Chair for Embedded Systems

Prof. Dr. J. Henkel

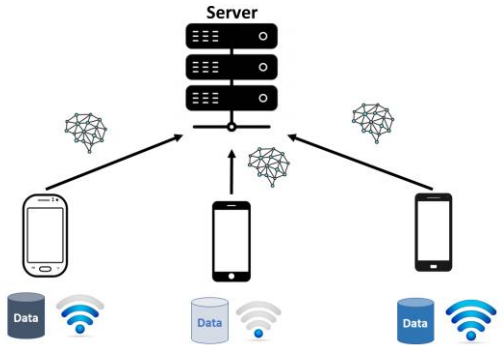
Master/Bachelor Thesis

Multi-objective Client Selection in Federated Learning

Federated Learning has gained attention due to the ability of devices to collaboratively train models while maintaining their data privacy. The training is coordinated by a server (or more) and consists of multiple training rounds. In each round, the server sends the model parameters to a subset of clients that train the model on their local data and upload the updated model parameter again to the server. The server then aggregates that trained parameters and starts a new round. This process is repeated till the model converges.

One of the main challenges of federated learning is the heterogeneity between clients/devices participating in the training process. Heterogeneity can arise at the data level, where devices have diverse data distributions, sizes, and characteristics. Another source of heterogeneity is at the system level, where devices differ in energy capacity, computational power, and communication capabilities. Furthermore, the device capabilities vary over time due to factors such as co-running applications, battery level, and communication signal strength.

The traditional federated learning process selects the participating devices randomly each round. However, this approach can be suboptimal, increasing training time and energy consumption or degrading model performance. In this project, we want to explore better client selection and scheduling techniques for federated learning using multi-criteria analysis. Criteria can be in terms of wall-time training time, fairness of clients' participation, and final accuracy for the federated process, as well as available energy, memory, data, computation, and communication on a device level. Since these criteria can be conflicting, for example, prioritizing faster training may reduce the accuracy or increase energy consumption, the project will explore trade-offs and optimization strategies to balance them effectively.



Skills required/beneficial for the thesis

- Programming skills (Python)
- Experience with machine learning is beneficial but not required

Skills acquired within the thesis

- Apply your programming experience to research on distributed learning
- Gain experience in resource-constrained environments on edge devices
- Work in a research environment

Language

- The collaboration with the colleagues will be in English

Contact

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