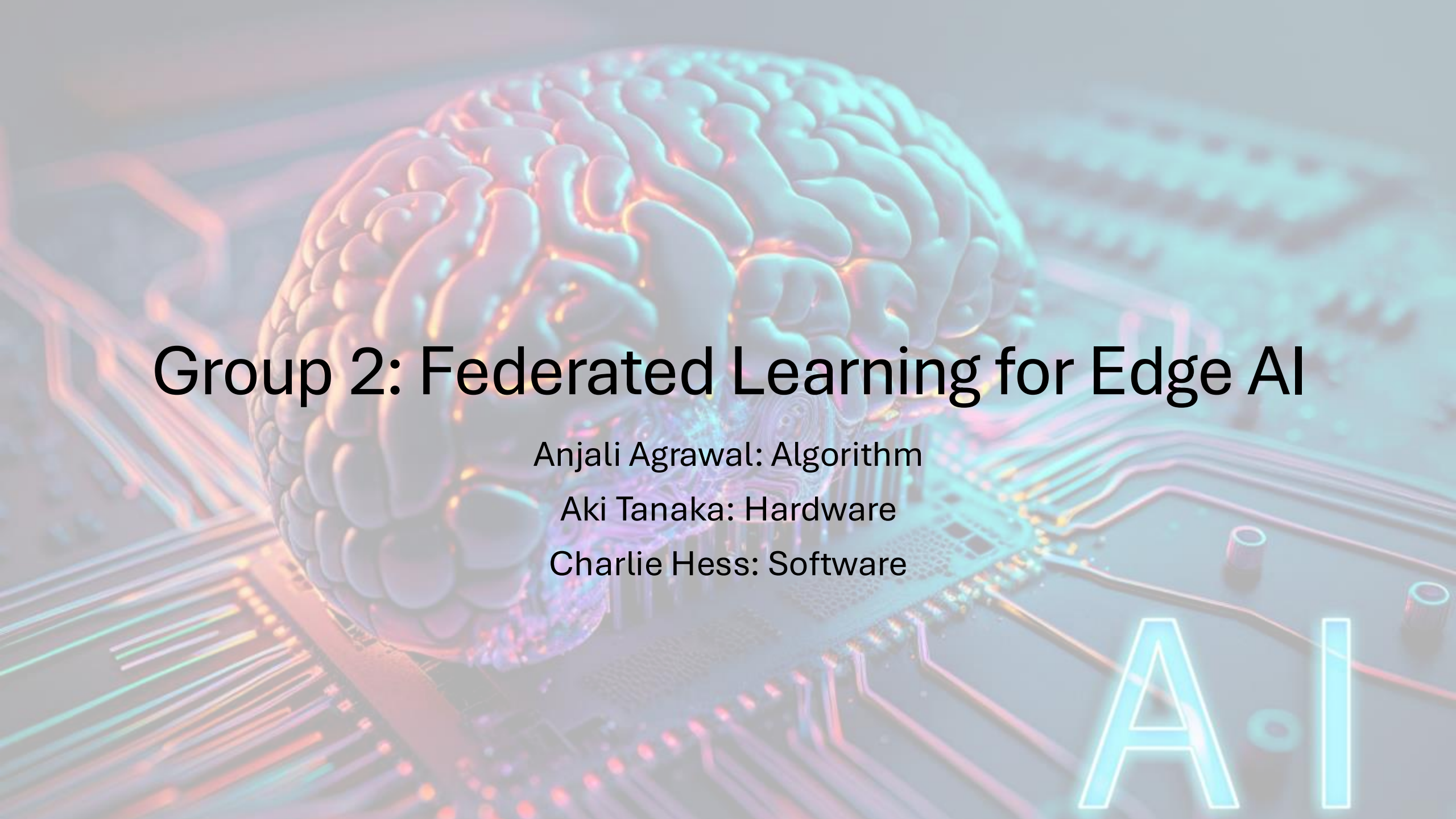


Group 2: Federated Learning for Edge AI

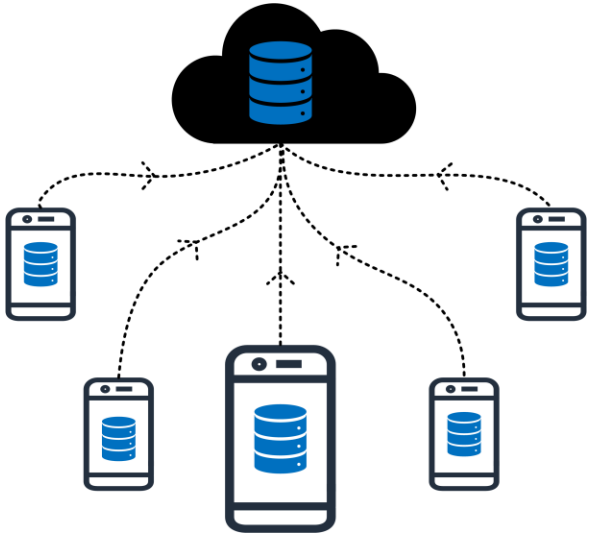
Anjali Agrawal: Algorithm

Aki Tanaka: Hardware

Charlie Hess: Software

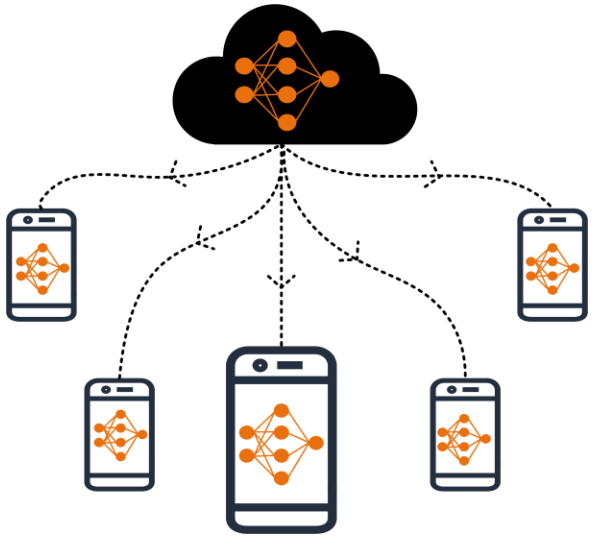
Traditional ML vs Federated Learning

Traditional Machine Learning:



- Models are trained on data aggregated from several edge devices.
- On centralized server, ML algorithms train themselves on the aggregated data and make predictions.

Federated Learning:



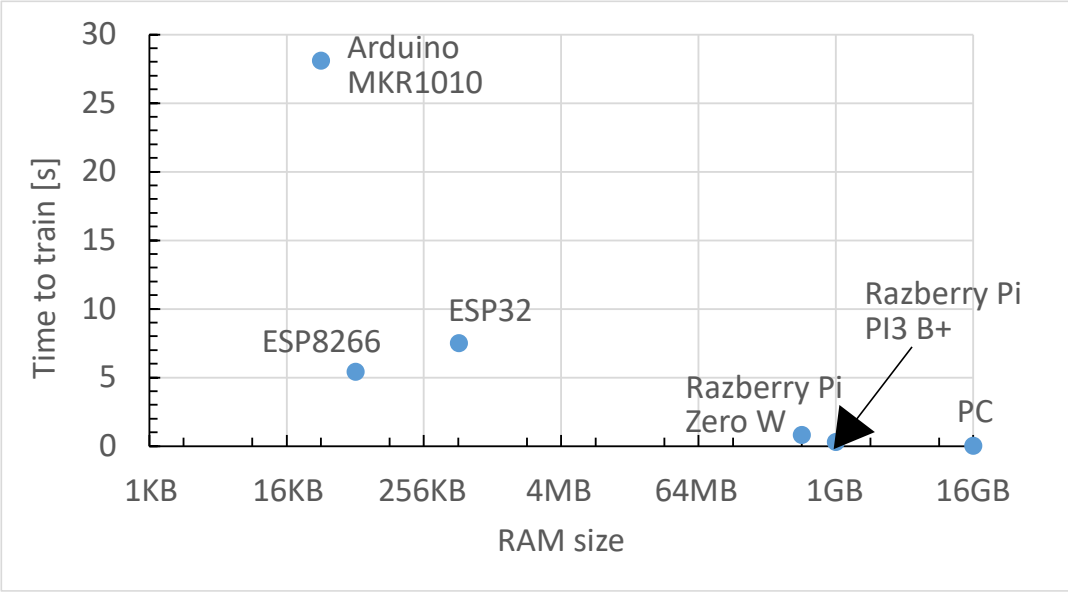
- Decentralized form of machine learning.
- Learning methods are distributed across the edge devices themselves.
- Model parameters are sent to individual devices where learning occurs locally.

Resource Constraints for Federated Learning

Prelim. literature review

Tradeoffs that we may explore:

- **Number of devices vs accuracy**
  - More num. of device degrades the accuracy, due to model updates may cancel each other out.
- **RAM Memory vs time to train**[1]



- Other key metrics:
  - Compute power, storage (flash memory), and resource constraints

[1] M. Ficco, et al., Federated learning for IoT devices: Enhancing TinyML with on-board training, Information Fusion, Volume 104, 2024, 102189, ISSN 1566-2535.

Proposed Approach: Contribution

Federated Learning: Approach adapted from [1]

GNU Compiler Collection (GCC)

Multiple MCU/CPU Federated Learning Workers, One Host

Arduino Nano 33, STM Micro Microcontrollers (Choice Pending Availability)

Tentative Action Items and Roadmap:

- Literature Review of Resource Constrained FL
- Adaptation of FL techniques to leverage multiple MCUs in training
- Observe sources of greatest resource usage (SRAM, Flash, Compute)
- Optimize technique to leverage fewest possible resources
- Extrapolate findings for consideration of adopting techniques to more limited MCUs and beyond

[1] M. M. Grau et al., "On-device training of machine learning models on microcontrollers with a look at Federated Learning: Proceedings of the conference on information technology for social good," ACM Conferences, https://dl.acm.org/doi/pdf/10.1145/3462203.3475896 (accessed Nov. 6, 2024).