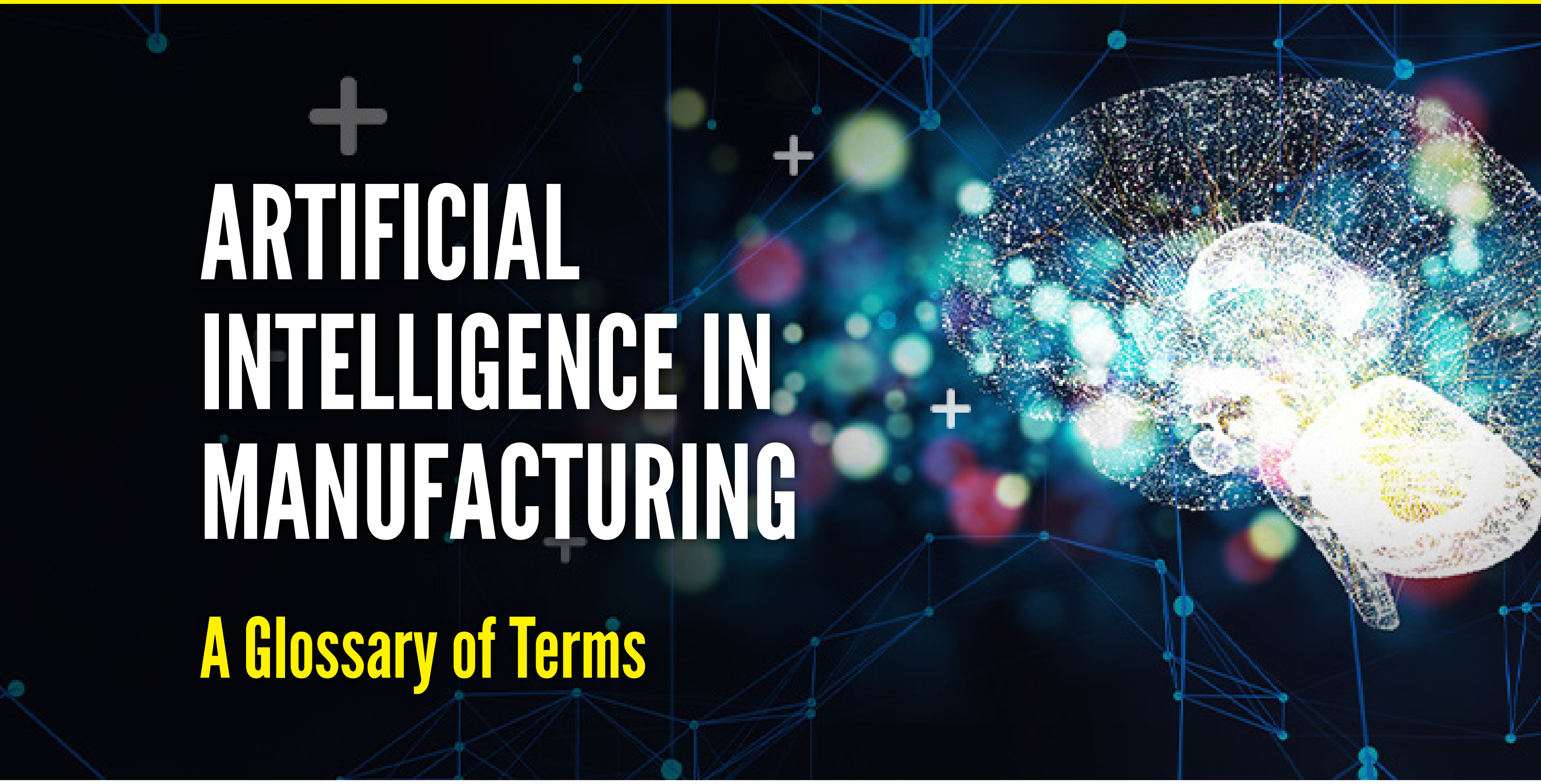
COGNEX



ARTIFICIAL INTELLIGENCE IN MANUFACTURING

A Glossary of Terms

Knowing a few basic terms and concepts related to artificial intelligence can make it easier to understand the latest technology and inspection advances in manufacturing. Below are some of the most common terms used in conversations and articles about artificial intelligence for factory automation.

Algorithm
A set of instructions and calculations that help a computer achieve an objective. In factory automation, algorithms can sort through massive data sets from sensors, scanners and digital cameras to reveal inefficiencies, boost quality and recommend improvements. A “learning” algorithm uses trial-and-error and learn-by-example methodologies to optimize production processes without human intervention.

Artificial intelligence (AI)
Computing techniques that attempt to mimic human decision-making, using automation to perform tasks that are difficult for humans. AI algorithms are central to factory automation because they can use technologies such as image recognition and natural language processing to reduce human error and anticipate production challenges.

Big data
Technologies that pull together enormous data sets from multiple sources, using analytics tools to generate unique insights. Big data lays the foundation of AI because learning algorithms require mountains of information to emulate human decision-making and produce accurate forecasts. An automated factory uses big data analytics to inform its AI initiatives.

Classification

Separating data into distinct categories that improve AI effectiveness. In factory automation, data-gathering devices scan the production environment and recognize specific objects like machine parts and electronic components. AI algorithms help classify these objects and route them to their proper destinations in the production line.

Clustering

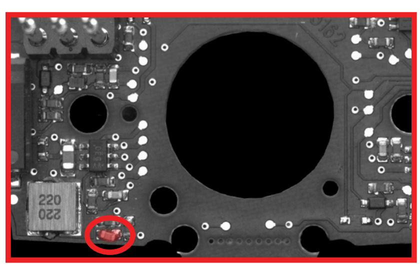
Segregating a population of data points into clusters to determine which ones are similar and which ones differ. Learning algorithms scan clusters to interpret their meaning and predict a proper course of action. For instance, clustering algorithms process data from optical scanning devices to determine what to do when a scan detects a product flaw.

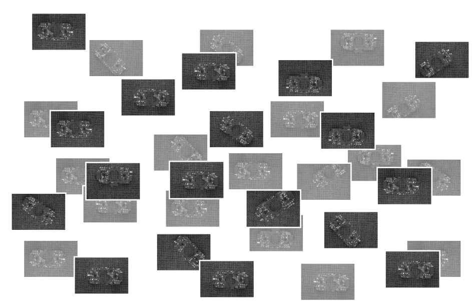
Data cleaning/ scrubbing

Removing flawed data to sharpen the effectiveness of a learning algorithm. AI depends on sophisticated data models that must have accurate, reliable and consistent data sources. Unfortunately, data-gathering often yields redundant, inaccurate, out-of-date or otherwise useless information. Thus, cleaning (or scrubbing) data reduces risks and enhances AI accuracy.

Deep learning

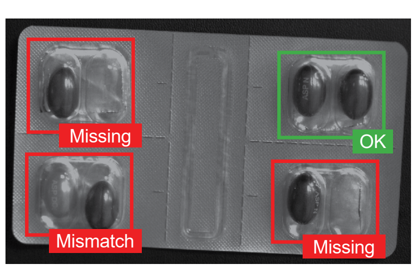
An AI technology designed to automate complex and highly customized applications. Processing takes place via a graphics processing unit (GPU), which enables users to build sophisticated neural networks from large, detailed image sets (hundreds to thousands of images). Leveraging these neural networks, deep learning quickly and efficiently analyzes vast image sets to detect subtle, variable defects and differentiate between acceptable and unacceptable anomalies.





Edge learning

An AI technology designed for ease of use. Processing takes place on-device, or “at the edge,” using a pre-trained set of algorithms. The technology is simple to setup, requiring smaller image sets (as few as 5 to 10 images) and shorter training periods than traditional deep learning-based solutions. Needing no domain expertise, non-vision experts can train edge learning tools and generate inspection results in minutes.



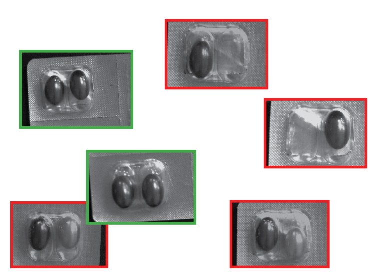
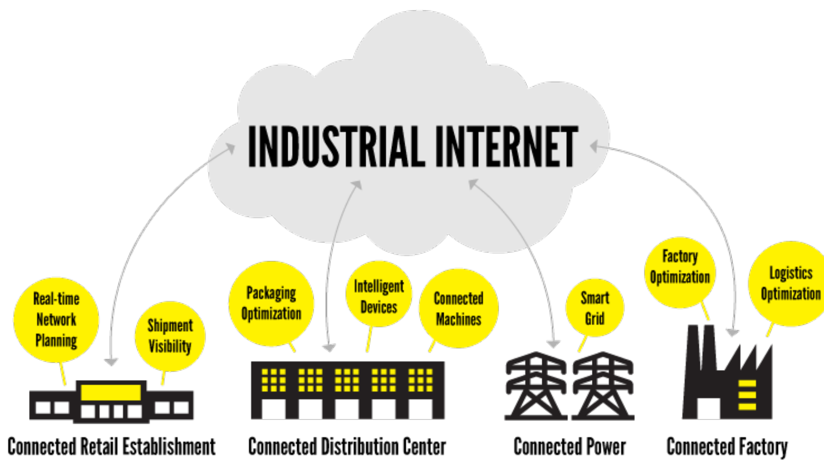


Image recognition Using AI to analyze the content of a digital image. Image recognition algorithms scan millions of pixels and apply edge learning or deep learning to distinguish between people, places, and things. These technologies enable barcode scanning and automated inspections that can dramatically improve the productivity of an automated factory. **See also:** machine vision.

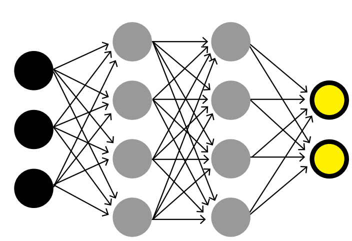
Internet of Things (IoT) A network of sensors connected to the Internet to gather real-time intelligence from machines and human behavior. Devices include smartphones, wearables, video cameras, traffic monitors, and sensors within machinery and production lines. IoT sensors generate the massive quantities of data required to enable machine learning.



Machine learning Computing processes that can improve outcomes without human programming. Machine learning algorithms train a computer to seek success and avoid failure millions of times to generate learning outcomes. Image recognition, for example, analyzes millions of images to discern between different objects in a digital picture. **See also:** training data.

Machine vision Rule-based algorithms that identify specific characteristics of an object. Machine vision technologies use data from optical scanners and digital cameras to inspect parts on production lines and scan barcodes in distribution centers. Though machine vision tools work much faster than the human eye, AI can dramatically improve these tools' accuracy and effectiveness.

Neural networks Algorithms and data nodes inspired by the neural pathways of the human nervous system. A neural network emulates how nerve cells receive information, process it and transmit it to other nerves. Thousands of processing nodes in a neural network find patterns in data such as images, text, and spoken words. These patterns help the algorithm decide what to do next and teach itself to perform better every time it succeeds at a task.



Optical character recognition (OCR)

Translating printed numbers, letters, and characters into meaningful digital data. AI technologies provide a quantum leap in OCR accuracy, enabling scanning of labels that are bent, torn, damaged and obscured by plastic wrappers.

Robotic process automation (RPA)

Devices, software, and processes that automate production processes, improving productivity and freeing people from tedious, repetitive tasks. RPA devices include robot arms that do tasks like welding automotive parts or assembling microprocessors. RPA software can include algorithms and applications that automate processes that previously required human input.

Structured vs. unstructured data

Distinct frameworks to help machines understand the meaning of data and process it accurately. Structured data is stored in consistent formats, much like the rows, columns, and cells of a spreadsheet. Unstructured data is like the text in a word processing file or the pixels in a video. AI algorithms allow factory automation systems to extract knowledge from both kinds of data.

Swarm intelligence

A collection of algorithms working together to produce intelligence that exceeds the ability of individuals within the swarm. Modeled on the behavior of bees, fish, birds, and other social organisms, a swarm intelligence system assigns simple, specific tasks to individual machine learning algorithms. Allowing these algorithms to work together can produce learning outcomes far more sophisticated than a single algorithm could generate. **See also:** neural networks.

Training data

Digital information that fuels learning in an AI algorithm. AI and neural network algorithms must know the difference between good and bad data. Training data lets them figure it out. In an automated factory, for instance, digital images provide training data that help algorithms learn to identify flawed machine parts and keep them out of finished products.

COGNEX

Companies around the world rely on Cognex vision and barcode reading solutions to optimize quality, drive down costs and control traceability.

Corporate Headquarters **One Vision Drive Natick, MA 01760 USA**

Regional Sales Offices

Americas
North America +1 844-999-2469
Brazil +55 11 4210 3919
Mexico +800 733 4116

Europe
Austria +49 721 958 8052
Belgium +32 289 370 75
France +33 1 7654 9318
Germany +49 721 958 8052
Hungary +36 800 80291
Ireland +44 121 29 65 163
Italy +39 02 3057 8196
Netherlands +31 207 941 398
Poland +48 717 121 086
Spain +34 93 299 28 14
Sweden +46 21 14 55 88
Switzerland +41 445 788 877
Turkey +90 216 900 1696
United Kingdom +44 121 29 65 163

Asia
China +86 21 2279 9455
India +9120 4014 7840
Japan +81 3 5977 5400
Korea +82 2 539 9047
Malaysia +6019 916 5532
Singapore +65 632 55 700
Taiwan +886 3 578 0060
Thailand +66 88 7978924
Vietnam +84 2444 583358

Lit. No. DLGLOSS 10-2022

www.cognex.com