# The potential of Federated Learning in Healthcare settings

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# Introduction

The increased adoption of internet connected devices, known as the Internet of Things (IoT) has driven both advances in artificial intelligence (AI), thanks to vast amounts of data and processing power now available to researchers, and public concerns over data privacy, with a Pew Research Centre survey finding that 79% of American adults are concerned with how their personal data is being used by companies [1].

Recently, researchers working in AI have been looking for ways to ensure data privacy in their models, while still being able to benefit from the increasing amounts of data. One approach that shows promise is Federated Learning (FL) [2].

FL is a type of machine learning (ML) architecture made up of many local clients, and a central server. In FL, the central server transmits an initial model to the clients. The clients will gather data and train models locally – each client will train its own model on its own data, thereby keeping the data private. Clients can be something as small as a smart watch, or as large as a hospital. Once a client has trained the local model on the local data, the model updates are transmitted to a central server. When all selected clients have transmitted their model updates, these are aggregated into a new global model which is transmitted back to the clients. This process is repeated until a desired level of performance has been reached.

This work will discuss the potential of FL in a healthcare setting, as well as the challenges which require more research.

# Potential of FL in healtcare

Given the ability for FL to keep client data private, there is now the potential to use this data to improve outcomes for patients. An example of this is in the area of FL models to be used for disease prediction, for example in detecting cancers through an analysis of medical images, as well as drug discovery by identifying patterns in numerous patient’s genetic makeup, their medication plans and responses to treatments. Another area of interest is personalised federated learning (PFL), where a global model is refined for the purpose customising it to the unique traits and needs of an individual client [3]. An example of PFL is was proposed in [4] where the authors developed an algorithm to aid in the diagnosis of Parkinson’s disease by using data gathered by an application on a patient’s smartphone which gathered data on the motor symptoms usually associated with Parkinson’s disease.

# challenges

While FL shows promise in a number of areas, there are a number of open challenges [5]. One challenge is on data and system heterogeneity, which is introduced by differences in data distributions across clients or servers or by differences in architecture of any devices involved in the learning process (i.e., differences in CPUs, RAM, bandwidth). Heterogeneity can have a negative impact on model convergence and accuracy. Another challenge is in the area of communications. Constant communication between the clients and the server can be expensive, and depending on the network topology the communication bandwidth can be limited, which can lead to bottlenecks. Working with multimodal data poses another challenge – what impact will data from various sources (audio, video, numerical data) have on the ability of a FL system to learn and produce accurate models? A fuller list of challenges can be found in Figure 1.

A diagram of a learning structure

Description automatically generated with medium confidence

***Figure 1*** *Challenges in Federated Learning*

# CONCLUSION

In a healthcare environment, FL offers a way to train ML models which can be widely used on data that remains local to the hospital or health centre, thereby allowing more users to benefit from a system trained on the most recent data.

# References

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