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EDITORIAL

IEEE ACCESS SPECIAL SECTION EDITORIAL: ARTIFICIAL INTELLIGENCE IN CYBERSECURITY

I. INTRODUCTION

The Internet has a significant impact on people's daily lives and work. Recent studies claim that Artificial Intelligence (AI) has resulted in advances of many scientific and technological fields, that is, AI-based medicine, AI-based transportation, and AI-based finance. The era of AI is upon us. As one of the biggest concerns, security is of significance to the development of a sustainable, resilient, and prosperous Internet ecosystem. However, cybersecurity still faces many challenging issues such as intrusion detection, privacy protection, proactive defense, anomalous behaviors, advanced threat detection, and so on. In addition, many threat variations emerge and spread continuously. AI-assisted self-adaptable approaches are expected to deal with these security issues. A joint consideration of the interweaving nature between AI and cybersecurity is a key factor for driving future secure Internet.

This Special Section of IEEE Access on AI technologies in cybersecurity and related issues aims at bringing the researchers together to disseminate their findings in the field of AI-related theory analysis for security and privacy while pushing forward potential cooperation with related engineering fields in the context of AI in cybersecurity.

The Call for Papers aroused great enthusiasm in the scientific community and received a lot of submissions. Among these, 30 articles were accepted for inclusion in this Special Section after a thorough review process by at least two independent referees. Theese accepted articles can be broadly categorized into three groups: the first, with ten articles, mainly tackles network security detection. The second group, consisting of another ten articles, addresses data privacy protection and authentication issues. Finally, the third group, which includes the last ten articles, focuses on AI-based cybersecurity in different industrial applications.

In the first group, the article, "Harnessing artificial intelligence capabilities to improve cybersecurity," by Zeadally *et al.*, explores AI's potential in improving cybersecurity solutions.

The article "Classification hardness for supervised learners on 20 years of intrusion detection data," by D'hooge *et al.*, surveys the classification of supervised machine learning methods on network intrusion detection data under increasingly difficult conditions, through an evaluation of public data sets that cover 20 years of data generation.

The article "An optimization method for intrusion detection classification model based on deep belief network," by Wei *et al.*, proposes a new joint optimization algorithm to optimize the intrusion detection classification model based on deep belief network.

The article "An adaptive ensemble machine learning model for intrusion detection," by Gao *et al.*, proposes an adaptive ensemble learning model to integrate the advantages of algorithms for different types of data detection and achieves optimal results through ensemble learning.

The article "Performance evaluation of a combined anomaly detection platform," by Monshizadeh *et al.*, introduces an efficient platform named Hybrid Anomaly Detection Model (HADM), which can filter network traffic and identify malicious activities on the network.

The article "SMASH: A malware detection method based on multi-feature ensemble learning," by Dai *et al.*, proposes a malware dynamic detection method based on mufti-feature ensemble learning. The method adopts the combination of software features with high-detection precision and low-level hardware features.

The article "Machine learning based file entropy analysis for ransomware detection in backup systems," by Lee *et al.*, proposes to use machine learning for classifying infected files based on file entropy analysis. The proposed method can recover the original file from the backup system by detecting ransomware-infected files that have been synchronized to the backup system.

The article "An empirical evaluation of deep learning for network anomaly detection," by Malaiya *et al.*, designs and examines deep learning models constructed based on fully connected networks, variational auto encoder, and sequence-to-sequence structures.

The article "Cyber threat detection based on artificial neural networks using event profiles," by Lee *et al.*, develops an AI-SIEM system based on a combination of event profiling for data preprocessing and different artificial neural network methods.

The article "Abnormal behavior detection scheme of UAV using recurrent neural networks," by Xiao *et al.*, proposes a UAV abnormal behavior detection scheme using Recurrent Neural Networks.

In the second group, the article "Securing data with blockchain and AI," by Wang *et al.*, proposes a secure networking architecture (named SecNet) to significantly improve the security of data sharing and the security of the whole network.

The article ‘‘Smart contract-based secure model for miner registration and block validation,’’ by Zhang and Lee, designs a new smart contract-based model that is secure against rewriting-history attacks.

The article ‘‘APDP: Attack-proof personalized differential privacy model for a smart home,’’ by Zhang *et al.*, introduces a smart home model based on fog computing and secured by differential privacy, and applies a personalized differential privacy scheme to provide privacy protection.

The article ‘‘Latent-space-level image anonymization with adversarial protector networks,’’ by Kim and Yang, proposes a privacy-preserving adversarial protector network as an image anonymization tool to convert an image into another synthetic image that is immune to model inversion attacks.

The article ‘‘A machine learning framework for biometric authentication using electrocardiogram,’’ by Kim *et al.*, introduces a framework for electrocardiogram-based biometric authentication in order to mitigate identified challenges on ECG authentication.

The article ‘‘Certificateless deniable authenticated encryption for location-based privacy protection,’’ by Chen *et al.*, proposes a certificateless deniable authenticated encryption scheme based on certificateless cryptosystems, which avoids managing public key certificates in public key infrastructure-based cryptosystems and key escrow problems in identity-based cryptosystems.

The article ‘‘In-air gesture interaction: Real time hand posture recognition using passive RFID tags,’’ by Cheng *et al.*, proposes a real-time static and dynamic gesture recognition system for in-air interaction using the backscatter communication between the battery-free passive tags and the RFID reader.

The article ‘‘An enhanced electrocardiogram biometric authentication system using machine learning,’’ by Al Alkeem *et al.*, proposes a versatile RRIF biometric authentication system which uses a regression-based interpretable ML approach with the new Overall Performance (OP) measure based on the data quality.

The article ‘‘Learning based adaptive network immune mechanism to defense eavesdropping attacks,’’ by Liu *et al.*, proposes a learning-based adaptive network immune mechanism to prevent eavesdropping attacks.

The article ‘‘Technical mapping of the grooming anatomy using machine learning paradigms: An information security approach,’’ by Zambrano *et al.*, uses a database of real cyber-pedophile chats and proposes latent dirichlet allocation topic modeling to determine the stages of the attack.

In the third group, the article ‘‘BiN: A two-level learning-based bug search for cross-architecture binary,’’ by Wu *et al.*, proposes a cross-platform large-scale binary vulnerability search method based on two-level feature semantic learning to alleviate the vast differences in the assembly codes caused by different compilation scenarios.

The article ‘‘DeepTAL: Deep learning for TDOA-based asynchronous localization security with measurement error and missing data,’’ by Xue *et al.*, proposes an improved localization algorithm for source localization using deep learning to address TDOA measurement errors or missing data in an asynchronous localization.

The article ‘‘Blog reliability analysis with conflicting interests of contexts in the extended branch for cyber-security,’’ by Ko *et al.*, proposes a method to define a fake blogger’s features by analyzing the blogger’s tendency on comments and blog posts, including photos.

The article ‘‘Sina weibo bursty event detection method,’’ by Yang *et al.*, proposes a bursty event detection method for quantifying the influence of microblog text.

The article ‘‘Visualize your IP-over-optical network in realtime: A P4-based flexible multilayer in-band network telemetry (ML-INT) system,’’ by Niu *et al.*, designs a P4-based flexible multilayer in-band network telemetry system to visualize an IP-over-optical network in real time.

The article ‘‘Steganalysis of AMR speech based on multiple classifiers combination,’’ by Tian *et al.*, presents a novel steganalysis scheme based on multiple classifiers combination, which focuses on steganalysis in adaptive multi-rate speech streams to detect covert communication behaviors effectively to prevent illegal uses of AMR steganography.

The article ‘‘A Q-learning based scheme to securely cache content in edge-enabled heterogeneous networks,’’ by Dai *et al.*, proposes a cooperative scheme between edge server and content provider in HetNets to improve the performance of content delivery, and proposes a Q-learning based scheme for content caching to improve the hit ratio.

The article ‘‘A rerouting framework against routing interruption for secure network management,’’ by He *et al.*, proposes a fast rerouting framework for routing interruption, which consists of two parts: diagnosing routing interruption and implementing fast rerouting.

The article ‘‘Ontology-based security context reasoning for power IoT-cloud security service,’’ by Choi and Choi, proposes a security context ontology model by analyzing the security vulnerabilities of a power system in a power IoT–Cloud environment and defines the security context inference rules.

The article ‘‘AID shuffling mechanism based on group-buying auction for identifier network security,’’ by Guan *et al.*, proposes an artificial intelligence based method called three-stage auction mechanism for identifier allocation, to promote the security of access network in identifier network.

Finally, the Lead Editor and all the Guest Editors would like to express their gratitude to all the authors who submitted their research articles to our Special Section. They highly appreciate the contributions of the volunteering reviewers for their constructive comments and suggestions. They would also like to acknowledge the guidance from the Editor-in-Chief and the entire IEEE ACCESS staff.

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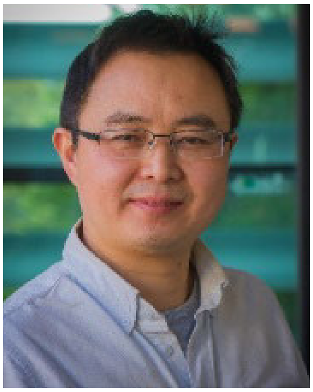

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