Utilizing Machine Learning for Anomaly Detection

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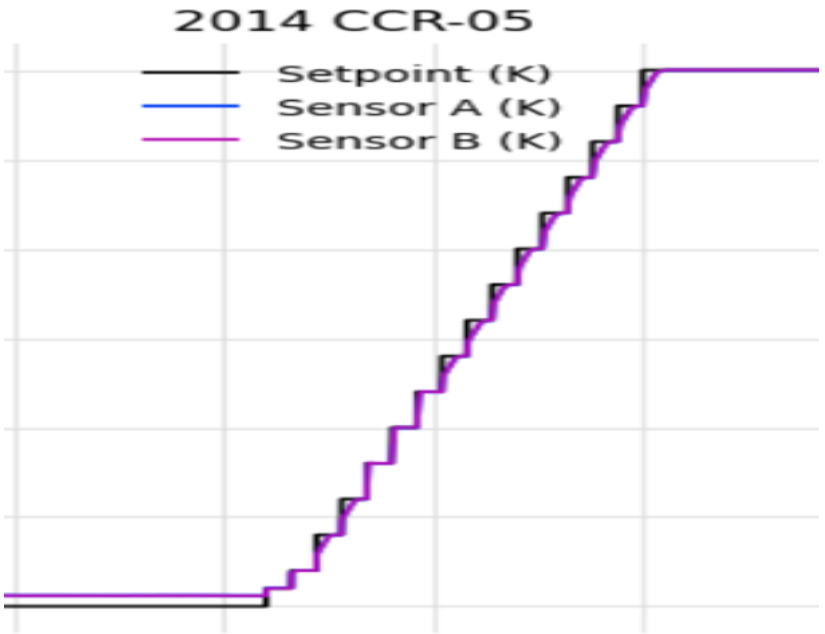
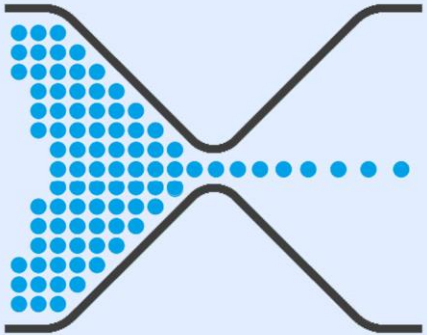
THE BOILING FROG SYNDROME
HELL NO!
101-19
VanSanter

Problem

- Closed Cycle Refrigerator (CCR)
- How does it currently work?
  - Control System
    - Setpoint
    - Sensor A, B, C, D
  - Manual troubleshooting (no notification or pinpoint system)



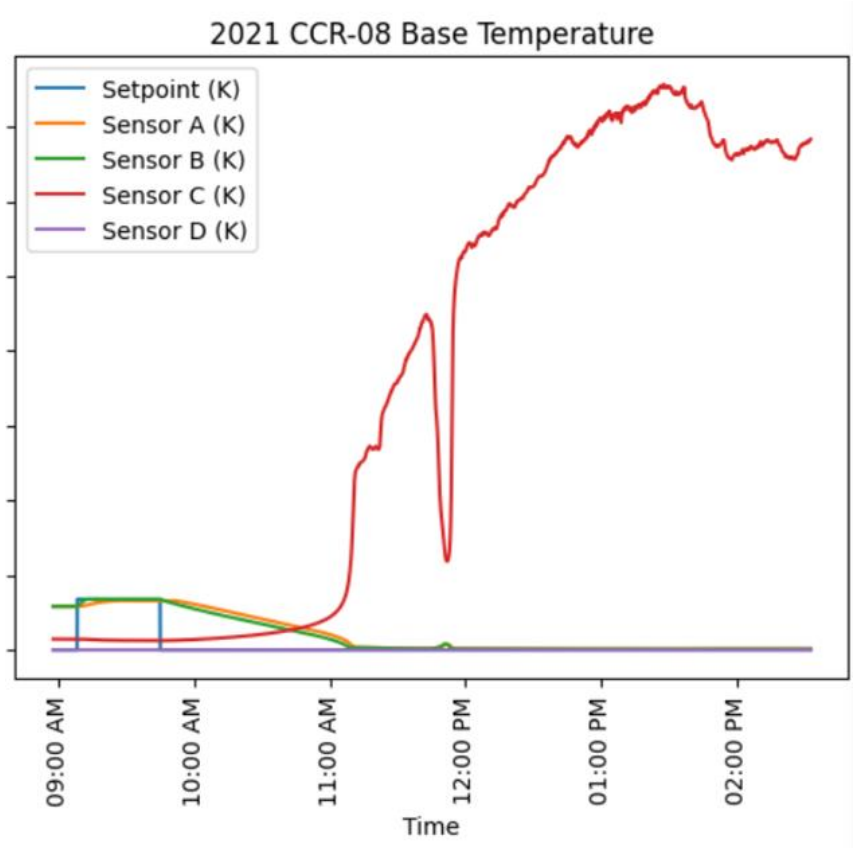
Unsupervised Machine Learning



- Building an internal representation of “normal behavior”
- Identify things that are completely new and never before seen as anomalous behavior

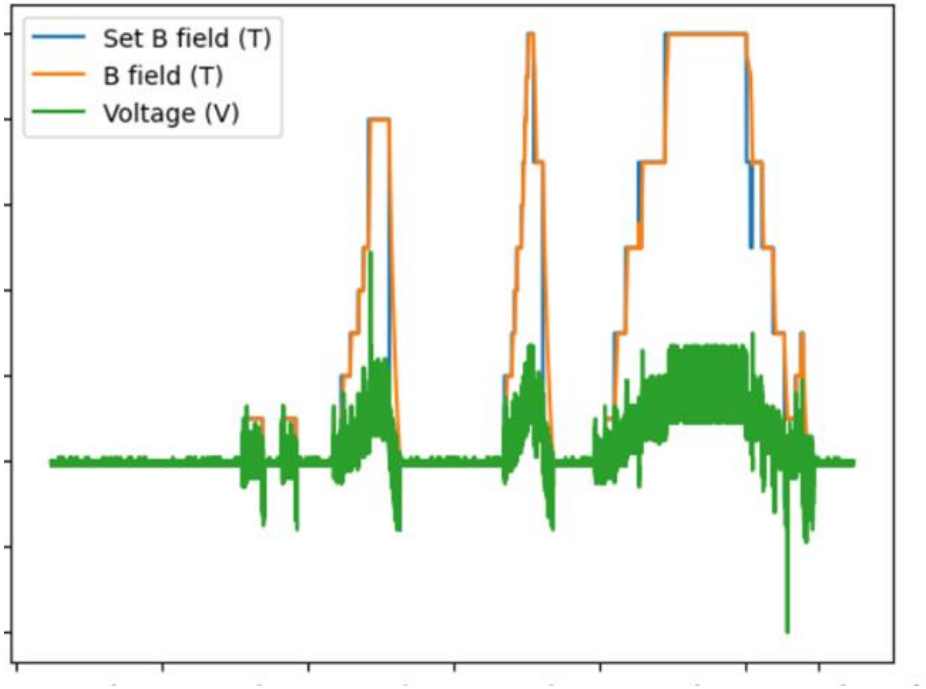
Objective

- Build and train a transformer model for sequence prediction
- Long Term: Tracks and predicts every available control parameter and sensor across the facility for anomalies

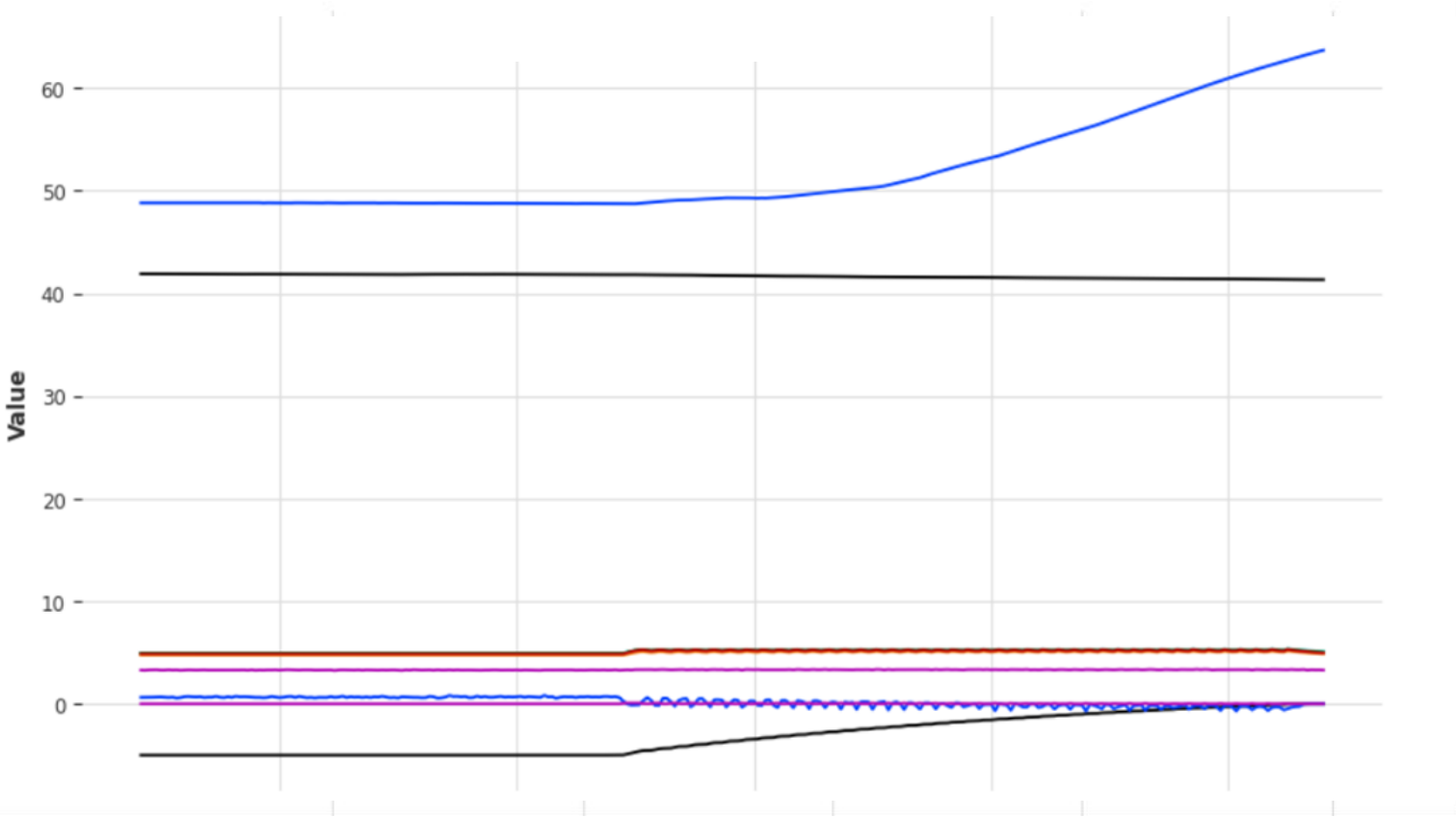


Transfer Learning

- A machine learning technique that uses knowledge learned from one task to improve performance on a related task
- Magnetism Dataset: comprised of exclusively normal CCR data
  - 30 individual experiments

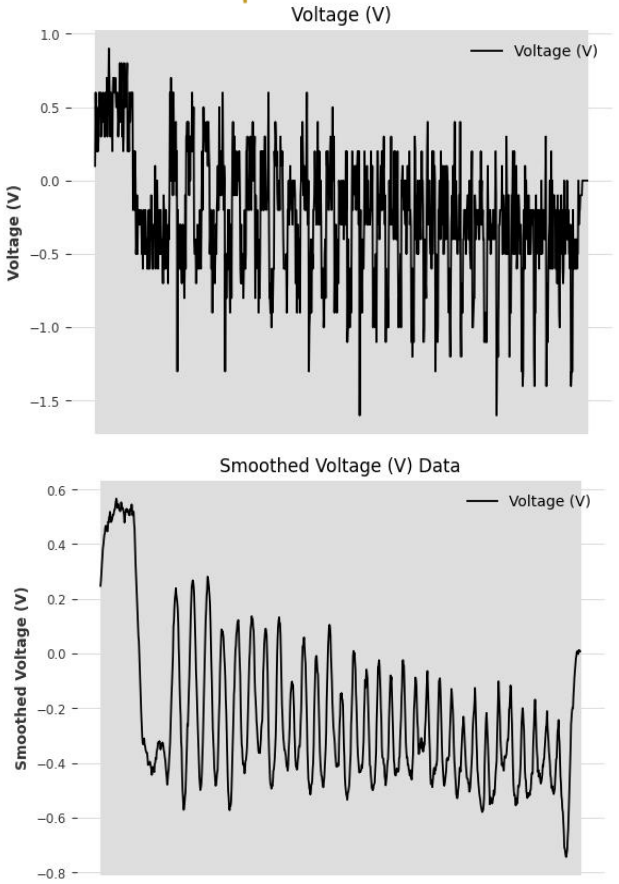


Actual



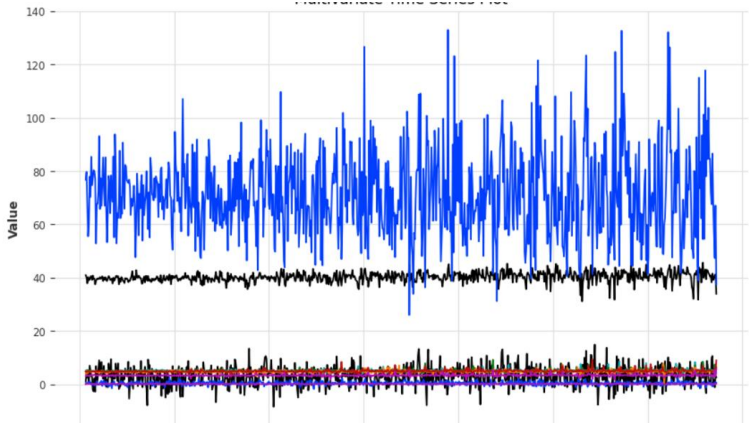
Feature Engineering

- Normalization (respective to each experiment)
- Upsample (1 minute)
  - Slicing into 2000 timestamps per time series
- Savitzky-Golay Filter
  - Smoothes Data

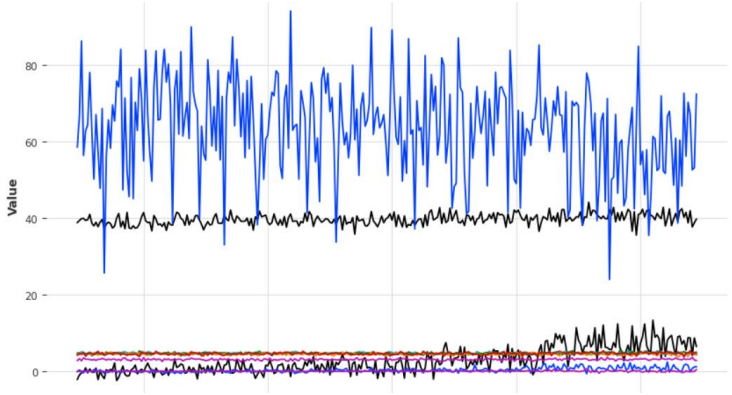


Results

197% SMAPE Score



45% SMAPE Score



Future Work

- Data Augmentation
  - Introduce Gaussian noise in conjunction with Savitzky-Golay Filter
- Known Unknown: trained signal used for labelled anomaly detection
- Next Steps:
  - Create a supervised machine learning model to detect anomalies
  - Identify frequent anomalies

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