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Research on the Application of Federated Learning in Smart Grid

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Introduction

This article combines the data characteristics and needs of smart grid to study the applicability of federated learning. From the perspective of holism, it surveys and sorts the current research status of federated learning frameworks in power measurement systems, grid data sharing, wind power load prediction, privacy protection and communication energy analysis, abnormal attack monitoring, etc. It analyzes its innovative applications in data privacy protection, distributed energy management system optimization, grid security monitoring and fault prediction, and evaluates its implementation effect and quality. Finally, it looks forward to the research challenges and future research directions of federated learning applications in smart grids from aspects such as data privacy protection and security, communication efficiency and computing resource optimization, model generalization and robustness improvement, differential privacy, homomorphic encryption.

Research Questions

1) Analysis of applicability of federated learning in smart grid: including data characteristics and requirements of smart grid, federated learning's applicability;
2) Application scenarios of smart grid federated learning;
3) Technical analysis of federated learning in smart grids: including comparative analysis of data privacy protection and security based on federated learning, communication efficiency and computation resource optimization, effect evaluation and comparative analysis.

Figures

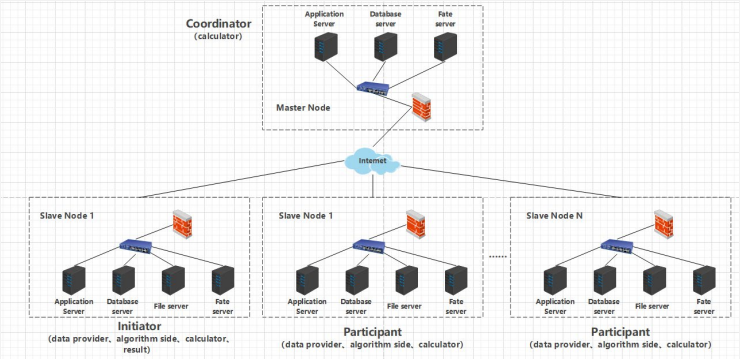

Figure 1. A privacy-preserving computing platform based on federated learning

Conclusion

Through in-depth research on the combination of smart grid and federated learning, this article has elaborated on the enormous potential and value of both in the energy field. Federated learning can achieve model optimization while protecting the privacy of smart grid data, and different energy nodes can jointly train and optimize energy management models in areas such as distributed energy management, grid security monitoring, and user-side demand response.

There are technical challenges in practical applications of federated learning for smart grids in terms of model training and optimization, communication efficiency, and computational resource optimization under the premise of data privacy. With continuous technological progress and in-depth application expansion, federated learning for smart grids will demonstrate its unique advantages and value in more fields and promote innovative development of the energy system.