New SCI task- 8MO-Yahyavi (HVAC Efficiency)

Target: HVAC Efficiency (0 = Low, 1 = Medium, 2 = High)

Phase 1: Prediction Task

* Use VIF method (with threshold of 5) for feature selection-report the results before continuing the task
* Do cross-validation using the 5-fold method
* Balance the train dataset using the edited nearest neighbor under-sampling method
* Normality Check for all variables in the train datasets: Shapiro-Wilk test
* Use Extreme Gradient Boosting for classification
* Optimize models using the Perfumer Optimization Algorithm🡪 Report all hyperparameter values in convergence iterations
* Use these metrics for performance evaluation: Accuracy, Precision, Recall, F1-score

Phase 2: Counterfactual Analysis

Choose each instance from the test dataset where HVAC Efficiency = 0 (Low), and use Coherent Actionable Recourse based on sound counterfactual Explanations (CARE) for counterfactual Analysis

* Scenario 1: What changes would make the model predict HVAC Efficiency = 1 (Medium) instead?
* Scenario 2: What changes would make the model predict HVAC Efficiency = 2 (High) instead?

Report counterfactual cases for all test samples

Use the following scenario Guideline for counterfactual analysis:

There are two types of variables in the dataset: Fixed (non-actionable or constrained due to physical/hardware limitations or ethical restrictions) and Actionable (can be changed or tuned by network operators or design) 🡪 only use actionable variables for counterfactual analysis:

| **Variable** | **Category** |
| --- | --- |
| Temperature | Fixed |
| Humidity | Fixed |
| CO2 | Fixed |
| Occupancy Count | Fixed |
| External Temperature | Fixed |
| **Kp** | Actionable |
| **Ki** | Actionable |
| **Kd** | Actionable |
| **Fuzzy Adjustment Factor** | Actionable |
| **HVAC Power Consumption** | Actionable |
| **Cooling Heating Output** | Actionable |
| **Response Time** | Actionable |
| **Energy Efficiency** | Actionable |