

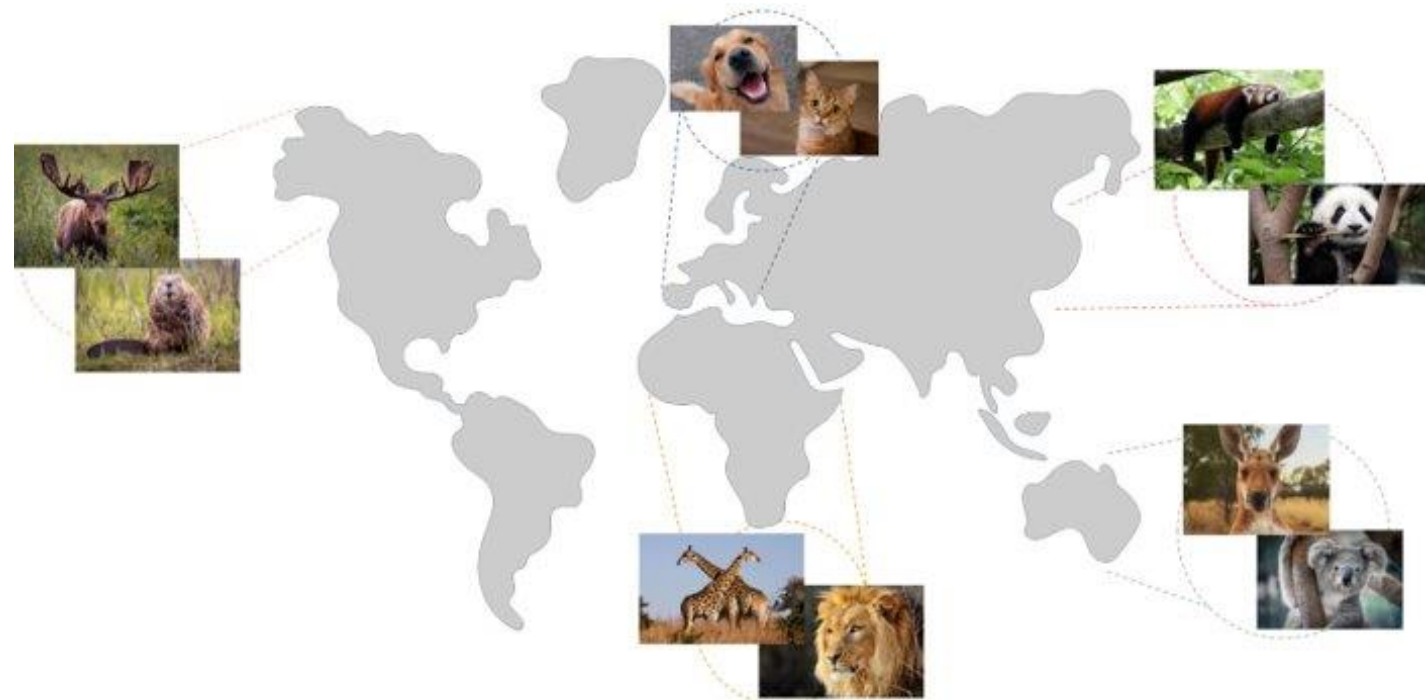
# Federated Learning across Domains

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## 1. Introduction

Federated Learning (FL)<sup>1</sup> aims at learning a model in a **distributed** way while preserving the **client's privacy**. In realistic scenarios, the clients' **data is non-i.i.d.** w.r.t. the global distribution and **unbalanced**.



## 2. Goal

The heterogeneous distribution of the clients' data leads to **degraded convergence performance and unstable learning**, posing a major challenge in realistic scenarios.

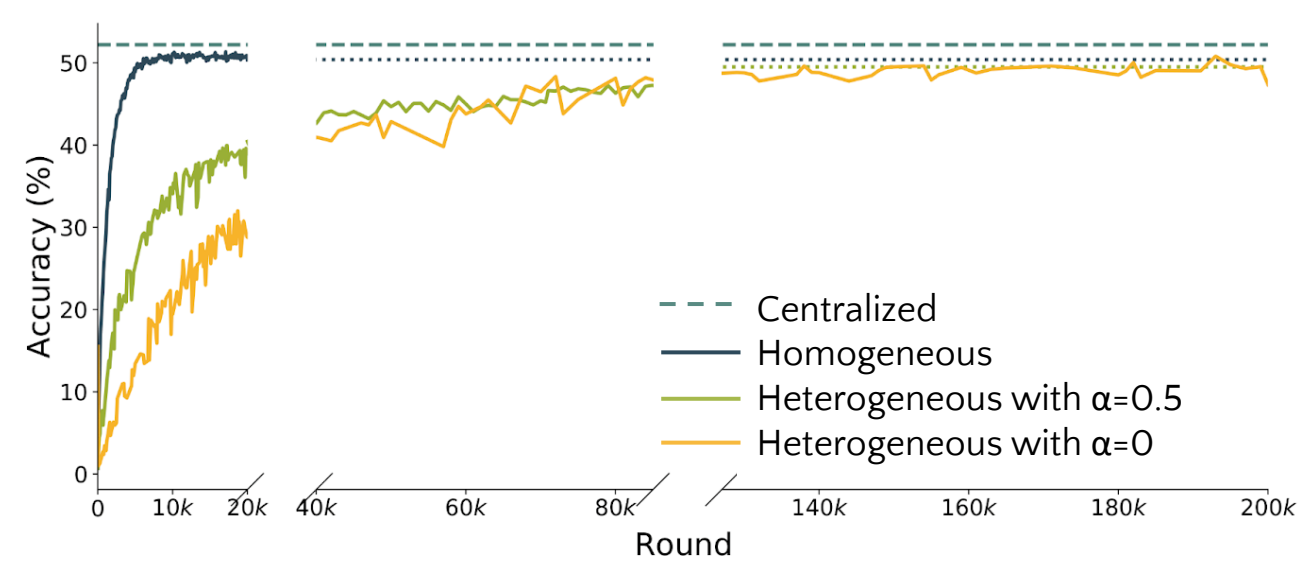
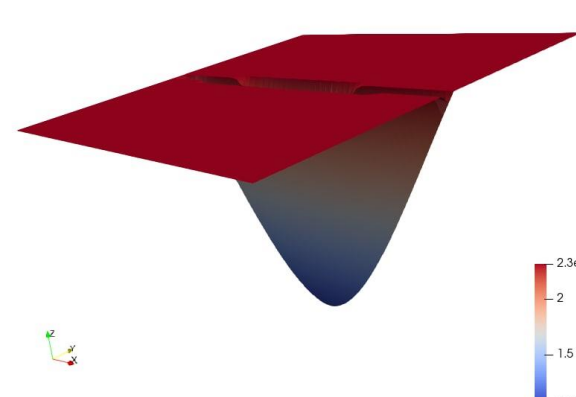


Fig.1 CIFAR100. Learning with varying trends of heterogeneity.

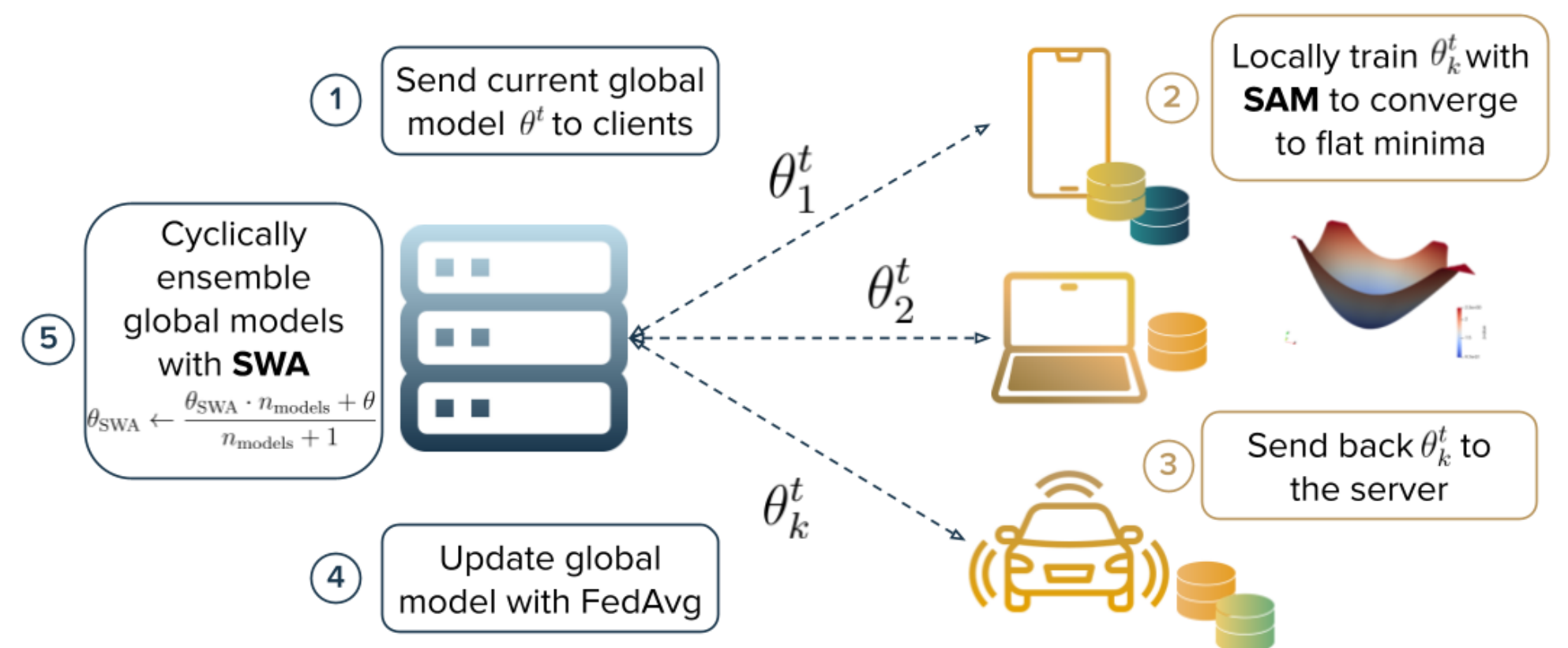
This thesis aims at explaining the **poor generalization** of the model through the lens of the loss landscape and developing algorithms for **faster and more stable learning**. We extend our research to realistic applications, such as **autonomous driving**.

## 3. Improving generalization

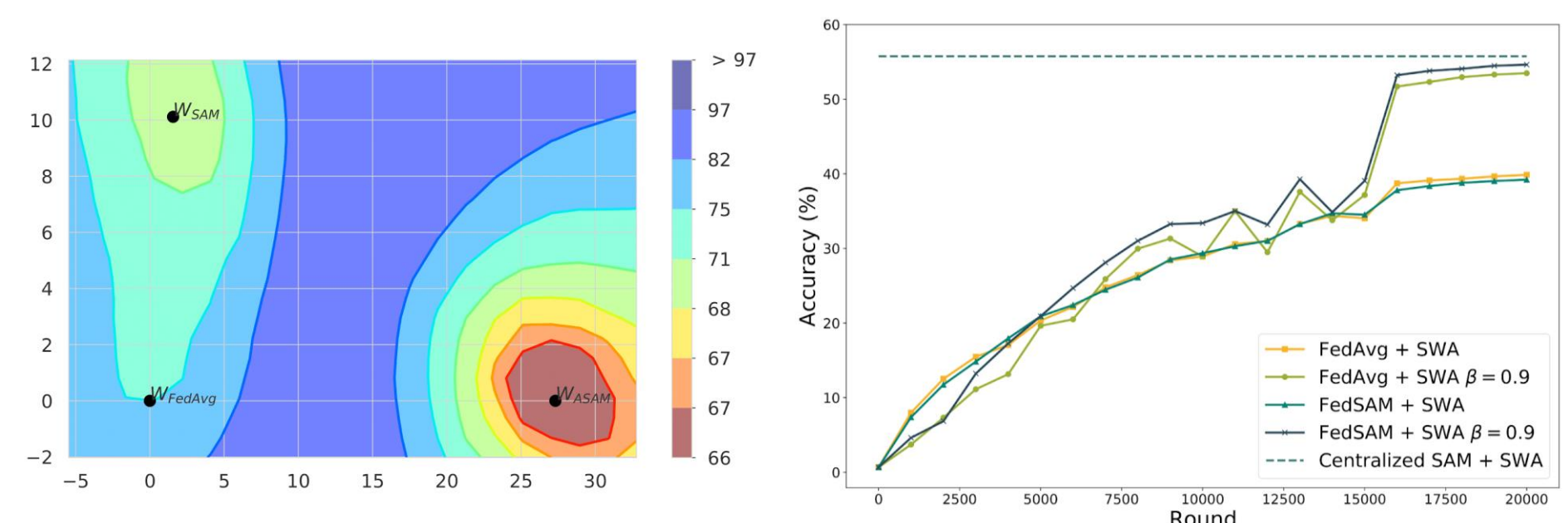
Federated models converge to sharp minima, linked with poor generalization.



*Can we encourage convergence towards flat minima to improve generalization?*

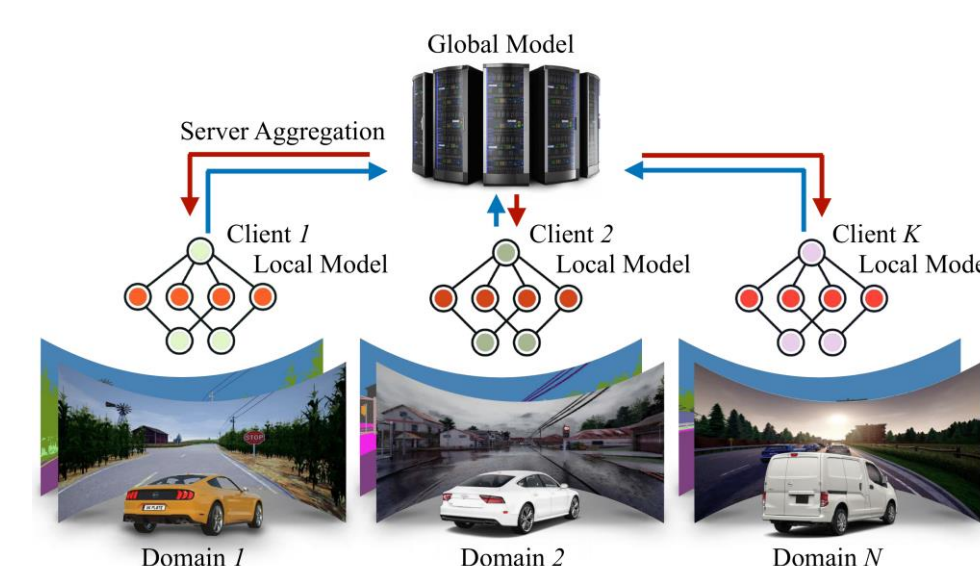


Results on heterogeneous CIFAR100 (1 class per client):



## 4. FL for autonomous driving

Task: Semantic Segmentation.



Challenges: class heterogeneity and domain shift across clients.

Main contributions:

- First benchmark for federated SS in autonomous driving<sup>5</sup>
- Self-supervised learning over clients' unlabelled data (more realistic)

## 5. References

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3. Izmailov, P., et al. Averaging weights leads to wider optima and better generalization. *UAI* (2018)
4. Caldarola, Debora, Barbara Caputo, and Marco Ciccone. "Improving generalization in federated learning by seeking flat minima." *ECCV* (2022)
5. Shenaj, Donald, et al. "Learning Across Domains and Devices: Style-Driven Source-Free Domain Adaptation in Clustered Federated Learning." *WACV* 2023