PROGRAMMING ARTIFICIAL INTELLIGENCE

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Abstract. *Programming Artificial Intelligence (AI) represents a captivating domain in today's information technology landscape. AI embodies the power and capabilities of computer systems that can analyze data, learn from experience, and perform tasks traditionally requiring human intelligence. Merging computer science, mathematics, and extensive datasets, AI programming emerges as a pivotal tool, revolutionizing daily life and industrial processes. This aspect of programming not only ensures the solution of complex tasks such as pattern recognition, automation of production processes, and trend forecasting, but also raises ethical and social questions. AI programming (or machine learning) encompasses processes such as supervised learning, unsupervised learning, reinforcement learning, and deep learning, enabling AI to qualitatively address various types of tasks. A closer examination of each AI learning method allows us to discern the positive and negative aspects of each. Additionally, delving into AI's role in telecommunications provides valuable insights into its multifaceted applications and the profound impact it has on human life.*

Keywords: *Artificial Intelligence, machine learning, telecommunications, programming.*

Introduction

21st century technologies are developing at an amazing speed, integrating into all spheres of our lives. The development of many aspects such as AI, neural network design, 3D printing, robotization and nanotechnology, which are interconnected with each other, predicts an amazing future for us. one of the most promising is AI, since all other areas can be based on it.

Artificial intelligence is the ability of a digital computer or a computer-controlled robot to perform tasks that are considered the prerogative of humans. Nowadays, the term is applied to the project of developing systems endowed with intellectual processes that are characteristic of human intelligence (reasoning, generalization, experience, analysis) [1]. In other words, AI is a huge range of algorithms and tools of mechanized learning that can rapidly acquire data, identify certain patterns, optimize or predict trends.

There are three types of artificial intelligence: Weak AI (Narrow AI), Strong AI (AGI), and Super AI [2].

The first type is widely used today, including applications like voice assistants, social media advertising, facial recognition, and romantic partner matching in apps, among others. These systems fall under Weak AI, which is the only type currently available.

Strong AI approaches the capabilities of human intelligence and, according to the classical Turing definition, possesses self-awareness. Experts estimate that AGI will likely emerge around 2075, with another 30 years required for Super AI.

Super AI could not only emulate humans but also surpass the best human minds in all fields, reprogramming itself, continually improving, and potentially developing new systems and algorithms autonomously.

Therefore, artificial intelligence is only at the beginning of its development path, and in the foreseeable future, its capabilities will far surpass the current abilities of both today's artificial intelligence and humans.

Methods of programming AI

The way of programming AI has evolved from year to year, new programming methods have been created and used to solve different problems. As of today, the main programming methods for AI are supervised learning, unsupervised learning, reinforcement learning, and deep learning, which is the biggest part of machine learning.

Figure 1 illustrates the structure of artificial intelligence and its internal hierarchy.

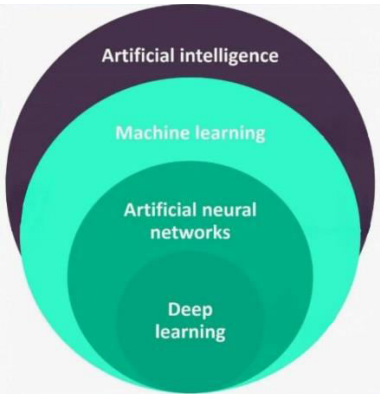

Figure 1. Structure of artificial intelligence

An important and widely used technology in the field of artificial intelligence is a deep learning [3, 4], a subset of machine learning that revolves around algorithms modeled on the structure and functionality of the brain, known as artificial neural networks. With the construction of more extensive neural networks and training on increasingly vast datasets, there is a persistent enhancement in their performance.

Deep learning models are computer files that data processing specialists have trained to perform tasks using an algorithm or a predefined set of steps. The technology of deep learning, through the creation of neural connections, powers many AI applications used in everyday products such as digital assistants, voice-activated TV remotes, fraud detection, and automatic face recognition. It is also a crucial component of emerging technologies like autonomous vehicles, virtual reality, and much more. In this way all subsequent AI learning methods come from the foundational deep learning.

Supervised learning is a branch of machine learning that combines algorithms and methods for building models based on a set of examples, including pairs of "known input - corresponding output" [5]. In other words, for an algorithm to fall under the category of supervised learning, it needs to operate on examples containing not just sets of independent variable vectors (features) but also associated values that the model aims to predict upon completing the training (referred to as targets).

Supervised learning in artificial intelligence is applied to various tasks, including classification, object detection, machine translation, voice recognition, recommendation systems, medical diagnosis and financial analytics.

Unsupervised learning is a machine learning technique that finds structures in data without the need for labels or guidance [6, 7]. In other words, an artificial neural network takes unlabeled data and tries to identify common characteristics and relationships in it by itself. Initially, artificial neural networks are fed with a diverse set of data, and then they are deployed to perform tasks in the real world using unlabeled data.

Sometimes, a neural network is unable to learn completely without labels, but obtaining a large amount of labeled data is not feasible. In such cases, partial teacher involvement is employed, some data is labeled, while the rest is left in its raw form. This accelerates training and enhances accuracy.

Unsupervised learning neural networks find applications in clustering data, dimensionality reduction, anomaly detection, content generation, image segmentation, self-organization, and other essential aspects of human activity.

Reinforcement learning is a branch of machine learning focused on instructing an agent to select actions from a set of possible actions available in an environment, aiming to maximize cumulative rewards received over a series of interactions [8]. It means that in reinforcement learning (RL), there is no predetermined answer key. However, the RL agent must still determine its actions to accomplish its task. Without pre-existing training data, the agent learns through experience, gathering training examples through trial-and-error while performing its task, aiming to maximize long-term reward.

Reinforcement Learning consists of four fundamental components [9]: agent - the software entity being trained to accomplish a defined task; environment - the context, whether physical or virtual, within which the agent operates and executes actions; action - a decision or move taken by the agent that influences the state of the environment; rewards - feedback provided to the agent based on its actions, which can be either positive or negative.

The interaction of these four main components can be observed in Figure 2.

Начало формы

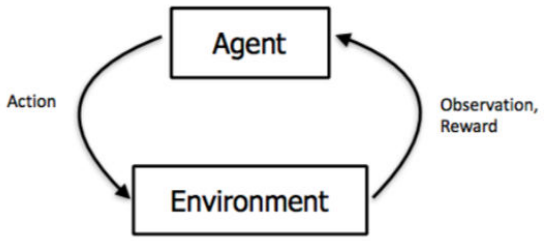

Figure 2. The agent observes the environment, takes an action to interact with the environment, and receives positive or negative reward

Reinforcement learning finds wide application in areas such as marketing, broadcasting journalism, healthcare, robotics, video games, and image processing.

Thanks to the diversity of artificial intelligence learning methods, it becomes possible to solve a multitude of tasks using various approaches, allowing for the effective achievement of goals in different fields.

Application in telecommunication

Artificial intelligence helps ensure the security of network technologies by automating monitoring and threat detection processes, analyzing large volumes of data to identify anomalies and predict potential attacks, and developing and implementing adaptive defense systems capable of responding to new threats in real time [10]. AI enhances production efficiency in telecommunications through network management automation, resource optimization, and data analysis for optimal infrastructure development. It also assists in technical support optimization, equipment failure prediction, and cloud services management. Within the realm of providing assistance, technical experts have the capability to utilize big data processing technology and artificial intelligence to efficiently strategize essential elements of network security administration, as well as fulfill the requirements of diverse technical applications.

Automating customer query processing through chatbots and virtual assistants and developing personalized services and recommendations based on analysis of user behavior and preferences pave the way for the evolution of this field, making it more modern, adaptive to changing requirements, and efficient in data transmission.

Conclusion

The advancement of technology has become inseparable from our daily existence, with artificial intelligence assuming a pivotal role in this evolution. It has reshaped our understanding of what was previously considered beyond imagination. A comprehensive examination of artificial intelligence programming techniques has illustrated the myriad tasks we can address with its aid. Incorporating artificial intelligence into the telecommunications industry is indicative of this trend and has notably bolstered the industry's standards. With artificial intelligence's backing, contemporary technologies will persist in progressing, presenting fresh opportunities to enhance our daily routines and professional endeavors.

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