Application of Artificial Intelligence in Computer Network Technology in big data era

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ABSTRACT

Computer network technology has seen tremendous opportunities as well as challenges due to the Big Data era's rapid data expansion. Modern networks, which are increasingly fueled by the exponential influx of data from many sources including IoT devices, cloud services, and social media, are too large, complicated, and dynamic for traditional network management techniques to handle. Computer networking is seeing a revolution because to artificial intelligence (AI), which is allowing networks to advance beyond their traditional limits and satisfy the demands of this data-driven world. Artificial intelligence (AI) methods, such as data analytics, deep learning, and machine learning, are being used to improve security, optimize network speed, and guarantee real-time decision-making. In instance, by anticipating congestion and dynamically modifying routing patterns, AI-driven systems make it possible to manage network traffic more effectively. AI also helps with threat identification, anomaly detection, and automated reactions to possible cyberattacks, all of which are vital for improving network security. Additionally, self-healing networks—which can recognize and fix problems on their own—are made possible by AI-powered systems, which lower downtime and increase network dependability. Network Function Virtualization (NFV) and Software-Defined Networking (SDN) integration are two more important networking applications of AI. These technologies gain from AI's capacity to automate configuration and management activities, control network slicing, and optimize resource allocation, all of which contribute to more adaptable and scalable networks. Additionally, AI makes predictive analytics easier in network planning, enhancing resource efficiency and predicting future traffic trends. The intricacy of model training, worries about data privacy, and the requirement for sophisticated infrastructure are some of the obstacles to integrating AI into network management, despite its enormous promise. Nevertheless, when AI develops further, it is anticipated to have a significant impact on how networking develops in the future, creating completely autonomous, self-optimizing, and extremely secure networks that can handle the Big Data era's constantly expanding demands.This study examines how artificial intelligence (AI) can be used in computer network technology, looking at how it can help with the challenges of current network management and how it can spur innovation in the Big Data era.

KEYWORDS: *Intelligent machines (AI),Technology of Computer Networks,The Era of Big Data, Machine Learning, In-depth Education, Network Enhancement, Traffic Control, Protection of Networks, Identification of Anomalies, Network Management That Is Automatic, Self-Repairing Systems,SDN, or software-defined networking.*

1. INTRODUCTION

The emergence of Big Data has revolutionized the creation, archiving, and processing of information by both individuals and companies. The swift development of data volumes presents network technologies with previously unheard-of difficulties in managing this expansion. Cloud computing, real-time data processing, social media platforms, IoT devices, and workplace apps all require sophisticated, fast data flows across a variety of contexts, which modern networks must accommodate. This increasing intricacy necessitates more intelligent, scalable, and effective network management systems. To meet the needs of contemporary data-driven systems, traditional approaches to computer network management and optimization are becoming less and less effective. Artificial Intelligence (AI) revolutionizes this situation. The design, monitoring, and management of networks is being completely transformed by AI through the use of techniques like machine learning, deep learning, and predictive analytics. The Big Data era requires AI's ability to automate repetitive processes, detect and reduce security risks, forecast traffic trends, and optimize resources instantly.AI integration into computer networks tackles a number of important issues. Network Optimization is an even with ever-increasing data quantities, AI can dynamically control network traffic, allowing for better data flow, less congestion, and efficient resource use. In the face of increasing threats and vulnerabilities, network security can be improved by AI algorithms that can detect anomalies, identify possible cyberattacks, and provide real-time actions to limit risks.AI-powered solutions can make it possible for networks to self-heal, which reduce downtime and increase overall network resilience by automatically identifying and fixing errors. Network management operations like configuration, load balancing, and traffic routing are made automated by AI, which greatly reduces manual intervention and increases network flexibility.

2. WHY AI IN NETWORKING?

More intelligent, scalable, and effective methods of managing and optimizing computer networks are desperately needed, as a result of the explosive growth of Big Data and the growing complexity of contemporary networks. Today's networks are too big, too fast, and too dynamic for traditional network management techniques, which mostly rely on manual configuration and static protocols. This is the point at which artificial intelligence (AI) becomes crucial.

The following are the main causes of AI's revolution in networking in the Big Data era:

2.1. Managing a Complex and Changing Network

Traffic in Conventional Networks:

Conventional networking frequently uses static rules and manual adjustments based on historical traffic patterns for traffic management, which makes it challenging to anticipate and adjust to sudden changes in data kinds and traffic volumes.

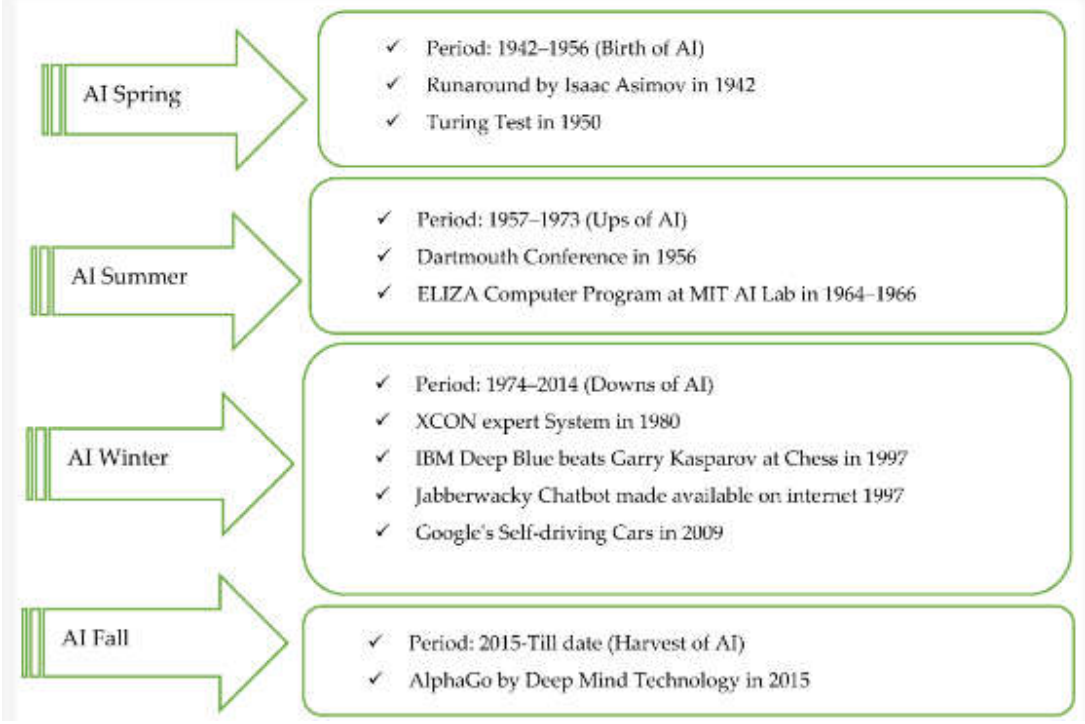
AI in Networking:

AI-powered systems are able to identify trends in massive volumes of real-time traffic data and dynamically modify network designs. In order to make better use of the available bandwidth and cut down on delays, machine learning algorithms can forecast traffic bottlenecks and optimize routing routes in real time.

Big Data Challenge:

As the amount of data from cloud computing, IoT devices, and other sources increases, artificial intelligence's capacity to process and adjust to enormous volumes of network data makes it easier to manage intricate traffic flows.

Figure 1. Brief History of AI: Compiled from Haenlein and Kaplan [50] and Wamba, Bawack, Guthrie, Queiroz and Carillo [14].



2.2. Manual Optimization Challenges in Real-Time Network Optimization:

Conventional optimization techniques are frequently too static and slow to handle network problems instantly. Manually adjusting configurations by network experts can be laborious and ineffective, particularly in large-scale settings.

Artificial Intelligence for Real-Time Optimization:

AI makes it possible to continuously and instantly monitor network performance. Without human assistance, algorithms are able to automatically modify factors such as bandwidth distribution, routing routes, and Quality of Service (QoS) settings, guaranteeing that the network is always operating at maximum efficiency.

Predictive analytics:

AI models can predict network activity, including traffic spikes or possible bottlenecks. This enables preventative actions to be performed before problems arise, guaranteeing a more seamless network operation.

Fig. 2. Several Segments for AI applications in Marketing Domain.

2.3. Strengthened Security for Networks:

Cyber security Difficulties:

Cyber security has grown to be a major worry in contemporary networks due to the exponential rise of data and the expanded attack surface. Conventional security measures are reactive; they frequently identify dangers only after an assault has taken place.

Security Powered by AI:

AI can greatly enhance security by spotting unusual patterns in real time, spotting dangers that haven't been identified yet (like zero-day attacks), and even forecasting possible weaknesses based on past data. Outliers in network traffic that can indicate DDoS attacks, malware infections, or illegal access can be found using AI-powered anomaly detection systems.

Automated Threat Mitigation:

By automatically preventing malicious traffic or isolating compromised network segments in response to threats, AI systems can reduce the likelihood of a security breach.

CONCLUSION:

The needs of modern digital environments cannot be adequately met by traditional network management techniques due to the exponential growth of Big Data and the growing complexity of contemporary networks. Computer network technology's incorporation of artificial intelligence (AI) offers revolutionary answers to these problems, facilitating more effective, safe, and expandable network operations. An indispensable tool in network management, artificial intelligence (AI) can process enormous volumes of real-time data, anticipate traffic patterns, and optimize resources. Even as data volumes and network needs continue to rise, artificial intelligence (AI) may improve network performance, simplify traffic management, and lower latency through machine learning, deep learning, and predictive analytics. AI-driven systems can also adjust to changing network conditions, increasing the flexibility and real-time handling of varying loads in networks. AI also makes it possible for more advanced threat identification, anomaly detection, and automated reactions to possible cyberattacks, all of which greatly improve network security. AI can proactively identify new threats and reduce risks before they do serious harm, while traditional security systems are reactive and frequently rely on pre-established rules. AI enables self-healing networks to identify errors and take remedial action on their own, reducing downtime and preserving service continuity. AI also has a major impact on new technologies like Network Function Virtualization (NFV) and Software-Defined Networking (SDN). When AI is included into these systems, networks become more self-managing and adaptive, facilitating resource allocation, automated configuration, and smooth scalability. For 5G networks to accommodate a variety of applications, such as edge computing and Internet of Things devices, high-performance, low-latency connections are essential.

The capacity of artificial intelligence (AI) to deliver predictive analytics, automate repetitive network administration operations, and guarantee real-time decision-making is crucial in the Big Data era, where the amount, velocity, and diversity of data consistently increase. It gives

businesses the resources they need to prosper in a world where everything is interconnected, in addition to managing the complexity of contemporary networks. Notwithstanding the apparent advantages, there are still obstacles to overcome before AI can be widely used in networking. These include worries about data privacy, the requirement for ongoing model training, and the difficulty of implementing AI solutions on a large scale. But as AI technologies advance and infrastructure changes to accommodate these developments, the possibility of highly secure, self-optimizing, and autonomous networks grows closer to reality. Finally, in order to fulfill the demands of the Big Data age, the incorporation of AI into computer network technology is not merely a trend but an essential evolution. By improving network security, scalability, and efficiency, artificial intelligence (AI) is changing networking and laying the groundwork for the next generation of resilient, intelligent, and adaptable networks that can meet the ever-increasing needs of the digital age. The future of computer networks will surely be greatly influenced by AI as it develops further, making sure that they can manage the potential and challenges of the Big Data era.

REFERENCES

1. **Wang, L., & Yu, F. R. (2020).** *Artificial Intelligence in Networking: Principles and Applications*. Springer.
2. **Zhao, Z., & Yang, L. (2021).** *Artificial Intelligence and Big Data: Opportunities and Challenges*. Springer.
3. **Cheng, X., & Zhang, H. (2019).** *Artificial Intelligence for Computer Networks*. Wiley.
4. **Li, J., Wang, Y., & Liu, L. (2020).** "Artificial Intelligence in Software-Defined Networking: A Survey." *IEEE Access, 8*, 61283-61307.
5. **Awasar, M., & Sharma, P. (2021).** "AI-Driven Network Traffic Management: A Review." *Journal of Network and Computer Applications, 175*, 102938.
6. **Ming, C., Zhang, Y., & Chen, S. (2020).** "Artificial Intelligence in Network Security: A Survey." *IEEE Transactions on Network and Service Management, 17*(4), 2873-2885.
7. **Cao, Y., & Zhao, Q. (2021).** "AI in 5G and Beyond: A Survey on Applications, Opportunities, and Challenges." *IEEE Network, 35*(4), 128-135.