



**SLOVENSKI STANDARD**  
**kSIST-TP FprEN ISO/IEC/TR 24029-1:2023**  
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**Umetna inteligenca (UI) - Ocenjevanje robustnosti nevronske omrežij - 1. del:  
Pregled (ISO/IEC TR 24029-1:2021)**

Artificial Intelligence (AI) - Assessment of the robustness of neural networks - Part 1:  
Overview (ISO/IEC TR 24029-1:2021)

Informationstechnik - Künstliche Intelligenz - Bewertung der Robustheit neuronaler Netze  
(ISO/IEC TR 24029-1:2021)

Intelligence artificielle (IA) - Évaluation de la robustesse des réseaux de neurones -  
Partie 1: Vue d'ensemble (ISO/IEC TR 24029-1:2021)

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35.020	Informacijska tehnika in tehnologija na splošno	Information technology (IT) in general
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# TECHNICAL REPORT

# ISO/IEC TR 24029-1

First edition  
2021-03

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## Artificial Intelligence (AI) — Assessment of the robustness of neural networks —

### Part 1: Overview

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## ISO/IEC TR 24029-1:2021(E)

### Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives) or [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs)).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 42, *Artificial intelligence*.

A list of all parts in the ISO/IEC 24029 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html) and [www.iec.ch/national-committees](http://www.iec.ch/national-committees).

## Introduction

When designing an AI system, several properties are often considered desirable, such as robustness, resiliency, reliability, accuracy, safety, security, privacy. A definition of robustness is provided in 3.6. Robustness is a crucial property that poses new challenges in the context of AI systems. For example, in AI systems there are some risks specifically tied to the robustness of AI systems. Understanding these risks is essential for the adoption of AI in many contexts. This document aims at providing an overview of the approaches available to assess these risks, with a particular focus on neural networks, which are heavily used in industry, government and academia.

In many organizations, software validation is an essential part of putting software into production. The objective is to ensure various properties including safety and performance of the software used in all parts of the system. In some domains, the software validation and verification process is also an important part of system certification. For example, in the automotive or aeronautic fields, existing standards, such as ISO 26262 or Reference [2], require some specific actions to justify the design, the implementation and the testing of any piece of embedded software.

The techniques used in AI systems are also subject to validation. However, common techniques used in AI systems pose new challenges that require specific approaches in order to ensure adequate testing and validation.

AI technologies are designed to fulfil various tasks, including interpolation/regression, classification and other tasks.

While many methods exist for validating non-AI systems, they are not always directly applicable to AI systems, and neural networks in particular. Neural network systems represent a specific challenge as they are both hard to explain and sometimes have unexpected behaviour due to their non-linear nature. As a result, alternative approaches are needed.

Methods are categorized into three groups: statistical methods, formal methods and empirical methods. This document provides background on these methods to assess the robustness of neural networks.

It is noted that characterizing the robustness of neural networks is an open area of research, and there are limitations to both testing and validation approaches.

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# Artificial Intelligence (AI) — Assessment of the robustness of neural networks —

## Part 1: Overview

### 1 Scope

This document provides background about existing methods to assess the robustness of neural networks.

### 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 terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

#### 3.1 artificial intelligence

##### AI

<system>capability of an engineered system to acquire, process and apply knowledge and skills

#### 3.2 field trial

trial of a new system in actual situations for which it is intended (potentially with a restricted user group)

Note 1 to entry: Situation encompasses environment and process of usage.

#### 3.3 input data

data for which a deployed machine learning model calculates a predicted output or inference

Note 1 to entry: Input data is also referred to by machine learning practitioners as out-of-sample data, new data and production data.

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### 3.4 neural network

neural net

NN

artificial neural network

ANN

network of primitive processing elements connected by weighted links with adjustable weights, in which each element produces a value by applying a non-linear function to its input values, and transmits it to other elements or presents it as an output value

Note 1 to entry: Whereas some neural networks are intended to simulate the functioning of neurons in the nervous system, most neural networks are used in artificial intelligence as realizations of the connectionist model.

Note 2 to entry: Examples of non-linear functions are a threshold function, a sigmoid function and a polynomial function.

[SOURCE: ISO/IEC 2382:2015, 2120625, modified — Abbreviated terms have been added under the terms and Notes 3 to 5 to entry have been removed.]

### 3.5 requirement

statement which translates or expresses a need and its associated constraints and conditions

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.37]

### 3.6 robustness

ability of an AI system to maintain its level of performance under any circumstances

Note 1 to entry: This document mainly describes data input circumstances such as domain change but the definition is broader not to exclude hardware failure and other types of circumstances.

### 3.7 testing

activity in which a system or component is executed under specified conditions, the results are observed or recorded, and an evaluation is made of some aspect of the system or component

[SOURCE: ISO/IEC/IEEE 26513:2017, 3.42]

### 3.8 test data

subset of *input data* (3.3) samples used to assess the generalization error of a final machine learning (ML) model selected from a set of candidate ML models

[SOURCE: Reference [2]]

### 3.9 training dataset

set of samples used to fit a machine learning model

### 3.10 validation

confirmation, through the provision of objective evidence, that the *requirements* (3.5) for a specific intended use or application have been fulfilled

[SOURCE: ISO/IEC 25000:2014, 4.41, modified — Note 1 to entry has been removed.]

### 3.11

#### **validation data**

subset of *input data* (3.3) samples used to assess the prediction error of a candidate machine learning model

Note 1 to entry: Machine learning (ML) model *validation* (3.10) can be used for ML model selection.

[SOURCE: Reference [2]]

### 3.12

#### **verification**

confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

[SOURCE: ISO/IEC 25000:2014, 4.43, modified — Note 1 to entry has been removed.]

## 4 Overview of the existing methods to assess the robustness of neural networks

### 4.1 General

#### 4.1.1 Robustness concept

Robustness goals aim at answering the question “To what degree is the system required to be robust?” or “What are the robustness properties of interest?”. Robustness properties demonstrate the degree to which the system performs with atypical data as opposed to the data expected in typical operations.

#### 4.1.2 Typical workflow to assess robustness

This subclause explains how the robustness of neural networks is assessed for different classes of AI applications such as classification, interpolation and other complex tasks.

There are different ways to assess the robustness of neural networks using objective information. A typical workflow for determining neural network (or other technique) robustness is as shown in [Figure 1](#).

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