AI4HPC: AI-based Scalable Analytics for Improving Performance, Resilience, and Security of HPC Systems
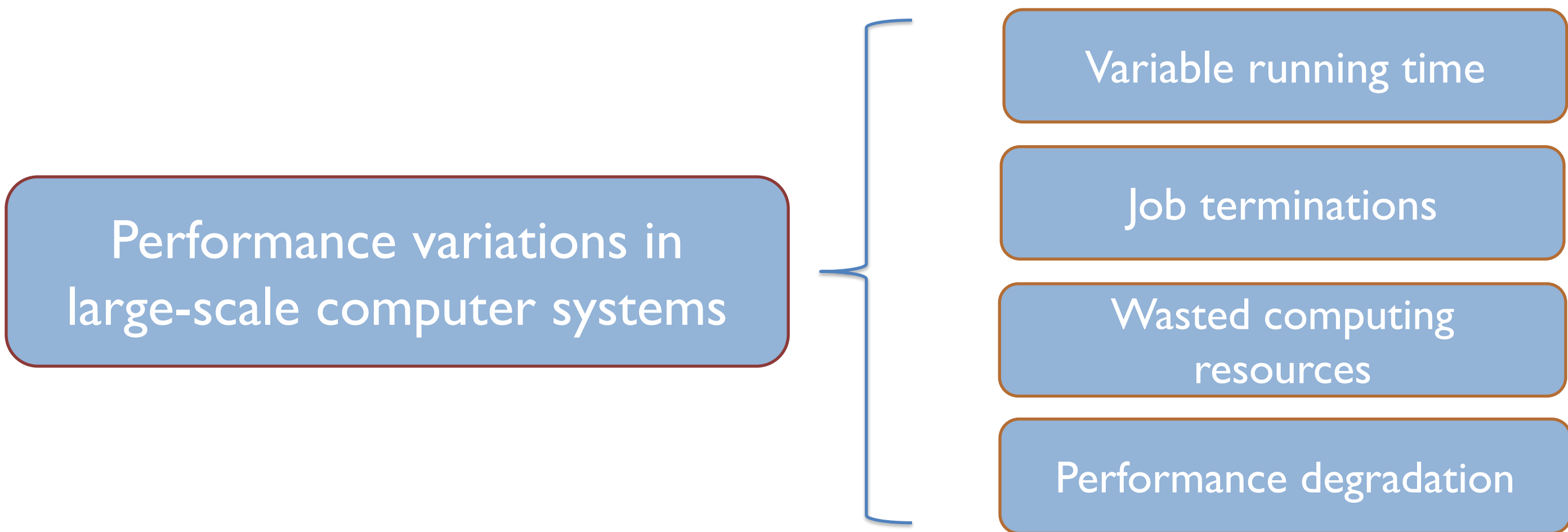
Sandia National Laboratories

Efe Sencan, Yin-Ching Lee, Burak Aksar, Richard Chen, Ayse K. Coskun
For contact: leewill@bu.edu, esencan@bu.edu

BOSTON UNIVERSITY

Background and Motivation

- Significant growth in the scale of large-scale computing systems
- Applications share network, memory, I/O, and computing resources
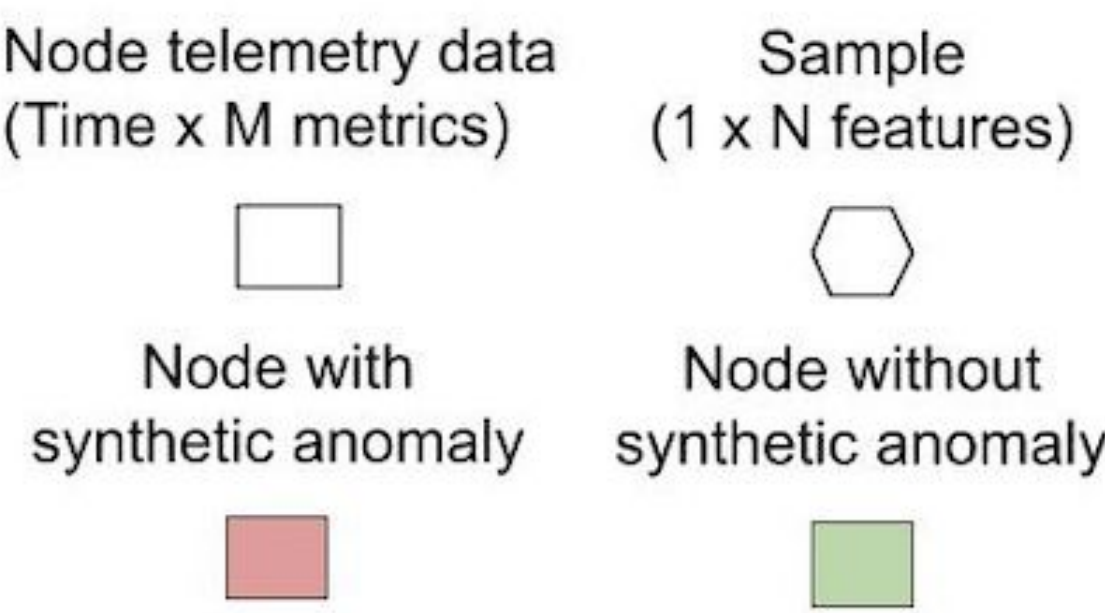- This sharing leads to unpredictable application performance

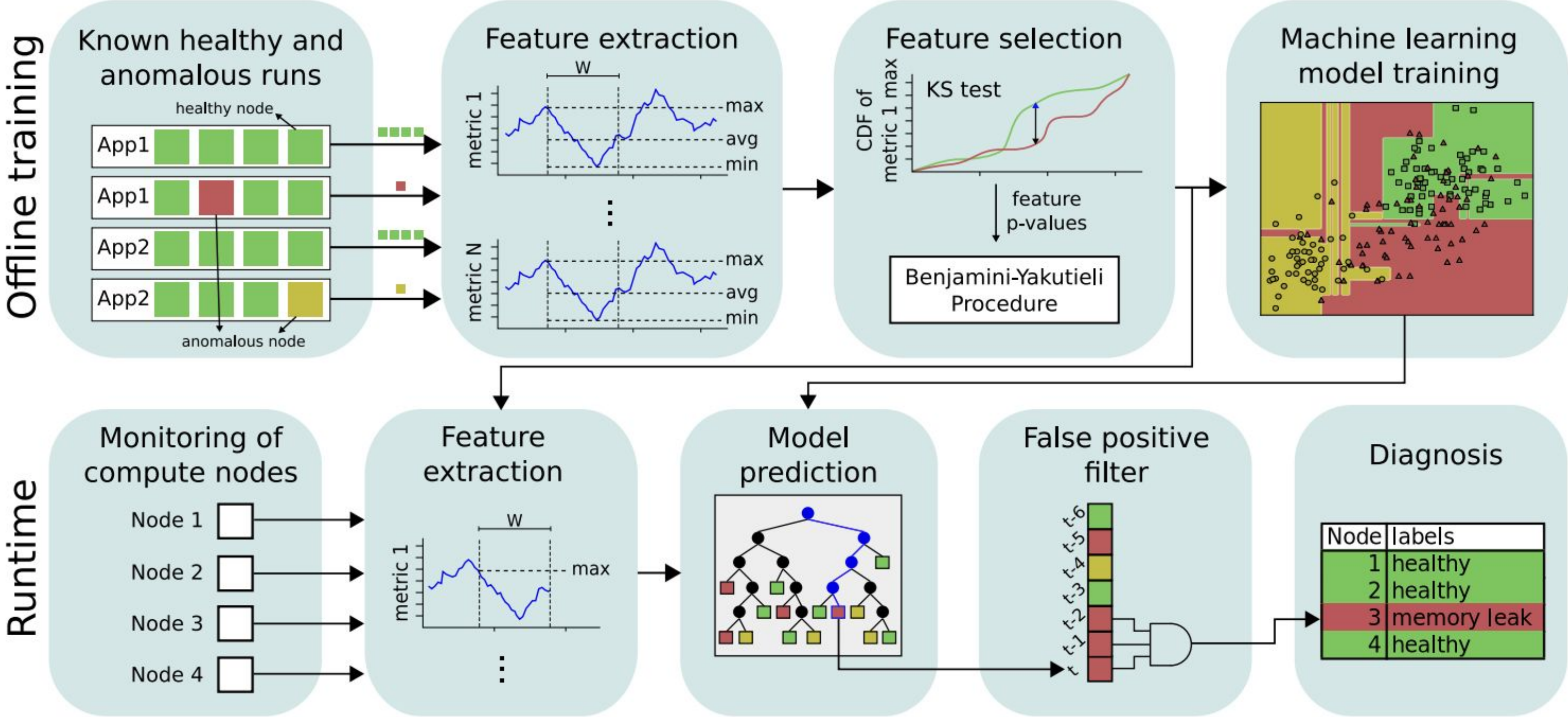Problems caused by performance variations

Telemetry Data Collection

Glossary:

Node telemetry data (Time x M metrics)

Sample (1 x N features)

Node with synthetic anomaly
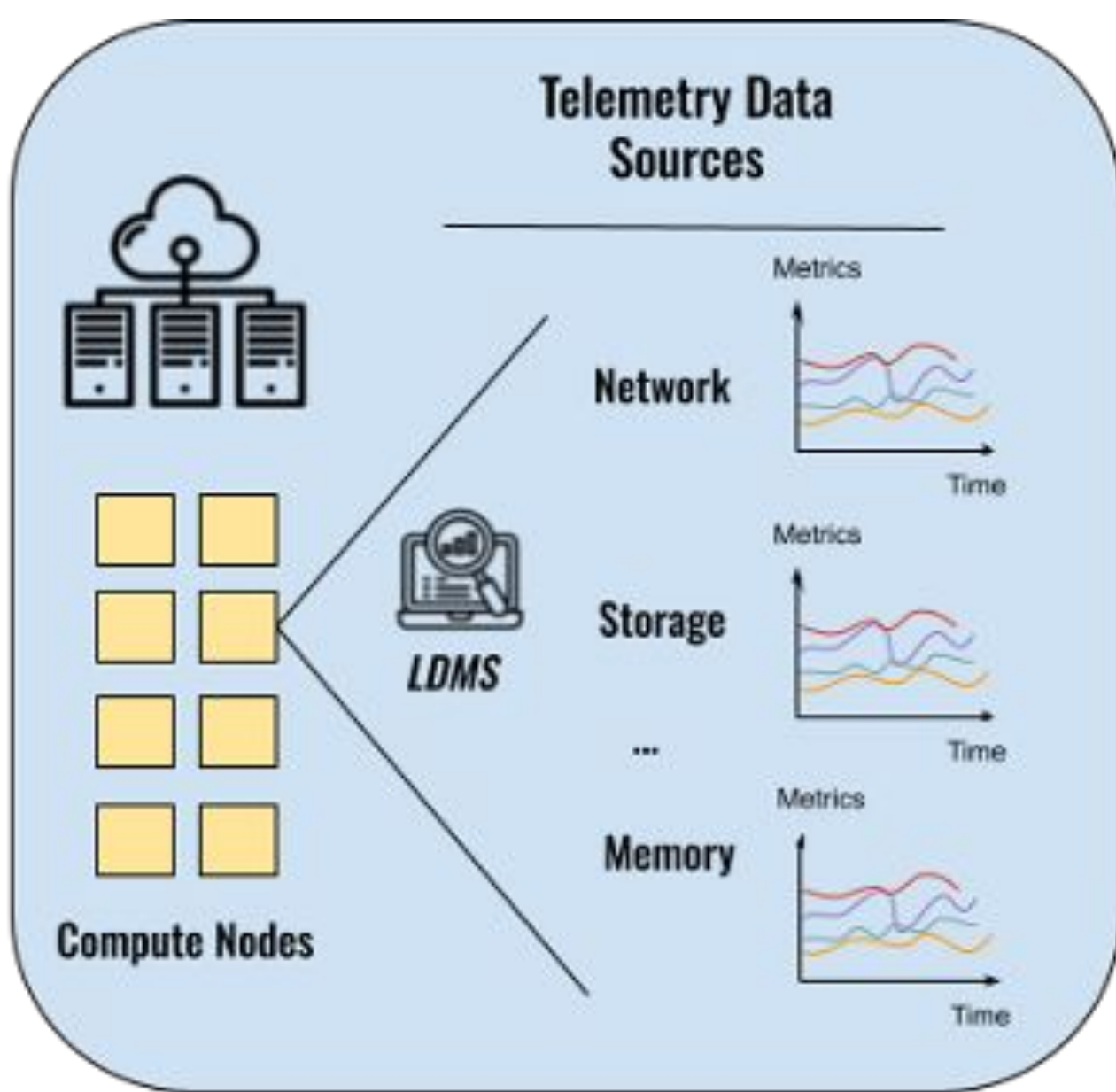
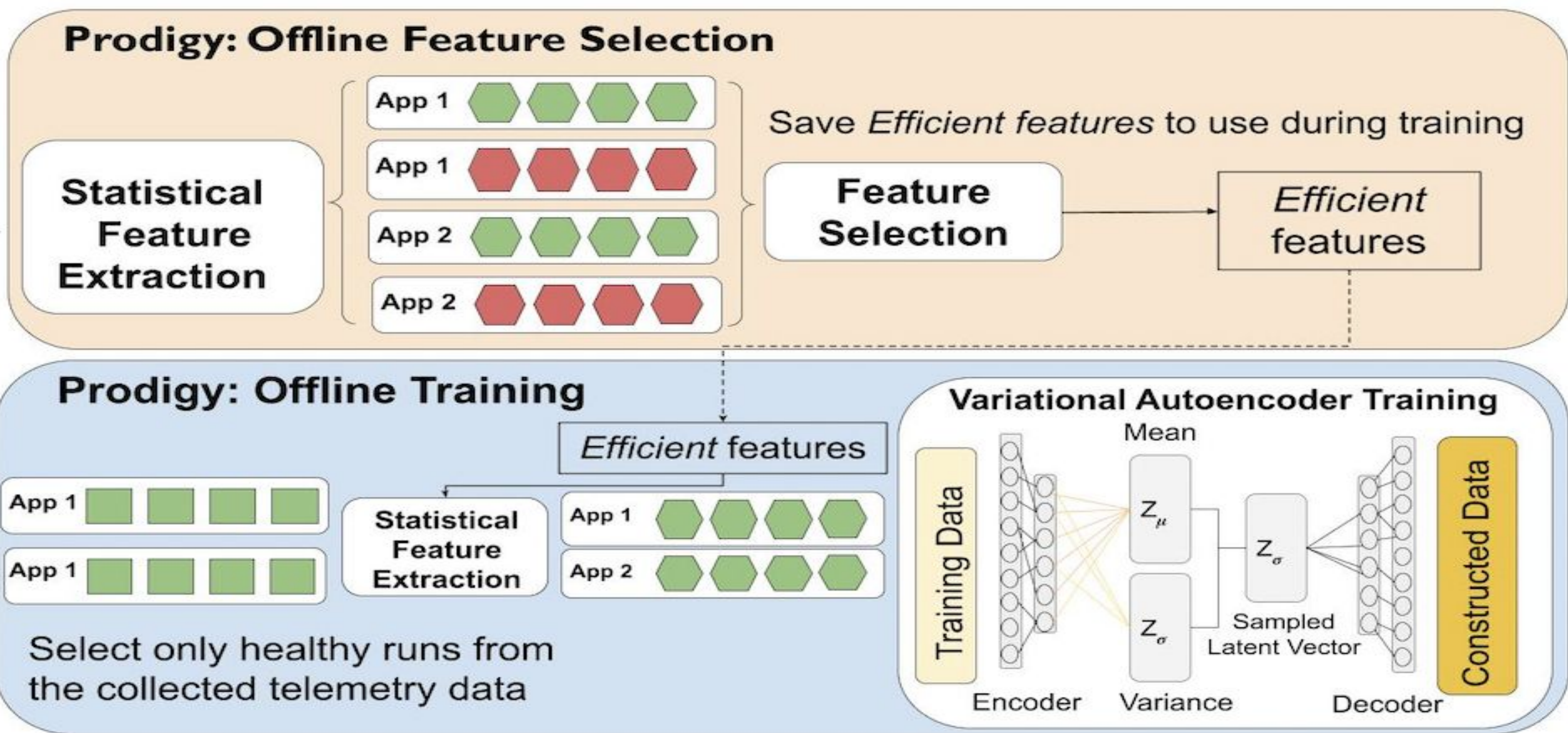Node without synthetic anomaly

Supervised Framework Architecture

Overall pipeline for supervised anomaly diagnosis framework [2]

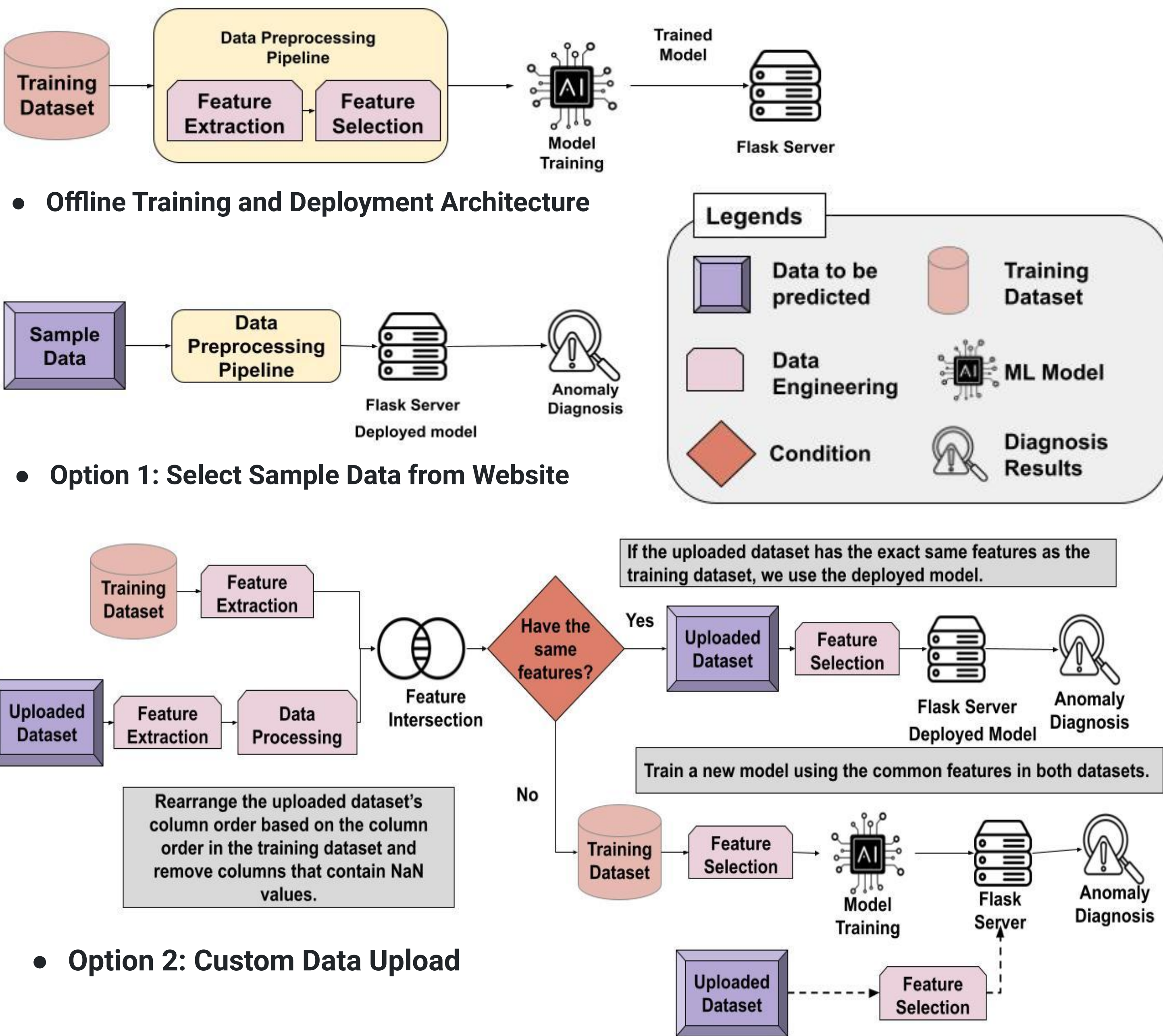## Unsupervised Framework Architecture

Prodigy: Unsupervised anomaly detection framework architecture [1]

Web-based Anomaly Diagnosis Framework

- **Framework Access:** AI4HPC offers both supervised and unsupervised anomaly detection frameworks in HPC systems.
- **User Interaction:** Enables training on custom datasets or application of pre-built models for analysis.
- **Easy Setup:** Docker integration for straightforward platform access and usage.

AI4HPC Architecture

- Offline Training and Deployment Architecture

Legends

- Data to be predicted
- Data Engineering
- Condition
- Training Dataset
- ML Model
- Diagnosis Results

- Option 1: Select Sample Data from Website

If the uploaded dataset has the exact same features as the training dataset, we use the deployed model.

Rearrange the uploaded dataset's column order based on the column order in the training dataset and remove columns that contain NaN values.

Train a new model using the common features in both datasets.

- Option 2: Custom Data Upload

Use Cases of AI4HPC

- **Automated Anomaly Diagnosis:** Utilizes AI for automated performance analysis, allowing users to upload and analyze their own dataset.
- **Accessible ML Tools:** Easy web access to ML models for analyzing HPC system data.
- **User-Driven Enhancement:** AI4HPC supports a feedback loop for users to contribute to the ongoing improvement of ML diagnostics.

References

[1] B. Aksar, E. Sencan, B. Schwaller, O. Aaziz, V. J. Leung, J. Brandt, B. Kulis, M. Egele, and A. K. Coskun. Prodigy: Towards Unsupervised Anomaly Detection in Production HPC Systems. The International Conference on High Performance Computing, Network, Storage, and Analysis (SC 2023), Nov. 2023

[2] O. Tuncer, E. Ates, Y. Zhang, A. Turk, J. Brandt, V. J. Leung, M. Egele, and A. K. Coskun. Online Diagnosis of Performance Variation in HPC Systems Using Machine Learning, in IEEE Transactions on Parallel and Distributed Systems (TPDS), vol. 30, no. 4, pp. 883-896, April 2019

Scan here for AI4HPC website