The Practice Research of Artificial Intelligence in Computer Network Technology in the New Era

Zixuan Ji
Slippery Rock University of Pennsylvania, PA 16057, USA.

Abstract: This paper summarizes the practical application and development trend of artificial intelligence technology in the field of computer network. Artificial intelligence has been widely used in network communication, management and security, and other aspects, to achieve the network independent optimization, fault self-healing, threat identification and other intelligent capabilities. Artificial intelligence is a key technology to promote the evolution of the next generation network to the direction of adaptive, intelligence and security. The use of artificial intelligence also faces challenges such as algorithm deviations and regulatory constraints. Collaborative innovation algorithms and systems and the establishment of legal ethics systems are needed to promote the healthy development of AI and the progress of computer networks.

Keywords: New Era; Artificial Intelligence; Computer Network Technology

Foreword

As the infrastructure of the information society, the performance, reliability and security of the computer network are related to the normal operation of the economy and society. However, the traditional network faces challenges such as complex management, frequent failures and security vulnerabilities. The new generation of artificial intelligence technology provides the possibility of intelligent upgrade of computer networks. This paper first summarizes the application status of AI in network communication, management and security; second, analyzes how AI promotes the improvement of adaptation, intelligence and security of next-generation networks; and finally, discusses the risks and regulation of using AI. In order to provide some thinking for artificial intelligence to help the computer network progress. The integration of artificial intelligence and network is of great significance to the construction of a safe and efficient digital society.

1. Application of artificial intelligence technology in computer network in the new era

1.1 Application in the field of network communication

With the development of 5G and other new generation of network technologies, the network communication field has put forward higher requirements for more intelligent network management and optimization. Artificial intelligence technology in the new era provides strong support for the leap of network communication capability. New artificial intelligence algorithms such as enhanced learning can realize network autonomous learning and optimization. For example, the Minerva algorithm developed by Google can automatically adjust the routing strategy according to the changes of the network environment to realize the autonomous operation of the network. The MAVE AI system proposed by the Chinese Academy of Sciences can also actively allocate network resources according to traffic changes to maximize throughput. This is more flexible and efficient than the traditional static artificial preset static strategy. AI also supports the construction of cognitive networks. For example, the BayesPhone project of CMU uses Bayesian learning to realize speech recognition, user intention understanding, etc., so that the network can actively perceive and adapt to the needs of users. The CogNet system of Bell Lab also builds an end-to-end cognitive network model to realize the functions of cognitive information exchange, distributed learning and so on.

1.2 Application in the field of network management

For large-scale and complex computer networks, the use of artificial intelligence for intelligent network management has also become urgent. Machine learning, deep learning and other artificial intelligence technologies are widely used in network traffic control, resource optimization, fault diagnosis and other aspects. Google's B4 network, for example, uses deep reinforcement learning algorithms to optimize network traffic. The algorithm can dynamically plan the routing strategy according to the network topology structure, traffic changes and other conditions, so as to improve the overall utilization efficiency of the network while ensuring the quality of key services. MIT researchers designed a system Polycone based on neural network, which can analyze massive network data and accurately locate network fault nodes. This greatly reduces the time for traditional troubleshooting.

1.3 Applications in the network security field

Deep learning can conduct behavioral analysis of network traffic and identify the existing abnormal intrusion behavior. Such as Baidu's X-DeepProtect system can detect 0-day attacks. Reinforcement learning can simulate the attack and defense game between hackers and generate defense strategies adversarial. Based on such artificial intelligence methods, the active detection and rapid response to cyber threats can be realized. At present, ai network security products have been initially implemented, such as Darktrace, Vectra and other unsupervised learning for threat monitoring. But to deal with the increasingly complex network attacks, we also need to connect the application of distributed AI in the field of network security. Artificial intelligence security will become an important direction of network security enhancement and innovation.

2. Artificial intelligence enables the development of next- generation network technology

2.1 Artificial intelligence helps with adaptive networks

The traditional network architecture is relatively static, and it is difficult to make rapid response and optimization in the face of network environment changes. The new generation of adaptive network has the ability to perceive the environment, autonomous learning and dynamic adjustment. The introduction of artificial intelligence provides a key support for the construction of adaptive networks. Artificial intelligence can collect network operation data, identify network status, and automatically adjust network parameters and topology according to traffic and resource changes. For example, the Darwin system of CMU uses reinforcement learning to adjust the data center network and realize the rapid reorganization after the switch failure. In addition, some digital twins and simulation technologies can use artificial intelligence to build "mirror images" of networks to help evaluate the effects of different control strategies.

2.2 Artificial intelligence supports network intelligence

The future development direction of the network is to achieve end-to-end intelligence. This requires networks to be, like the human brain, able to perceive the environment, understand needs, and make decisions. Artificial intelligence technology provides the possibility to achieve this goal. Artificial intelligence can analyze user behavior data, predict network demand, and realize active resource allocation. Microsoft's Astute system, for example, can reserve network bandwidth in advance based on the conference schedule. In addition, through natural language understanding, computer vision and other technologies, the network can understand users' intentions and provide intelligent services just like humans. For example, the Net2Text system of CMU can transform the network failure phenomenon into a text description to help with the diagnosis. Artificial intelligence makes networks more like in terms of "perception-thinking-decision making", with the ability to analyze and solve problems independently. This not only greatly simplifies network management, but also makes the network more user-friendly. Enabling network intelligence is a revolutionary progress that artificial intelligence can bring to the future network.

2.3 Artificial intelligence ensures network security

Artificial intelligence can perform a correlation analysis of massive network data, identify abnormal behavior patterns, and realize the active discovery of known and zero-day threats. For example, MIT's AI2 system successfully detected 97% of the phishing sites. In addition, artificial intelligence can also attack and attack, like human hackers to find system

vulnerabilities, so as to improve the antagonism of the network. DARPA's Cyber Grand Challenge, for example, shows the possibility of AI automatic attack and defense. Ai assistance can also improve safety traceability and event response efficiency. For example, Endgame's endpoint detection system can quickly locate the intrusion source and assist the security team to respond. As the "firewall" and "immune system" of network security, artificial intelligence can continuously monitor threats, active vulnerability discovery, counter attacks, etc., which will greatly improve the security and anti-attack ability of the network. This is also the urgent direction of the field of network security.

3. Challenges of the integration of AI with computer networks

3.1 Algorithm deviation and safety risks

Most of the existing AI algorithms are based on finite sample training, so it is difficult to avoid data selection bias. This may lead to errors in network management decisions, such as errors in limiting normal user traffic. Moreover, the complex network environment also increases the model fitting error. For example, the network control algorithm based on reinforcement learning is difficult to fully simulate the causal relationship in the real world, and there are also decision-making risks. The AI systems are also at risk of being exploited for cyber attacks. Hackers can conduct adversarial attacks through data deception and mislead the network security system to produce wrong output. Or reverse engineering using model extraction, bypassing the AI defense. This can easily lead to the network defense line is breached. In order to meet the above challenges, it is necessary to improve the algorithm robustness and model interpretability, so as to reduce the security risks of the AI system itself and ensure that it can be stably and reliably applied to key network systems.

3.2 Problems in legal and ethical regulation

How to protect the privacy of the users when the AI system monitors the network users automatically? Is there a discriminatory algorithm bias in data utilization? This requires establishing a clear legal red line. In addition, the use of artificial intelligence in the field of network attack and defense has increased the problem of boundary blur. Will, for example, automatic AI confrontation exacerbate cyber warfare? This requires strict international laws. Artificial intelligence also faces ethical regulations. Whether they can guarantee decisions that meet moral and social norms requires humanistic considerations. And how to balance the decision-making authority of AI and the regulatory relationship of human beings, which needs to define clear ethical principles. The use of artificial intelligence to empower the network should not only consider the technical effect, but also need to improve the legal supervision system and clarify the ethical bottom line. This is an important prerequisite for promoting the network application of artificial intelligence. It also requires relevant enterprises, the government and the public to form a broad consensus to jointly promote the development of AI in a direction beneficial to mankind.

Conclusion

AI technology in the new era has shown broad application prospects in network communication, management and security. It realizes the ability of autonomous learning, semantic understanding and intelligent decision-making of the network, and greatly improves the intelligent level of the network. The introduction of artificial intelligence will also promote the next generation of networks to the direction of adaptation, cognition and security, and achieve a revolutionary leap from connection to intelligence. However, we also need to recognize the risks that AI may bring, and strengthen legal regulations and ethical constraints to ensure the healthy development of AI and the harmonious progress of the network. The deep integration of artificial intelligence and the network still needs the joint efforts of all sectors to promote the well-being of human society.

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