

Neural Network

Swipe



Neural Network

In information technology (IT), an artificial neural network (ANN) is a system of hardware and/or software patterned after the operation of neurons in the human brain. ANNs, also called, simply, neural networks -- are a variety of deep learning technology, which also falls under the umbrella of artificial intelligence, or AI.

Commercial applications of these technologies generally focus on solving complex signal processing or pattern recognition problems. Examples of significant commercial applications since 2000 include handwriting recognition for check processing, speech-to-text transcription, oil-exploration data analysis, weather prediction and facial recognition.

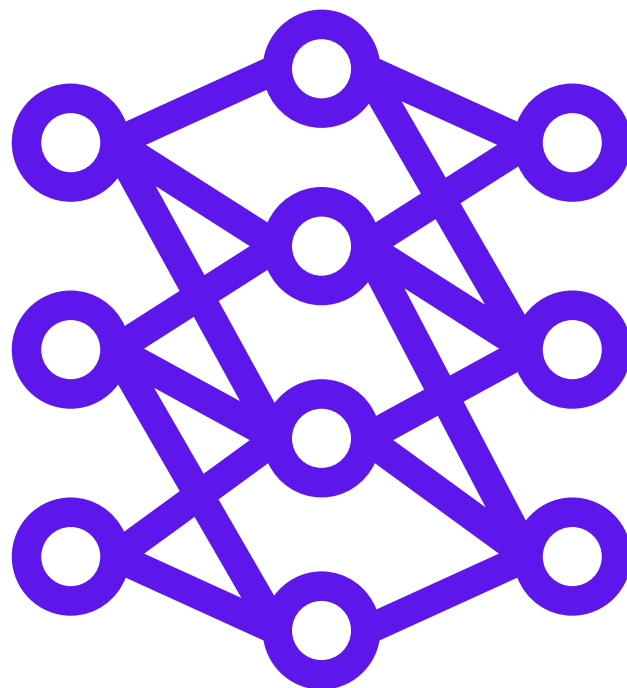
How artificial neural networks work?

- An ANN usually involves a large number of processors operating in parallel and arranged in tiers. The first tier receives the raw input information.
- Analogous to optic nerves in human visual processing.
- Each successive tier receives the output from the tier preceding it, rather than the raw input -- in the same way neurons further from the optic nerve receive signals from those closer to it.
- The last tier produces the output of the system.

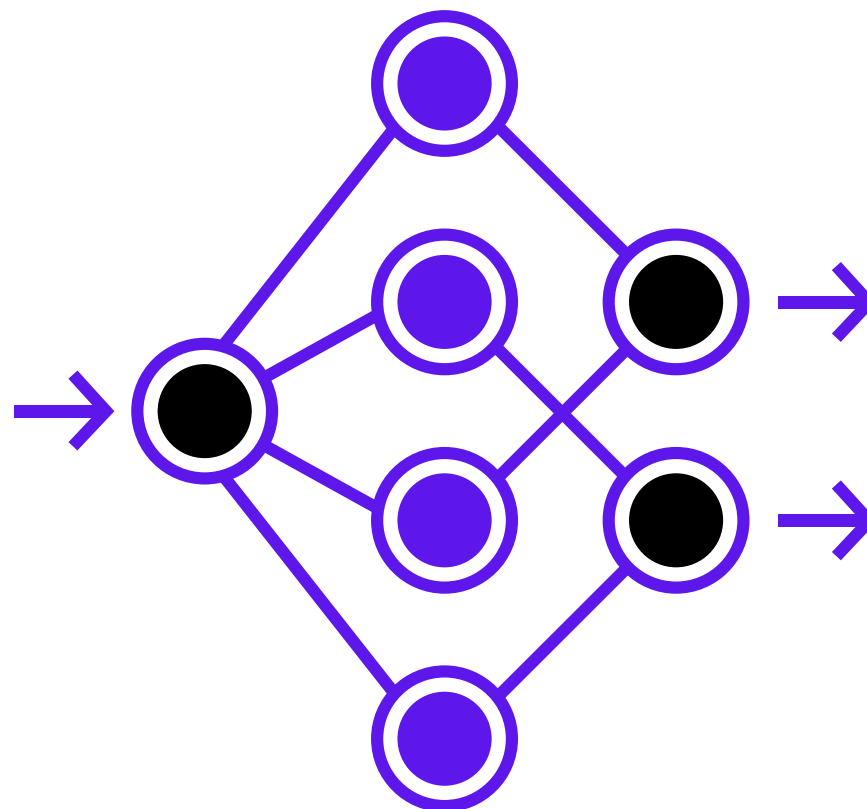
- Each processing node has its own small sphere of knowledge, including what it has seen and any rules it was originally programmed with or developed for itself.
- The tiers are highly interconnected, which means each node in tier n will be connected to many nodes in tier $n-1$ its inputs and in tier $n+1$, which provides input data for those nodes. There may be one or multiple nodes in the output layer, from which the answer it produces can be read.
- Artificial neural networks are notable for being adaptive, which means they modify themselves as they learn from initial training and subsequent runs provide more information about the world.
- The most basic learning model is centered on weighting the input streams, which is how each node weights the importance of input data from each of its predecessors. Inputs that contribute to getting right answers are weighted higher.

How neural networks learn?

- Typically, an ANN is initially trained or fed large amounts of data. Training consists of providing input and telling the network what the output should be.
- For example, to build a network that identifies the faces of actors, the initial training might be a series of pictures, including actors, non-actors, masks, statuary and animal faces.

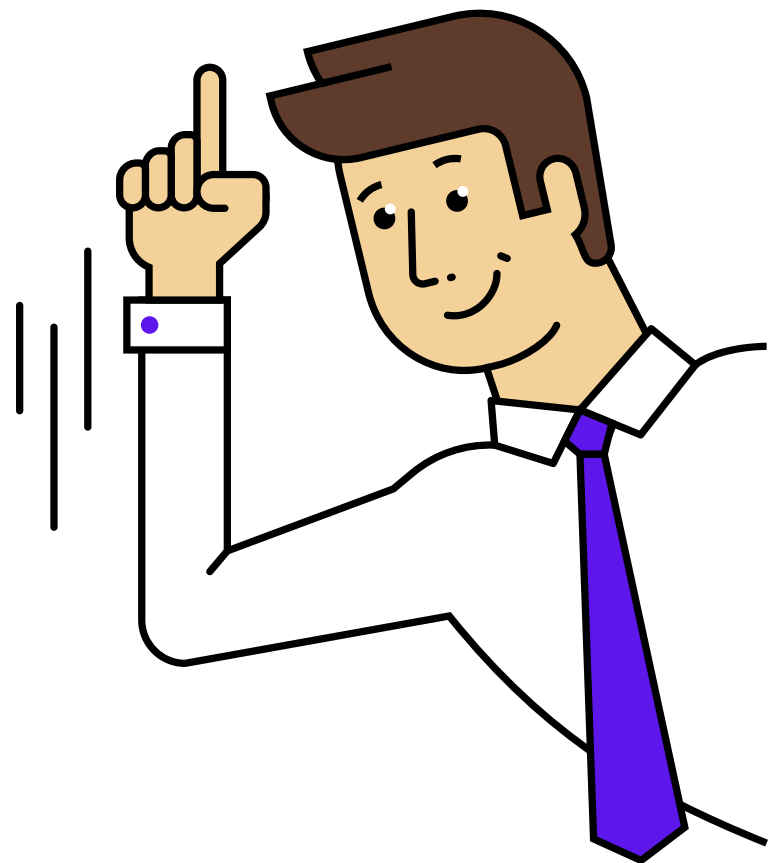


- Each input is accompanied by the matching identification, such as actors' names or "not actor" or "not human" information. Providing the answers allows the model to adjust its internal weightings to learn how to do its job better.
- For example, if nodes David, Dianne and Dakota tell node Ernie the current input image is a picture of Brad Pitt, but node Durango says it is Betty White, and the training program confirms it is Pitt, Ernie will decrease the weight it assigns to Durango's input and increase the weight it gives to that of David, Dianne and Dakota.



Types of Neural Networks

- Feed-forward neural networks
- Recurrent neural networks
- Convolutional neural networks
- Deconvolutional neural networks
- Modular neural networks



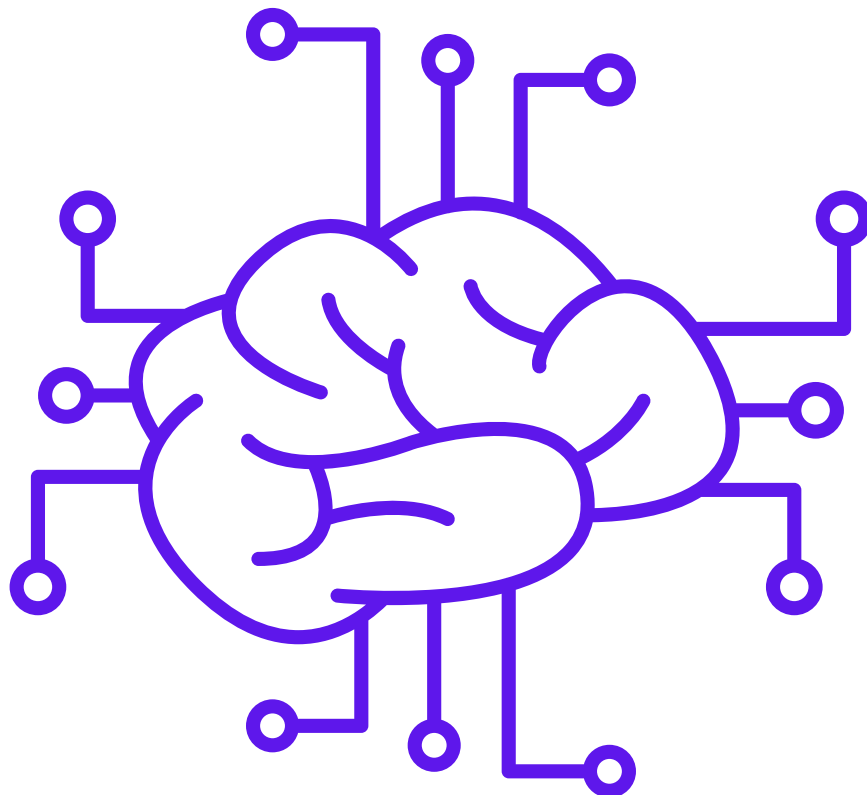
Advantages of artificial neural networks

- **Parallel processing abilities mean the network can perform more than one job at a time.**
- **Information is stored on an entire network, not just a database.**
- **The ability to learn and model nonlinear, complex relationships helps model the real-life relationships between input and output.**
- **Fault tolerance means the corruption of one or more cells of the ANN will not stop the generation of output.**
- **Gradual corruption means the network will slowly degrade over time, instead of a problem destroying the network instantly.**

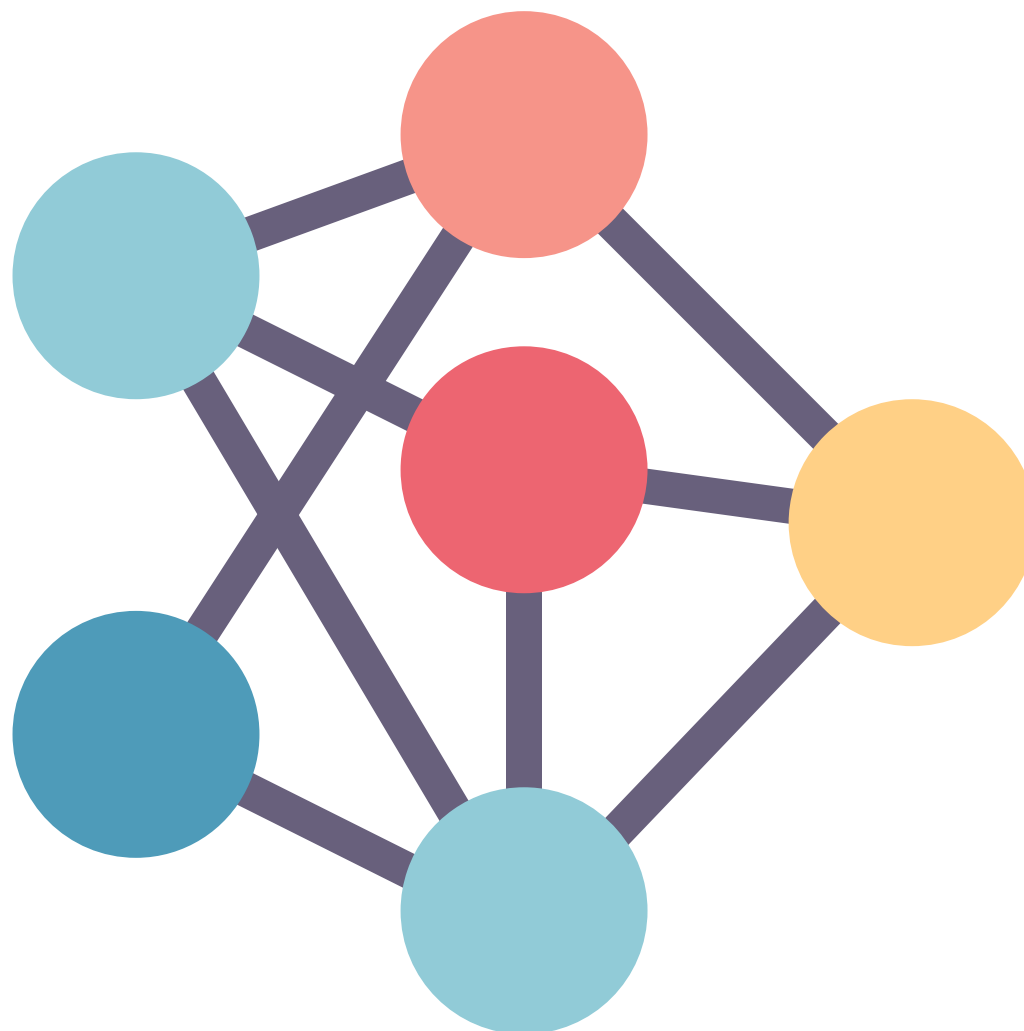
- **The ability to produce output with incomplete knowledge with the loss of performance being based on how important the missing information is.**
- **No restrictions are placed on the input variables, such as how they should be distributed.**
- **Machine learning means the ANN can learn from events and make decisions based on the observations.**
- **The ability to learn hidden relationships in the data without commanding any fixed relationship means an ANN can better model highly volatile data and non-constant variance.**
- **The ability to generalize and infer unseen relationships on unseen data means ANNs can predict the output of unseen data.**

Disadvantages of artificial neural networks

- The lack of rules for determining the proper network structure means the appropriate artificial neural network architecture can only be found through trial and error and experience.
- The requirement of processors with parallel processing abilities makes neural networks hardware-dependent.



- **The network works with numerical information, therefore all problems must be translated into numerical values before they can be presented to the ANN.**
- **The lack of explanation behind probing solutions is one of the biggest disadvantages in ANNs. The inability to explain the why or how behind the solution generates a lack of trust in the network.**



Applications of artificial neural networks

Image recognition was one of the first areas to which neural networks were successfully applied, but the technology uses have expanded to many more areas, including:

- Chatbots**
- Natural language processing, translation and language generation**
- Stock market prediction**
- Delivery driver route planning and optimization**
- Drug discovery and development**

Topics for next Post

- **Classification and Regression trees (CART)**
- **Linear Regression**

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