WHAT ANIMAL AM I?

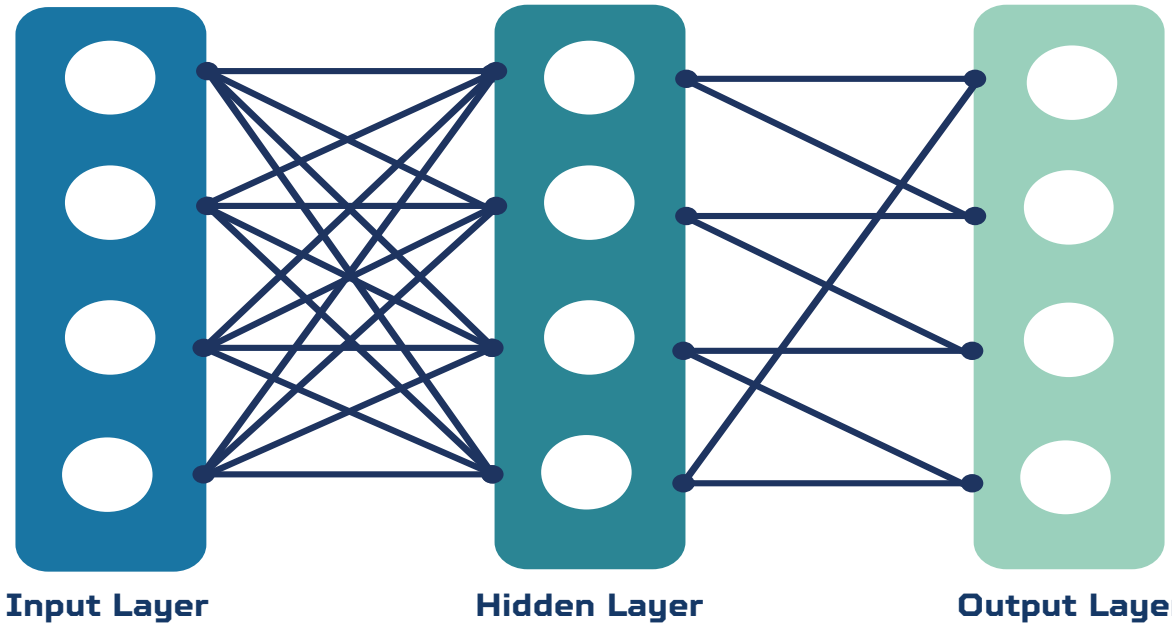
Being able to recognize any unknown animal at any time and anywhere? That would be a really cool talent! Instead of memorizing, using an AI system for that would be less cumbersome: enter features and find out the animal species – quite simple and practical, isn‘t it?

That‘s exactly what the present neural network can do. With the settings you have determined, it can recognize the given animals. It is also said that the neural network has learned the behaviour of "recognizing animals". For instance, from the inputs **predator**, **no spots** and **no horns,** but **four legs**, it recognizes that the animal is a tiger, indicated by the output color code . These colors actually symbolize numbers, namely the number of incoming signals at the output neuron. For the **tiger**, it is **1221**.

In artificial neural networks, the controller settings are not programmed manually, instead the network learns autonomously. For this, the neural network needs information about the features of many different animals. From these training data, it derives how the animals can be distinguished. When a new animal needs to be recognized, the network receives the necessary information as input and evaluates it. If the evaluation is correct, the next animal can be examined. If the evaluation is incorrect, the neural network has to adjust its previous configuration, which in the LED network means the controller settings, to correctly classify the animal.

You have proceeded in exactly the same manner: Initially, you took one animal and adjusted the LED network so that it recognized the animal by outputting the corresponding color code. Then, you looked at another animal and adjusted the LED network using the sliders so that the LED network could now correctly recognize both animals. You did this until (almost) all animals could be recognized. By the way, the best setting for the sliders in the middle is 2 - 2 - 1 - 1. In a neural network, the sliders, which ultimately decide whether a signal is passed on or not, are called neurons. Since they are in the middle of the network and not directly visible from the outside, this layer of the neural network is also called the hidden layer.

However, an artificial neural network does not actually adjust controllers nor does it consist of LED strips. The LED strips represent connections between individual neurons, on which numerical values (light in the LED network) are transmitted. This happens similarly to neurons in our brain. Whether an LED strip transmits information (i.e. lights up) depends on the setting of switches and sliders. This is also the case in the neural network. The strength at which a connection transmits numerical values depends on the weights of the connections. These indicate how important the connection is. Whether information is transmitted at all is decided by the threshold values at the neurons. Just like in the LED network, multiple pieces of information converge in a neuron. **And similar to how you decided in the LED network through the sliders whether information is transmitted, the neuron decides using a mathematical function whether to transmit information.** For information to be transmitted, a certain amount of information (threshold value) must be exceeded. This means that initially, a certain number of pieces of information (numerical values) must enter the neuron before it transmits the information.



Structure of a neuronal network

Once the neural network has found a good setting for the training data, this is checked using a second dataset, the test data. If too many datasets are not recognized correctly, the neural network needs to be corrected. Much data is required for both the training and test datasets, so initially, many data must be collected if one wants to teach a neural network a specific behavior.

How many different features does the neural network need to distinguish between different animal species?

That depends entirely on how many different animal species are to be recognized. For distinguishing only two animal species, one cleverly chosen feature in which the animals differ is sufficient. However, this is no longer enough for three animals. In addition to the number of evaluated pieces of information, it is also important to find as many good features as possible.

Consider the combination "predator" and "horns". What do you notice?

Exactly! There are no horned predators in the world. Therefore, this input combination would only allow a maximum of three instead of four animals to be distinguished because the feature combination "predator - horns" does not exist. In our animal inventory, only the oryx antelope can ultimately be identified unambiguously using these features because it is the only animal with horns. All other animals would only be divided into two groups by the LED network - predators and non-predators. More features are therefore necessary for unambiguous identification.

Two other differentiation problems of the neural network are also related to the features:

Why cannot the LED network distinguish between orang-utan and flamingo or between iguana and zebra?

You just need to look at the characteristics of the two pairs of animals: Orang-utans and flamingos are both not predators, have no spots, no horns and no four legs. Therefore, for the present LED network, the two animals have the same properties since only these properties are entered into the LED network. Even if you try to change the settings on the sliders, the input information and thus the output remain the same in the end. This also applies, of course, to iguanas and zebras, which are both not spotted, horned predators but both have four legs. To change that, new features would have to be included in the neural network, in which these animals differ, such as mammal and feathers.

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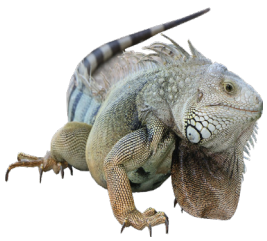

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SOURCES

Graphic "Structre of a neuronal network"
created by Michaela Müller-Unterweger

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