Commentary

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International Journal of Innovative Research in Computer and Communication Engineering

2022
Vol.9 No.9:91

Bio-Inspired Computing can be Distinguished from Traditional Artificial Intelligence

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Received date: October 24, 2022, Manuscript No. IJIRCCE-22-15418; **Editor assigned date:** October 26, 2022, PreQC No. IJIRCCE-22-15418 (PQ); **Reviewed date:** November 07, 2022, QC No. IJIRCCE-22-15418; **Revised date:** November 17, 2022, Manuscript No. IJIRCCE-22-15418 (R); **Published date:** November 24, 2022, DOI: 10.36648/ijircce.7.9.91.

Citation: Johnson R (2022) Bio-Inspired Computing can be Distinguished from Traditional Artificial Intelligence. Int J Inn Res Compu Commun Eng Vol.7 No.9: 91.

Description

The ideas behind biological computing trace back to 1936 and the first description of an abstract computer, which is now known as a Turing machine. Turing firstly described the abstract construct using a biological specimen. Turing imagined a mathematician that has three important attributes. He always has a pencil with an eraser, an unlimited number of papers and a working set of eyes. The eyes allow the mathematician to see and perceive any symbols written on the paper while the pencil allows him to write and erase any symbols that he wants. Lastly the unlimited paper allows him to store anything he wants memory. Using these ideas he was able to describe an abstraction of the modern digital computer. However Turing mentioned that anything that can perform these functions can be considered such a machine and he even said that even electricity should not be required to describe digital computation and machine thinking in general. Bio-inspired computing can be distinguished from traditional artificial intelligence by its approach to computer learning. Bio-inspired computing uses an evolutionary approach, while traditional A.I. uses a creationist approach. Bio-inspired computing begins with a set of simple rules and simple organisms which adhere to those rules. Over time, these organisms evolve within simple constraints. This method could be considered bottom-up or decentralized. In traditional artificial intelligence, intelligence is often programmed from above the programmer is the creator and makes something and imbues it with its intelligence.

Bio-Inspired Computing

Advances in brain and neuroscience especially with the help of new technologies and new equipment, support researchers to obtain multi-scale, multi-type biological evidence of the brain through different experimental methods and are trying to reveal the structure of bio-intelligence from different aspects and functional basis. From the microscopic neurons, synaptic working mechanisms and their characteristics to the mesoscopic network connection model, to the links in the macroscopic brain interval and their synergistic characteristics, the multi-scale structure and functional mechanisms of brains derived from these experimental and mechanistic studies will provide important inspiration for building a future brain-inspired computing model.

Broadly speaking, brain-inspired chip refers to a chip designed with reference to the structure of human brain neurons and the cognitive mode of human brain. Obviously, the "neuromorphic chip" is a brain-inspired chip that focuses on the design of the chip structure with reference to the human brain neuron model and its tissue structure, which represents a major direction of brain-inspired chip research. Along with the rise and development of “brain plans” in various countries, a large number of research results on neuromorphic chips have emerged, which have received extensive international attention and are well known to the academic community and the industry. For example, EU-backed Spinnakers and Brain Scales, Stanford's Neurogrid, IBM's true north, and Qualcomm’s True North is a brain-inspired chip that IBM has been developing for nearly 10 years. The US DARPA program has been funding IBM to develop pulsed neural network chips for intelligent processing since 2008. In 2011, IBM first developed two cognitive silicon prototypes by simulating brain structures that could learn and process information like the brain. Each neuron of a brain-inspired chip is cross-connected with massive parallelism. In 2014, IBM released a second-generation brain-inspired chip called "True North. In 2012, the Institute of Computing Technology of the Chinese Academy of Sciences (CAS) and the French Irina collaborated to develop the first chip in the world to support the deep neural network processor architecture chip "Cambrian".

Brain-Inspired Chip

The technology has won the best international conferences in the field of computer architecture, ASPLOS and MICRO and its design method and performance have been recognized internationally. The chip can be used as an outstanding representative of the research direction of brain-inspired chips most of the existing brain-inspired chips are still based on the research of von Neumann architecture, and most of the chip manufacturing materials are still using traditional semiconductor materials. The neural chip is only borrowing the most basic unit of brain information processing. The most basic computer system, such as storage and computational fusion, pulse discharge mechanism, the connection mechanism between neurons and the mechanism between different scale information processing units has not been integrated into the study of brain-inspired computing architecture. Now an important international trend is to develop neural computing components such as brain mersisters, memory containers, and sensory sensors based on new materials such as nanometers, thus supporting the construction of more complex brain-inspired computing architectures. The development of brain-inspired computers and large-scale brain computing systems based on brain-inspired chip development also requires a corresponding software environment to support its wide application. An ANN is based on a collection of connected units or nodes called artificial neurons, which loosely model the neurons in a biological brain. Each connection, like the synapses in a biological brain, can transmit a signal to other neurons. An artificial neuron receives signals then processes them and can signal neurons connected to it. The signal at a connection is a real number and the output of each neuron is computed by some non-linear function of the sum of its inputs. The connections are called edges. Neurons and edges typically have a weight that adjusts as learning proceeds. The weight increases or decreases the strength of the signal at a connection.

Neurons may have a threshold such that a signal is sent only if the aggregate signal crosses that threshold. Typically, neurons are aggregated into layers. Different layers may perform different transformations on their inputs. Signals travel from the first layer the input layer, to the last layer the output layer, possibly after traversing the layers multiple times. remote control has a set of predefined commands that it will only carry out when it receives a signal from a control source, typically a remote-controlled human. Rather than robotics, it might be more appropriate to classify devices that are primarily controlled by human commands as automation. Using their pre-existing programming, artificial intelligence-enabled robots can react to objects and issues they encounter on their own and independently interact with their environment. A hybrid is a type of programming that uses AI and RC functions at the same time. The substitution of people who work in hazardous or unhealthy environments should be one of the greatest OSH advantages brought about by the increased use of robotics. Autonomous robots are especially useful in the nuclear industry space defense and security industries, as well as logistics, maintenance, and inspection. They can take the place of human workers who are doing dirty, boring, or dangerous work. This prevents workers from being exposed to dangerous agents and conditions and reduces physical, ergonomic and psychosocial risks. Robots are already being used to handle radioactive materials, handle monotonous and repetitive tasks and work in explosive environments, for instance. In the not-too-distant future, robots will carry out numerous other highly monotonous, risky, or unpleasant tasks in a variety of industries, including agriculture, construction, transportation, healthcare, firefighting and cleaning services.