Chapter 19
Application of Machine Learning Algorithms to the IoE: A Survey

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ABSTRACT

The internet of everything is a network that connects people, data, process, and things, making it easier to understand that many subfields of knowledge are discussable while addressing this subject. This chapter makes a survey on the application of machine learning algorithms to the internet of everything. This survey is particularly focused in computational frameworks for the development of intelligent systems and applications of machine learning algorithms as possible engines of wealth creation. A final example shows how to develop a simple end-to-end system.

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INTRODUCTION

The first steps toward the present Internet were made in the late 1950s, with the initial studies on packet switching. After that, the development of protocols for internetworking, by which multiple separate networks could be joined into a network of networks, were made. Later, in 1969, the first internetwork message was sent over the Advanced Research Projects Agency Network (ARPANET), from the University of California to a second network node at Stanford Research Institute. A definition came for the Internet as the worldwide interconnection of individual networks operated by government and other third parties. However, the very first commercial Internet Service Providers for the Internet we know and use today only appeared in the late 1980s, established in Australia and the United States. In the same decade, the earlier World Wide Web was devised with the linking documents conception, forming an information system reachable by any network node, consequence of the researches made at European Organization for Nuclear Research (CERN). Since then, the Internet usage has spread in such a way that the International Telecommunications Union estimates the number of world Internet users at 3.6 billion by end 2017, i.e., 48% of the world's population.

In the Internet context, several, many times overlapping concepts, appeared in the last decades (Lueth, 2015; Perera, 2017): Machine-to-Machine (M2M), Internet of Things (IoT), Internet (of People – IoP), Web of Things (WoT), Internet of Everything (IoE) etc. (see Figure 1). As the name suggests, M2M indicates the communication between machines over some mean and protocol. In the present, those communications many times are done using the Internet Protocol (IP). On the other hand, the IoP is the internet that connects people, delivering information generated by persons. The WoT has a narrower scope as it solely focuses on software architecture. IoT is more intricate to bound since many times it moves from the sensors, tags and actuators to the end users, passing through the deployment of electronics and firmware, communications, (embed, edge or datacenter) computation, data storage etc. (see Figure 2). Conjugating the characterizations presented in various works (Serpanos & Wolf, 2018; Tan & Wang, 2010; Vermesan & Friess, 2011), a long definition arises as: the IoT is the dynamic global network infrastructure, with self-configuring capabilities based on standard and interoperable communication protocols, where a massive number of physical and virtual things have identities, physical attributes, and virtual personalities. These things use intelligent interfaces, often over the same Internet Protocol that connects the Internet, to connect and communicate, without human-to-machine input, through wired and wireless networks within social, environment, and user contexts, being seamlessly integrated in smart spaces and into the information network. In other words, IoT allows people and things (physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, tags, actuators, tags etc.) to be connected anywhere, anytime, with anything and anyone, enabling the collection and exchange of data. Extending the IoT concept, IoE aims to include all sorts of connections that one can envision as, the IoE is the networked connection of people, data, process, and things. In other words, IoE extends IoT by including intelligent and robust communication between machines-to-people (M2P), machine-to-machine, people-to-machines and people-to-people (P2P), i.e., the more expansive IoE concept includes M2M communications, machine-to-people and technology assisted people-to-people interactions.

It is expected that by 2020 between 20 and 30 billion devices will be interconnected in the IoT/IoE space. This rise in the quantity of apparatuses will also be accompanied by a growing diversity of distinct IoT/IoE device types, capable of directly gathering information from multiple sources, including health monitoring, asset tracking, environmental monitoring, predictive maintenance and home automation,