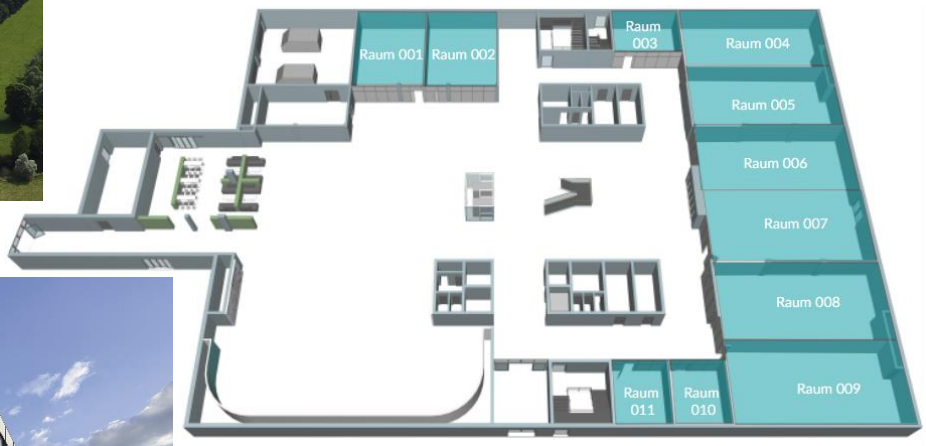
Process Description and Motivation

Running an energy-efficient facility management is one of the cornerstones for sustainable production processes at Phoenix Contact. In this challenge, you are faced with the task of predicting temperature curves for six meeting rooms (see image below).

The results of your model will become part of the process equation to run more energy-efficient and sophisticated facility management solutions at Phoenix Contact.



Dataset Description

The dataset you are provided with, are containing time-series data for six different rooms in Building 4 at our Bad Pyrmont facility. The time-series data has a timespan starting from January 2018 to December 2021 and is including data measured in 15-minutes time intervals.

For each room, there are identical sets of features which consists of:

	Timestamp	Room	RoomTemperature	AirqualityPerc	HeaterPerc	CoolerPerc	TempSupplyAir	RelativeHumiditySupplyAir	HeatingPower	CoolingPower	AirTemperature
0	01.01.2018 00:00	Raum 004	21,3	NaN	0	0	18,4	40,8	0	1,4	9,5
1	01.01.2018 00:15	Raum 004	21,3	NaN	0	0	18,33	40,8	0	0,5	9,5
2	01.01.2018 00:30	Raum 004	21,3	NaN	0	0	18,34	40,8	0	1	9,1
3	01.01.2018 00:45	Raum 004	21,3	NaN	0	0	18,34	40,7	0	0,1	9,3
4	01.01.2018 01:00	Raum 004	21,3	NaN	0	0	18,34	40,7	0	0,9	9,4

RelativeHumidity	WindDirection	WindVelocity	BrightnessNorth	BrightnessEast	BrightnessSouth	BrightnessWest	Beamerstate	BucketAttendees
NaN	235	NaN	0	0	0	0	0	0
NaN	253	NaN	0	0	0	0	0	0
NaN	251	NaN	0	0	0	0	0	0
NaN	195	NaN	0	0	0	0	0	0
NaN	235	NaN	0	0	0	0	0	0

Column Description

Column	Description	Unit
Timestamp	Timestamp	YYYY-MM-DD hh:mm:ss
Room	Room numbers between 4 - 9 as seen in the image above	String
RoomTemperature	Room temperature	°C
AirqualityPerc	Quality of Air	%
HeaterPerc	Regulating how much hot water will be added to raise the temperature	%
CoolerPerc	Regulating how much cold water will be added to lower the temperature	%
TempSupplyAir	Temperature supply air	°C
RelativeHumiditySupplyAir	Relative humidity of supply air	%
HeatingPower	Power used to heat up air (coherently to HeaterProc)	kW
CoolingPower	Power used to cool down air (coherently to CoolerProc)	kW
AirTemperature	Temperature of air measured outside	°C
RelativeHumidity	Relative humidity measured outside	%
WindDirection	Direction wind is blowing measured outside	degree (0-360)
WindVelocity	Speed of blown air measured outside	m/s
BrightnessNorth	Brightness measured from the north	klx
BrightnessEast	Brightness measured from the east	klx
BrightnessSouth	Brightness measured from the south	klx
BrightnessWest	Brightness measured from the west	klx
BucketAttendees	Binning Number of people that were in that room at a given time	0, 5, 10, 15, 20, 25, 50
Beamerstate	0 = Stand by; 1 = Powered on	0,1

Challenge Description

Task 1 (30 points)

The goal of the challenge is to predict the future temperature curves in the respective rooms of Building 4 at the Bad Pyrmont site. Your task is to create a model based on the provided training dataset named "data.csv". Create a model which predicts the needed temperature at a given time. The results will be used later on in task 2.

Evaluation

There are four test datasets (Which mustn't be used for training!):

- test_jan2022.csv
- test_feb2022.csv
- test_march2022.csv
- test_april2022.csv

Predict the temperature curve of the last 7 days of each month of 2022.

For evaluation, you need to provide four datasets containing the prediction for the last 7 days each month:

- pred_jan2022.csv
- pred_feb2022.csv
- pred_march2022.csv
- pred_april2022.csv

The respective output file (preferable *.csv) should look like the following sample:

Timestamp	Room	Prediction
2022-04-28 00:00:00	Raum 001	22.3
2022-04-28 00:15:00	Raum 001	22.3
2022-04-28 00:30:00	Raum 001	22.1
2022-04-28 00:45:00	Raum 001	22.0
2022-04-28 01:00:00	Raum 001	21.2
…	…	…

As an evaluation metric, the root-mean-square error (RMSE) is calculated:

$$RMSE = \sqrt{\sum_{i=1}^{n} \frac{(\hat{y}i - yi)^2}{n}}$$

The overall mean RMSE for pred_[jan-april]2022.csv will be calculated. A leader board will be created starting with the Team that has the **lowest** RMSE at the first place.

E.g.:

Team	RMSE	Points
Team C	0,2547445	30
Team A	0,4786337	29
Team Y	1,3734587	28
Team D	2,3877341	27

For further evaluation purposes, you are required to also provide your code that you wrote while solving this Challenge. It will be used to reproduce your results and to verify its integrity.

Task 2 (1-3 points)

Task 1 is the first step to make the building a little smarter. However, these solutions must be converted correctly into the living system to make central heating viable. For that we would like you to create a mock-up based on your solutions from task 1 which shows us, how we should implement your solutions.

Everyone that will pitch their ideas and solutions will gain 1 point. However, a jury of 4 total members will look precisely at your pitches and solutions to determine which 5 teams took the top and provided the most feasible solutions. These 5 teams will receive 3 instead of 1 point for Task 2!

Please roughly consider the following points:

- Needs to increase accuracy
    - More/Different Features - If, which?
    - Data pipeline or communication concept (mock up)
    - Computational power
    - Interaction with users or building – If, which?
- Why is your solution “smart” (doesn’t mean it has to be a fancy solution, maybe the simplest one is the best after all)
- What area/rooms would you focus on next?