National Institute of Biomedical Imaging and Bioengineering

Artificial Intelligence (AI)

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What are the types of AI and how do they differ?

Artificial Intelligence

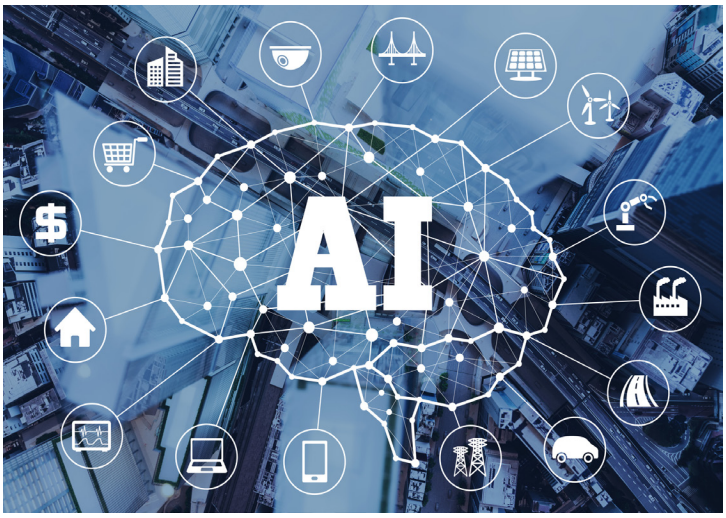
A feature where machines learn to perform tasks, rather than simply carrying out computations that are input by human users.

- Early applications of AI included machines that could play games such as checkers and chess, and programs that could reproduce language.

Machine Learning

An approach to AI in which a computer algorithm (a set of rules and procedures) is developed to analyze and make predictions from data that is fed into the system.

- Machine learning-based technologies are routinely used every day, such as personalized news feeds and traffic prediction maps.



AI is integrated into numerous technologies that people use every day. Credit: iStock-metamorworks.

Neural Networks

A machine learning approach modeled after the brain in which algorithms process signals via interconnected nodes called artificial neurons.

- Mimicking biological nervous systems, artificial neural networks have been used successfully to recognize and predict patterns of neural signals involved in brain function.

Deep Learning

A form of machine learning that uses many layers of computation to form what is described as a deep neural network, capable of learning from large amounts of complex, unstructured data.

- Deep neural networks are responsible for voice-controlled virtual assistants as well as self-driving vehicles, which learn to recognize traffic signs.

How is AI being used to improve medical care and biomedical research?

Radiology

The ability of AI to interpret imaging results may aid in detecting a minute change in an image that a clinician might accidentally miss.

Telehealth

Wearable devices allow for constant monitoring of a patient and the detection of physiological changes that may provide early warning signs of an event such as an asthma attack.

Imaging

One example is the use of AI to evaluate how an individual will look after facial and cleft palate surgery.

Clinical care

A large focus of AI in the healthcare sector is in clinical decision support systems, which use health observations and case knowledge to assist with treatment decisions.

How are NIBIB-funded researchers using AI in their biomedical research?

Early diagnosis of Alzheimer's disease (AD) using analysis of brain networks

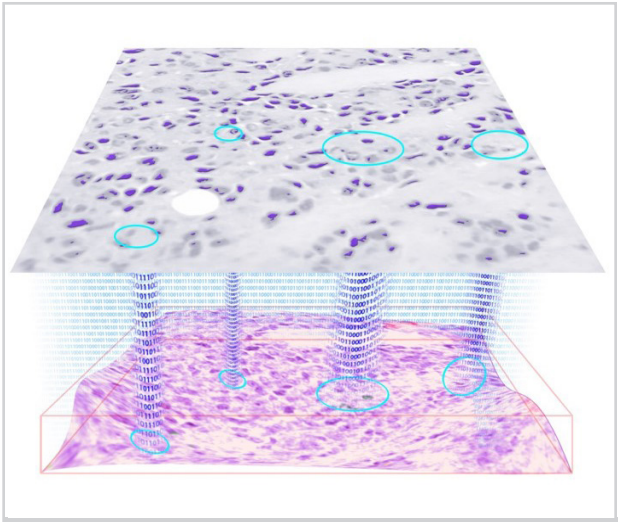
AD-related neurological degeneration begins long before the appearance of clinical symptoms. Information provided by functional MRI (fMRI) neuroimaging data, which can detect changes in brain tissue during the early phases of AD, holds potential for early detection and treatment. The researchers are combining the ability of fMRI to detect subtle brain changes with the ability of machine learning to analyze multiple brain changes over time. This approach aims to improve early detection of AD, as well as other neurological disorders including schizophrenia, autism, and multiple sclerosis.

Prediction of blood glucose levels using wearable sensors

NIBIB-funded researchers are building machine learning models to better manage blood glucose levels by using data obtained from wearable sensors. New portable sensing technologies provide continuous measurements that include heart rate, skin conductance, temperature, and body movements. The data will be used to train an artificial intelligence network to help predict changes in blood glucose levels before they occur. Anticipating and preventing blood glucose control problems will enhance patient safety and reduce costly complications.

Enhanced image analysis for improved colorectal cancer screening

This project aims to develop an advanced image scanning system with high detection sensitivity and specificity for colon cancers. The researchers will develop deep neural networks that can analyze a wider field on the radiographic images obtained during surgery. The wider scans will include the suspected lesion areas and more surrounding tissue. The neural networks will compare patient images with images of past diagnosed cases. The system is expected to outperform current computer-aided systems in the diagnosis of colorectal lesions. Broad adoption could advance the prevention and early diagnosis of cancer.



Artistic depiction of a deep neural network reconstructing a histopathology slide to reveal microscopic features of human tissue. Credit: Ozcan Lab@UCLA.

Smart clothing to reduce low back pain

Smart, cyber-physically assistive clothing (CPAC) is being developed in an effort to reduce the high prevalence of low back pain. Forces on back muscles and discs that occur during daily tasks are major risk factors for back pain and injury. The researchers are gathering a public data set of more than 500 movements measured from each subject to inform a machine learning algorithm. The information will be used to develop assistive clothing that can detect unsafe conditions and intervene to protect low back health. The long-term vision is to create smart clothing that can monitor lumbar loading; train safe movement patterns; directly assist wearers to reduce incidence of low back pain; and reduce costs related to health care expenses and missed work.

Contact

National Institute of Biomedical Imaging and Bioengineering
Office of Science Policy and Communications
6707 Democracy Blvd., Suite 200
Bethesda, MD 20892

Phone: 301-496-8859
Website: **www.nibib.nih.gov**
Email: **info@nibib.nih.gov**