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ITU-T F.748.35 (06/2024)

SERIES F: Non-telephone telecommunication services

Multimedia services

Requirement and framework of trustworthy federated machine learning based service

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Recommendation ITU-T F.748.35

Requirement and framework of trustworthy federated machine learning based service

Summary

Federated machine learning (FML) is an emerging distributed machine learning paradigm that enables collaborative model training, learning, utilization and construction from a large number of distributed datasets on the basis of ensuring data security and legal compliance. In FML, computing takes place where the data are, and although the data are available, neither the data computing nor the data are visible. There are some challenges for FML-based services in aspects of trust as they perform in distributed or decentralized environments. All the challenges are often brought about by a lack of trust in the multiple participants of FML-based services, usually in the processes of model training and utilization, such as data indexing, data computing, parameter exchanging, etc.

Specific functional components are needed to enhance the trustworthiness of FML-based services, such as enhancing dataset indexing, data computing, parameter exchange and model utilization. The distributed ledger technology (DLT) system is one type of trustworthy shared data system that can be used to also store FML-based service data. The FML-based service can take advantage of the convergence between FML and those components, especially to help address trust-related challenges for FML-based services.

Recommendation ITU-T F.748.35 provides a trustworthy FML-based service, and specifies its concept, general characteristics and requirements, and reference framework.

History*

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Keywords

Distributed ledger technology (DLT), federated machine learning (FML), framework, trustworthiness.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Recommendation ITU-T F.748.35

Requirement and framework of trustworthy federated machine learning based service

1 Scope

This Recommendation provides the requirements and framework of trustworthy federated machine learning (FML) based services.

The scope includes:

– Concept, general characteristics and requirements of trustworthy FML-based services;

– Reference framework of trustworthy FML-based services.

Use cases of trustworthy FML-based service are provided in an appendix.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

None.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 distributed ledger [b-ITU-T X.1400]: A type of ledger that is shared, replicated, and synchronized in a distributed and decentralized manner.

3.1.2 distributed ledger technology (DLT) [b-ITU-T X.1400]: Technology that enables the operation and use of distributed ledgers.

3.1.3 federated machine learning (FML) [b-IEEE P3652.1]: A framework or system that enables multiple participants to collaboratively build and use machine learning models without disclosing the raw and private data owned by the participants while achieving good performance.

3.1.4 federated machine learning model (FMLM) [b-IEEE P3652.1]: The result of the model-training process of a federated machine learning system. The learned model can be used in order to make certain machine-learning inference tasks on new data, e.g., classification, recognition, prediction, and recommendation.

3.1.5 ledger [b-ITU-T X.1400]: Information store that keeps final and definitive (immutable) records of transactions.

3.1.6 trust [b-ITU-T Y.3052]: The measurable belief and/or confidence which represents accumulated value from history and the expecting value for the future.

NOTE – Trust is quantitatively and/or qualitatively calculated and measured. Trust is used to evaluate values of entities, value-chains among multiple stakeholders and human behaviours, including decision making.

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3.1.7 trustworthy [b-ISO/TR 15801]: Ability to demonstrate authenticity, integrity and availability of electronically stored information over time.

3.1.8 trusted system [b-ISO/TR 15801]: Information technology system with the capability of managing electronically stored information in a trustworthy manner.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 federated machine learning coordinator: A party who composes and manages tasks for federated machine learning (FML) model training and utilization through coordination with FML participants.

3.2.2 federated machine learning participant: A party who provides datasets and computing resources to participate the activities of a federated machine learning (FML)-based service, such as data pre-processing, model training, model utilization, etc.

3.2.3 federated machine learning model training dataset: A dataset to be used to train federated machine learning (FML) models.

3.2.4 federated machine learning model training module: An executable program to be used to train federated machine learning (FML) models with FML model training datasets.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DLT	Distributed Ledger Technology
FML	Federated Machine Learning
FMLM	Federated Machine Learning Model
FMLS	Federated Machine Learning-based Service
ML	Machine Learning
RMCT	Robust Model Compression Training
T-FMLS	Trustworthy FML-based Service
TSS	Trustworthy Shared Storage

5 Conventions

This Recommendation uses the following conventions:

– The keywords "is required to" indicate a requirement that must be strictly followed and from which no deviation is permitted if conformance with this Recommendation is to be claimed.

– The keywords "is recommended" indicate a requirement that is recommended, but which is not absolutely required to claim conformance with this Recommendation.

6 Overview of trustworthy FML-based services

Federated machine learning (FML) is an emerging distributed machine learning (ML) paradigm that enables collaborative model training, learning, utilization and construction from a large number of distributed datasets on the basis of ensuring data security and legal compliance. In FML, computing takes place where the data are, and although the data are available, neither the data computing nor the data are visible.

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