29	0	India
27	1	US

Figure 2. Natural language character processing

In the diagram above, the "age" column represents a numeric feature and is not processed. The data in the columns "gender" and "nationality" have classification characteristics. This is when you need to turn it into a digital feature. We use the one-hot vector to represent the classification features of the text instead of using simple 1,2,3... The reason is that the text represented by 1 and the text represented by 2 cannot be added to the text information represented by 3, and it is more reasonable to use the one-hot vector to add

Using the one-hot method we can represent:

US is [1,0,0...] ;

China is [0,1,0...] ;

India is [0,0,1...] .

So the first line of text information can use the vector [35,1,1,0,0...] The third line of information can be used with the vector [29,0,0,0,1...] Indicates. (If "nationality" is empty, we can use an all-zero vector.)

2.3. Recurrent neural network

Similar to human reading, recurrent neural networks input one word at a time, and then continuously loop input words until the end of the whole sentence, which is suitable for processing text, speech and other data with time sequence information. The network structure of RNN is shown as follows: Firstly, A text is converted into vector x through word embedding process, and then passed into the neural network parameter matrix A, and the state vector h is output. Then enter the next text data... This repeated loop processing of text is the main idea of RNN. Each output state h contains only the information of all the previous words, and the last output state h contains the information of the entire sentence. Note that the entire RNN has only one parameter matrix A, and the one on the right is the expansion of the network on the left.

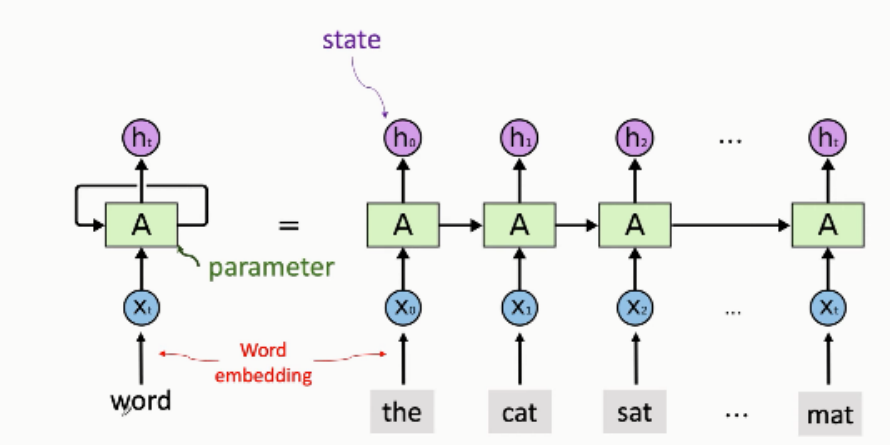

Figure 3. Network structure of RNN

The status of the parameter matrix A is shown in the figure below. Finally, the hyperbolic tangent function tanh is used to round the parameters to [-1, 1]. This function is used to avoid the matrix parameters being too large or too small.

The innovation of recurrent neural network (RNN) architecture for the next generation of intelligence is manifested in its ability to process sequential data, including natural language processing, time series analysis, audio processing and other multi-field applications. The innovation of RNN is that it has memory function and can capture contextual information in the sequence, which makes it have great potential in simulating human cognition and understanding sequence data, helping to promote the development of the next generation of intelligent systems in the fields of language understanding, sentiment analysis, speech recognition and so on.

2.4. Application case

The next generation of artificial intelligence (AI) is at the forefront of innovation and development, covering a wide range of fields such as healthcare, finance, education, transportation, agriculture, entertainment, and more. In the medical field, it is changing the way diseases are diagnosed and treated, and improving medical efficiency. In the financial sector, AI is used for risk management, intelligent investment and automated trading, driving innovation in financial services. In the field of education, AI improves personalized learning and the customization of educational resources. In the transportation sector, autonomous driving technology is redefining mobility. In agriculture, AI provides precision agriculture solutions that improve the efficiency of agricultural production. In entertainment, AI creates immersive experiences and creative entertainment. These innovative applications will profoundly impact our lives and work, creating unprecedented opportunities and challenges in various fields.

This paper mainly analyzes and expounds the innovative application of the combination of next-generation AI and finance as a case study. For example, reinforcement learning algorithms such as Deep Q Networks (DQN) are able to formulate optimized investment strategies in dynamic market environments, making decisions based on historical data and real-time information. In addition, sentiment analysis algorithms based on natural language processing can analyze social media and news data to better understand market sentiment. The combination of these algorithms allows the next generation of AI to respond more quickly and accurately to market changes, increasing return on investment.

3. DQN APPLICATION AND INTRODUCTION

This application scenario aims at the intelligent realization of trading strategies in stock trading. The reinforcement learning model based on DQN is adopted. DQN is an improvement and optimization based on Q learning combined with neural network. Human Level Control Through Deep Reinforcement Learning was proposed by Deep Mind in 2015. Replace the Q table with a neural network, and add Memory to resampling and training the previous experience.

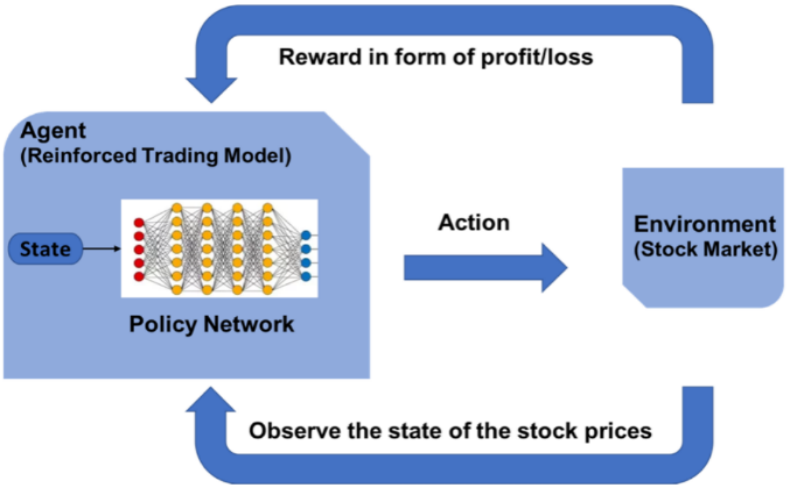

Figure 4. Reinforcement learning model of DQN

3.1. Financial data Agent

As a policy subject, the agent is generally established in the form of class. It is generally composed of the following parts:

Main parameters:

state: State, which usually refers to the state of the environment and the state of the agent in the environment. In this modeling, state_size is to investigate how long the stock price history of the algorithm itself will be used as the input state.

Action space: For stock market strategies, there are three general actions: buy, sell, sit;

gamma gamma: refers to the learning rate, but also the degree of far-sightedness of the algorithm itself;

epsilon ε: is the probability occupied by the random strategy in the ε-greedy strategy, which will gradually decrease during the training process. In this code, decay rate epsilon_decay and minimum value epsilon_min are set.

model

The core of the model is a 4-layer convolutional neural network, the size of the input is determined by the state, and the output is determined by the action space. Here is the function formula:

$$Q(St,At,w)\leftarrow Q(St,At,w)+\alpha[Rt+1+\gamma maxa\hat{}q(st+1,at,w)-Q(St,At,w)] \quad (2)$$

$$\Delta w=\alpha(Rt+1+\gamma maxa\hat{}q(st+1,at,w)-\hat{}q(st,st,w))\cdot\nabla w\hat{}q(st,at,w) \quad (3)$$

Among them, DQN model is a value-based reinforcement learning algorithm, which is the combination of Q-Learning reinforcement learning and neural network. The basic idea of Q-learning is to find the optimal strategy by constantly updating the estimation of the value function Q(s,a), which can learn and find the optimal strategy under unknown environment. By introducing deep neural network (DNN) into Q-Learning to replace Q-Table, the universality of Q-Learning can be improved, so that the model can cover the market state that has not occurred in the training set, and output continuous action decisions, and finally maximize the value of the combination.

3.2. DQN model is introduced

Reinforcement learning led by the next generation of AI has been widely used in the financial field. In psychological behaviorism, people learn through constant interaction with their environment. The environment will reward or punish people's different behaviors, and people can gradually predict the

results of different behaviors in learning, so that they can learn to maximize the benefits of habitual behaviors. This is where the basic idea of Reinforcement Learning comes from. Reinforcement learning hopes to train the Agent to learn to make the optimal decision through repeated experience acquired through interaction with the system, which is similar to the process of investment and trading by investors in reality. Therefore, reinforcement learning is suitable for situations such as order execution, market making, portfolio management, etc., where decisions need to be made based on specific market conditions.

Reinforcement learning can be divided into two types: Model-Free learning and Model-Given learning. Model-free learning does not learn and understand the environment, but only makes decisions based on the currently known information. Model learning will predict the possible state of the environment in the future, for example, automatic driving will predict the surrounding environment in the future to respond in advance.

According to the output results, reinforcement learning can also be divided into two types: Policy-Based and Value-Based. In the policy-based approach, the Agent will develop a set of action strategies and optimize the strategies so as to obtain the maximum reward in a given state. By maintaining a value table or value function, the value-based method can calculate the value of each action according to the current state, and select the action with the greatest value. Therefore, the value-based method is more suitable for the selection of discrete actions.

Q-Learning is a value-based model-free learning algorithm. It only makes action choices based on known market information, and outputs actions with the highest value. Reflected in the issue of option replication, the "action" is the position of the underlying asset, while the "value" is the return of the portfolio. Therefore, the characteristics and effects of Q-Learning are very suitable for the purpose of option replication. We can use Q-Learning to improve the dynamic option replication strategy, so that the model can learn the known information of the market and output positions that maximize the value of the portfolio.

4. THE CHALLENGE OF THE NEXT GENERATION OF AI

Artificial intelligence is actually up to now, there are a lot of statements, but there are interpretative problems, there are security problems, there are robustness problems, how to be supervised like people, semi-supervised more is unsupervised, people are learning through advanced experience, not just clear data learning, although there is data implicit in it, but this inside the environment is different, Different consciousness, different emotions, different reflection, different insight and action ability, at this time people's cognitive perception is also different.

4.1. Data and model drive together

The present or the first and second generation of artificial intelligence, in this way of thinking, how to combine with people to face the challenges of the next generation of artificial intelligence, of course, for people, our common sense and common sense reasoning, including uncertainty is one of the basic capabilities of our innovation. How to let the machine face common sense, common sense reasoning and uncertain reasoning is the concern of the next generation of artificial intelligence. So the core of artificial intelligence is not just machine learning algorithms, not just existing deep learning models, in that sense, from the earliest feature-centered concerns, to learning-centered processing, and now the combination of representation and learning of this approach to artificial intelligence, it should be said that there has been a fundamental change. We are facing a common open environment, facing a large number of data, but also a small sample, how to do. Therefore, the difficulty of massive data, network overfitting, hyper-parametric optimization, as well as the lack of high-performance hardware and poor interpretability, how to explain the problem of robust interpretability security in the face of

common sense, a priori, causality and reasoning, also needs hardware support. Therefore, how to solve the difficult problem expounded by artificial intelligence step by step.

4.2. Concepts are abstracted into models

Automatic learning, progressive learning, learning convergence, stability, gradient stagnation attribute and other mathematical problems are the next generation of artificial intelligence algorithms and models to solve the basic theoretical problems.

4.3. The combination of production, learning and research

Recently, our country has attached great importance to solving these problems from the top level, and the country has issued corresponding plans, these plans are known to you, as I said, these plans are to perceive and solve these problems from an academic point of view, and the country has also established corresponding AI open innovation platform, all of which is what we really need to do. And we are facing the major national needs and major tasks of the country, how to combine with the national development to do the corresponding work. What do these companies do? Autonomous driving, urban brain, medical imaging, intelligent audio and video, intelligent vision, including the recent Tiktok and wechat, including Huawei's 5G, we all know that these technologies banned by the United States on China are actually core technologies that affect the development of our next generation of national economy.

To sum up, the next generation of artificial intelligence actually needs to serve the country in many new infrastructure areas, including 5G, UHV, rail transit, big data, industrial Internet, in fact, it comes down to information infrastructure, integration infrastructure, and innovation infrastructure. Therefore, how to achieve innovative breakthroughs from 0 to 1 is not necessarily simply to do research, but more importantly to combine production, university and research to establish a national innovative environment, technology, innovative environment and innovative talent training mechanism.

5. CONCLUSION

This paper discusses the evolution of the Internet and its profound impact on communication, collaboration, and productivity. It highlights the emergence of next-generation artificial intelligence (AI) and its potential to revolutionize various fields. The paper explores key technologies such as holographic interconnection and intelligent interconnection, emphasizing the role of advanced algorithms in shaping the future of AI. It also presents a case study on the application of deep reinforcement learning using DQN in the financial sector. The challenges of the next generation of AI, including interpretability, security, and robustness, are outlined, and the importance of combining research, production, and learning to serve the country's strategic needs is emphasized.

This paper delves into the history of the Internet's development and its transformative impact on global communication and collaboration. It highlights the emergence of next-generation artificial intelligence (AI) and its potential to reshape various industries. The paper discusses key technologies such as holographic interconnection and intelligent interconnection, with a focus on advanced algorithms. A case study on using deep reinforcement learning with DQN in finance is presented. The paper also addresses challenges faced by the next generation of AI, including interpretability, security, and robustness. It underscores the importance of integrating research, production, and learning to meet the country's strategic objectives.

ACKNOWLEDGMENTS

At the end of this article, I would like to express my Deep gratitude to the article "Deep Learning Model Aids Breast Cancer Detection" and its author Meiqing Cai. This article has provided me with valuable inspiration and theoretical basis to help me better understand the development status and application fields of the next generation of artificial intelligence. Not only did it provide me with valuable insights into the application of deep learning models in breast cancer detection, it also inspired my exploration of the future potential of artificial intelligence. in addition, I would like to thank the editors and reviewers of the journal Frontiers in Computing and Intelligent Systems for their work in making this article widely available and shared. The high-quality publication of journals provides a valuable resource for the academic and research communities and promotes the dissemination and sharing of scientific knowledge.

In conclusion, I sincerely thank Meiqing Cai for their work and their contributions to the field of artificial intelligence, as well as the journal Frontiers in Computing and Intelligent Systems for its support. Their work has provided me with valuable references and inspiration to better explore the frontiers of the next generation of AI.

REFERENCES

[1] Zheng, Jiajian, et al. “The Credit Card Anti-Fraud Detection Model in the Context of Dynamic Integration Selection Algorithm”. Frontiers in Computing and Intelligent Systems, vol. 6, no. 3, Jan. 2024, pp. 119-22, https://doi.org/10.54097/a5jafgdv.

[2] Qian, Jili, et al. “Analysis and Diagnosis of Hemolytic Specimens by AU5800 Biochemical Analyzer Combined With AI Technology”. Frontiers in Computing and Intelligent Systems, vol. 6, no. 3, Jan. 2024, pp. 100-3, https://doi.org/10.54097/qoseeQ5N.

[3] Song, Tianbo, et al. “Development of Machine Learning and Artificial Intelligence in Toxic Pathology”. Frontiers in Computing and Intelligent Systems, vol. 6, no. 3, Jan. 2024, pp. 137-41, https://doi.org/10.54097/Be1ExjZa.

[4] Du, Shuqian, et al. “Application of HPV-16 in Liquid-Based Thin Layer Cytology of Host Genetic Lesions Based on AI Diagnostic Technology Presentation of Liquid”. Journal of Theory and Practice of Engineering Science, vol. 3, no. 12, Dec. 2023, pp. 1-6, doi:10.53469/jtpes.2023.03(12).01.

[5] “Implementation of Computer Vision Technology Based on Artificial Intelligence for Medical Image Analysis”. International Journal of Computer Science and Information Technology, vol. 1, no. 1, Dec. 2023, pp. 69-76, https://doi.org/10.62051/ijcsit.v1n1.10.

[6] “Enhancing Computer Digital Signal Processing through the Utilization of RNN Sequence Algorithms”. International Journal of Computer Science and Information Technology, vol. 1, no. 1, Dec. 2023, pp. 60-68, https://doi.org/10.62051/ijcsit.v1n1.09.

[7] Dong, Xinqi, et al. “The Prediction Trend of Enterprise Financial Risk Based on Machine Learning ARIMA Model”. Journal of Theory and Practice of Engineering Science, vol. 4, no. 01, Jan. 2024, pp. 65-71, doi:10.53469/jtpes.2024.04(01).09.

[8] Tan, Kai, et al. “Integrating Advanced Computer Vision and AI Algorithms for Autonomous Driving Systems”. Journal of Theory and Practice of Engineering Science, vol. 4, no. 01, Jan. 2024, pp. 41-48, doi:10.53469/jtpes.2024.04(01).06.

[9] “A Deep Learning-Based Algorithm for Crop Disease Identification Positioning Using Computer Vision”. International Journal of Computer Science and Information Technology, vol. 1, no. 1, Dec. 2023, pp. 85-92, https://doi.org/10.62051/ijcsit.v1n1.12.

[10] Wang, Sihao, et al. “Diabetes Risk Analysis Based on Machine Learning LASSO Regression Model”. Journal of Theory and Practice of Engineering Science, vol. 4, no. 01, Jan. 2024, pp. 58-64, doi:10.53469/jtpes.2024.04(01).08.

[11] Wei, Kuo, et al. “Strategic Application of AI Intelligent Algorithm in Network Threat Detection and Defense”. Journal of Theory and Practice of Engineering Science, vol. 4, no. 01, Jan. 2024, pp. 49-57, doi:10.53469/jtpes.2024.04(01).07.

[12] “Based on Intelligent Advertising Recommendation and Abnormal Advertising Monitoring System in the Field of Machine Learning”. International Journal of Computer Science and Information Technology, vol. 1, no. 1, Dec. 2023, pp. 17-23, https://doi.org/10.62051/ijcsit.v1n1.03.

[13] Yu, Liqiang, et al. “Research on Machine Learning With Algorithms and Development”. Journal of Theory and Practice of Engineering Science, vol. 3, no. 12, Dec. 2023, pp. 7-14, doi:10.53469/jtpes.2023.03(12).02.

[14] Liu, Bo, et al. "Integration and Performance Analysis of Artificial Intelligence and Computer Vision Based on Deep Learning Algorithms." arXiv preprint arXiv:2312.12872 (2023).

[15] Yu, L., Liu, B., Lin, Q., Zhao, X., & Che, C. (2024). Semantic Similarity Matching for Patent Documents Using Ensemble BERT-related Model and Novel Text Processing Method. arXiv preprint arXiv:2401.06782.

[16] Huang, J., Zhao, X., Che, C., Lin, Q., & Liu, B. (2024). Enhancing Essay Scoring with Adversarial Weights Perturbation and Metric-specific AttentionPooling. arXiv preprint arXiv:2401.05433.

[17] Tianbo, Song, Hu Weijun, Cai Jiangfeng, Liu Weijia, Yuan Quan, and He Kun. "Bio-inspired Swarm Intelligence: a Flocking Project With Group Object Recognition." In 2023 3rd International Conference on Consumer Electronics and Computer Engineering (ICCECE), pp. 834-837. IEEE, 2023.DOI: 10.1109/mce.2022.3206678

[18] Liu, B., Zhao, X., Hu, H., Lin, Q., & Huang, J. (2023). Detection of Esophageal Cancer Lesions Based on CBAM Faster R-CNN. Journal of Theory and Practice of Engineering Science, 3(12), 36–42. https://doi.org/10.53469/jtpes.2023.03(12).06

[19] Liu, Bo, et al. "Integration and Performance Analysis of Artificial Intelligence and Computer Vision Based on Deep Learning Algorithms." arXiv preprint arXiv:2312.12872 (2023).