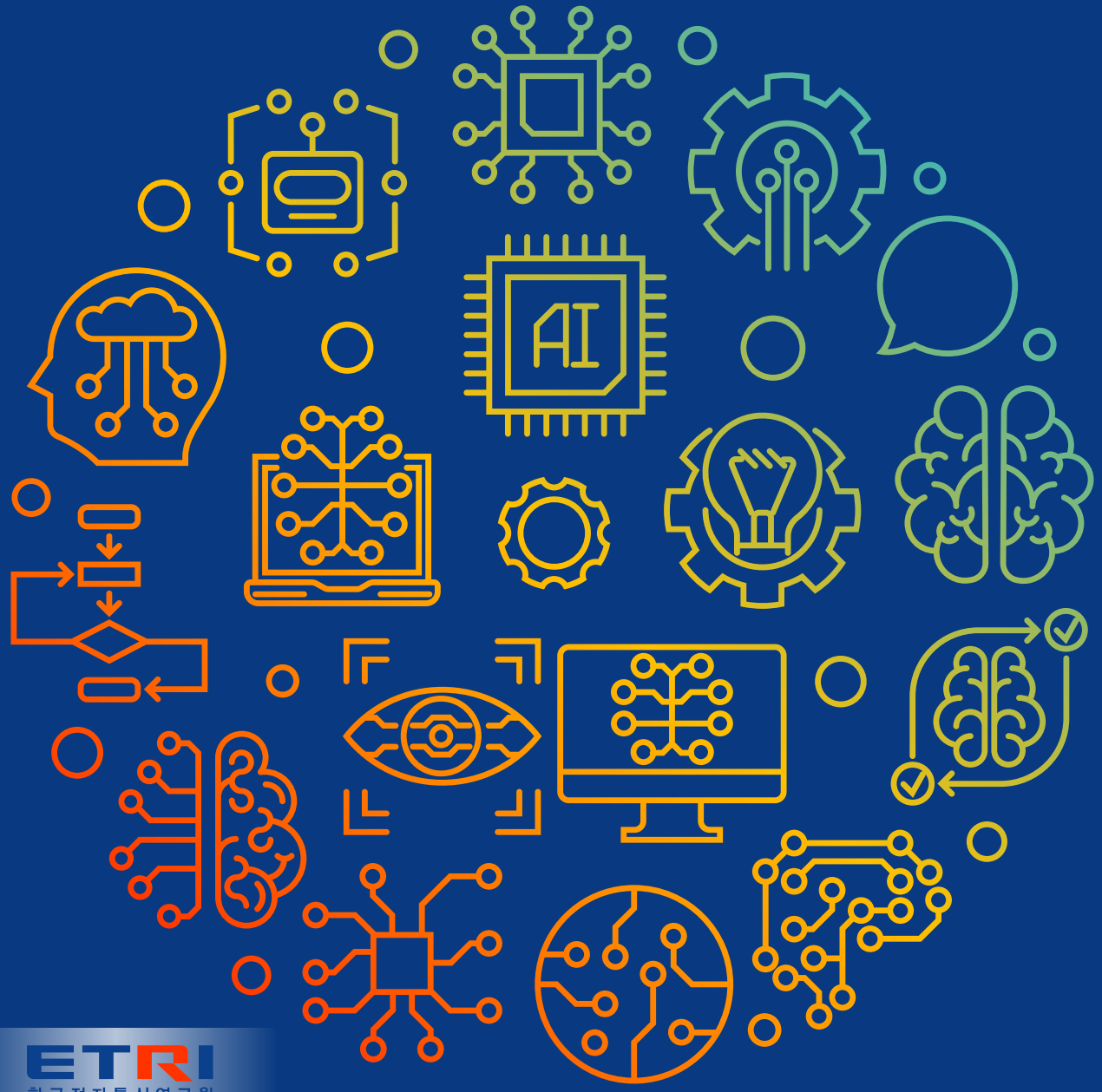


인공지능 표준화 동향 및 주요 이슈

신성필
(spshin@etri.re.kr)

Introduction of Presenter

- TTA 인공지능기반기술 그룹(PG1005) 간사 (2019~현재)
- ITU-T SG13 전문가
  - ✓ Y.3531 에디터– Cloud computing – Functional requirements for machine learning as a service
  - ✓ **Y.Sup72 에디터–Artificial intelligence standardization roadmap**
  - ✓ Y.3607 에디터 - Big data - Functional architecture for data provenance
  - ✓ Y.RaaS-reqts 에디터– Cloud computing - Functional requirements for Robotics as a Service
  - ✓ **JCA-ML MLSR 에디터 – Machine learning standardization roadmap**
- 前 JTC 1/SC 42 (Artificial Intelligence) 전문위원
  - ✓ WG1 (Foundational) 대표위원
  - ✓ ISO/IEC 22989 (인공지능 개념 및 용어) 개발 참여
  - ✓ ISO/IEC 23053 (기계학습 기반 인공지능 시스템 프레임워크) 개발 참여
  - ✓ ISO/IEC 5259 (인공지능 데이터 품질)시리즈 개발 참여
- (기타) W3C WebML WG, COVESA Data Expert Group 등 인공지능 및 응용 관련 국제 사실표준화 활동

Introduction to ITU-T Y.Sup72 - Artificial intelligence standardization roadmap (2022)

ITU-T SG13

Future Network, Cloud Computing & Data Handling


ITUPublications
Recommendations

International Telecommunication Union
Standardization Sector

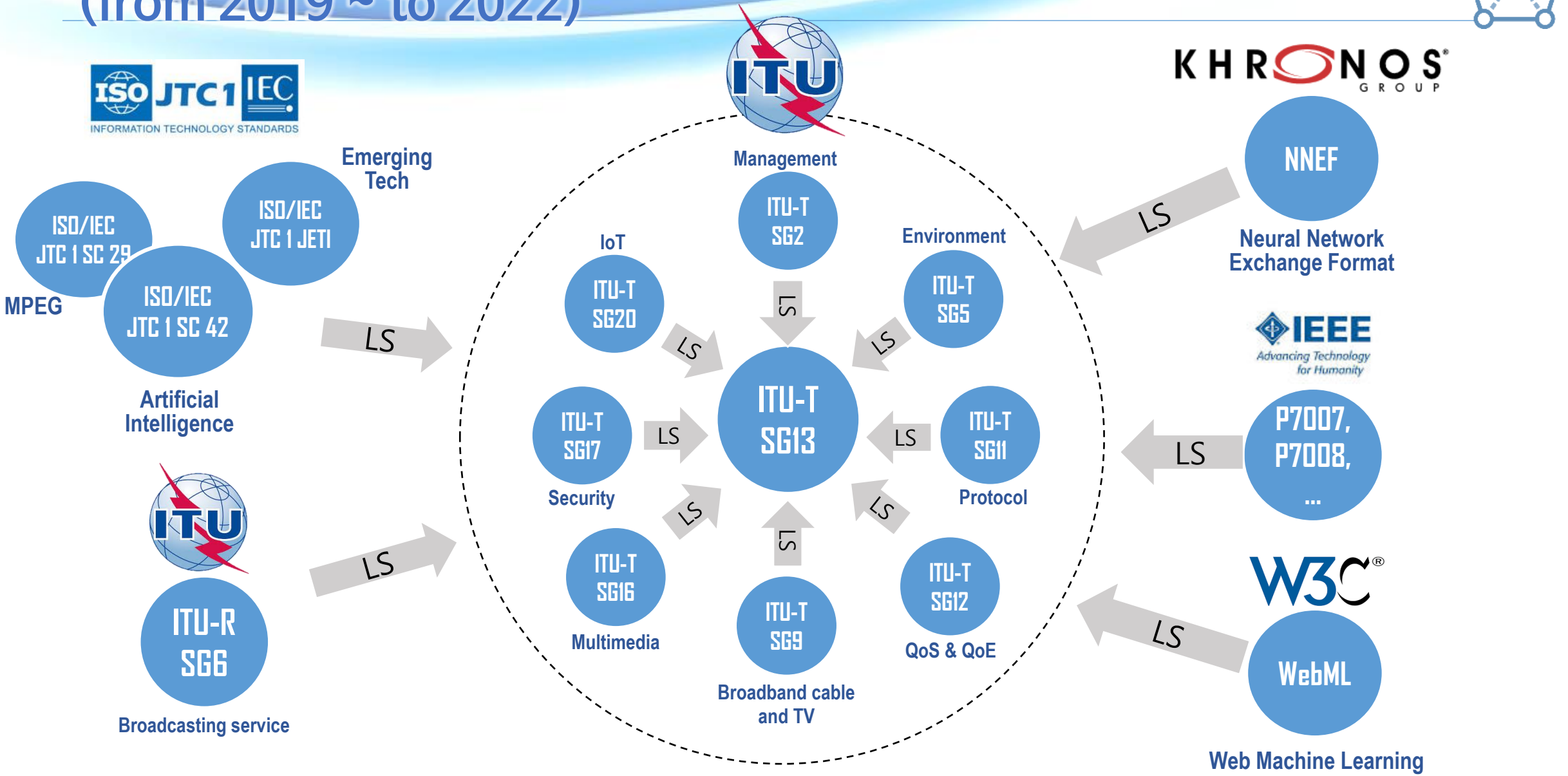
Supplement

ITU-T Y Suppl. 72 (11/2022)

SERIES Y: Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities

ITU-T Y.3000-series – Artificial intelligence standardization roadmap

Development Methodology of ITU-T Y.Sup72 (from 2019 ~ to 2022)



LS : Liaison Statement (업무연락문)

Collection of AI Standardization work in SDOs

Table 7-6 – ITU-T SG20 deliverables and work items

Study group	Reference	Title	Status
SG20	ITU-T Y.4470	Reference architecture of artificial intelligence service exposure for smart sustainable cities	In force (Approved on 2020-08-29)
SG20	ITU-T Y.Sup63	Unlocking Internet of things with artificial intelligence	In force (Agreed on 2020-07-16)
SG20	ITU-T Y.CDML-arc	Reference architecture of collaborative decentralized machine learning for intelligent IoT services	Under study (Timing: 2023-Q1)
SG20	ITU-T Y.RA-FML	Requirements and reference architecture of IoT and smart city & community service based on federated machine learning	Under study (Timing: 2023-Q1)
SG20	ITU-T Y.AI-DECCS	Functional architecture of AI enabled device-edge-cloud collaborative services for IoT and smart city	Under study (Timing: 2023-Q3)

- **ITU-T Y.4470**: This Recommendation introduces the artificial intelligence service exposure (AISE) for smart sustainable cities (SSC), analyses common characteristics and high-level requirements of AISE, brings a reference architecture of AISE and relevant common capabilities. The AISE is one of the bases, supporting functional entities for smart sustainable cities, with which the SSC services can use the uniform interfaces (exposed by the AISE) to integrate and access the AI capabilities (functionalities) of AI services (e.g., machine learning services for video/audio/picture recognition, natural language processing services, traffic prediction services etc.). The AISE can leverage the AI capabilities developed and exposed by AI service providers for SSC services, and can support the SSC service providers to integrate and access the exposed AI capabilities. The AISE can provide security and privacy mechanism on the SSC data. The AISE can support the AI service providers to design and train AI capabilities with local SSC data on AISE in SSCs, and can support the SSC services to integrate and access AI capabilities.

  URI: https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14503

- **ITU-T Y.Sup63**: As the IoT system seeks to spread within the urban realm in keeping with smart and sustainable city aspirations, the need to manage the burgeoning big data and establishing a self-sustaining urban ecosystem is at the fore-front. Accordingly, this

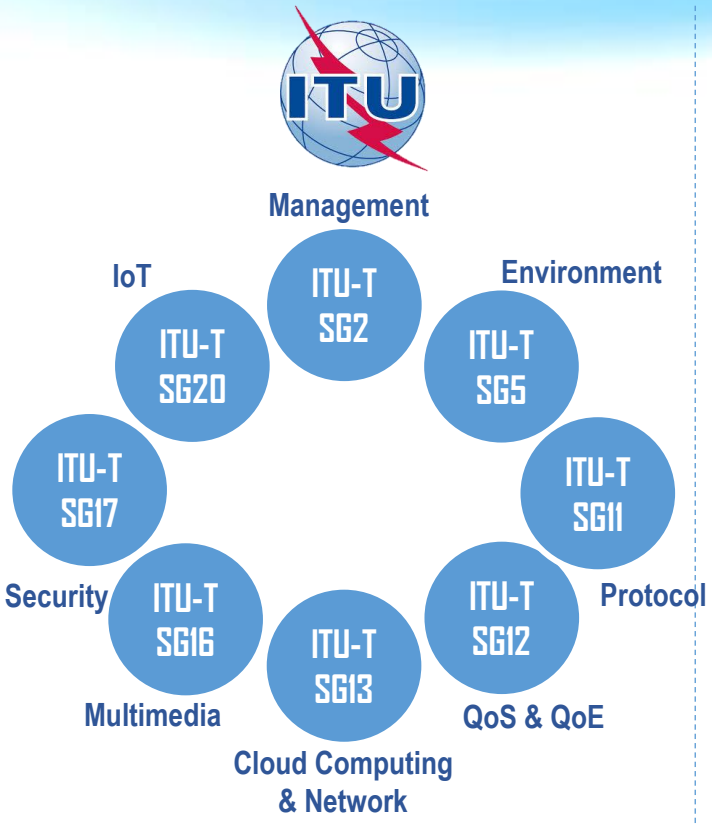
Table 7-11 – JTC 1/SC 42 deliverables and work items

WG	Reference	Name/Title	Status
WG1	ISO/IEC 22989	Artificial intelligence – Concepts and terminology	FDIS
WG1	ISO/IEC 23053	Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML)	FDIS
WG1	ISO/IEC 42001	Artificial intelligence – Management System	CD2
WG2	ISO/IEC 24668	Information technology – Artificial intelligence –Process management framework for Big data analytics	FDIS
WG2	ISO/IEC 5259-1	Data quality for analytics and ML – Part 1: Overview, terminology, and examples	CD
WG2	ISO/IEC 5259-2	Data quality for analytics and ML – Part 2: Data quality measures	CD
WG2	ISO/IEC 5259-3	Data quality for analytics and ML – Part 3: Data Quality Management Requirements and Guidelines	CD
WG2	ISO/IEC 5259-4	Data quality for analytics and ML – Part 4: Data quality process framework	CD
WG2	ISO/IEC 5259-5	Data quality for analytics and ML – Part 5: Data quality governance	WD
WG2	ISO/IEC 8183	Artificial intelligence – Data life cycle framework	DIS
WG3	ISO/IEC 23894	Information Technology – Artificial Intelligence – Risk Management	DIS
WG3	ISO/IEC TR 24027:2021	Information technology – Artificial Intelligence (AI) – Bias in AI systems and AI aided decision making	Published
WG3	ISO/IEC TR 24028:2020	Information technology – Artificial Intelligence (AI) – Overview of trustworthiness in Artificial Intelligence	Published
WG3	ISO/IEC TR	Artificial Intelligence (AI) – Assessment of the	Published

AI standardization gap analysis of artificial intelligence (ITU-T Y.Sup72)

		General/ Definition	Requirement/ Use case	Architecture	API, Interface and its profile	Data model, format, schema	Others (e.g., guideline)
Foundational		ISO/IEC 22989 ISO/IEC 23053 ISO/IEC 5338	ISO/IEC TR 24030:2021	ISO/IEC 23053	W3C WebNN API	NNEF 1.0.3	ISO/IEC 42001 ISO/IEC 5339, IEEE P2841
Data		ISO/IEC 5259-1	ISO/IEC 5259-2, ISO/IEC 5259-3			ISO/IEC 5259-4	L.1305, TR.sgfdm, X.gdsml, ISO/IEC 24668, ISO/IEC 5259-5, ISO/IEC 8183
Trustworthiness		ISO/IEC 23894, ISO/IEC TR 24027:2021, ISO/IEC TR 24028:2020, ISO/IEC TR 24029-1:2021, ISO/IEC TR 5469, ISO/IEC TS 6254 ISO/IEC 5471, ISO/IEC TS 8200 ISO/IEC TS 12791, ISO/IEC 12792 ISO/IEC TS 29119-11	ISO/IEC AWI 24029-2 ISO/IEC 25059	ISO/IEC AWI TR 5469			XSTR-SEC-AI, ISO/IEC 25059
Ethical/Societal Concerns		ISO/IEC TR 24368	E.AIQ	IEEE P7006,	IEEE P7012	IEEE P7013	X.Sup37, IEEE P7010, IEEE P7014
Computational characteristics		ISO/IEC TR 24372:2022, ISO/IEC 17903, IEEE P2807		ISO/IEC 5392			ISO/IEC TS 4213
Governance		ISO/IEC 38507:2022					
AI Applications	Computing	F.748.13	Y.3531, F.748.13, F.AICP-GA, F.748.21, F.FML-TS-FR, Q.5001, M.rfmls	F.748.13, F.748.20	F.748.12	IEEE P2805.3	F.748.11, F.748.17, F.AI-CPP, IEEE P3652.1
	Network & Telecommunications (5G/6G)	Y.3180, Y.3654, Y.3174, Y.3176, Y.3182, M.3080	Y.3170, Y.QKDN-ml-fra, Y.IMT2020-DJLML, Y.ML-IMT2020-MLFO, Y.3181, Q.IMT2020-SAO, M.3381, M.3382, M.rla-AI, M.rmnoc-AI, M.rsca, M.rsmca, M.rODFos	Y.3172, Y.3175, Y.3115, Y.3177, Y.3178, Y.3173, Y.3181, Y.ML-IMT2020-VNS, F.CDN-AINW, J.1600, Q.3646, Q.IMT2020-SAO	E.475, Q.5023, Q.5024, Q.5025, Q.3646, Q.IMT2020-SAO, M.il-AITOM, M.ilef-AITOM, M.tsm-rest, M.la-AI-ia		Y.Sup55, Y.Sup70, L.Sup43, P.1402, M.il-AITOM, M.rsca, M.ilef-AITOM
	Smart City & IoT		Y.RA-FML, J.1611	Y.4470, Y.CDML-arc, Y.RA-FML, Y.AI-DECCS			L.Sup41, Y.Sup63
	Healthcare	F.Med-Data-QC, IEEE P2802	H.AI-SaMD-Req, IEEE P2801	HSTP.Med-AI-CCTA			IEEE P2801, IEEE P2802
	Autonomation	IEEE P7007, IEEE P7008	F.749.13, F.749.4, F.AI-RPAS		IEEE P7009		IEEE P2755.2
	Multimedia	ISO/IEC 6048	F.742.1, F.AI-SCS, F.746.13, F.ADT4MM, F.AI-MKGDS, F.AI-RSRSreqs, F.REAIOCR, P.SAMD, J.pcnp-char, ITU-R BT.2447-2	FSTP-ACC-AI, F.748.19, J.1302	F.746.11, H.862.5, , ISO/IEC 15938-13, ISO/IEC 15938-15, ISO/IEC 15938-17, IEEE P7013, IEEE P3333.1.3	ISO/IEC 23090-8	P.565, P.565.1, P.Sup28, ITU-R Question 144/6
	Others (e.g, blockchain, customer service)	F.Sup4	F.746.16, F.747.11, F.747.12, F.AI-SF				L.Sup42, L.Sup53, L.Sup48, E.AIQ

AI Standardization Works in ITU-T



Focus Groups (link)

FG-AI4A, FG-AI4AD, FG-AI4EE, FG-AI4H

- ITU-T Recommendation : Purpose of improving communication, network, multimedia service, etc. **by using AI**
- **Application specific standardization with / by / for using AI**

ITU-T SG13

Reference	Title	Status
[ITU-T Y.3170]	Requirements for machine learning-based quality of service assurance for the IMT-2020 network	Published 2018
[ITU-T Y.3175 (ex. Y.qos-ml-arc)]	Functional architecture of machine learning based quality of service assurance for the IMT-2020 network	Approved on 2020-04-29
[ITU-T Y.MecTa-ML]	Mechanism of traffic awareness for application-descriptor-agnostic traffic based on machine learning	4Q 2020
[ITU-T 3531 (ex.Y.MlaaS-reqts)]	Cloud computing- functional requirements for machine learning as a service	Approved in 2020-09-29
[ITU-T Y.3172]	Architectural framework for machine learning in future networks including IMT-2020	Consented 2019-03
[ITU-T Y.bDDN-MLMec]	Mechanisms of machine learning for big data driven networking	4Q 2021
[ITU-T Y.3174]	Mechanism of traffic awareness for application-descriptor-agnostic traffic based on machine learning	4Q 2019
[ITU-T Y.3170 series Suppl 55]	Machine learning in future networks including IMT-2020: use cases	Agreed on 2019-10-25
[ITU-T Y.IMT2020-NSAA-reqts]	Requirements for network slicing with AI-assisted analysis in IMT-2020 networks	Approved on 2020-02-06
[ITU-T Y.3176]	Machine learning marketplace integration in future networks including IMT-2020	Approved on 2020-09-29
[ITU-T Y.IMT2020-AIICDN-arch]	AI integrated cross-domain network architecture for future networks including IMT-2020	2021-12
[ITU-T Y.3177]	Architectural framework of artificial intelligence-based network automation for resource and fault managem ent in future networks including IMT-2020	Approved on 2021-02-13
[ITU-T Y.3178]	Functional framework of AI-based network service provisioning in future networks including IMT-2020	Approved 2021-07
[ITU-T Y.3173]	Framework for evaluating intelligence levels of future networks including IMT-2020	Published 2020-02
[ITU-T Y.QKDN-qos-ml-req]	Requirements of machine learning based QoS assurance for quantum key distribution networks	2022-12 (High priority)
[Supplement 70 to ITU-T Y.3800-series]	Quantum Key Distribution Networks - Applications of Machine Learning	Agreed on 2021-07-16
[ITU-T Y.QKDN-ml-fra]	Quantum Key Distribution Networks - Functional requirements and architecture for machine learning	2022-12
[ITU-T Y.IMT2020-DJLML]	Requirements and framework for distributed joint learning to enable machine learning in future networks in cluding IMT-2020	2023-Q4
[ITU-T Y.ML-IMT2020-MLFO]	Requirements and architecture for machine learning function orchestrator	-
[ITU-T Y.ML-IMT2020-SANDBOX	Machine learning sandbox for future networks including IMT-2020: requirements and architecture framework	2022-Q2
[ITU-T Y.ML-IMT2020-ETE-MGMT]	Machine learning based end-to-end multi-domain network slice management and orchestration	2022-Q2
[ITU-T Y.ML-IMT2020-VNS]	Framework for network slicing management enabled by machine learning including input from verticals	2022-Q2

ITU-T SG16

Reference	Title	Status
[ITU-T F.749.13]	Framework and requirements for civilian unmanned aerial vehicle flight control using artificial intelligence	Approved on 2021-06-13
[ITU-T F.749.4]	Use cases and requirements for multimedia communication enabled vehicle systems using artificial intelligence	Approved on 2021-06-13
[ITU-T H.862.5]	Emotion enabled multimodal user interface based on artificial neural network	2021
[ITU-T F.748.13]	Technical framework for shared machine learning system	Approved on 2021-06-13
[ITU-T F.SCAI]	Requirements for smart class based on artificial intelligence	2021
[ITU-T FSTP-ACC-AI]	Guideline on the use of AI for ICT accessibility	2021
[ITU-T F.CDN-AINW]	Requirements and reference model for CDN services over AI network	2023
[ITU-T FSTP-ACC-AI]	Guideline on the use of AI for ICT accessibility	2020
[ITU-T F.748.11]	Metrics and evaluation methods for deep neural network processor benchmark	2020-07
[ITU-T F.AI-DLFE]	Deep Learning Software Framework Evaluation Methodology	2021
[ITU-T F.AI-DMPC]	Technical framework for Deep Neural Network model partition and collaborative execution	2021
[ITU-T F.AI-FASD]	Framework for audio structuralizing based on deep neural network	2021
[ITU-T F.AI-ILICSS]	Technical Requirements and Evaluation Methods of Intelligent Levels of Intelligent Customer Service System	2021
[ITU-T F.AI-SCS]	Use cases and requirements for speech interaction of intelligent customer service	2021
[ITU-T F.IMCS]	Requirements for smart speaker based Intelligent Multimedia Communication System	2021
[ITU-T F.Sup4]	Overview of convergence of artificial intelligence and blockchain	2021
[ITU-T F.746.11]	Interfaces for intelligent question answering system	2020-07
[ITU-T H.AI-SaMD-Req]	Requirements for artificial intelligence/machine learning (AI/ML)-based software as a medical device (SaMD)	2021
[ITU-T HSTP.Med-AI-CCTA]	Guidelines on development and application of artificial intelligence in coronary computed tomography angiography	2022
[ITU-T F.ADT4MN]	Requirements and framework of AI-based detection technologies for 5G multimedia messages	2023-Q2
[ITU-T F.AICP-GA]	Technical specification for artificial intelligence cloud platform: General architecture	2023
[ITU-T F.AICP-MD]	Technical specification for artificial intelligence cloud platform: Model development	2023
[ITU-T F.AI-CPP]	Technical specification for artificial intelligence cloud platform: Performance	2024-04
[ITU-T F.AI-ISD]	Requirements for intelligent surface-defect detection service in industrial production line	2022-Q3
[ITU-T F.AI-MKGDS]	Requirements for the construction of multimedia knowledge graph database structure based on Artificial Intelligence	2021
[ITU-T F.AI-RPAS]	Technical requirements and evaluation methods for a robotic process automation	2023
[ITU-T F.AI-RSRSreqs]	Requirements for real-time super-resolution service based on artificial intelligence	2023
[ITU-T F.FDIS]	Requirements and framework for feature-based distributed intelligent systems	2022-Q4
[ITU-T F.IMCS]	Requirements for smart speaker based intelligent multimedia communication system	2022
[ITU-T F.REAIOCR]	Requirements and evaluation methods for AI-based optical character recognition service	2021
[ITU-T F.TCEF-FML]	Trusted contribution evaluation framework on federated machine learning services	2022
[ITU-T F.Med-Data-QC]	General framework of quality control of medical images for machine learning applications	2022
[ITU-T F.AI-MVSLWS (ex F.AI-VDSLWS)]	Requirements for artificial intelligence based machine vision service in smart logistics warehouse system	2022
[ITU-T F.AI-SF]	Requirements for smart factory based on artificial intelligence	2022
[F.FML-TS-FR]	Requirement and framework of trustworthy federated machine learning based service	2023

ITU-T SG17

Reference	Title	Status
[ITU-T X.Sup-cs-ml]	Supplement to X.1231: Countering spam based on machine learning	2022-09
[ITU-T TR.sgfdm]	Technical Report: FHE-based data collaboration in machine learning	2022-09
[ITU-T TR.sec-ai]	Technical Report: Guidelines for security management of using artificial intelligence technology	2023-04
[ITU-T X.gdsml]	Guidelines for data security using machine learning in big data infrastructure	2024-09

ITU-T SG20

Reference	Title	Status
[ITU-T Y.4470]	Reference architecture of artificial intelligence service exposure for smart sustainable cities	Approved on 2020-08-29
[ITU-T Y.Suppl.63 to ITU-T Y.4000 series]	Unlocking Internet of things with artificial intelligence	Agreed on 2020-07-16
[ITU-T Y.CDML-arc]	Reference architecture of collaborative decentralized machine learning for intelligent IoT services	2022 Q4
[ITU-T Y.RA-FML]	Requirements and reference architecture of IoT and smart city & community service based on federated machine learning	2022 Q3
[ITU-T Y.AI-DECCS]	Functional architecture of AI enabled device-edge-cloud collaborative services for IoT and smart city	2022 Q4

JTC 1/SC 42 – Artificial Intelligence

About

Secretariat: ANSI

Committee Manager: Ms Heather Benko

Chairperson (until end 2024): Mr Wael William Diab

ISO Technical Programme Manager [TPM]: Mr Andrew Dryden
ISO Editorial Manager [EM]: Ms Christelle Gansonre

Creation date: 2017

Scope

Standardization in the area of Artificial Intelligence

- Serve as the focus and proponent for JTC 1's standardization program on Artificial Intelligence
- Provide guidance to JTC 1, IEC, and ISO committees developing Artificial Intelligence applications

20
Published ISO standards *

33
ISO standards under development *

37
Participating members

Reference ↓	Title
ISO/IEC JTC 1/SC 42/WG 5	Computational approaches and computational characteristics of AI systems
ISO/IEC JTC 1/SC 42/WG 4	Use cases and applications
ISO/IEC JTC 1/SC 42/WG 3	Trustworthiness
ISO/IEC JTC 1/SC 42/WG 2	Data
ISO/IEC JTC 1/SC 42/WG 1	Foundational standards
ISO/IEC JTC 1/SC 42/JWG 5	Joint Working Group ISO/IEC JTC1/SC42 - ISO/TC 37 WG: Natural language processing systems
ISO/IEC JTC 1/SC 42/JWG 4	Joint Working Group ISO/IEC JTC1/SC42 - IEC TC65/SC65A: Functional safety and AI systems
ISO/IEC JTC 1/SC 42/JWG 3	Joint Working Group ISO/IEC JTC1/SC42 - ISO/TC 215 WG : AI enabled health informatics
ISO/IEC JTC 1/SC 42/JWG 2	Joint Working Group ISO/IEC JTC1/SC 42 - ISO/IEC JTC1/SC 7 : Testing of AI-based systems
ISO/IEC JTC 1/SC 42/AHG 7	JTC1 joint development review
ISO/IEC JTC 1/SC 42/AHG 4	Liaison with SC 27
ISO/IEC JTC 1/SC 42/AG 3	AI standardization roadmapping

https://www.iso.org/committee/6794475.html

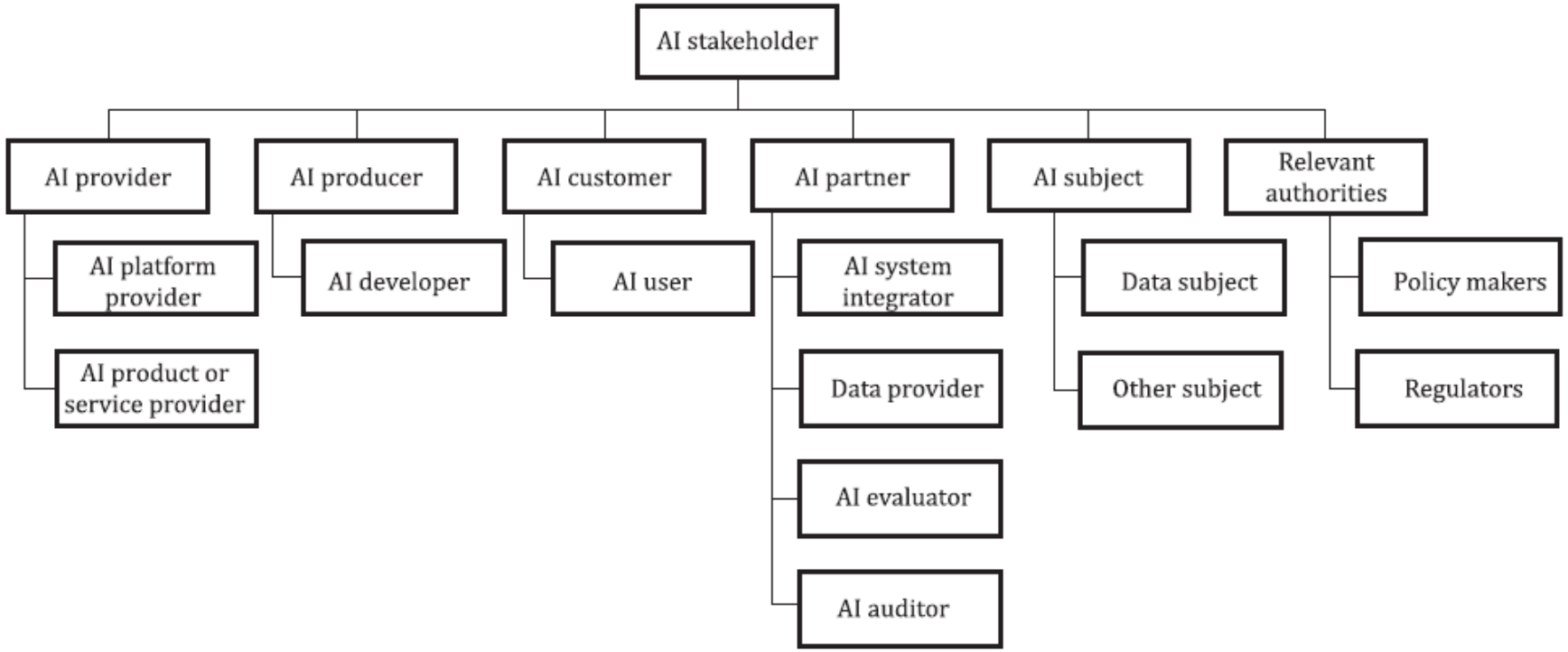
JTC 1/SC 42 – PUBLISHED ISO STANDARDS

STANDARD AND/OR PROJECT UNDER THE DIRECT RESPONSIBILITY OF ISO/IEC JTC 1/SC 42 SECRETARIAT	STAGE
ISO/IEC 22989: 2022, Information technology — Artificial intelligence — **Artificial intelligence concepts and terminology**	60.60
ISO/IEC 23053:2022, **Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML)**	60.60
ISO/IEC 20546:2019, Information technology — Big data — Overview and vocabulary	60.60
ISO/IEC TR 20547-1:2020, Information technology — Big data reference architecture — Part 1: Framework and application process	60.60
ISO/IEC TR 20547-2:2018, Information technology — Big data reference architecture — Part 2: Use cases and derived requirements	60.60
ISO/IEC 20547-3:2020, Information technology — Big data reference architecture — Part 3: Reference architecture	60.60
ISO/IEC TR 20547-5:2018, Information technology — Big data reference architecture — Part 5: Standards roadmap	60.60
ISO/IEC TR 24027:2021, Information technology — Artificial intelligence (AI) — **Bias in AI systems** and AI aided decision making	60.60
ISO/IEC TR 24028:2020, Information technology — Artificial intelligence — Overview of **trustworthiness** in artificial intelligence	60.60
ISO/IEC TR 24029-1:2021, Artificial Intelligence (AI) — Assessment of the **robustness** of neural networks — Part 1: Overview	60.60
ISO/IEC TR 24030:2021, Information technology — Artificial intelligence (AI) — **Use cases**	90.92
ISO/IEC TR 24372:2021, Information technology — Artificial intelligence (AI) — Overview of **computational approaches** for AI systems	60.60
…	

Baseline Doc.

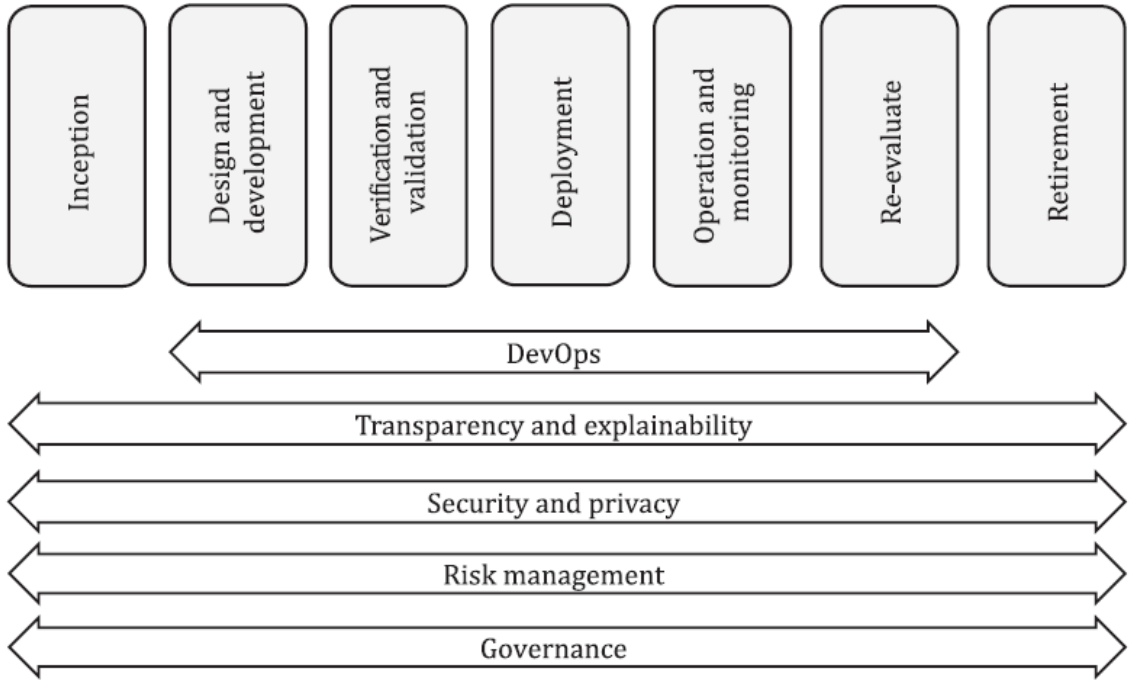
ISO/IEC 22989: 2022, AI concepts and terminology

- Provides 115 terms : AI, data, machine learning, neural networks, trustworthiness, NLP, and computer vision
- AI stakeholder roles and sub-roles

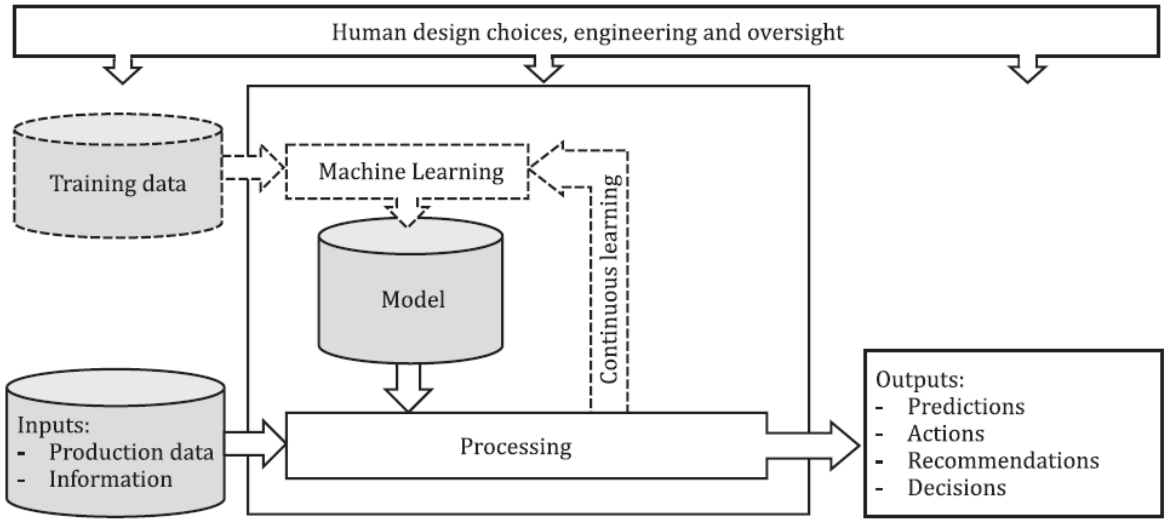


ISO/IEC 22989: 2022, AI concepts and terminology

- AI system life cycle model

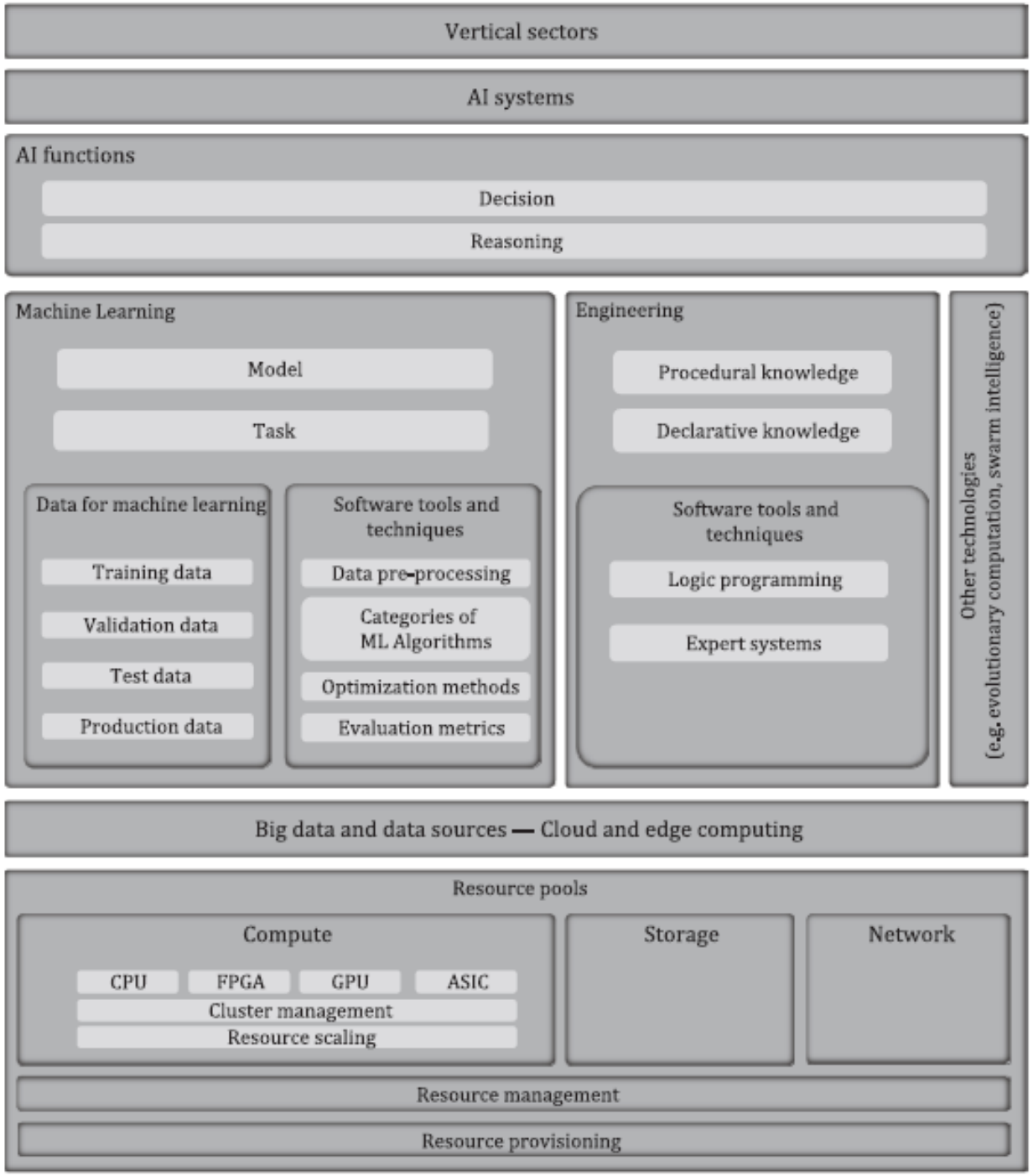


- AI system functional view



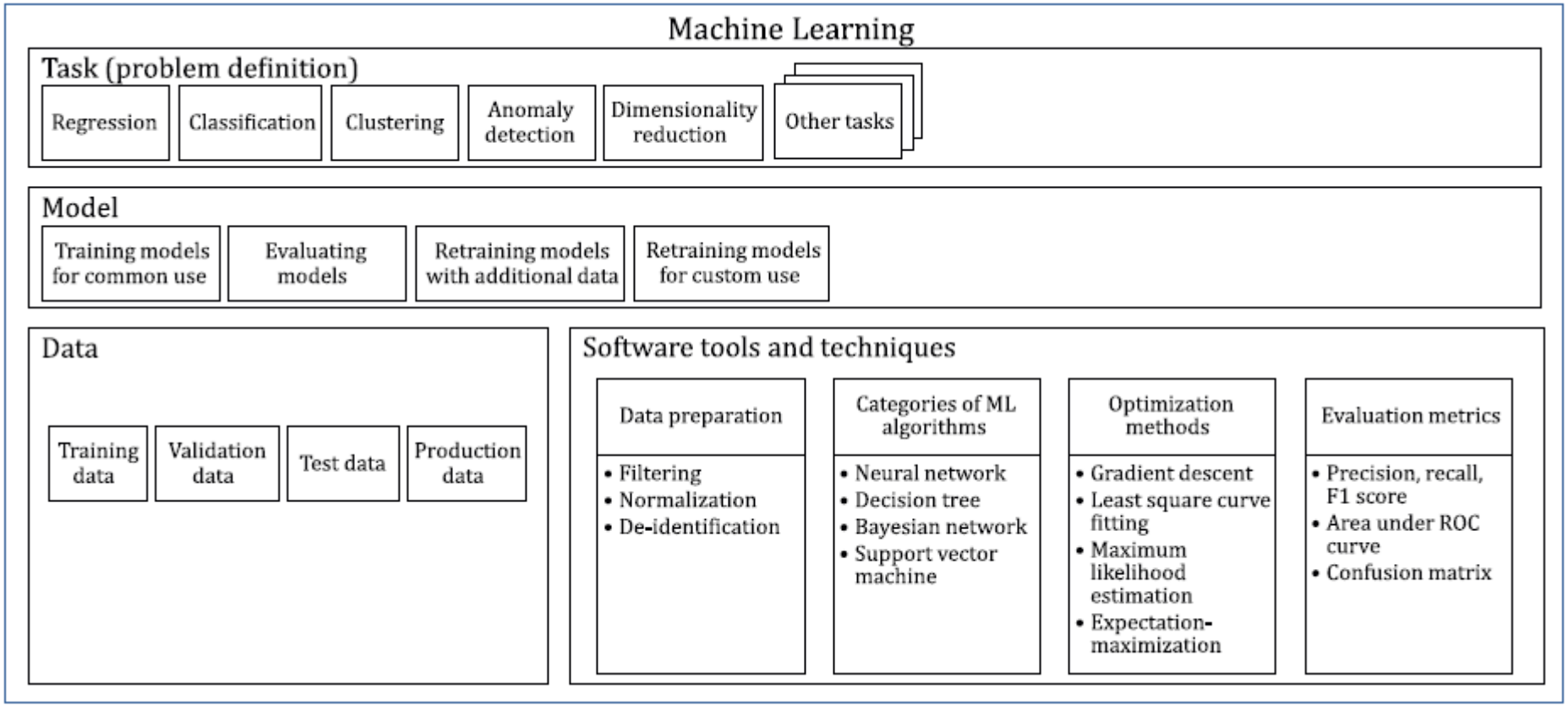
ISO/IEC 22989: 2022, AI concepts and terminology

- AI ecosystem : AI ecosystem in terms of functional layers



ISO/IEC 23053:2022, Framework for AI Systems Using ML

- Machine learning system



ISO/IEC 23053:2022, Framework for AI Systems Using ML

- Machine learning approaches : ML Models

Supervised machine learning

Classification	Regression
• Logistic regression • Linear discriminant analysis • Naïve Bayes • k-nearest neighbour • Decision tree • Ensemble methods (random forests, AdaBoost) • Kernel methods, support vector machine • Neural networks	• Linear and non-linear curve fitting • Regression tree • Ridge and Lasso regression • Bayesian regression • Elastic net regression • Support vector regression • Gaussian process regression • Neural networks

Unsupervised machine learning

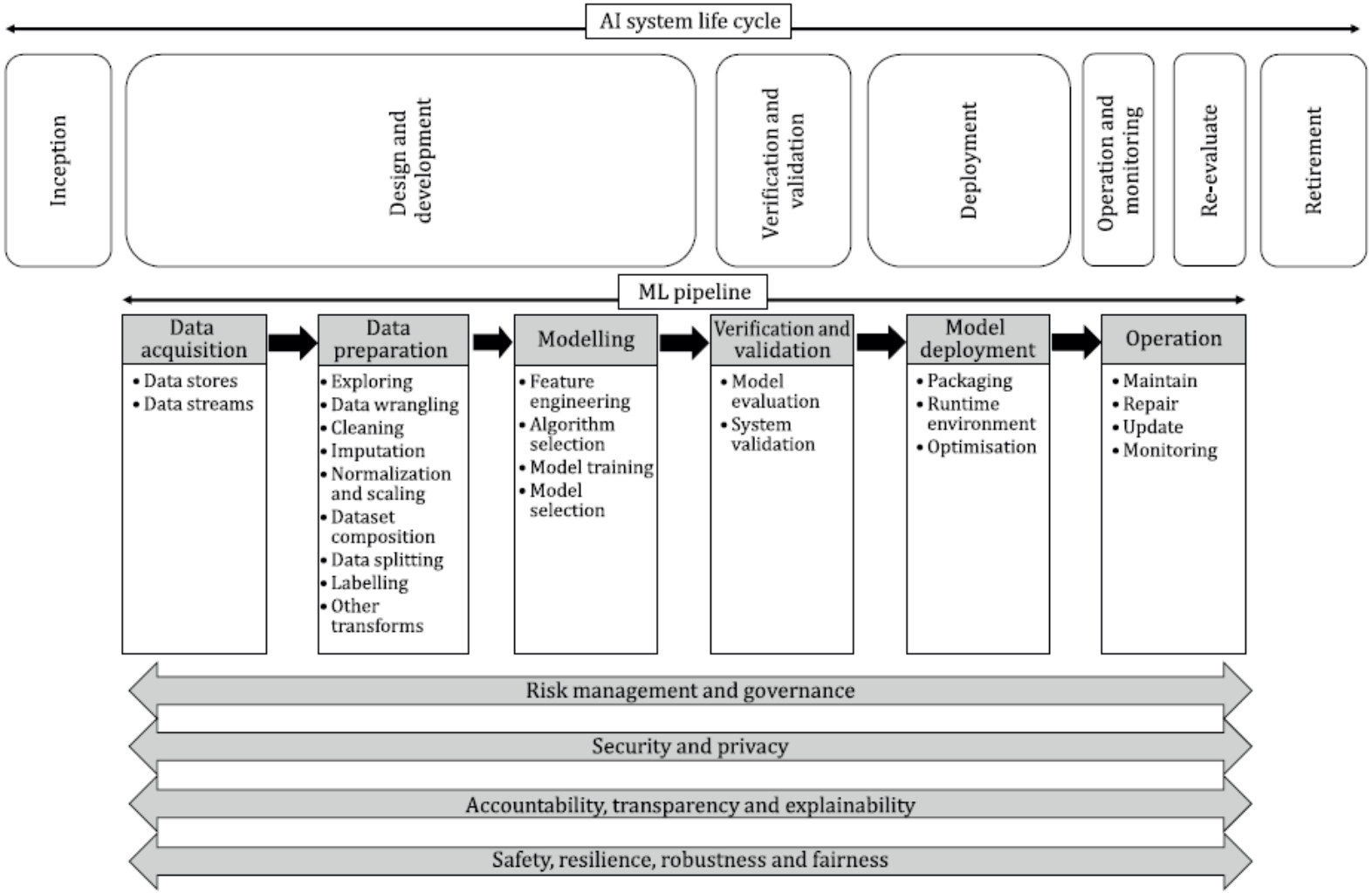
Clustering	Dimension reduction
• k-means clustering • Hierarchical clustering • Gaussian mixture model • Density-based clustering • Genetic algorithms • Spectral clustering • Scale-space clustering • Neural networks	• Principal component analysis • Tensor decomposition • Isometric feature mapping • Locally linear embedding • t-distributed stochastic neighbour embedding • Uniform manifold approximation and projection • Neural networks

Reinforcement machine learning

Model-free	Model-based
• Monte Carlo • Current state/current action/next reward/next state/next action • Q-learning, deep Q-learning • Policy improvement with path integrals • Trust region policy optimization • Deep deterministic policy gradient • Proximal Policy Optimization • Neural networks	• Dynamic programming • Explicit explore or exploit • Model-based interval estimation • Model-based Bayesian reinforcement learning • Differential dynamic programming • Neural networks

ISO/IEC 23053:2022, Framework for AI Systems Using ML

- Machine learning pipeline and mapping to the AI system life cycle



De facto standardization organization

KHRONOS GROUP

NNEF

Neural Network Exchange Format

W3C®

WebML

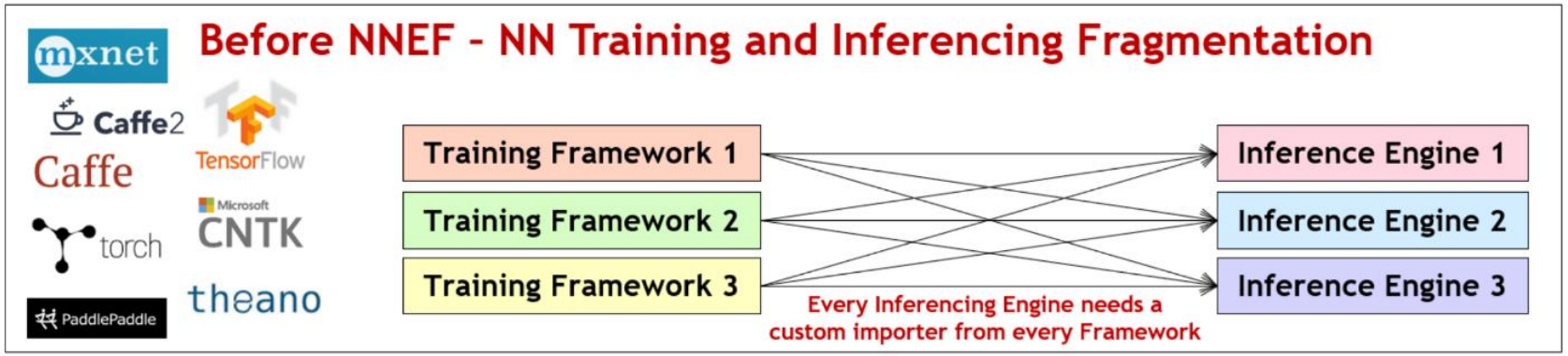
Web Machine Learning

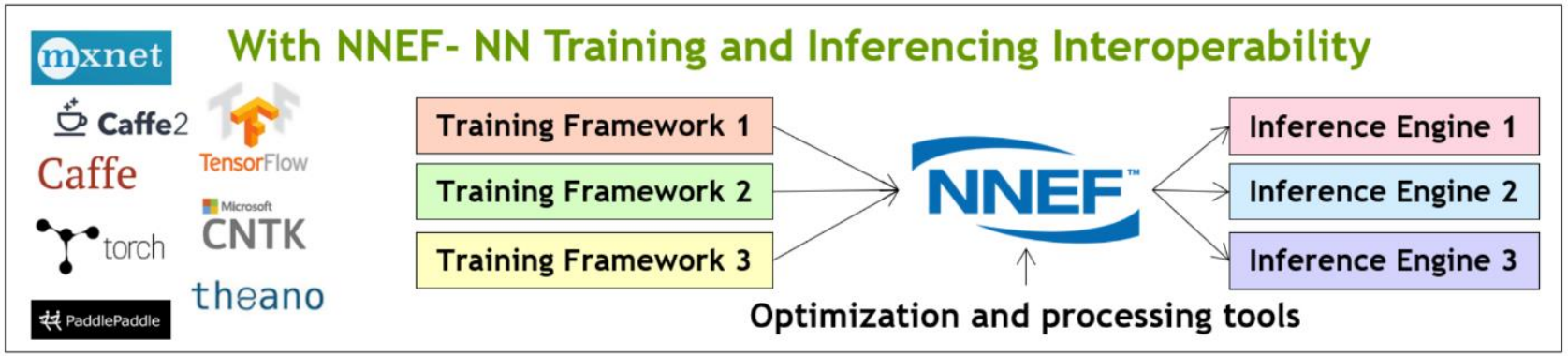
IEEE Advancing Technology for Humanity

P7007, P7008, P7009, ...

Khronous Group – NNEF

Reference	Title	Status
NNEF 1.0.3	Neural Network Exchange Format (NNEF)	Published 2020-08





* https://www.khronos.org/nnef

Khronous Group – NNEF

KHRONOS GROUP

NNEF-Tools

NNEF reduces machine learning deployment fragmentation by enabling a rich mix of neural network training tools and inference engines to be used by applications across a diverse range of devices and platforms.

This repository contains tools to generate and consume NNEF documents, such as a parser (C++ and Python) that can be included in consumer applications and converters for deep learning frameworks.

- NNEF Model Zoo
- NNEF Tests
- NNEF Tools
- NNEF Parser

NNEF Model Zoo

A **Model Zoo** is now available; the 'models' folder contains a variety of NNEF models converted from various sources.

NNEF Tests

NNEF Tests folder contains tests to verify installation and unit tests.

NNEF Tools

NNEF Tools folder contains tools to convert pre-trained models in `tensorFlow` / `caffe` / `caffe2` / `ONNX` to NNEF format.

NNEF Parser

NNEF Parser folder contains `C++` and `Python` source code for a sample NNEF graph parser.

* https://github.com/KhronosGroup/NNEF-Tools

NNEF model zoo

The following collection of models were compiled by running the convert provides a link to the original and the converted model.

- TensorFlow models have been acquired from [https://www.tensorflo
- ONNX models have been acquired from [https://github.com/onnx/m
- Caffe models have been acquired from [https://github.com/BVLC/ca
- Caffe2 models have been acquired from [https://github.com/caffe2/

AlexNet

Floating point models

Name	Size	Original	Converted
BVLC AlexNet	244 Mb	Caffe	NNEF
BVLC AlexNet	244 Mb	ONNX	NNEF

VGG

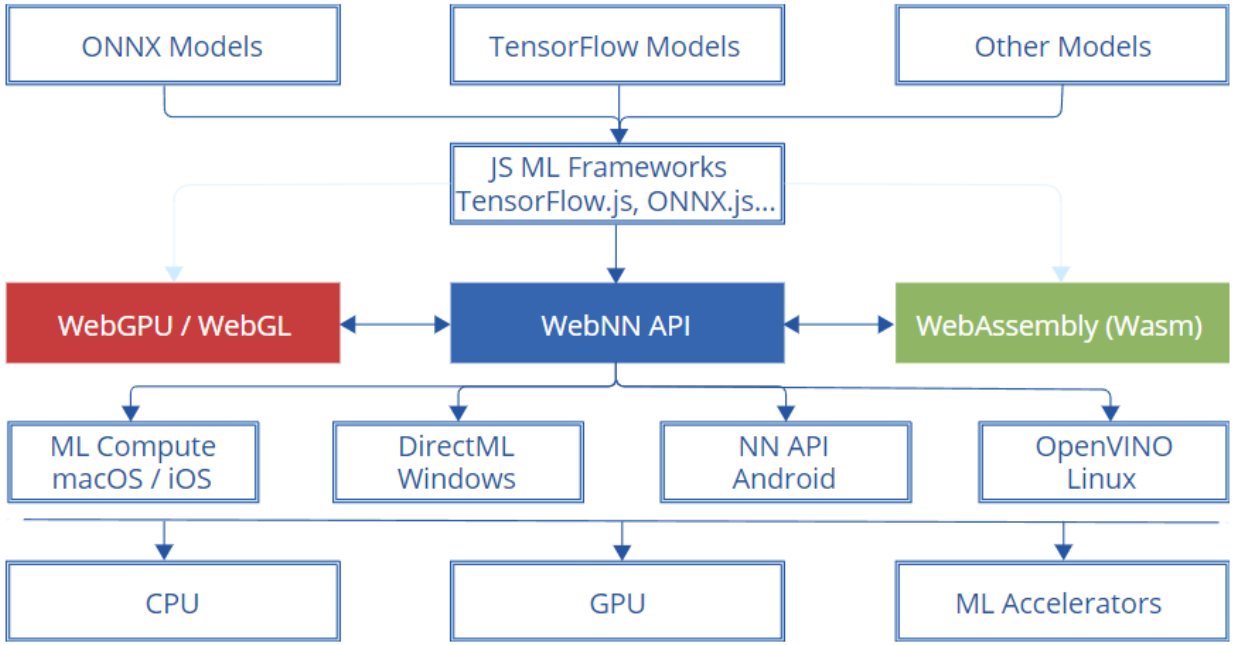
Floating point models

Name	Size	Original	Converted
VGG-16	553.6 MB Mb	Caffe	NNEF

Latest Models such as Transformer based models are not yet supported…

W3C – WebNN API

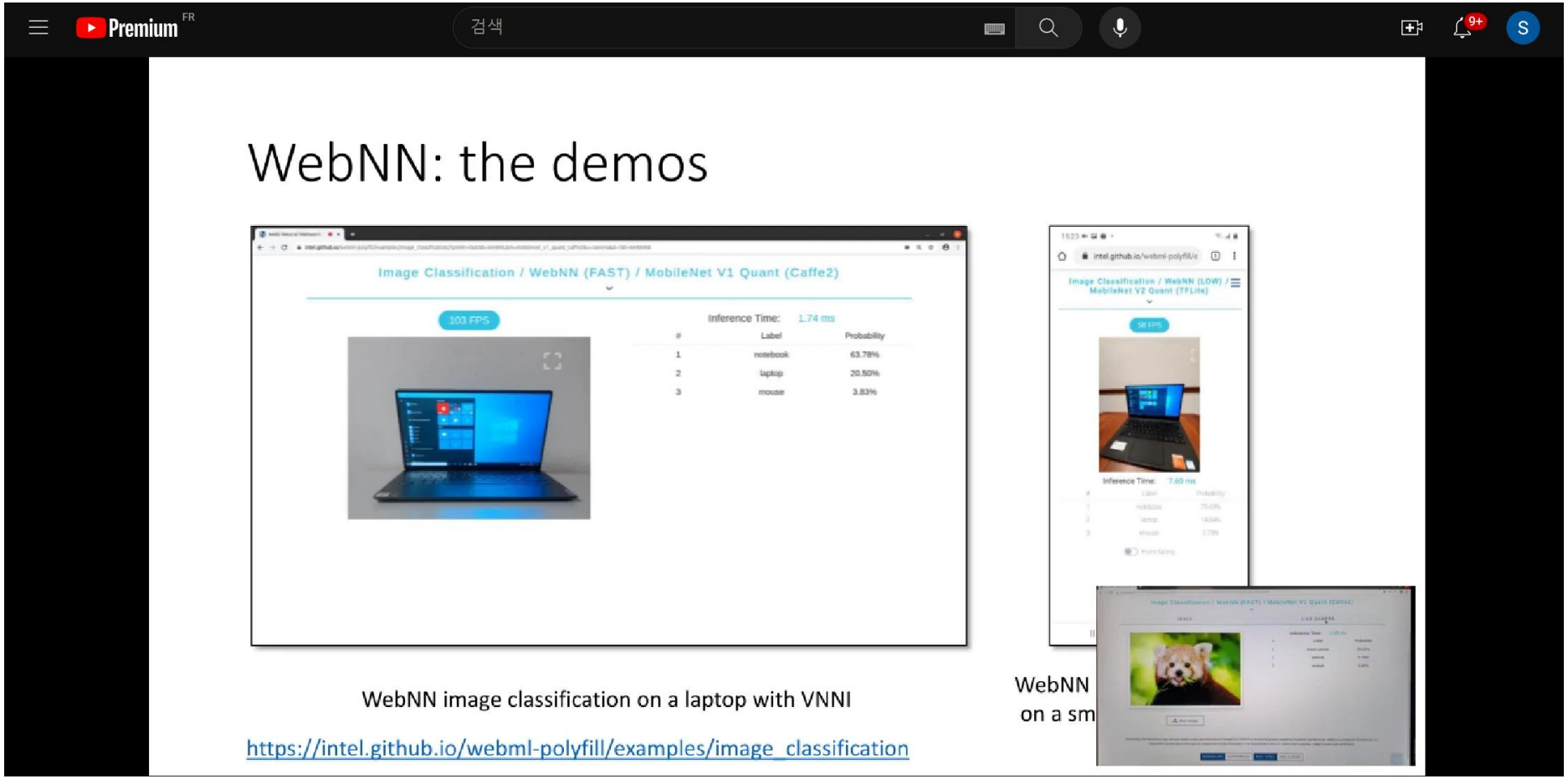
Group	Reference	Title	Status
WebML WG	WebNN API	Web Neural Network API	Candidate Recommendation Draft (Aug 2023)



- Take advantage of the native OS services for machine learning
- Get capabilities from the underlying hardware innovations
- Implement consistent, efficient, and reliable AI experiences on the web
- Benefit web applications and frameworks including TensorFlow.js, ONNX.js

* https://webmachinelearning.github.io/webnn-intro/

W3C – WebNN API



* https://www.youtube.com/watch?v=8vnQYOQSIqM

IEEE

Reference	Name/Title	Status
P7006	Standard for Personal Data Artificial Intelligence (AI) Agent	PAR Approval 2017-03-23
P7007	Ontological Standard for **Ethically Driven** Robotics and Automation Systems	PAR Approval 2017-03-23
P7008	Standard for **Ethically Driven** Nudging for Robotic, Intelligent and Autonomous Systems	PAR Approval 2017-06-15
P7009	Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems	PAR Approval 2017-06-15
P7010	Wellbeing Metrics Standard for **Ethical Artificial Intelligence** and Autonomous Systems	PAR Approval 2017-06-15
P7012	Standard for Machine Readable Personal Privacy Terms	PAR Approval 2017-12-06
P7013	Inclusion and Application Standards for Automated Facial Analysis Technology	PAR Approval 2018-05-14
P7014	Standard for Ethical considerations in Emulated Empathy in Autonomous and Intelligent Systems	PAR Approval 2019-06-13
P2755.2	Recommended Practice for Implementation and Management Methodology for Software Based Intelligent Process Auto mation (SBIPA)	PAR Approval 2019-05-21
P2801	Recommended Practice for the Quality Management of Datasets for Medical Artificial Intelligence	PAR Approval 2018-12-05
P2802	Standard for the Performance and Safety Evaluation of Artificial Intelligence Based Medical Device: Terminology	PAR Approval 2018-12-05
P2807	Framework of Knowledge Graphs	PAR Approval 2017-03-23
P2841	Framework and Process for Deep Learning Evaluation	PAR Approval 2019-09-05
P2805.3	Cloud-Edge Collaboration Protocols for Machine Learning	PAR Approval 2019-02-08
P3333.1.3	Standard for the Deep Learning-Based Assessment of Visual Experience Based on Human Factors	PAR Approval 2017-09-28
P3652.1	Guide for Architectural Framework and Application of Federated Machine Learning	PAR Approval 2018-12-05

JCA-ML Motivations :
Problems of Standard fragmentation in AI

- Uncoordinated work
- Lack of consistency
- Duplication of work

Introduction to JCA-ML

JCA-ML

"***Using Machine Learning (ML) to unleash the full potential of telecommunications/ICTs.***" - Mr Kangchan Lee, the JCA-ML Chairman

Initiated by the SG13 in July 2022, the JCA-ML starts its operation from March 2023. The scope of JCA-ML is the coordination of the ITU-T work programme on applications of machine learning and its related standardization work for telecommunications/ICTs. JCA-ML seeks cooperation and collaboration from external standards development organizations, consortia, forums, and academia studying ML applications and their relevant works. Mr Kangchan Lee (ETRI, Republic of Korea) was appointed as the Chairman and Mr Marco Carugi (Huawei, China) as the Vice-chairman of JCA-ML. JCA-ML reports to SG13.

- Scope and Terms of Reference
- Parent Group: ITU-T SG13

MANAGEMENT AND CONTACTS

- **Chairman:**
  Dr Kangchan Lee
  (ETRI, Korea (Rep. of)
- **Vice-chairman:**
  Mr Marco Carugi
  (Huawei China)
- **JCA-ML Secretariat:**
  tsbjcaml@itu.int

MAILING LIST

- **Mailing list: jcaml@lists.itu.int**

An ITU User Account is required to subscribe to the mailing list.

- **Account holders:** Log in here, search for *jcaml* and click subscribe.
- **Non-account holders:** Sign up for a (free) ITU account here, then follow previous instruction.
- To view previous exchanges on this mailing list, visit the mailing list archive.

Meetings | News | Past meetings

Meeting #2
Geneva, 19 July 2023,1300-1430

- Announcement
- Registration (*mandatory*)
- Documents
- Remote participation

Your inputs are welcome

- **Submission deadline:**
- Submit inputs to tsbjcaml@itu.int in your preferred format, see templates below:
- **Templates:** Document

A free ITU User Account is required to access the remote participation tool and JCA-ML documents, sign up for a (free) ITU account here.

DOCUMENT AREA

- Documents

An ITU User account is required to access the documents. **Non- account holders** can sign up for a (free) ITU account here.

- Web site : https://www.itu.int/en/ITU-T/jca/ml/
- Document : https://extranet.itu.int/sites/itu-t/jca/ml/

- Initiated on July 2022
- 1st Meeting on March 2023

Introduction to JCA-ML

HOME > 뉴스 > 소프트웨어

ETRI, AI 국제표준화 주도...개발자에서 조정자로 위상 높아져

강석오 기자 | 승인 2022.07.27 10:02 | 댓글 0

ITU 머신러닝 표준화 공동조정그룹 의장에 ETRI 이강찬 실장 선임
2024년까지 인공지능 분야 국제표준화 청사진 '머신러닝 표준화 로드맵' 개발

[데이터넷] 한국전자통신연구원(원장 김명준, ETRI)은 국제전기통신연합 전기통신표준화부문(ITU-T) 산하 SG13 총회에서 머신러닝 표준화 공동조정그룹(JCA-ML)이 신설되면서 초대 의장에 이강찬 실장이 선임됐다고 밝혔다. 공동조정그룹은 ITU-T 산하의 연구반 및 타 표준화기구에서 개발 중인 관련 표준화 작업의 조정을 위한 그룹이다.

JCA-ML

"***Using Machine Learning (ML) to unleash the full potential of telecommunications/ICTs.***" - Mr Kangchan Lee, the JCA-ML Chairman

Initiated by the SG13 in July 2022, the JCA-ML starts its operation from March 2023. The scope of JCA-ML is the coordination of the ITU-T work programme on applications of machine learning and its related standardization work for telecommunications/ICTs. JCA-ML seeks cooperation and collaboration from external standards development organizations, consortia, forums, and academia studying ML applications and their relevant works. Mr Kangchan Lee (ETRI, Republic of Korea) was appointed as the Chairman and Mr Marco Carugi (Huawei, China) as the Vice-chairman of JCA-ML. JCA-ML reports to SG13.

- **Scope and Terms of Reference**
- Parent Group: **ITU-T SG13**

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- To view previous exchanges on this mailing list, visit the mailing list archive.

Meetings | News | Past meetings

Meeting #3
Geneva, 27 October 2023
1300-1430

- Invitation
- Registration
- Documents
- Remote participation

Your inputs are welcome

- **Submission deadline:**
- Submit inputs to tsbjcaml@itu.int in your preferred format, see templates below:
- **Templates:** Document

A free ITU User Account is required to access the remote participation tool and JCA-ML documents, sign up for a (free) ITU account here.

DOCUMENT AREA

- **Documents**

An ITU User account is required to access the documents. **Non- account holders** can sign up for a (free) ITU account here.

* https://www.itu.int/en/ITU-T/jca/ml/Pages/default.aspx

Objectives of JCA-ML

1. The JCA-ML ensures that the ITU-T work programme on applications of machine learning and its related standardization work for telecommunications/ICTs is progressed in a well-coordinated manner among all ITU-T study groups and their relevant Questions.
2. JCA-ML **monitors the work programmes** of other SDO's to detect duplication and promotes the usage of terms and definitions in a manner consistent with existing standardized definitions in this area.
3. Whenever **duplication of** effort or planning issues are discovered, the JCA-MLs reports this to the parent study group to **coordinate all activities** with other relevant groups.
4. The JCA-ML considers and encourages possibilities of **cooperation and collaboration** on applications of machine learning with relevant groups such as ISO/IEC JTC 1, ISO/IEC JTC 1/SC 42, ISO/IEC JTC 1/SC 29, ISO/TC37, IEC TC 62, IEC SMB Advisory Committee on Information security and data privacy, IEC SMB Strategic Group 11, IEC SMB Strategic Group 12, IEEE, Khronos Group, W3C, etc. as well as open-source communities where ML applications experts eagerly participate and contribute.
5. The JCA-ML **periodically reviews the roadmaps in ITU-T** (e.g., Artificial Intelligence Standardization Roadmap [ITU-T Y.sup.aisr]) to collect relevant information of the on-going and published deliverables from ITU-T, other relevant standard development organizations, consortia and forums, including support to a gap analysis under its parent group.
6. The JCA-ML considers the work of standards development organizations consortia and forums for use in its **coordination function** and provides information on this work for use by the relevant study groups in their work.
7. To **facilitate internal coordination** within ITU-T, JCA-ML invites representatives of all ITU-T study groups and focus groups to its meetings.
8. To **foster external collaboration**, JCA-ML invites representatives from other relevant standards development organizations, regional/national organizations, consortia and forums to join the JCA.

Deliverables of JCA-ML

Deliverables	Goal
Machine Learning Standardization Roadmap	• Focused on machine learning with similar way ITU-T Y Suppl. 72, ITU-T Y.3000-series - Artificial Intelligence Standardization Roadmap • Collect ML related existing, approved, and under-developing Recommendations/Standards via liaison exchanges • Providing standardization gap analysis
Glossary of terms and definitions for machine learning	• Collect terms and definitions defined in the deliverables from ITU-T and other relevant SDOs in the 'Machine Learning Standardization Roadmap.' • Organize to compare similar terms and definitions defined in published standards of ITU-T and other relevant SDOs. • Essential resource for anyone who needs to develop documents at ITU-T and other relevant SDOs. Moreover, it can help to avoid duplicated terms and definitions in the field of ML in the future

MLSR – Machine Learning Standardization Roadmap

Table 7-1 – ITU-T SG13 deliverables and work items

Study group	Reference	Title	Status	Topics
SG13	ITU-T Y.3176	Machine learning marketplace integration in future networks including IMT-2020	In force (Approved on 2020-09-29)	ML Applications, Others
SG13	ITU-T Y.3812	Requirements of machine learning based QoS assurance for quantum key distribution networks	AAP (Approved on 2022-09-29)	ML Applications
SG13	ITU-T Y.Sup70	Quantum Key Distribution Networks – Applications of Machine Learning	In force (Agreed on 2021-07-16)	ML Applications, Others
SG13	ITU-T Y.3814	Quantum Key Distribution Networks – Functional requirements and architecture for machine learning	AAP (Consented on 2022-11-25)	ML Applications
SG13	ITU-T Y.IMT2020-DJLML	Requirements and framework for distributed joint learning to enable machine learning in future networks including IMT-2020	Under study (Timing: 2023-Q4)	ML Framework ML Applications
SG13	ITU-T Y.ML-IMT2020	Requirements and architecture for machine learning function	Under study (Timing: TBD)	ML Applications

Topic-based gap analysis

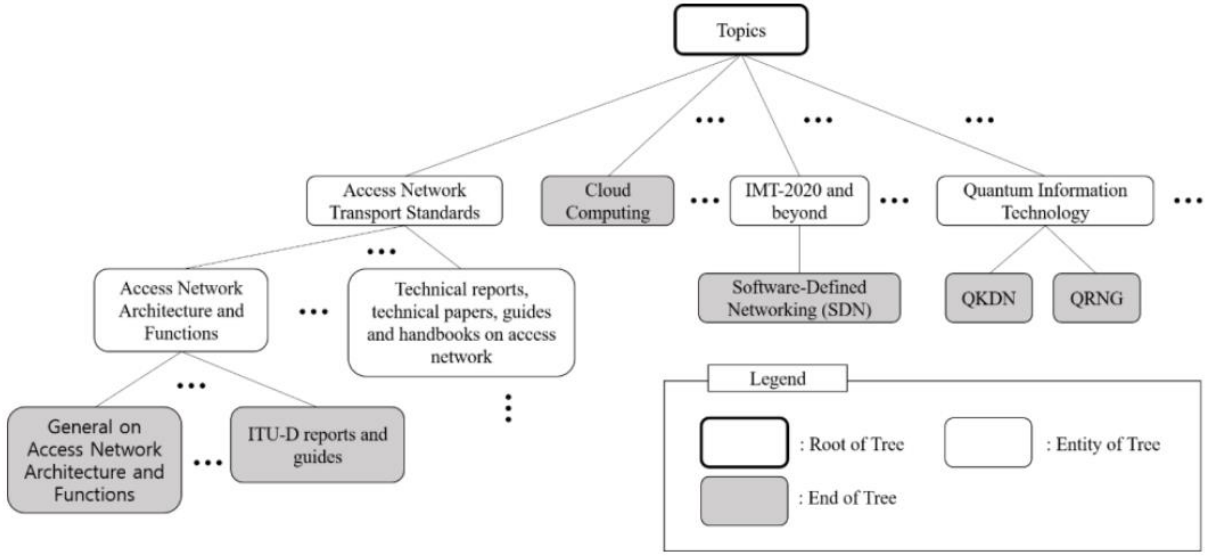


Figure 1 - Structure of 'Topics' in "ITU-T landscape for ICT standards"

JCA-ML will request to update the 'Topics' in the context of "Machine Learning" into the above structure. As depicted in the figure 1, the structures of 'Topic' vary by domain, therefore, JCA-ML should be decided appropriate topics under machine learning circumstances. The followings are candidate topics of machine learning;

- Foundation;
- Data;
- Assessment and testing;
- Trustworthiness: including bias, robustness, explainability, controllability, and transparency for ML models or ML systems;
- ML applications;
- Others.

Glossary of terms and definitions for machine learning

3 Definitions

3.1 Terms defined elsewhere

This document uses the following terms defined elsewhere:

3.1.1 accuracy [ISO/IEC TS 4213]: Number of correctly classified samples divided by all classified samples.

NOTE – It is calculated as $a=(T_P+T_N)/(T_P+F_P+T_N+F_N)$.

3.1.2 artificial intelligence
AI [ISO/IEC 22989]: Research and development of mechanisms and applications of AI systems (3.1.3).

NOTE 1 – Research and development can take place across any number of fields such as computer science, data science, humanities, mathematics and natural sciences.

3.1.3 artificial intelligence system
AI system [ISO/IEC 22989]: engineered system that generates outputs such as content, forecasts, recommendations or decisions for a given set of human-defined objectives.

NOTE 1 – The engineered system can use various techniques and approaches related to artificial intelligence (3.1.2) to develop a model (3.1.50) to represent data, knowledge (3.1.36), processes, etc. which can be used to conduct tasks (3.1.68).

NOTE 2 – AI systems are designed to operate with varying levels of automation (3.1.4).

3.1.4 automatic
automation
automated [ISO/IEC 22989]: pertaining to a process or system that, under specified conditions, functions without human intervention.

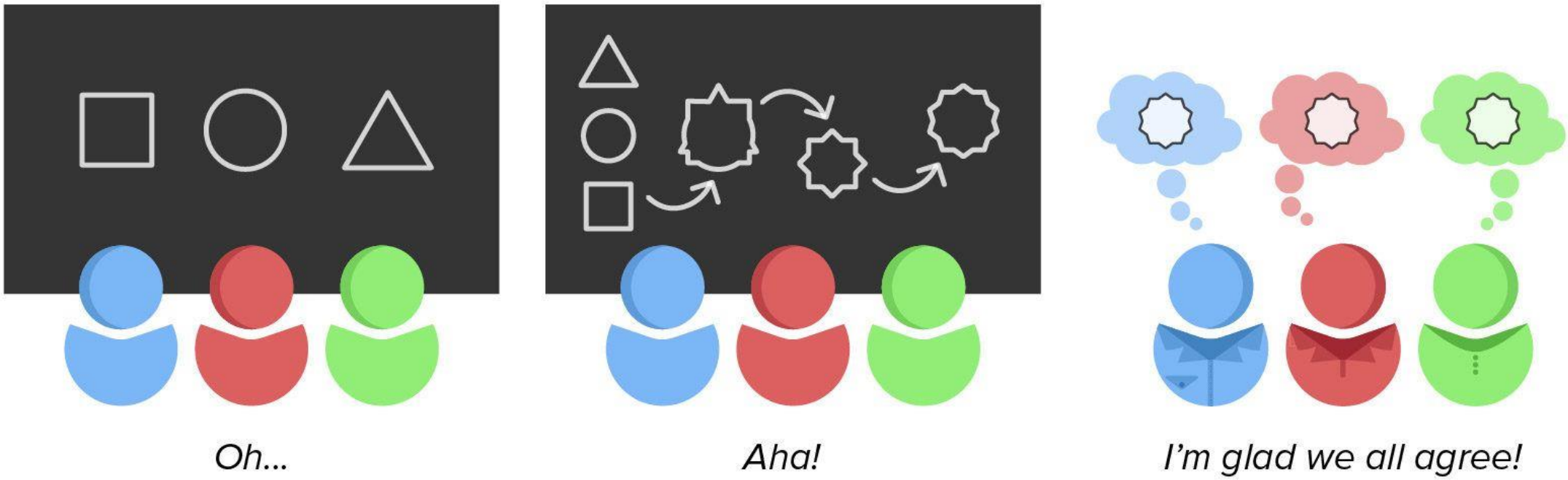
1. Collection of definitions in published standards

Table I.1: Identical terms for machine learning

Terms	Clause (Deliverables)
Deep learning	- 3.1.18 (ITU-T F.748.12) - 3.1.19 (ISO/IEC 22989)
Inference	- 3.1.22 (ITU-T F.748.20) - 3.1.34 (ISO/IEC 22989)
Machine learning	- 3.1.40 (ITU-T Y.3172) - 3.1.41 (ISO/IEC 22989)
Machine learning model	- 3.1.43 (ITU-T Y.3172) - 3.1.44 (ISO/IEC 22989)
Support vector machine	- 3.1.66 (ITU-T X.1235) - 3.1.67 (ISO/IEC 22989)

2. Find identical terms in ML fields

Wrap-up : Roles of standardization works in de jure



Towards common understanding for AI

Wrap-up : Roles of standardization works in de jure

용어사전

TTA 한국정보통신기술협회 Telecommunications Technology Association
정보통신용어사전

지도형 기계 학습, 指導型機械學習, Supervised learning

동의어 : 지도 학습

기계 학습 중 컴퓨터가 입력값과 그에 따른 출력값이 있는 데이터를 이용하여 주어진 입력에 맞는 출력을 찾는 학습 지도형 기계 학습 모델은 입력된 문제에 대한 답을 예측하는 데 사용된다. 기계 번역, 상품 추천, 질병 진단 등에 응·

'짜장면' 표준어 됐다

최원형 기자 +구독

표준어로 새로 인정된 단어들 출처: 국립국어원

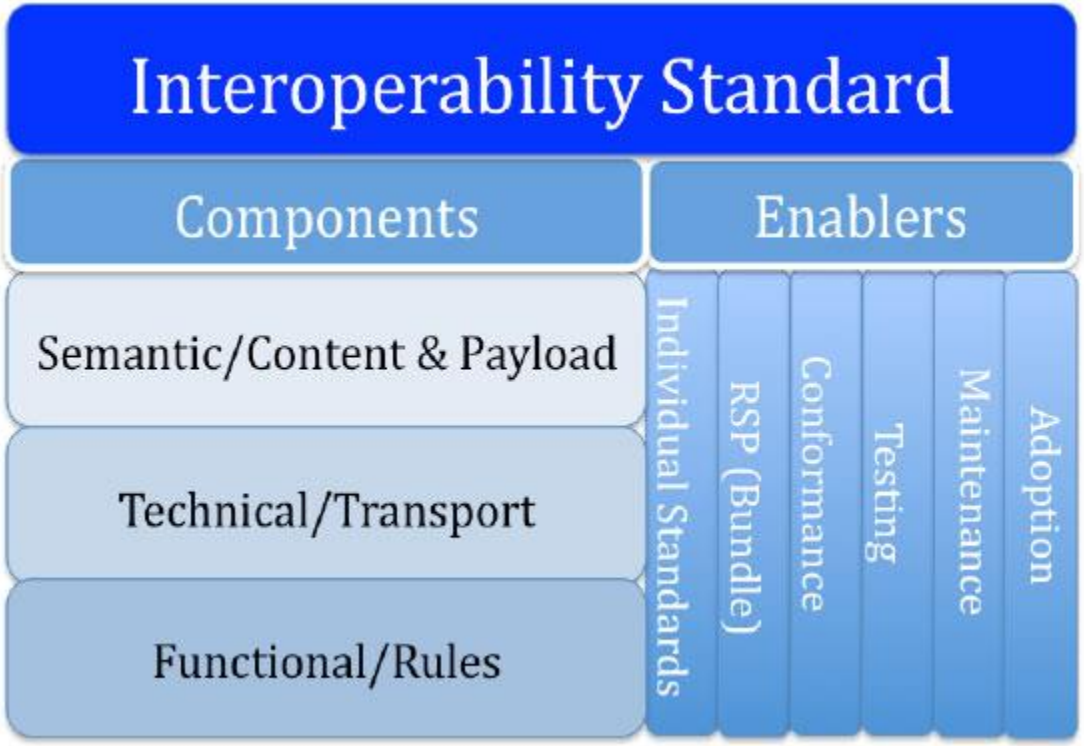
추가된 표준어	현재 표준어	내용
간지럽히다	간질이다	
남사스럽다	남우세스럽다	현재 표준어와 같은 뜻으로 추가 인정
맨날	만날	
~길래	~기에	
개발새발	괴발개발	현재 표준어와 별도의 표준어로 추가 인정
눈꼬리	눈초리	
짜장면	자장면	두 가지 표기 모두 표준어로 인정

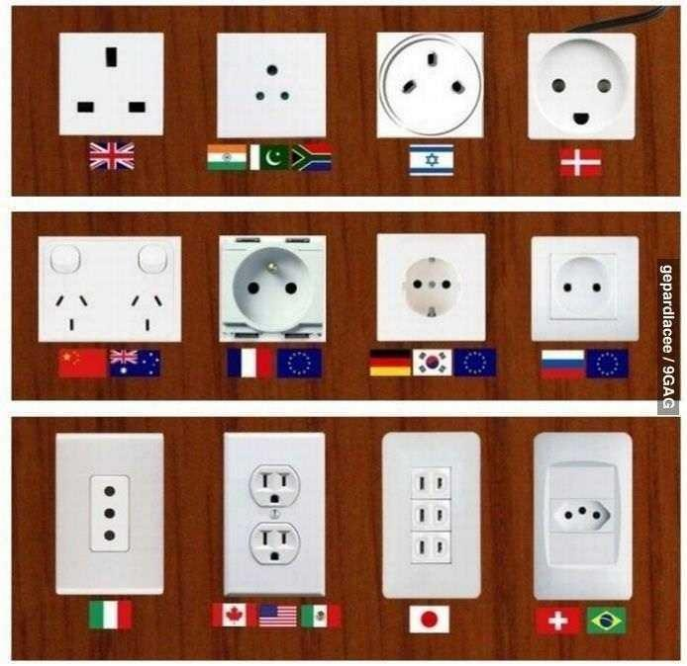
※ 나머지 표준어 추가 단어
등물, 못자리, 복숭아뼈, 세간살이, 쌀쌀롭하다, 토란대, 허접쓰레기, 흙담, 나래, 내음, 떨구다, 뜨락, 먹거리, 메꾸다, 손주, 어리숙하다, 연신, 휑하니, 걸리적거리다, 고적거리다, 두리뭉실하다, 맨숭맨숭/맹숭맹숭, 바둥바둥, 새초롬하다, 아웅다웅, 야멸차다, 오손도손, 찌푸둥하다, 추근거리다, 택견, 품새

'자장면'과 복수로 사용가능
국립국어원, 39개 단어 인정
현실괴리감 반영해 첫 확대

* https://www.hani.co.kr/arti/culture/culture_general/494286.html

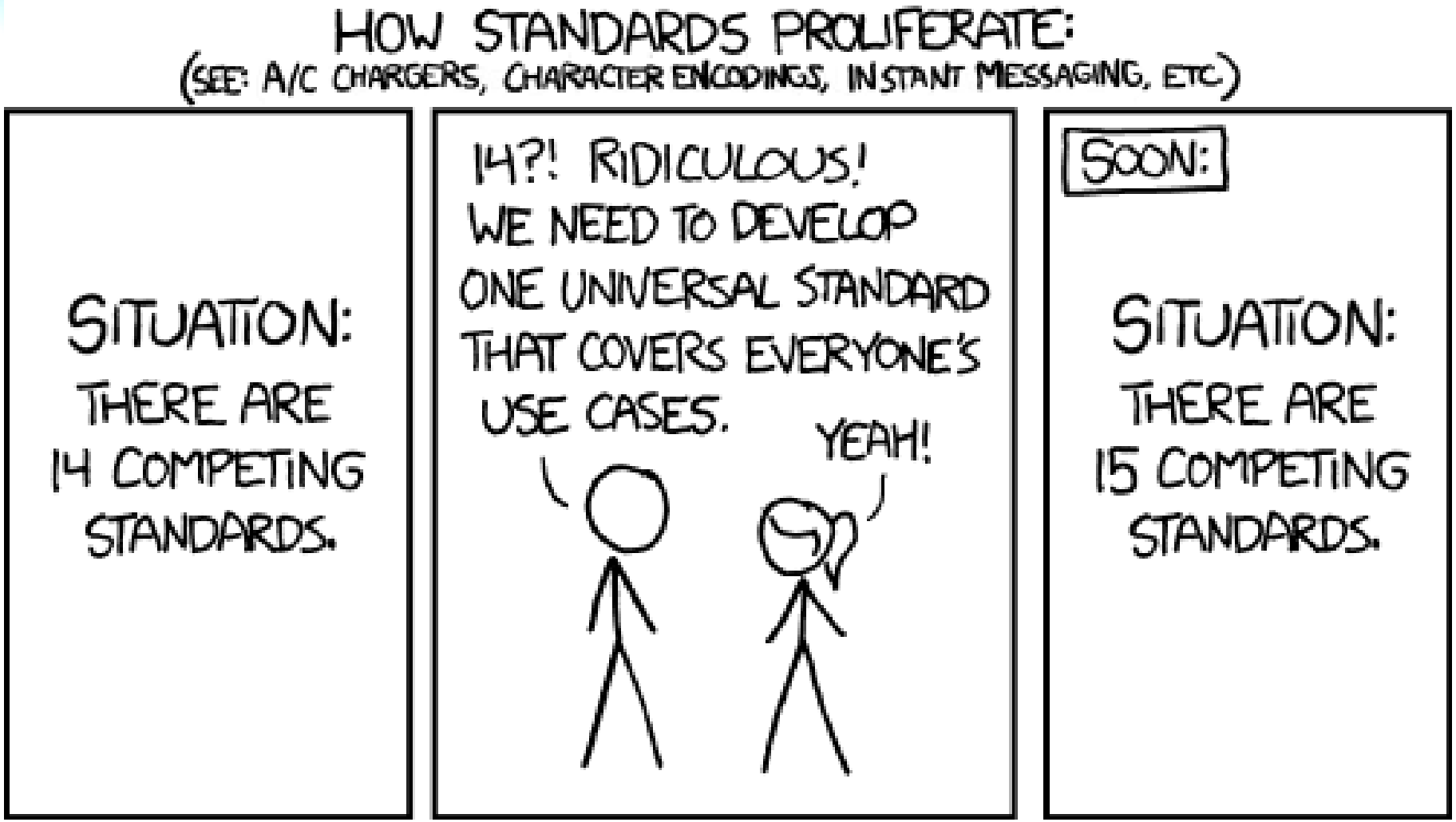
Wrap-up : Roles of standardization works in de facto



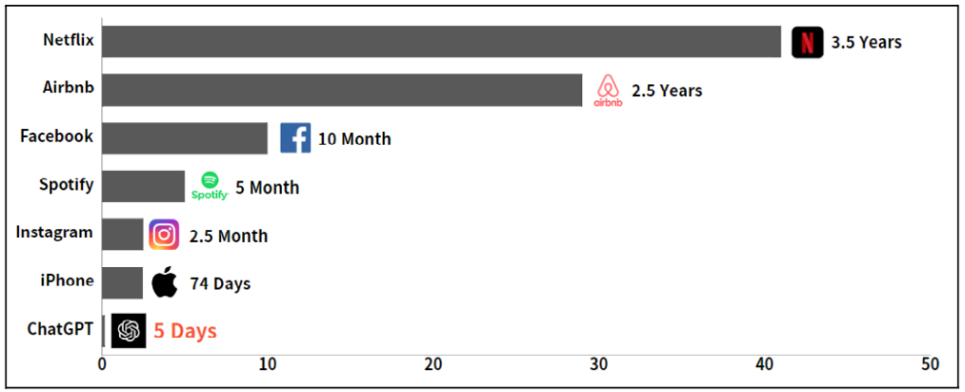


Support Interoperability and common formats in AI

Wrap-up : Roles of standardization works in de facto

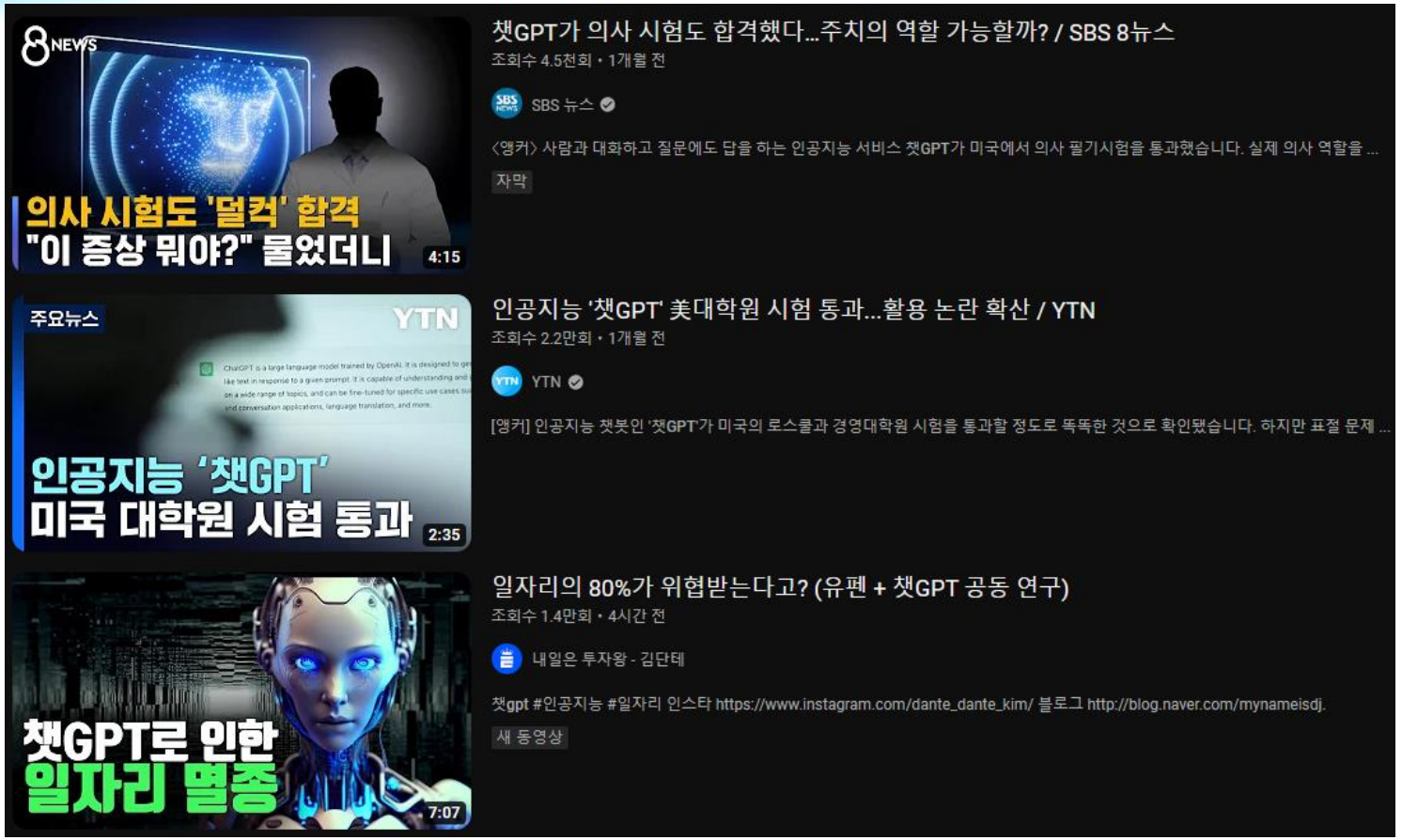


Upcoming Issues in AI standardization



<주요 혁신 서비스의 100만 유저 달성 기간>

(출처: 보안동향, https://www.cyberone.kr/news-trends-detail?id=97052&page=1)

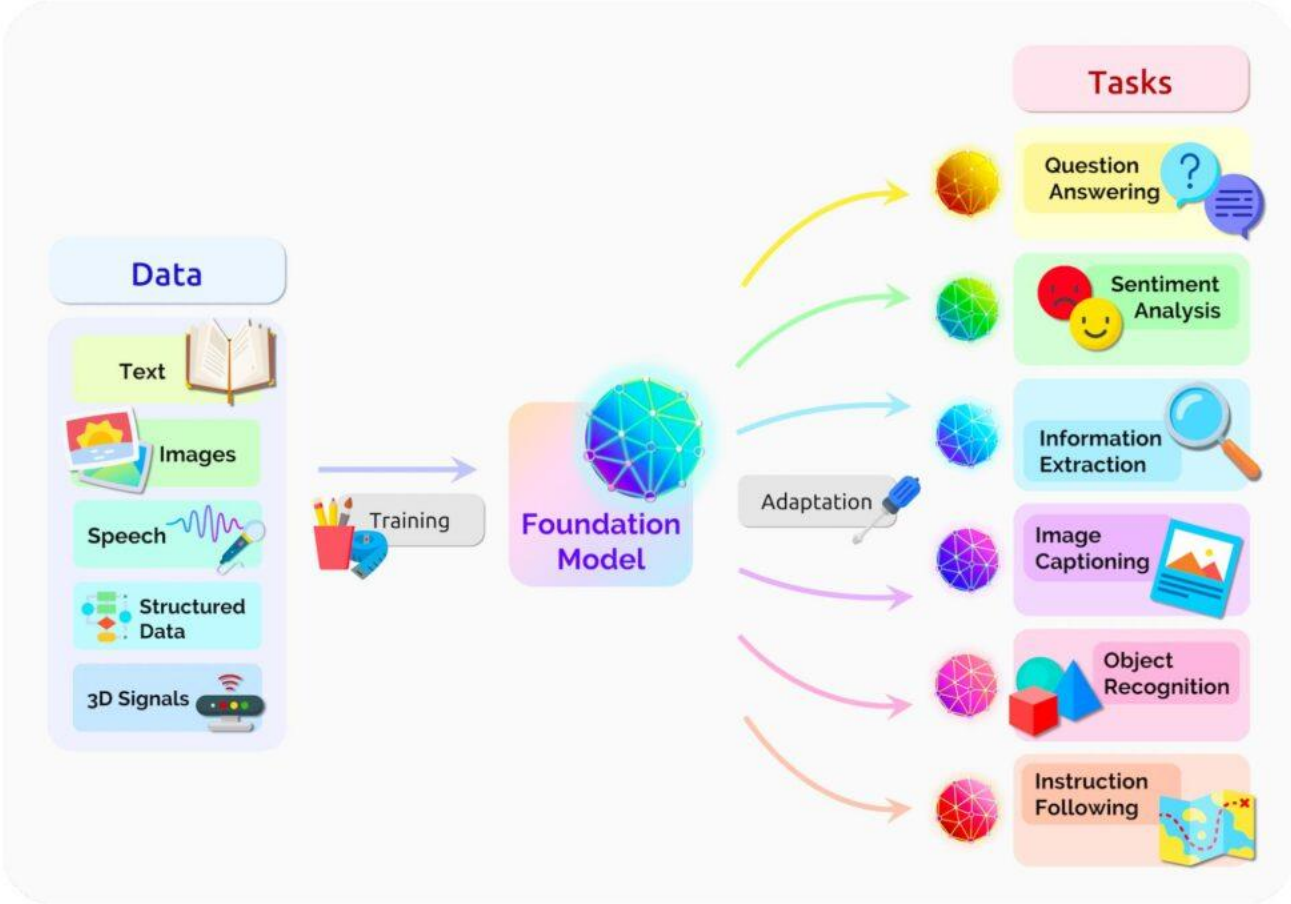


<ChatGPT 관련 뉴스>

(출처: 3월 28일 기준 유투브 검색)

Upcoming Issues in AI standardization

1. Concepts and terminologies for foundational models
2. Transformer-based hyperscale ML model supports reference architecture
3. State-of-The-Art learning algorithms support APIs
   (e.g. Federated Learning, Transfer Learning)
4. Multi-modality support for ML data
5. Etc…(The possibilities are infinite!)



출처: Bommasani, R. et al., (2021), **On the Opportunities and Risks of Foundation Models**. arXiv:2108.07258v3

Thank You

Sungpil Shin
Intelligence & Information Standards Research Section of ETRI

Office. +82-42-860-1379
Email: spshin@etri.re.kr