Artificial Intelligence Brain-Inspired Intelligent Computation

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Abstract- Computation occurred within human brain is very much awesome and is not possible to be emulated 100% exactly in Artificial Intelligence (AI) method-based machines. What scientists did and have been done so far up to now are to try to model it as close as to what exactly occurs within the brain. Human brain has an awesome mechanism in performing computation with the end result is new knowledge and human uses the knowledge to actuate his organs. In this paper we will show a new approach for emulating the computation occured within human brain to obtain new knowledge based on the inputs sensed by the system's sensory system taken from the environment. When this process is carried out recursively, the system's knowledge becomes newer and newer, and it is called as knowledge growing. This approach is designed for an agent that has ability to think and act rationally like human. Our cognitive modelling approach is resulted in a model of human information processing and a technique to obtain the most maximum performance should be taken by the cognitive agent. This method is called as A3S (Arwin-Adang-Aciek-Sembiring), the agent is called as Knowledge-Growing System (KGS) and this brain-inspired method opens a new perspective in AI that we call as Cognitive Artificial Intelligence (CAI).

Keywords- Cognitive Artificial Intelligence, Knowledge-Growing System, Fundamentals of Cognitive AI

INTRODUCTION

Brain science and brain-inspired artificial intelligence have the potential for strengthening business and management. Brain-inspired artificial intelligence (AI) uses principles of brain science to build algorithms and AI systems with human-like intelligence. Some concepts (e.g., cognition, inference, memory, and intelligence) and principles of brain science are introduced in this paper. The research progress in several topics are also presented that include brain-inspired artificial intelligence and brain-inspired computing, project management and brain-inspired management, the integration of brain science into leadership (especially crisis leadership), and brain-inspired decision-making for business. Future research and trends in some topics are introduced.

Applying mechanisms and principles of human intelligence and converging the brain and artificial intelligence (AI) is currently a research trend. The applications of AI in brain simulation are countless. Brain-inspired intelligent systems will improve next-generation information processing by applying theories, techniques, and applications inspired by the information processing principles from the brain.

Exploring Future Opportunities of Brain-Inspired Artificial Intelligence focuses on the convergence of AI with brain-inspired intelligence. It presents research on brain-inspired cognitive machines with vision, audition, language processing, and thinking capabilities. Covering topics such as data analysis tools, knowledge representation, and super-resolution, this premier reference source is an essential resource for engineers, developers, computer scientists, students and educators of higher education, librarians, researchers, and academicians.

The fields of neuroscience and artificial intelligence (AI) have a long and interweaved history. In recent times, however, communication and collaboration between the two fields has less conventional. In this article, we discuss that better understanding of biological brains could play a vital role in building intelligent machines. However, we survey that historical interactions between the AI and neuroscience fields have emphasize the current advances in AI that have been inspired by the study of neural computation in humans and other animals. We conclude that by highlighting themes that have been the key for advancing the future research in both the fields. Last decades, automation technology has made a serious progress and today systematizes a wide range of tasks having before needed human physical and mental abilities. Nonetheless, a number of important problem domains remain that cannot yet be handled by our current machines and computers. A few prominent examples are

applications involving "real-world" perception, situation assessment, and decision-making tasks. Recently, researchers have suggested to use the concepts of "Brain-Like Artificial Intelligence", i.e. concepts inspired by the functioning principles of the human or animal brain, for further advances these are the problems of domain. This article discusses that the potential of Brain-Like Artificial Intelligence for innovative automation solutions and reviews a number of approaches developed together with the ICT intellectual automation group of the Vienna University of Technology targeting the topics of "real-world" perception, situation assessment, and decisionmaking for applications in building the automation environments and autonomous agents. Additionally, it is demonstrated by a concrete example how such developments can also be contributed for an advancement of the state of the art in the field of brain sciences. In modern years, several studies have been provided insight on the functioning of the brain which consists of neurons and form networks via interconnection among them by synapses. Neural networks are formed by interconnected systems of neurons, and mainly there are two types, the Artificial Neural Network (ANNs) and Biological Neural Network (interconnected nerve cells). The ANNs are computationally influenced by human neurons and are used in model neural systems. The reasoning foundations of ANNs have been useful in variance detection, in areas of medicine such as instant physician, electronic noses, pattern recognition, and model biological systems. Advancing research in artificial intelligence are used in the architecture of the human brain seeks to model systems by studying the brain rather than looking towards the technology for brain models. This study explores the concept of ANNs as a simulator of the biological neuron, and its area of applications.

LITERATURE SURVEY

1. Brain-Inspired Computational Intelligence

Author - JiantingNing, Xinyi Huang

Year-2022

Biological intelligent systems have many qualities that are often lacking in artificially designed systems including robustness, flexibility, and adaptability to environments. At a point in time where visibility into naturally intelligent systems is exploding thanks to modern brain imaging and recording techniques, our ability to learn from nature and to build biologically inspired intelligent systems has never been greater. At the same time, the growth in computer science and technology has unleashed enough computational power, that an explosion of intelligent applications from augmented reality to naturally speaking intelligent virtual agents is now certain. This special issue will promote, facilitate, and integrate studies from many disciplines, unified by the challenge of developing the computational replication of all essential aspects of the human mind, an endeavor which is interdisciplinary in nature and promises to yield bi-directional flow of understanding between all involved disciplines. Solutions in the form of embodied agents possessing fluid emotional intelligence and capable of free natural language communication are expected based on symbolic cognitive modeling, deep learning, and hybrid approaches.

2. Brain Science and Brain-inspired Artificial Intelligence: Advances and Trends

Author - Mrs. T. Ratnamala 2 Syed Ameer Sohail

Year-2023

Brain science and brain-inspired artificial intelligence have been very significant areas. They have a wide range of applications including military and defense, intelligent manufacturing, business intelligence and management, medical service and healthcare, etc. Many countries have launched national brain-related projects to increase the national interests and capability in the competitive global world. In this paper, we introduce some concepts, principles, and emerging technologies of brain science and brain-inspired artificial intelligence; present their advances and trends; and outline some challenges in brain-inspired computing and computation based on spiking-neural-networks (SNNs). Specifically, the advances and trends cover brain-inspired computing, neuromorphic computing systems, and multi-scale brain simulation, brain association graph, brainnetome and the connectome, brain imaging, brain-inspired chips and brain-inspired devices, brain-computer interface (BCI) and brain-machine interface (BMI), brain-inspired robotics and applications, quantum robots, and cyborg (human-machine hybrids).

3. Revolutionizing AI and Computing the Neuromorphic Engineering Paradigm in Neuromorphic Chips

Author - Narayan Hampiholi

Year-2023

This research explores the cutting-edge field of neuromorphic engineering, providing a thorough analysis of its principles, hardware design, and practical uses. It highlights that event-driven mechanisms, parallel processing, and synaptic plasticity are essential for neuromorphic chip design. This article examines the revolutionary influence of neuromorphic devices across multiple disciplines, such as speech recognition, robotics, and computer vision. Technical and ethical challenges are explained, emphasizing standardization, scalability, and societal ramifications. Besides, this research considers how neuromorphic chips can transform computers and artificial intelligence. It emphasizes the necessity of continual multidisciplinary research and innovation to overcome obstacles and realize this paradigm shift's full potential. This research aims to define neuromorphic engineering and explain its goal to emulate the neural structure of the human brain to improve computational speed and efficiency. Provide insight into how the human brain processes information through a vast network of neurons and synapses and how this biological model inspires the architecture of neuromorphic chips. Explain how neuromorphic chips can potentially address the limitations of current AI technologies by enabling more efficient processing of complex algorithms and enhancing machine learning capabilities.

EXISTING SYSTEM

Artificial intelligence (AI), cognitive computing, machine learning, and brain-inspired computing are among the most trending research focuses in cyber physical systems (CPSs). Brain inspiration computing leads to faster more efficient threat detection in CPSs. This has resulted in the development of brain-inspired computing algorithms including nature-inspired algorithms, genetic algorithms, swarm algorithms, and pattern recognition algorithms, for addressing hard computational problems and CPS research challenges. Cognitive cyber-physical systems (CCPSs) are witnessing a rapid transformation as an interdisciplinary technology that blends physical components and computing devices to enable AI-based solutions.

DISADVANTAGES

- This era is witnessing a rapid transformation in digital technology, AI with brain-inspired computing-based solutions will play a vital role in industrial informatics.
- Other applications like smart household devices, medical systems, autonomous driving systems, robotic systems use in connected devices, data analytics, cloud computing, and artificial intelligence automate the process further.
- These enabling technologies have full capabilities to provide interoperability, information transparency, technical assistance, and decentralized decisions.

PROPOSED SYSTEM

Brain science and brain-inspired artificial intelligence have the potential for strengthening business and management. Brain-inspired artificial intelligence (AI) uses principles of brain science to build algorithms and AI systems with human-like intelligence. Some concepts (e.g., cognition, inference, memory, and intelligence) and principles of brain science are introduced in this paper. The research progress in several topics are also presented that include brain-inspired artificial intelligence and brain-inspired computing, project management and brain-inspired management, the integration of brain science into leadership (especially crisis leadership), and brain-inspired decision-making for business. Future research and trends in some topics are introduced.

ADVANTAGES

- Social behaviors and human stress are closely related. Their interrelation was disclosed through experiments that were completed in animal models of explaining how social interactions in rodents could lead to stress and how social behaviors could change in response to stressors.
- Human stress resulting from social interactions has been proven to greatly influence individual well-being/health greatly.
- Disruption of iron homeostasis in the human brain may influence the neurophysiological mechanism, cognition, as well as social behaviors.
- This will lead to the development of various neuropathology's eventually. The iron accumulation in the brain is most likely related

to the outcome of stress-induced depression as well as pathophysiological changes that are typical of anxiety and mood disorders.

MODULES DESCRIPTION

Neural Networks

As previously noted, neural networks have perhaps drawn the most inspiration from the human brain and have had the greatest effect on the area of artificial intelligence.

Neural Networks, in essence, are computer models that imitate the behavior and structure of organic neurons. The networks are composed of multiple layers of linked nodes known as artificial neurons, which help in information processing and transmission. This is comparable to what dendrites, somas, and axons perform in organic brain networks.

Recurring Feedback

This is a training strategy for the brain-inspired approach to AI and models developed for it. The output of a neural network is returned as input to allow the network to integrate its output as extra data input during training. This is analogous to how the brain uses feedback loops to change its model depending on prior experiences.

Reinforcement Learning

Reinforcement Learning is a machine learning method that uses deep learning for training AI systems. It was inspired by the way humans learn via trial and error. It entails an AI agent earning rewards or penalties based on its activities. This allows the agent to learn from its failures and be more efficient in future actions. This method is highly prevalent in game development.

Unsupervised Learning

The brain is continually getting fresh streams of data in the form of noises, visual material, sensory experiences to the skin, and so on. It must make sense of everything and strive to develop a cohesive and logical understanding of how all these seemingly differing occurrences affect its physical condition.

Unsupervised Learning is a technique used in artificial intelligence that allows it to make sense of seemingly differing data points. It is an AI training approach in which AI systems are trained to make sense of raw, unstructured data without explicit labeling using various unsupervised learning algorithms.

CONCLUSION

The continuous development of artificial intelligence has a profound impact on biomedical research and other fields.Brain-inspired computing is an important intersection of multimodal technology and biomedical field. This paper provides a comprehensive review of machine learning (ML) and deep learning (DL) models in brain-inspired computing, tracking their evolution, application value, challenges, and potential research trajectories. First, the basic concepts and development history are reviewed, and their evolution is divided into two stages: recent machine learning and current deep learning, emphasizing the importance of each stage in the research state of brain-inspired computing. In addition, the latest progress and key techniques of deep learning in different tasks of brain-inspired computing are introduced from six perspectives. Despite significant progress, challenges remain in making full use of its capabilities. This paper aims to provide a comprehensive review of brain-inspired computing models based on machine learning and deep learning, highlighting their potential in various applications and providing a valuable reference for future academic research.

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