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	Causality-based Thermal Prediction for Data Center	
Application domain	Other (data center)	
Deployment model	On-premise systems	
Status	Prototype	
Scope[1]	Data Center	
Objective(s)[2]	Minimize energy usage in managing data center	
Narrative	Short description (not more than 150 words)	Data centers tend to be overcooled to prevent computing machines from failing due to heat. A reliable fine-grained control that could regulate air control unit (ACU) supply air temperature or flow is needed to avoid overcooling. Methods that are based on correlation-based techniques do not generalize well. Hence, we seek to uncover the causal relationship between ACUs supplying cool air and temperature at the cabinets to prioritize which ACUs should be regulated to control a hot-spot near a cabinet.

[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?.

<table>
<tr><td></td><td>Complete description</td><td colspan="3">First, we perform experiments in 6SigmaRoom for the layout of the data center being studied. We collect time-series data for supply air temperature and flow per ACU, and for inlet temperature at the cabinets. Next, we test the recorded time series for checking if Granger-causality (G-causality) can be established between the supply air temperature from an ACU to a cabinet. G-causality establishes the unidirectional temporal precedence for data center control actions from ACUs that leads to changes in specific cabinet temperatures. A variable X is said to Granger-Cause Y if, including data about past terms from X, leads to a better prediction of the future value of Y (i.e., Yt+1) than predicting Yt+1 based solely on past terms from Y.

We show by way of simulation that the ACU flows that Granger-Cause reduction in temperature at a cabinet provide a larger share of influence (based on Zone of Influence/Thermal Correlation Index from the simulation) on the cabinet. This could allow an operator to come up with a better control strategy to control hotspots in a data center by regulating ACU supply air temperature/flows.</td></tr>
<tr><td>Stakeholders[3]</td><td colspan="4">Data center owner; Data center users; Environment</td></tr>
<tr><td>Stakeholders' assets, values[4]</td><td colspan="4">Competitiveness; Reputation; Stability</td></tr>
<tr><td>System's threats & vulnerabilities[5]</td><td colspan="4">Incorrect AI system use; Security threats</td></tr>
<tr><td rowspan="3">Key performance indicators (KPIs)</td><td>ID</td><td>Name</td><td>Description</td><td>Reference to mentioned use case objectives</td></tr>
<tr><td>1</td><td>Zone of Influence/ Thermal Correlation Index</td><td>Extent of influence of ACUs on data center racks.</td><td>Helps in improved control.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">AI features</td><td>Task(s)</td><td colspan="3">Prediction</td></tr>
<tr><td>Method(s)[6]</td><td colspan="3">Regression</td></tr>
<tr><td>Hardware[7]</td><td colspan="3">64 GB RAM Windows server</td></tr>
<tr><td>Topology[8]</td><td colspan="3">NA</td></tr>
</table>

[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.

[7] Hardware system used in development and deployment.

[8] Topology of the deployment network architecture.

	Terms and concepts used[9]	Granger Causality
Standardization opportunities/ requirements	• Standardization towards testing robustness • Standardization of input data format and application side information model • Benchmark datasets • Failsafe mode of operation	
Challenges and issues	Data sufficiency	
Societal Concerns[10]	Description	Promoting sustainable industries, and investing in scientific research and innovation, are all important ways to facilitate sustainable development.
	SDGs[11] to be achieved	Industry, Innovation, and Infrastructure

[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	Causality-based Thermal Prediction for Data Center. 2018 IEEE 23rd International Conference on Emerging Technologies and Factory Automation (ETFA). Turin, Italy. 4-7 Sept. 2018.	Published	Use case taken from this reference	ABB	https://www.researchgate.net/publication/328995714_Causality-Based_Thermal_Prediction_for_Data_Center

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