Glossary //

01 Breaking down **artificial intelligence** is no
02 mean feat. Put very simply, it is the attempt
03 to transfer human ways of learning and think-
04 ing to computers and machines. With this glos-
05 sary, we want to delve a little deeper into
06 the subject and show you how we interpret the
07 most important concepts from the broad field
08 of AI at the Production Technology Center
09 Berlin.

Artificial Intelligence

According to Prof. John McCarthy (1955, Stanford), artificial intelligence (AI) encompasses the science and engineering of intelligent machines. The intelligence of an agent is measured by its ability to independently solve previously unknown tasks based on prior knowledge. In practice, the focus of AI is on emulating typical human cognitive abilities, such as natural understanding of language and images. The technologies used to map these abilities onto computers fall under the field of machine learning. The field is currently experiencing a renaissance due to breakthroughs in deep learning.

Machine Learning (ML)

refers to software methods that can derive the best possible behavior based on sample data without having to explicitly program each individual case. Different principles of learning can be distinguished: supervised learning, unsupervised learning and reinforcement learning.

Supervised Learning

In supervised learning, the computer learns a behavior from a set of given input and output examples, a so-called training dataset.

Reinforcement Learning

In reinforcement learning, the computer attempts to replicate learning processes in nature by inferring optimal action strategies based on a reward signal to be maximized. Unlike supervised learning, the software agent is not shown the correct actions at any point in time, but only whether the task was successfully completed or not. This gives the agent great autonomy in finding a solution. Thus, reinforcement learning holds great potentials e.g. for programming robots in uncontrolled, dynamic environments.

Unsupervised Learning

In unsupervised learning, the expected outputs are not specified in training examples. The computer recognizes regularities or anomalies in the input data on its own.

Computer Vision

deals with the perception and interpretation of images and videos by computers. Among the most prominent applications are face recognition, autonomous driving and object recognition. Applications in the industrial environment such as image-based quality inspection and visually controlled execution of robot movements (visual servoing) are summarized under the field of machine vision.

Deep Learning (DL)

is currently the most successful machine learning method. Inspired by information processing in the brain, DL employs artificial neural networks. Due to their high capacity, modern neural networks are particularly efficient in analyzing large amounts of data, resulting in a high robustness of the solutions they generate. In some specific scenarios, such as image recognition and natural language processing tasks, DL methods have already been able to significantly outperform a human being.

Artificial Neural Networks

are information processing structures inspired by their biological counterparts. They currently consist of up to several 100 million processing units (neurons) that are arranged in layers and interconnected with each other. The sensitivity of each neuron to incoming information, i.e. whether this information is passed on to the next neuron or not, is regulated by a variable weight. These weights determine the overall functionality of the network and are computed using complex optimization methods such as gradient descent.

Data Analytics

describes the collection, organization, storage and processing of data with the aim of extracting and using the underlying information to gain in-depth knowledge about a process or procedure. The focus is often on the optimization of processes and procedures in production systems as well as the optimization of design decisions. Another major application area for data analytics at Fraunhofer IPK is estimating the service life of a component for predictive maintenance.

Find more definitions in the publications of the German Academic Association for Production Technology (WGP):