Technical Report

ISO/IEC TR 23888-1

Information technology — Artificial intelligence for multimedia —

Part 1: Vision and scenarios

Technologies de l'information — Intelligence artificielle pour le multimédia —

Partie 1: Vision et scénarios

First edition
2026-07

Reference number
ISO/IEC TR 23888-1:2026(en)

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information.*

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Introduction

This document is part of the ISO/IEC 23888 series (also known as MPEG-AI) on artificial intelligence (AI) for multimedia.

Information technology — Artificial intelligence for multimedia —

Part 1: Vision and scenarios

1 Scope

This document presents the role of artificial intelligence (AI) technologies, including neural networks (NN), in multimedia coding and processing activities. It describes the current perspectives on AI for multimedia and identifies working assumptions and technical challenges expected from working with AI and NN-based technologies. This document highlights a variety of multimedia coding activities, key scenarios and gaps that are to be addressed by further standardization efforts.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 General AI concepts and terminology

3.1.1
AI component
functional element that constructs an *AI system* (3.1.4)

[SOURCE: ISO/IEC 22989:2022, 3.1.2]

3.1.2
activation function
function applied to the weighted combination of all inputs of a *neuron* (3.1.15)

Note 1 to entry: Activation function allows neural networks to learn complicated features in the data. They are typically non-linear.

[SOURCE: ISO/IEC 22989:2022, 3.4.1]

3.1.3
artificial intelligence
AI
<discipline> research and development of mechanisms and applications of *AI systems* (3.1.4)

[SOURCE: ISO/IEC 22989:2022, 3.1.3, modified — Note 1 to entry has been removed.]

3.1.4
artificial intelligence system
AI system
engineered system that generates outputs such as content, forecasts, recommendations or decisions for a given set of human-defined objectives

[SOURCE: ISO/IEC 22989:2022, 3.1.4, modified — Note 1 to entry has been removed.]

3.1.5
convolutional neural network
CNN
neural network (3.1.14) using *convolution* (3.1.6) in at least one of its layers

[SOURCE: ISO/IEC 22989:2022, 3.4.2, modified — removed "feed forward"]

3.1.6
convolution
mathematical operation involving a sliding dot product or cross-correlation of the input data.

[SOURCE: ISO/IEC 22989:2022, 3.4.3]

3.1.7
deep learning
deep neural network learning
<artificial intelligence> approach to creating rich hierarchical representations through the training of *neural networks* (3.1.14) with many hidden layers.

Note 1 to entry: Deep learning is a subset of ML (3.1.11)

[SOURCE: ISO/IEC 22989:2022, 3.4.4]

3.1.8
downstream task
The downstream task is a task that depends on the output of a previous task or process. It involves applying a pre-trained model to a new problem.

3.1.9
inference
reasoning by which conclusions are derived from known premises

Note 1 to entry: In AI, a premise is either a fact, a rule, a model, a feature or raw data.

Note 2 to entry: The term "inference" refers both to the process and its result.

[SOURCE: ISO/IEC 22989:2022, 3.1.17]

3.1.10
model
physical, mathematical or otherwise logical representation of a system, entity, phenomenon, process or data

[SOURCE: ISO/IEC 22989:2022, 3.1.23]

3.1.11
machine learning
ML
process of optimizing model *parameters* (3.1.17) through computational techniques, such that the *model's* (3.1.10) behaviour reflects the data or experience

[SOURCE: ISO/IEC 22989:2022, 3.3.5]

3.1.12
machine learning algorithm
algorithm to determine *parameters* (3.1.17) of a machine learning *model* (3.1.10) from data according to given criteria

EXAMPLE

Consider a simple deblocking filter consisting of a single convolution layer, which creates an output image $I_{out} = I_{in} \otimes \theta$, where I_{in} is the input image and theta is the parameter matrix of the convolution kernel, which are to be learned from a set of pairs of input and output images.

[SOURCE: ISO/IEC 22989:2022, 3.3.6, modified — Example has been replaced]

3.1.13
machine learning model
mathematical construct that generates an *inference* (3.1.9) or prediction based on input data or information

EXAMPLE

For a simple deblocking filter $I_{out} = I_{in} \otimes \theta$ learned from image pairs (I_{in}, I_{out}), where the model is represented by the set of parameters defined as θ.

Note 1 to entry: A machine learning model results from training based on a machine learning algorithm (3.3.6).

[SOURCE: ISO/IEC 22989:2022, 3.3.7, modified — Example has been replaced]

3.1.14
neural network
NN
neural net
artificial neural network
<artificial intelligence> network of one or more layers of *neurons* (3.1.15) connected by weighted links with adjustable weights, which takes input data and produces an output.

[SOURCE: ISO/IEC 22989:2022, 3.4.8], modified — Notes have been removed]

3.1.15
neuron
<artificial intelligence> primitive processing element which takes one or more input values and produces an output value by combining the input values and applying an *activation function* (3.1.2) on the result

[SOURCE: ISO/IEC 22989:2022, 3.4.9, modified – note 1 to entry has been removed]

3.1.16
multilayered perceptron
neural network consisting of a group of source nodes, one or more hidden layers, and one output layer, and using a monotonic activation function

Note 1 to entry: Each artificial neuron in a multilayered perceptron is a single-layer perceptron.

Note 2 to entry: Multilayered perceptrons can implement any Boolean function.

[SOURCE: ISO/IEC 2382:2015, modified — Note 3 to entry removed, "feedforward network" replaced by "neural network"]

3.1.17
parameter
model parameter
internal variable of a *model* (3.1.10) that affects how it computes its outputs

Note 1 to entry: Examples of parameters include the weights in a neural network and the transition probabilities in a Markov model.