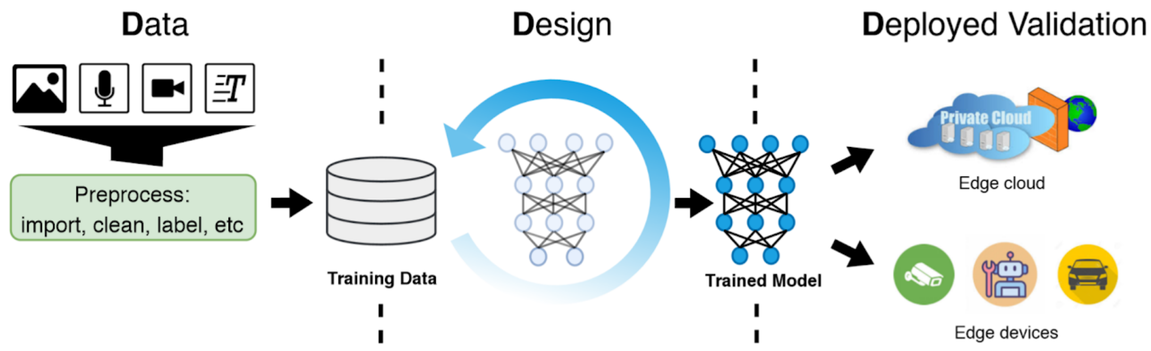
# 3DML: A Platform for Data, Design and Deployed Validation of Machine Learning for Wireless Networks and Mobile Applications

PI: Yingyan (Celine) Lin[1]
Co-PIs: Joseph Cavallaro[2], Ang Chen[3], Rahman Doost-Mohammady[2], Ashutosh Sabharwal[2]
[1] Georgia Institute of Technology [2] Rice University [3] University of Michigan

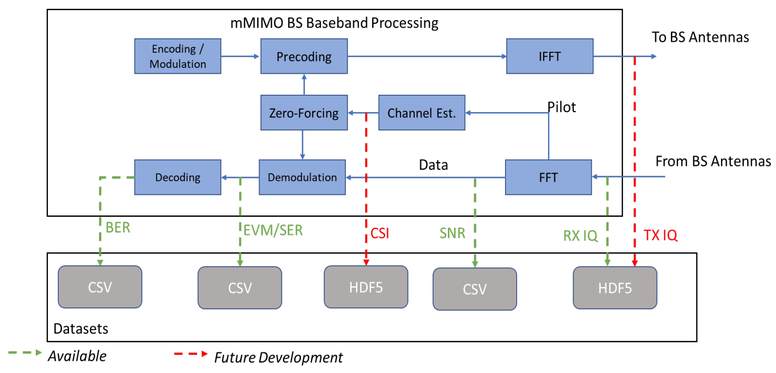
## 3DML: Project Overview

- **3DML aims to develop a community platform for facilitating the development of ML based innovations for next-generation wireless networks and mobile applications.**
  - **Considering the ML research workflow's 3 major D's (i.e., Data, Design, and Deployed Validation), 3DML integrates 3 key thrusts**

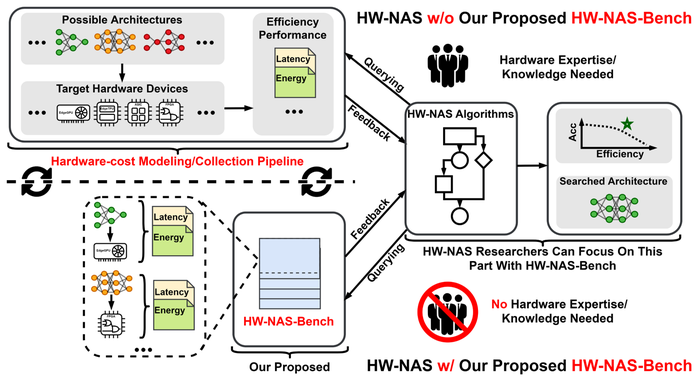



## 3DML-Data: Automated Data Collection

- **PHY Layer Dataset**
  - **Agora, a real-time massive MIMO PHY layer software, to collect PHY layer data (e.g., TX IQ, CSI, BER, EVM, SNR)**



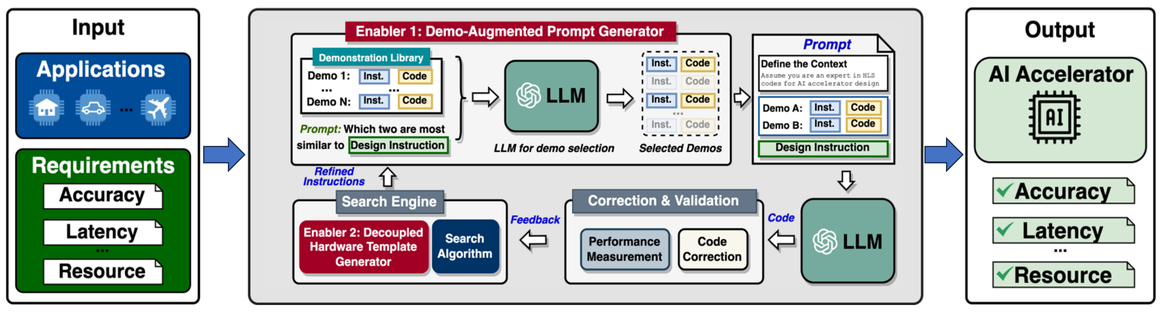

- **HW-NAS-Bench Dataset**
  - **The 1st dataset for HardWare-aware Neural Architecture Search (HW-NAS)**



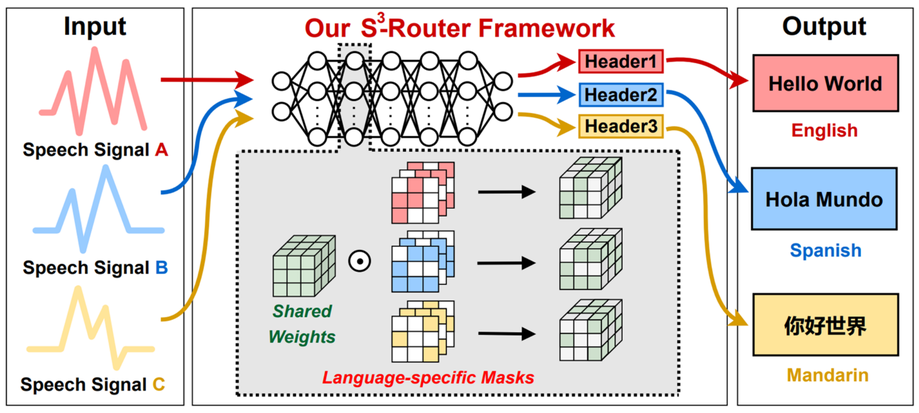

- **Results Dissem. to Communities**
  - **1) 6 massive MIMO datasets, including**
    - **Coherent vs. Non-Coherent MU-MIMO with Uplink Dataset**
    - **Multi-User MIMO Dataset**
    - **Full-Duplex Massive MIMO Dataset**
    - **MU-MIMO with User Mobility Dataset**
    - **Distributed MU-MIMO Beamforming Dataset**
    - **MIMO Resource Scheduler Dataset**
  - **2) 1 HW-NAS dataset**
  - **3) Presentations at Mobile Wireless Week Workshop 2022, 2023 and ICLR 2021**

## 3DML-Client: An Automated Model-Builder and a Model Compression Library

- **GPT4AIGChip ML Accelerator Generator**
  - **A generic large language model (LLM) powered ML Accelerator Design Automation Pipeline**



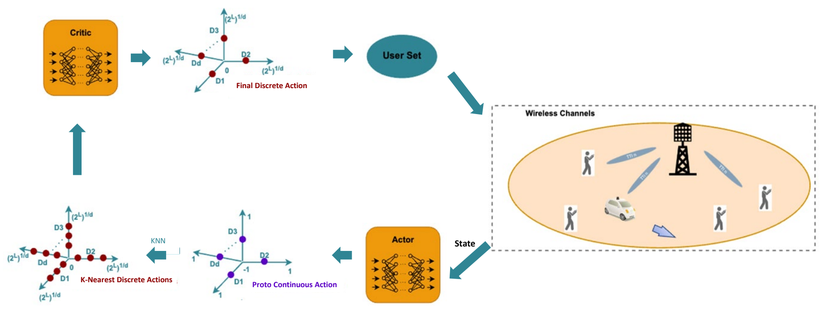

- **S3-Router for Eff. Multilingual Multitask Speech**
  - **Sparsity to encode language-/task-specific information**



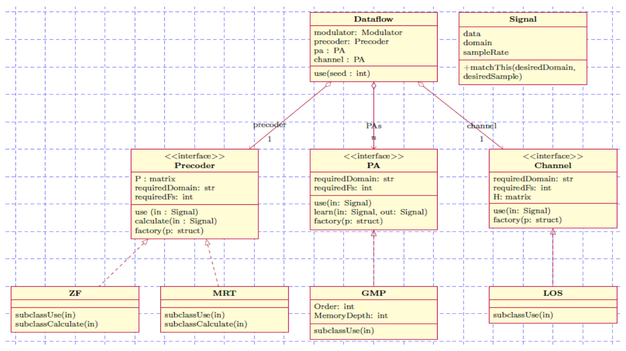

- **Results Dissem. to Communities**
  - **1) *AutoDL* (3DML-Client tutorial) at ISCA 2023, DAC 2023, and MICRO 2022**
  - **2) Presentations at ICCAD 2022/2023 and NeurIPS 2022**

## 3DML-Infrastructure: Automated ML Model and Customized Module Generation

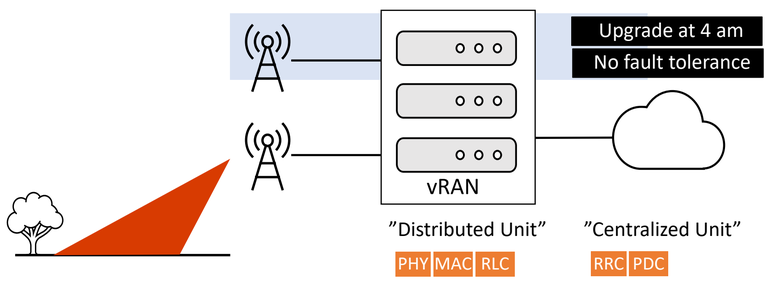
- **Massive MIMO Resource Scheduler**
  - **SMART-Scheduler, a deep reinforcement learning based scheduler**




- **MIMO Simulator with Amplifiers**
  - **For digital predistortion**




- **Commercial-grade 5G vRAN Testbed**
  - **Atlas, the 1st system that provides resilience for the DU**




- **Results Disseminated to Communities**
  - **1) The 1st reference in MathWorks for NN-based digital predistortion design**
  - **2) 1 massive MIMO simulation environment**
  - **3) 1 MIMO resource scheduler**
  - **4) Presentation at Mobicom 2023**
- **FPGA tool flow (ongoing)**
  - **For RF fingerprint identification**
  - **For a multi-level multi-node wireless network**