# NEURAL NETWORKS

How can a machine understand if the contents of your luggage are dangerous or not? In this poster we will try to go through the inner workings of a neural network trained to detect hazardous items. This kind of system is already in use in various industries like security, health and transports. Let's have a look inside this black box and try to understand how a machine can see.

**INPUT IMAGE**
The image that will be decomposed in order to be submitted to the network.

**NEURON DISPOSITION**
The disposition of the neurons in the network can vary depending on the task. The number of neurons and the shape of the connections is what the developers choose, usually starting from a set of standard models.

**TRAINING DATA**
The dataset is composed of thousands of images classified as "safe" or "not safe"; the machine detects, without knowing the label, which category an image belongs to. The set of algorithms in which we use a labeled dataset is called supervised learning.

**LABEL**
A label expresses one or more feature of the image. It is usually assigned by humans. During the training this tag is hidden from the network, it will be used to check the output during the evaluation phase.

1 INPUT LAYER

2 HIDDEN LAYERS

3 OUTPUT LAYER

95%

OUTPUT

**1 INPUT LAYER**
It is the first layer of the neural network which passes the raw information to subsequent layers without performing any computational tasks.

**2 HIDDEN LAYERS**
The hidden layer consists of one or several layers and acts as the connection between the input and output layer. These layers perform all the computational work.

**3 OUTPUT LAYER**
The output layer is responsible for producing the predicted output of neural networks.

The output consists of a symbol and a percentage value. The symbol indicates whether the package is considered safe or not, while the percentage indicates the confidence level of the forecast.

## TRAINED MODEL

Thanks to the training phase, the model is ready to perform a determined computational task with a high level of accuracy.

## TRAINING PHASE

During the training phase, a neural network is fed thousands of labeled images, learning to classify them.

95%
62%
29%
42%
35%

**FORWARD PROPAGATION**

**CONNECTION:**
It is the link between neurons in which the signal passes through.

**NEURON**
It is the basic unit of computation in a neural network. The role of the neuron is to receive signal from other nodes.

**ACTIVATION FUNCTION**
It defines when a neuron fires. It's a threshold: the signal is sent onward only if the aggregate signal crosses it. For each neuron, you choose the one that works best in a particular scenario.

**WEIGHT**
Each connection has an associated weight. During the learning process it increases or decreases depending on the strength of the signal at a connection.

**BACKPROPAGATION**

**ADJUSTMENTS**
During the learning process the thresholds and the weights are adjusted according to the signal it receives from the backpropagation.

**LABEL CLASSIFICATION**

NOT SAFE

SAFE

EVALUATION PROCESS

It is the comparison between predicted output and expected output. This difference determines the intensity of the backpropagation.

23%

PREDICTED OUTPUT

EXPECTED OUTPUT

Depending on the output of the evaluation, the signal goes backwards into the network adjusting the weights and thresholds until training data with the same labels consistently yield similar outputs.

VISUAL EXPLANATIONS OF STATISTICAL METHODS

Neural networks


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