**Neural Network**

**Abstract:**

Neural networks are a set of algorithms, modeled loosely after the human brain, that are designed to recognize patterns. They interpret sensory data through a kind of machine perception, labeling or clustering raw input. The patterns they recognize are numerical, contained in vectors, into which all real-world data, be it images, sound, text or time series, must be translated.

Neural networks help us cluster and classify. You can think of them as a clustering and classification layer on top of the data you store and manage. They help to group unlabeled data according to similarities among the example inputs, and they classify data when they have a [labeled dataset to train on](https://skymind.ai/wiki/supervised-learning). (Neural networks can also extract features that are fed to other algorithms for clustering and classification; so you can think of deep neural networks as components of larger machine-learning applications involving algorithms for [reinforcement learning](https://skymind.ai/wiki/deep-reinforcement-learning), classification and [regression](https://skymind.ai/wiki/logistic-regression).)

**Classification**

All classification tasks depend upon labeled datasets; that is, humans must transfer their knowledge to the dataset in order for a neural network to learn the correlation between labels and data. This is known as [*supervised learning*](https://skymind.ai/wiki/supervised-learning).

* Detect faces, identify people in images, recognize facial expressions (angry, joyful)
* Identify objects in images (stop signs, pedestrians, lane markers…)
* Recognize gestures in video
* Detect voices, identify speakers, transcribe speech to text, recognize sentiment in voices
* Classify text as spam (in emails), or fraudulent (in insurance claims); recognize sentiment in text (customer feedback)

Any labels that humans can generate, any outcomes that you care about and which correlate to data, can be used to train a neural network.

Clustering

Clustering or grouping is the detection of similarities. Deep learning does not require labels to detect similarities. Learning without labels is called [*unsupervised learning*](https://skymind.ai/wiki/unsupervised-learning). Unlabeled data is the majority of data in the world. One law of machine learning is: the more data an algorithm can train on, the more accurate it will be. Therefore, unsupervised learning has the potential to produce highly accurate models.

* Search: Comparing documents, images or sounds to surface similar items.
* Anomaly detection: The flipside of detecting similarities is detecting anomalies, or unusual behavior. In many cases, unusual behavior correlates highly with things you want to detect and prevent, such as fraud.

**Predictive Analytics: Regressions**

With classification, deep learning is able to establish correlations between, say, pixels in an image and the name of a person. You might call this a static prediction. By the same token, exposed to enough of the right data, deep learning is able to establish correlations between present events and future events. It can run regression between the past and the future. The future event is like the label in a sense. Deep learning doesn’t necessarily care about time, or the fact that something hasn’t happened yet. Given a time series, deep learning may read a string of number and predict the number most likely to occur next.

* Hardware breakdowns (data centers, manufacturing, transport)
* Health breakdowns (strokes, heart attacks based on vital stats and data from wearables)
* Customer churn (predicting the likelihood that a customer will leave, based on web activity and metadata)
* Employee turnover (ditto, but for employees)

The better we can predict, the better we can prevent and pre-empt. As you can see, with neural networks, we’re moving towards a world of fewer surprises. Not zero surprises, just marginally fewer. We’re also moving toward a world of smarter agents that combine neural networks with other algorithms like [reinforcement learning](https://skymind.ai/wiki/deep-reinforcement-learning) to attain goals.

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