Application of Artificial Intelligence & Machine Learning for Precision Medicine

February 17, 2023

Federated Learning at Owkin

↳ Joseph Lehár, SVP Strategy, Owkin

The volume of health data is surging

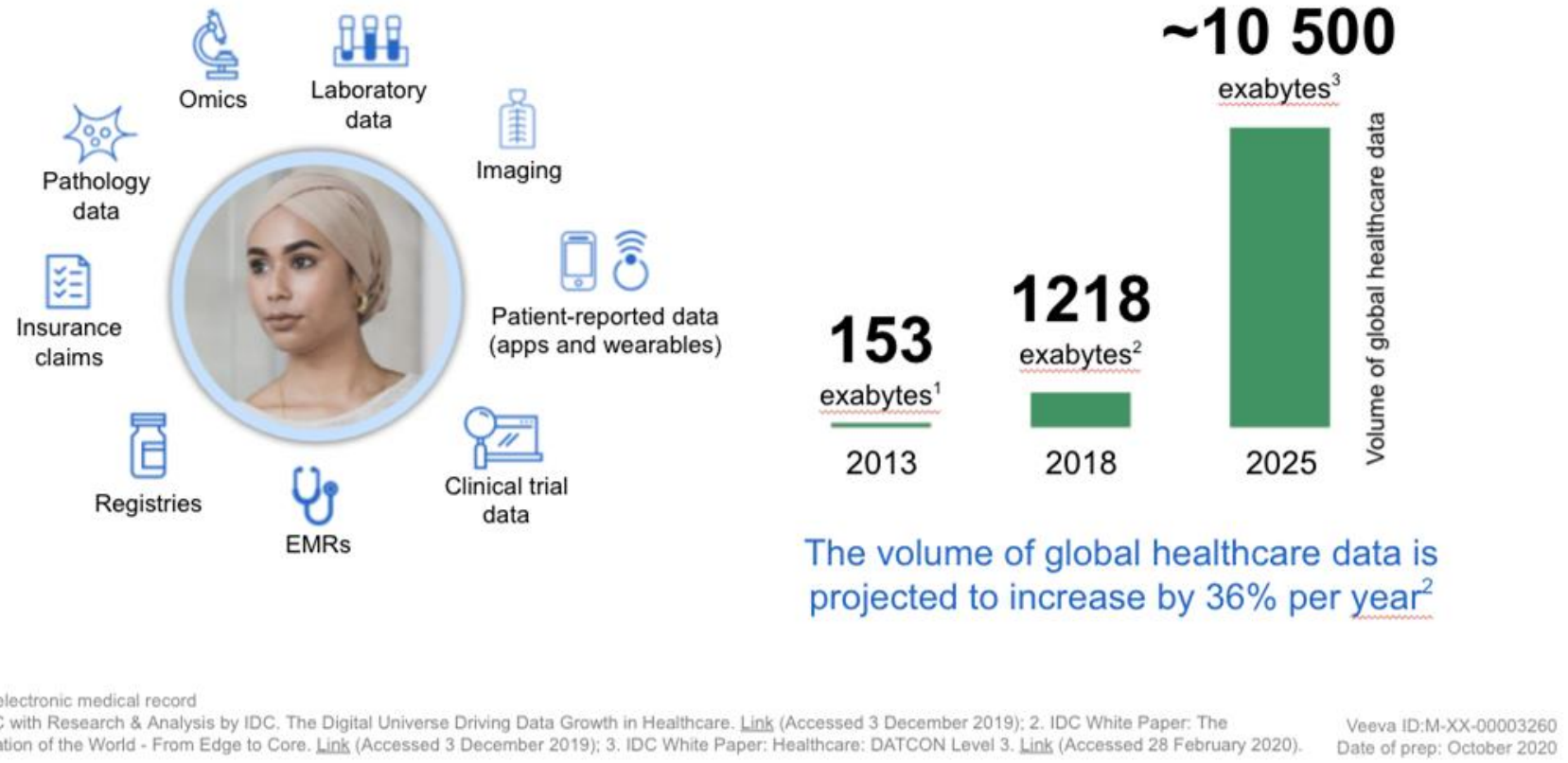


Image from Presentation by Asif Jan - F Hoffmann La Roche AG

Health data are siloed

Decentralized production

No natural monopoly for data production in healthcare (different from mobile data)

Many actors generate data:

- Hospitals
- Companies
- Devices

Medical data are regulated

Data are **personal and sensitive** information. They fall under the EU **GDPR**:

- Need legal basis / consent from patient
- Only specific purpose / no reuse
- Patient opt-out

Medical data are valuable

Challenges

- **Cost** for data collection is high.
- **Perceived value** is high.
- Existing market with high **price** of data

Competitive ecosystem

- Academics
- Startups
- Pharmas

Health data are siloed

Decentralized production

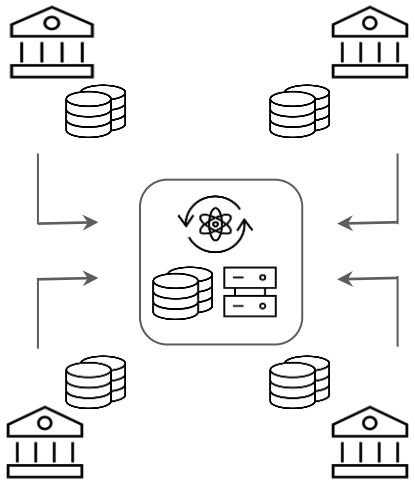
Medical data are regulated

Medical data are valuable

Collaboration between data managers is essential, but privacy and security are paramount

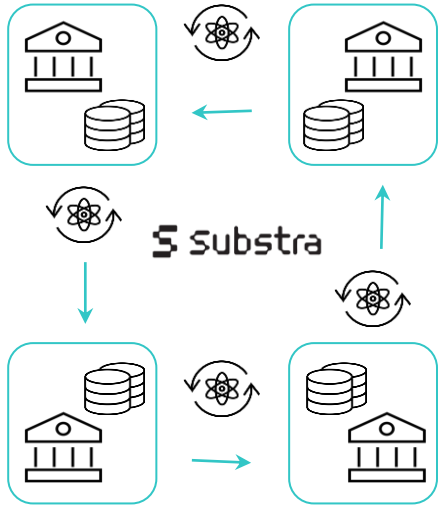
Substra: Federated access to break silos and reach global datasets

Aggregation



Bring data
to the model

Federated



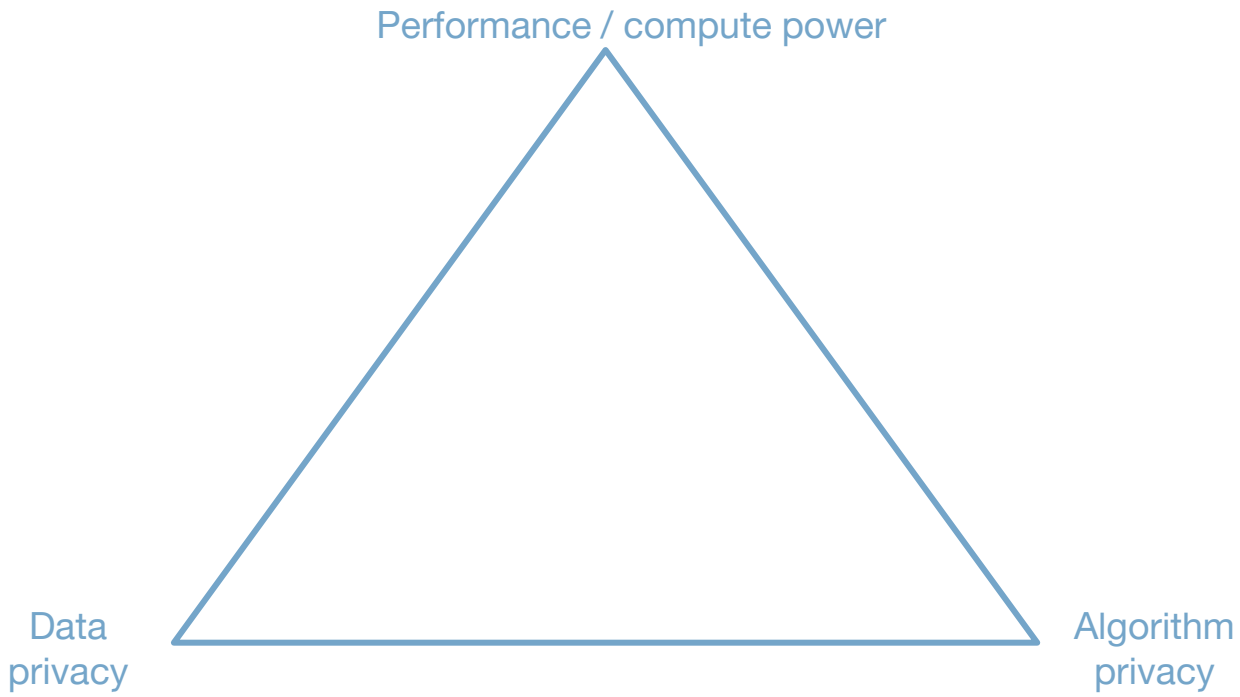
Bring model
to the data

Secure & private

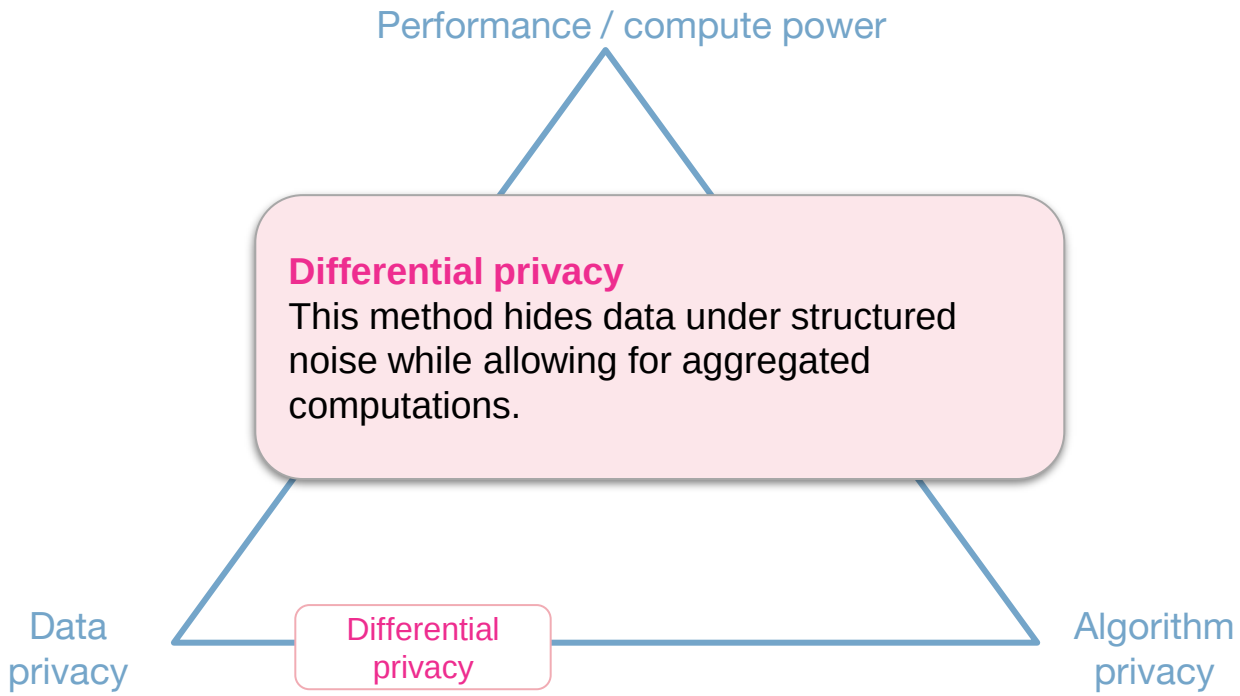
Institute controls data

Efficient & scalable

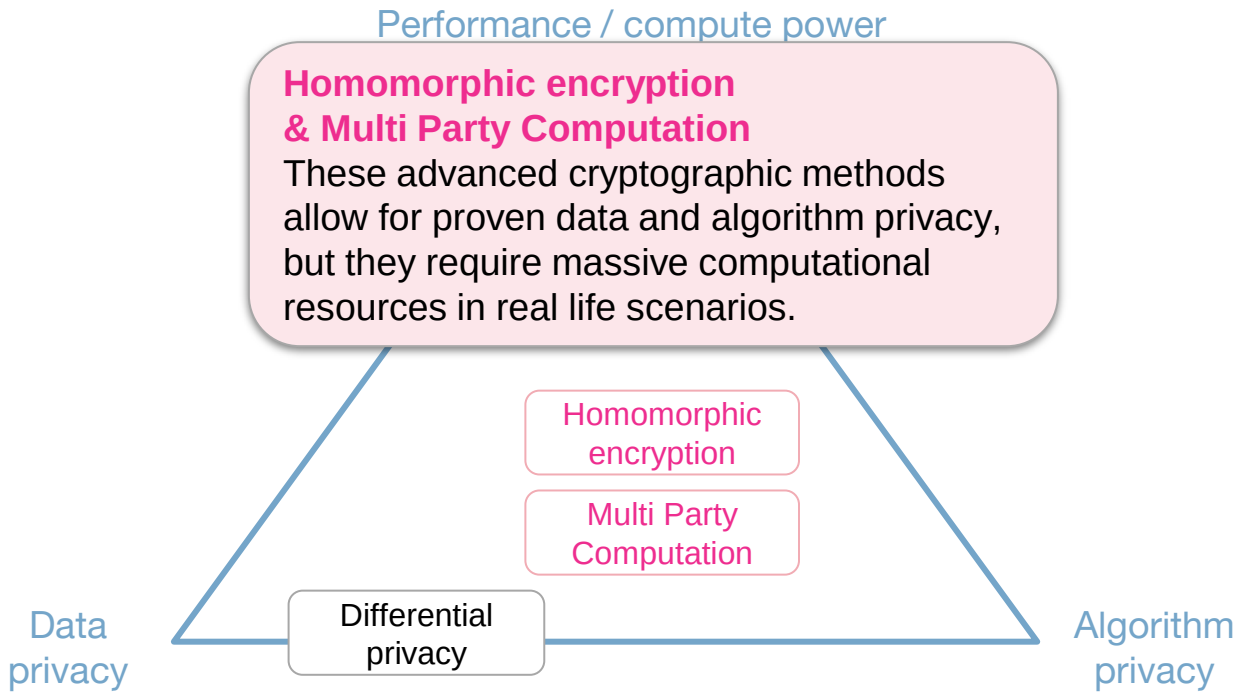
Technical landscape for collaborative machine learning



Technical landscape for collaborative machine learning



Technical landscape for collaborative machine learning



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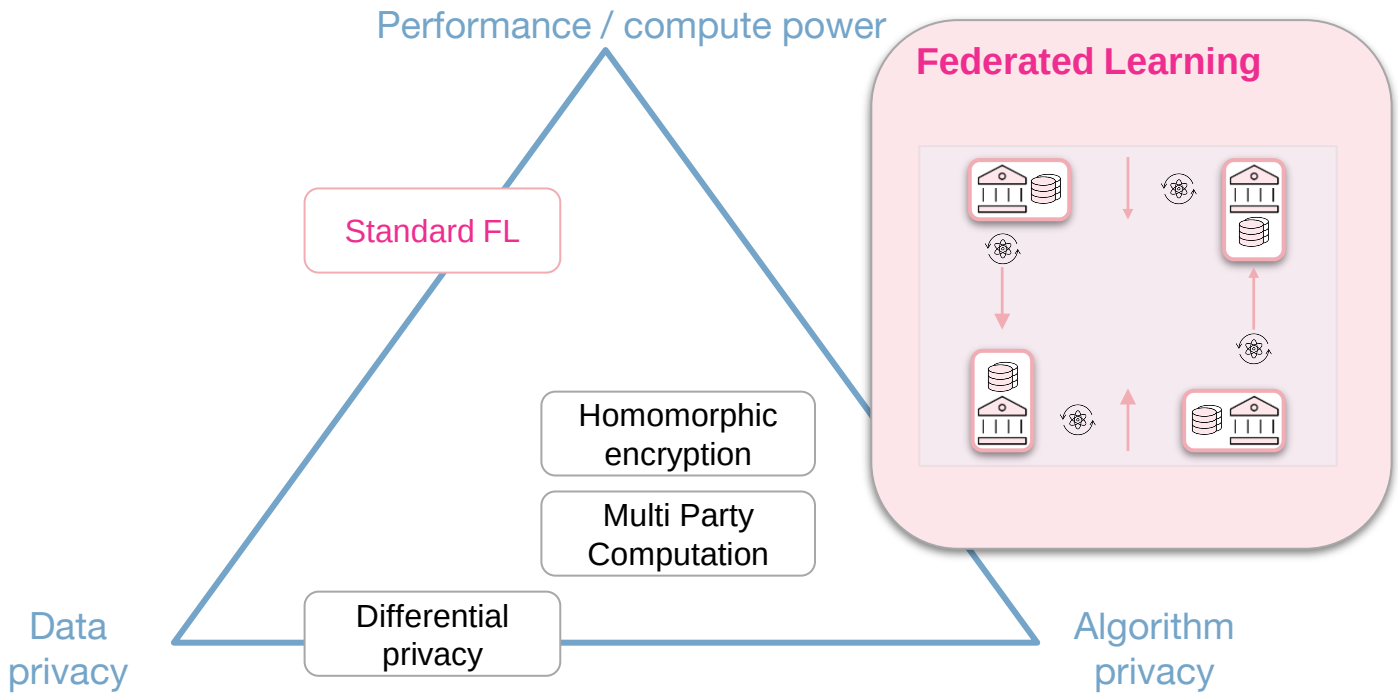

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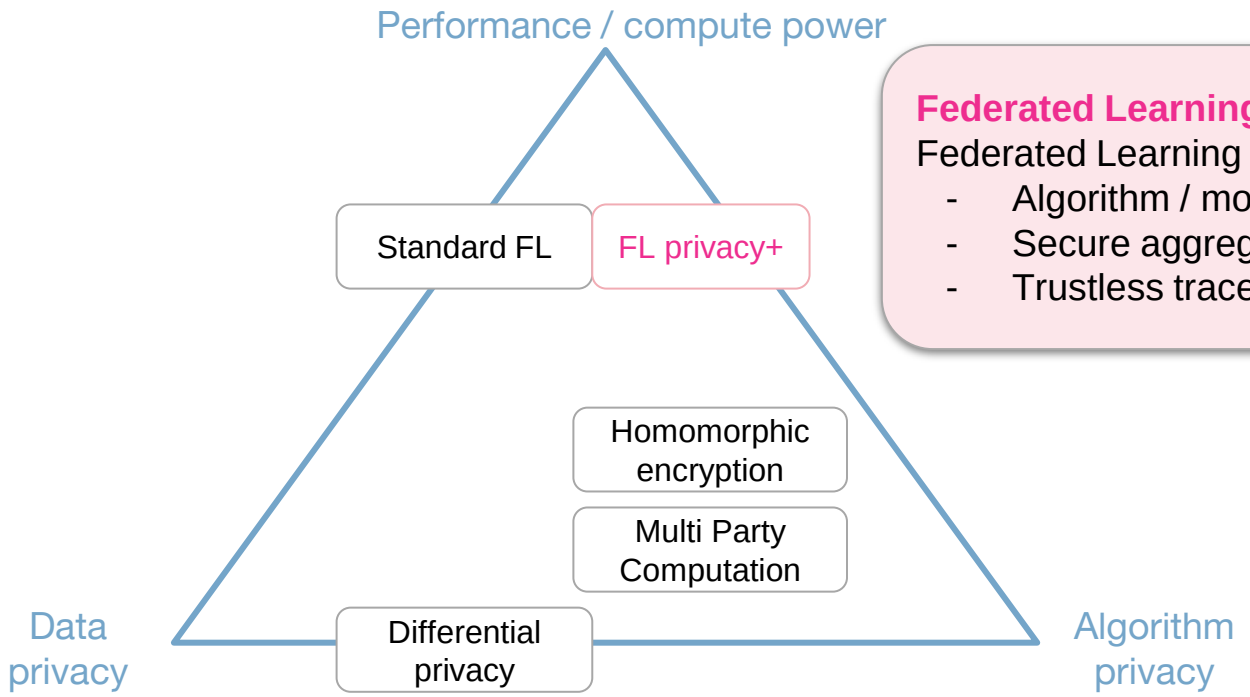
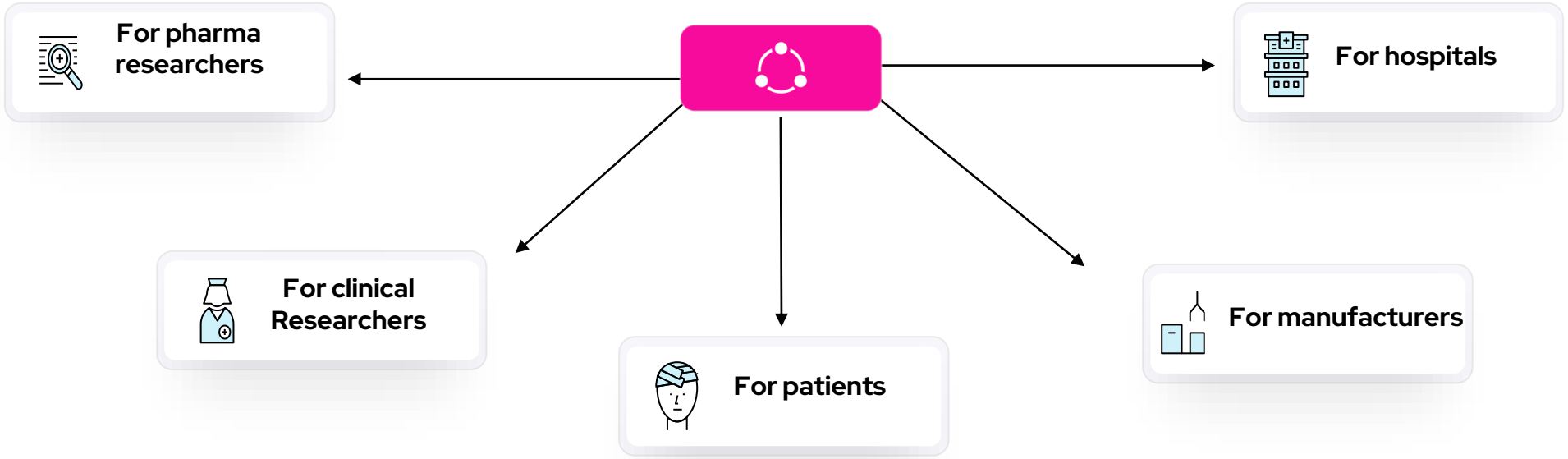


Federated Learning privacy +
Federated Learning hardened with
- Algorithm / model compilation
- Secure aggregation (MPC - HE)
- Trustless traceability

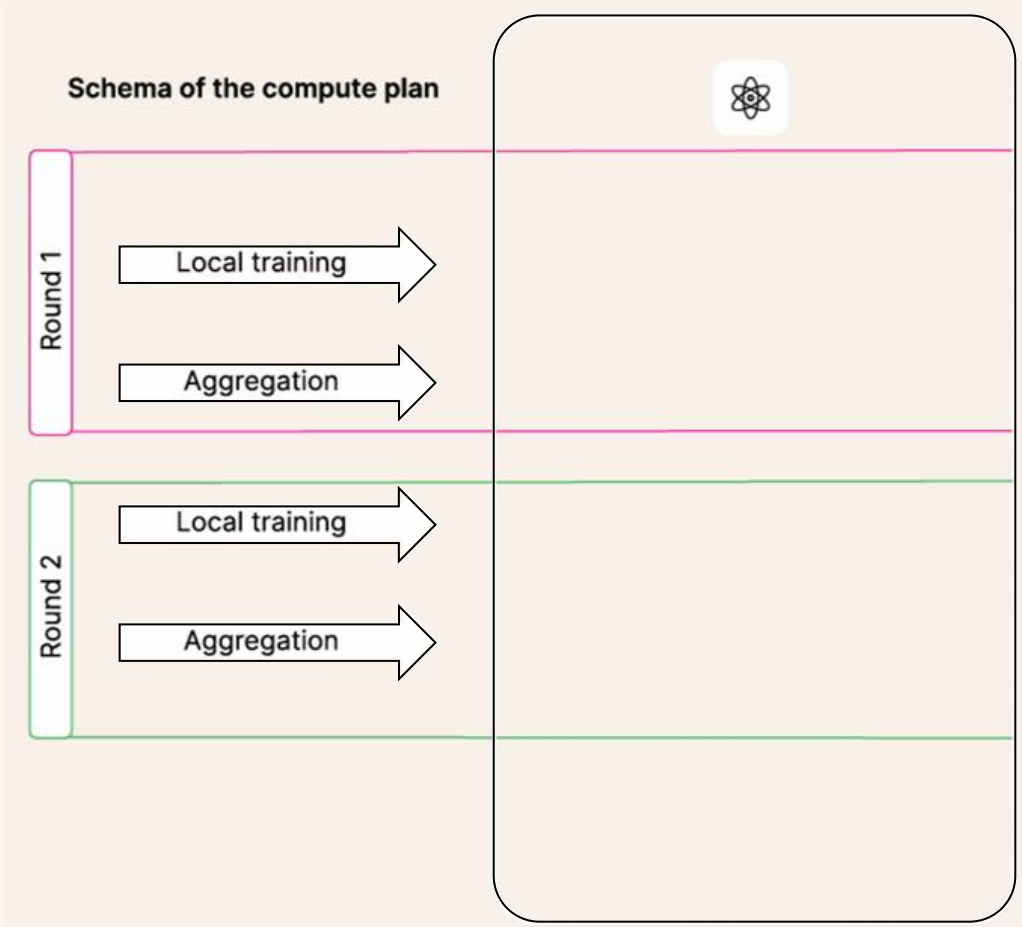
Federated learning: the future for AI in medical research

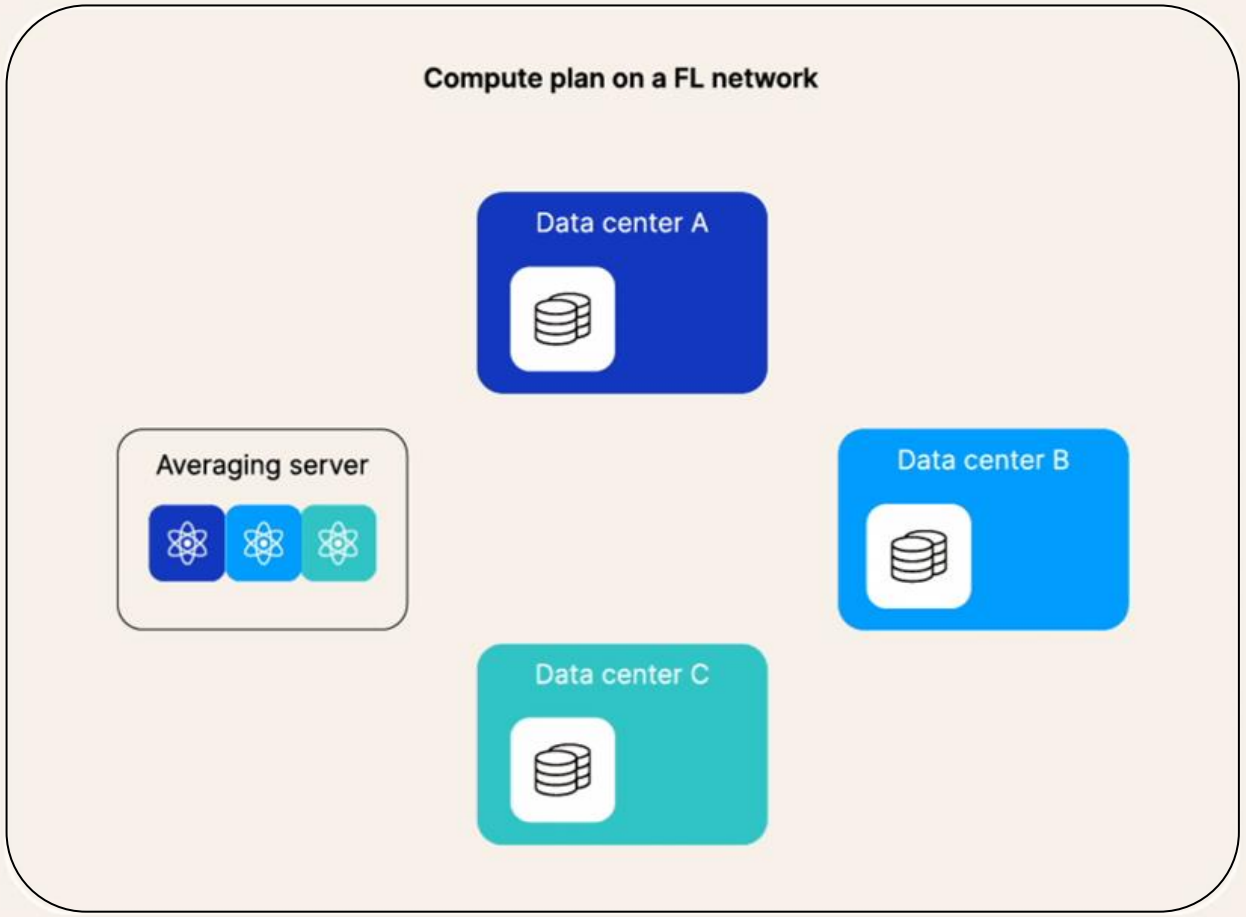
+ Coopetitive consortia
+ International collaboration
+ Grouping of heterogeneous data
+ In situ validation at scale
+ Critical mass for rare disease R&D
+ Non-duplication of data



Owkin's federated learning platform, powered by Substra

Ready-to-use, open source federated learning software developed by Owkin, now hosted by the Linux Foundation AI & Data Foundation





How Substra is applied at Owkin

Register data

Multiple hospitals register data on their Substra servers

Register model

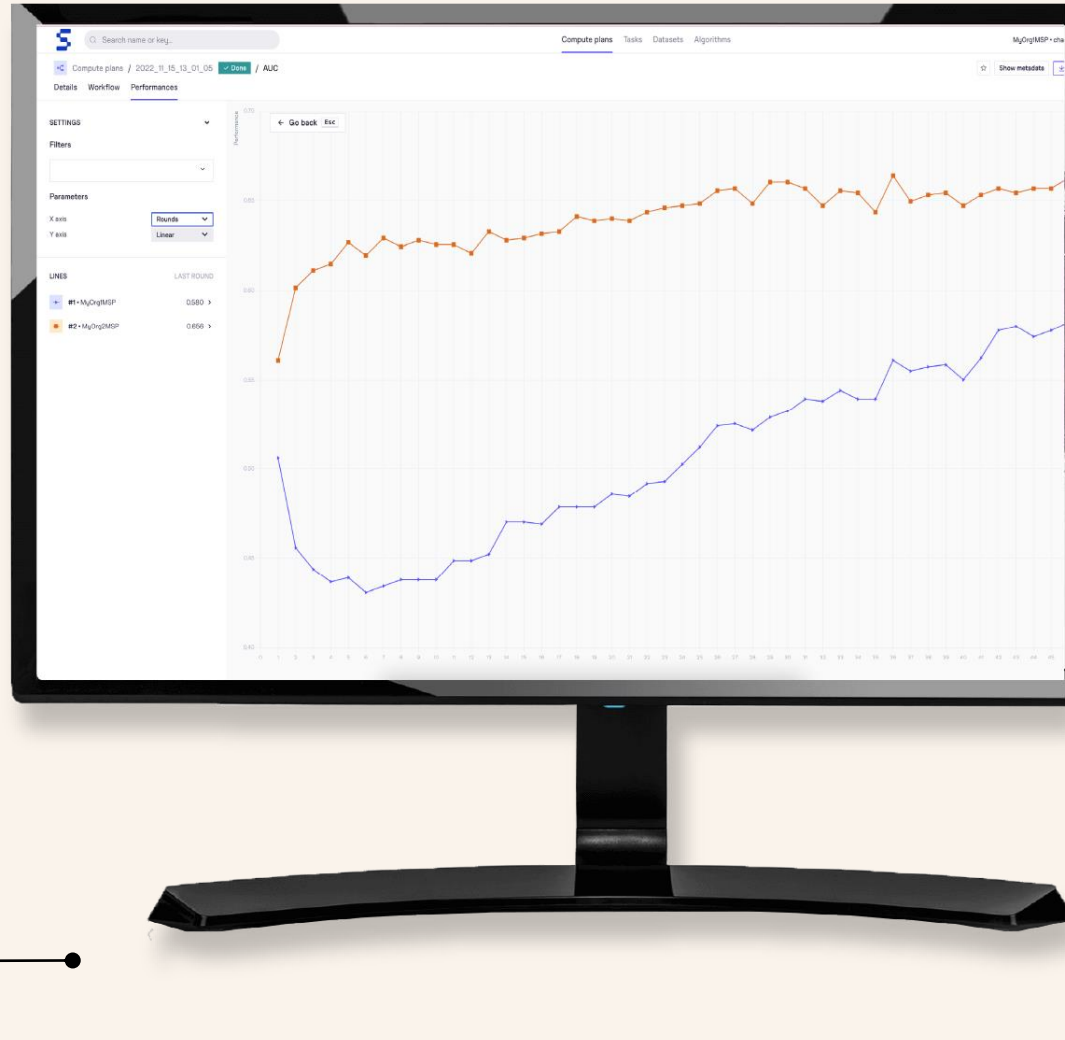
A data scientist registers a model to be trained on Substra

Train model

Computation is done securely and autonomously through the Substra network

Examine performance

Everyone can easily examine performance, visualise the model and compare to select the best option.



Case study: MELLODDY collaboration, Substra in action

Objectives

Leverage the world's largest collection of small molecules with known biochemical or cellular activity to enable more accurate predictive models and increase efficiencies in drug discovery

Project

Consortium

Owkin led European IMI consortium – €18.4M Budget. Project duration: 2019-2022

Research questions

- Prove feasibility of a trustless & privacy preserving federated learning platform
- Develop & train multi-task machine learning models for drug discovery

Data

- 10 million annotated small molecules
- 1 billion assay biological activity labels
- Multiple high-complexity phenotypes from high throughput screening

Partners

Pharmaceutical partners

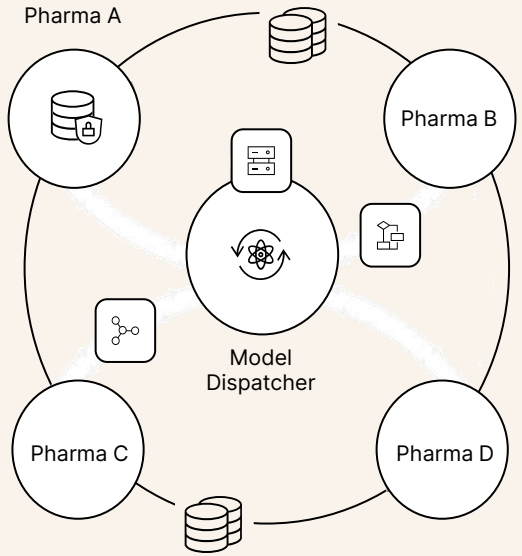
Other partners

Project Coordinators

Results

Successful runs of training traceable, privacy preserving, federated multi-task models on the MELLODDY platform using Substra

MELLODDY notably improved the performance of drug discovery models via privacy-preserving and federated learning for all 10 pharmaceutical partners.



Why use Substra to connect and build models from healthcare data

Substra is the only federated learning software proven in real production environments powering medical research

Data agnostic

Can be used with many different data modalities such as video, images, audio, time series or tabular data

Framework agnostic

Compatible with any machine learning model from any framework including TensorFlow, Torch and Scikit-Learn

Infrastructure agnostic

Works seamlessly with any IT infrastructure setup - on premise or in the cloud

Flexible

Can be deployed in a federated production environment or used on a single machine to perform simulations and debug code

Traceable

Monitoring, traceability and fine grained permissions for complete control of data manipulations

Secure

Proven in strict privacy settings to meet global compliance requirements for hospitals and pharmaceutical companies

OWKIN: AI for precision medicine

Our data network

Selected academic partners

Consortia

Published collaborative research

24 peer-reviewed papers since 2018

What we do

Multimodal Patient Data

INPUT

Federated Data Access

Multimodal Integration

Artificial Intelligence

OUTPUT

Diagnostics

Pharma Solutions

Drug Discovery

Owkin's reverse translational approach to precision medicine

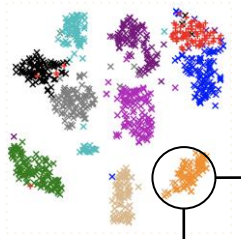
We apply AI to multimodal patient data to enable discovery and development

Multimodal patient data

- Clinical
- Histology
- RNA-seq
- DNA-seq/WES
- Spatial -omic / Single cell

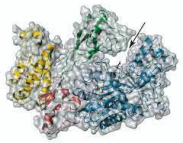
AI-driven subtyping

Patient subtypes with distinct biology



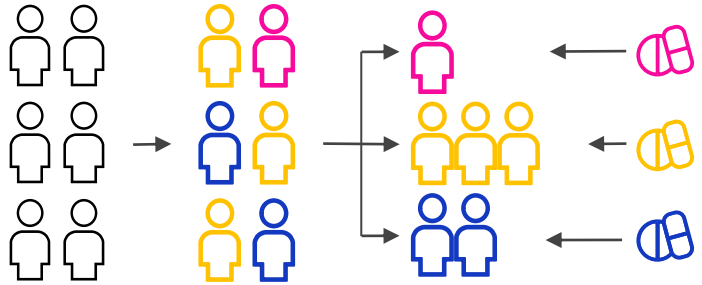
AI-driven **target discovery** and validation

New target identification for a subtype



AI-discovered biomarkers

Personalized medicine



Right drug for each patient

→ Better outcomes
→ Faster trials

Join our revolution towards precision medicine

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New York, Boston, London, Berlin, Nantes, Paris

Humanity: The people at the heart of AI-augmented healthcare
Published by Owkin (2023)