ISO/IEC JTC 1/SC 42/WG 4
Use cases and applications
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ISO/IEC JTC 1 SC 42 Artificial Intelligence – Working Group 4

Use Case Submission Form

The quality of use case submissions will be evaluated for inclusion in the Working Group's Technical Report based the application area, relevant AI technologies, credible reference sources (see References section), and the following characteristics:

— Data Focus & Learning: Use cases for AI system which utilizes Machine Learning, and those that use a fixed *a priori* knowledge base.

— Level of Autonomy: Use cases demonstrating several degrees (dependent, autonomous, human/critic in the loop, etc.) of AI system autonomy.

— Verifiability & Transparency: Use cases demonstrating several types and levels of verifiability and transparency, including approaches for explainable AI, accountability, etc.

— Impact: Use cases demonstrating the impact of AI systems to society, environment, etc.

— Architecture: Use cases demonstrating several architectural paradigms for AI systems (e.g., cloud, distributed AI, crowdsourcing, swarm intelligence, etc.)

1. General

ID	(leave blank, for internal use)	
Use case name	Machine Learning Tools in Support of Transformer Diagnostics	
Application domain	Performance evaluation and diagnostics	
Deployment model	Prototype	
Status	Under development	
Scope[1]	Power Transformers operation and maintenance	
Objective(s)[2]	Use of Machine Learning (ML) algorithms as supporting tools for the automatic classification of power transformers operating condition	
Narrative	Short description (not more than 150 words)	The successful use of ML tools may find multiple applications in the industry such as providing fast ways of analysing new data streaming from online sensors, evaluating the importance of individual variables in the context of transformer condition assessment and also the need or adequacy of data imputation in the so widely common problem of missing data
	Complete description	The work consists of training 12 ML algorithms with real data from 1,000 (one thousand) transformers that were individually analyzed by human experts.

[1] The scope defines the intended area of applicability, limits, and audience.
[2] The intention of the system; what is to be accomplished?; who/what will benefit?.

		Each transformer in the database is scored with a 'green', 'yellow' or 'red' card depending on the data, the interpretation of human experts, or even after some calculations carried out by the company's internal algorithms frequently utilized by the experts to identify units with technical operational issues. The ML algorithms, however, do not utilize or are given any of the engineering tools employed by the human experts. The algorithms only employed the raw data in a supervised learning process in which a column named 'Class' was added to the transformer information with the classification red, yellow or green provided by the human expert.		
Stakeholders[3]	Transformers end users			
Stakeholders' assets, values[4]	Enhanced diagnostic of transformer fleet with consequent improvement on predictive maintenance and therefore electrical grid reliability			
System's threats & vulnerabilities[5]	Lack of enough data to perform the analysis			
Key performance indicators (KPIs)	ID	Name	Description	Reference to mentioned use case objectives
	1	Algorithm accuracy	Output when compared to the human expert analysis of the same data	See reference
AI features	Task(s)	Statistical learning		
	Method(s)[6]	12 ML methods used for the comparison exercise: Linear Algorithms 1. General linear regression (logistic regression) - GLM 2. Linear discriminant analysis - LDA Non-linear Algorithms 1. Classification and regression trees (CART and C5.0) 2. Naïve Bayes algorithm (NB) 3. K-Nearest Neighbor (KNN) 4. Support Vector Machine (SVM) Ensemble Algorithms 1. Random Forest (stochastic assembly of a large number of		

[3] Stakeholder are those that can affect or be affected by the AI system in the scenario; e.g., organizations, customers, 3rd parties, end users, community, environment, negative influencers, bad actors, etc.

[4] Stakeholders' assets and values that are at stake with potential risk of being compromised by the AI system deployment – e.g., competitiveness, reputation, trustworthiness, fair treatment, safety, privacy, stability, etc.

[5] Threats and vulnerabilities can compromise the assets and values above - e.g., different sources of bias, incorrect AI system use, new security threats, challenges to accountability, new privacy threats (hidden patterns), etc.

[6] AI method(s)/framework(s) used in development.

		CART algorithms) 2. Tree Bagging (Tree Bagging) 3. Extreme Gradient Boosting Machine (xGBM1 and xGBM2) 4. Artificial Neural Networks (ANN)
	Hardware[7]	Standard laptop
	Topology[8]	NA
	Terms and concepts used[9]	Machine Learning Algorithms, Transformer Diagnostics, Condition Assessment, Automated Tool
Standardization opportunities/ requirements	Standardization of asset performance data format and analysis	
Challenges and issues	Data availability, missing data, imbalanced classes	
Societal Concerns[10]	Description	Safe and reliable power delivery
	SDGs[11] to be achieved	Industry, Innovation, and Infrastructure

[7] Hardware system used in development and deployment.
[8] Topology of the deployment network architecture.
[9] Terms and concepts used here should be consistent with those defined by Working Group 1 (AWI 22989 and AWI 23053) or to be recommended for inclusion.
[10] To be inserted.
[11] The Sustainable Development Goals (SDGs), also known as the Global Goals, are a collection of 17 global goals set by the United Nations General Assembly. SDGs are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.
URL: http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

References

References						
No.	Type	Reference	Status	Impact on use case	Originator/organization	Link
1	Conference	Cheim, Luiz V. Machine Learning Tools in Support of Transformer Diagnostics Cigre General Session Paris 2018, paper reference A2-206	Presented in Aug 2018	Use case taken from this reference	ABB	Cigre web page