Weather Conditions and Climate Change with ClimateWins - Machine Learning Approach

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Objectives

- Using Machine Learning (ML) to predict the consequences of climate change
  - for Europe
  - potentially for the globe
- The goal is to apply ML to find the best resources for predicting weather and climate change where people live

Hypotheses

- ML algorithms can accurately predict weather conditions for a given location
- ML algorithms can predict if the weather for a given location will be appropriate for certain activities
- ML models can be used to predict scenarios of climate change locally and globally

Data profile

- Available weather data come from US's NOAA (The National Oceanic and Atmospheric Administration), Japan's JMA (The Japan Meteorological Agency), world temperature records and others

- The scope of weather conditions is broad (e.g. mean temperature, cloud cover, wind speed, precipitation, …)

- The data covers 18 weather stations in Europe – risk of different data sampling

- The data collection reaches as far back as XIX century – risk of inaccurate or incomplete records

- The data is collected from urban stations – risk of underrepresentation of rural regions

Use case

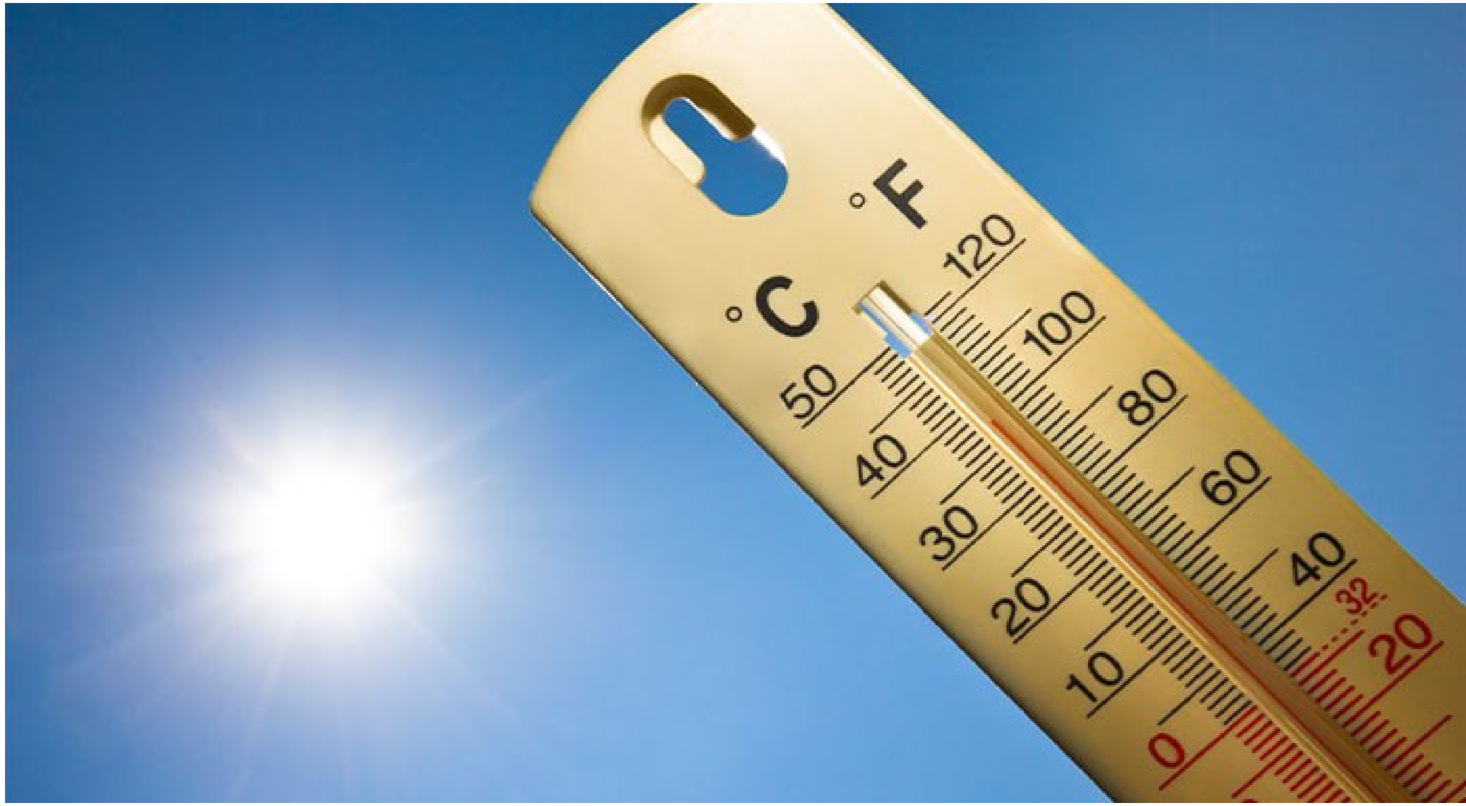
The use case to test the ML algorithms for ClimateWins was aimed at finding the "pleasant weather" conditions

Hypothesis: Temperature can predict weather pleasant enough for outside activities

For this the mean temperature feature was chosen to work with

The data was scaled (StandardScaler from sklearn.preprocessing) and optimized with gradient descent function

Then, three weather stations were excluded as they were missing in the pleasant weather answer set



The processed data set was used to train the supervised learning classifier with three different methods:

- KNN (K-nearest neighbors)
- DT (decision tree)
- ANN (artificial neuronal networks)

Gradient descent

Gradient descent function was applied on the temperature data to see how well it works and whether it can be incorporated into larger machine learning functions

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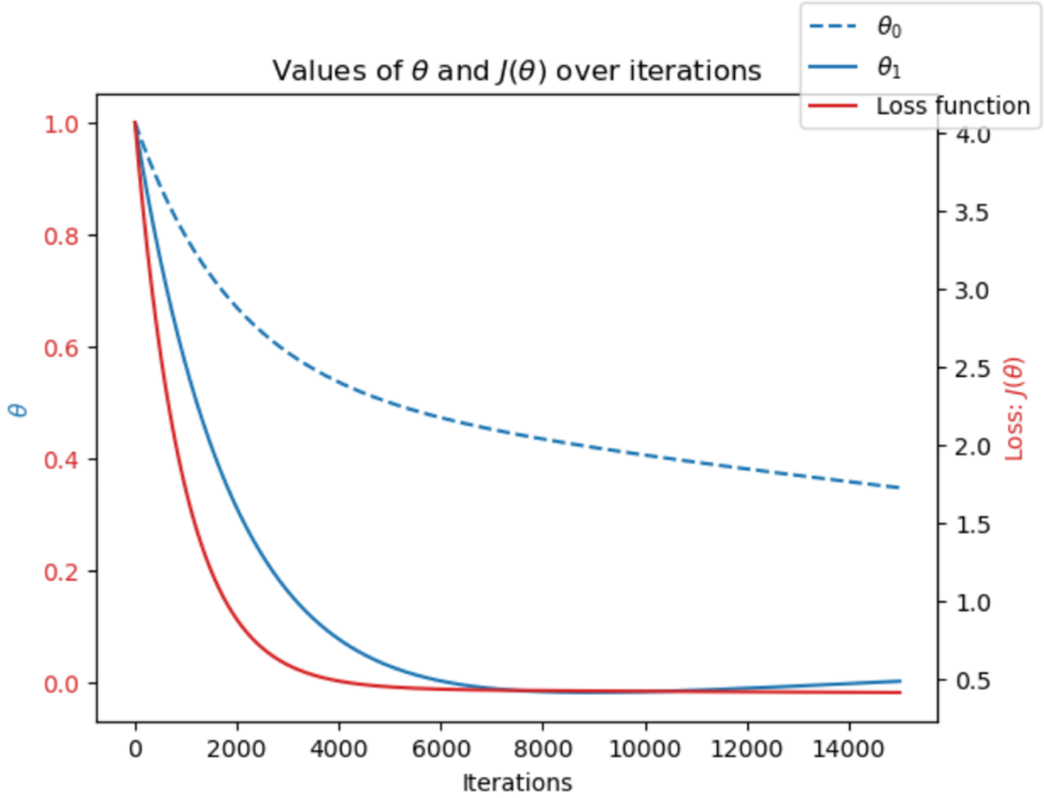

An example from one of the weather stations

θ_0 – bias during training (intercept)
θ_1 – weight for the input feature
Loss function - how much error the model has at each step

KNN method

The KNN classifier performed well

On average the model accuracy per station is 84.38%

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Model parameters: K=4
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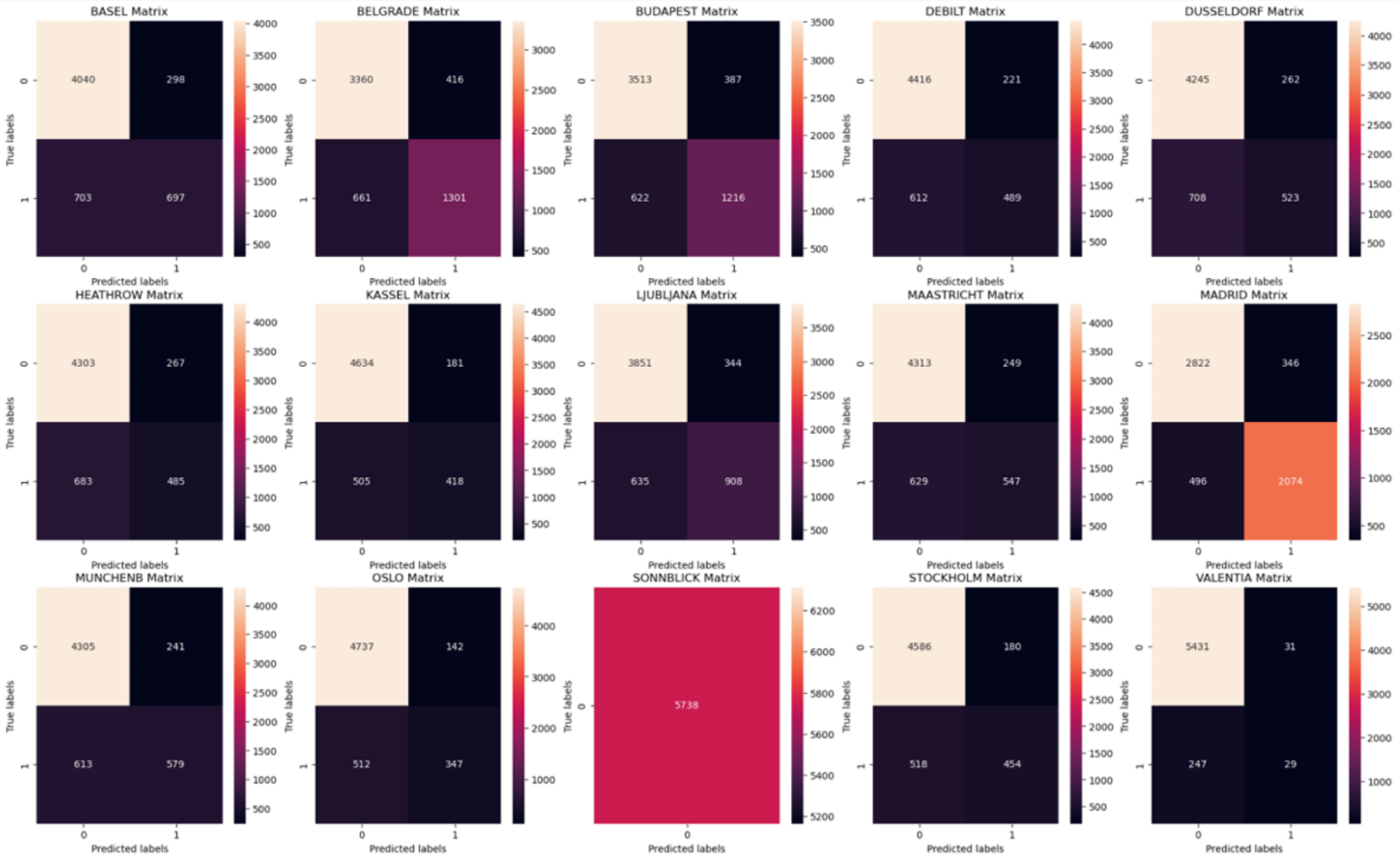
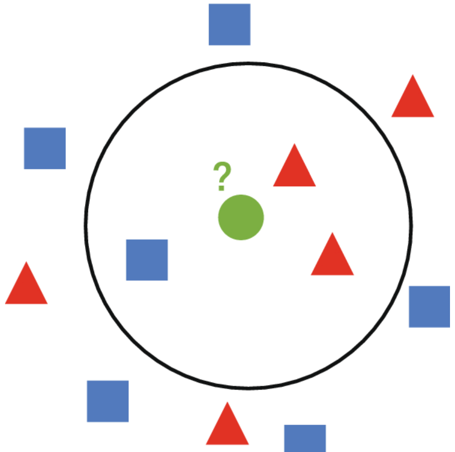
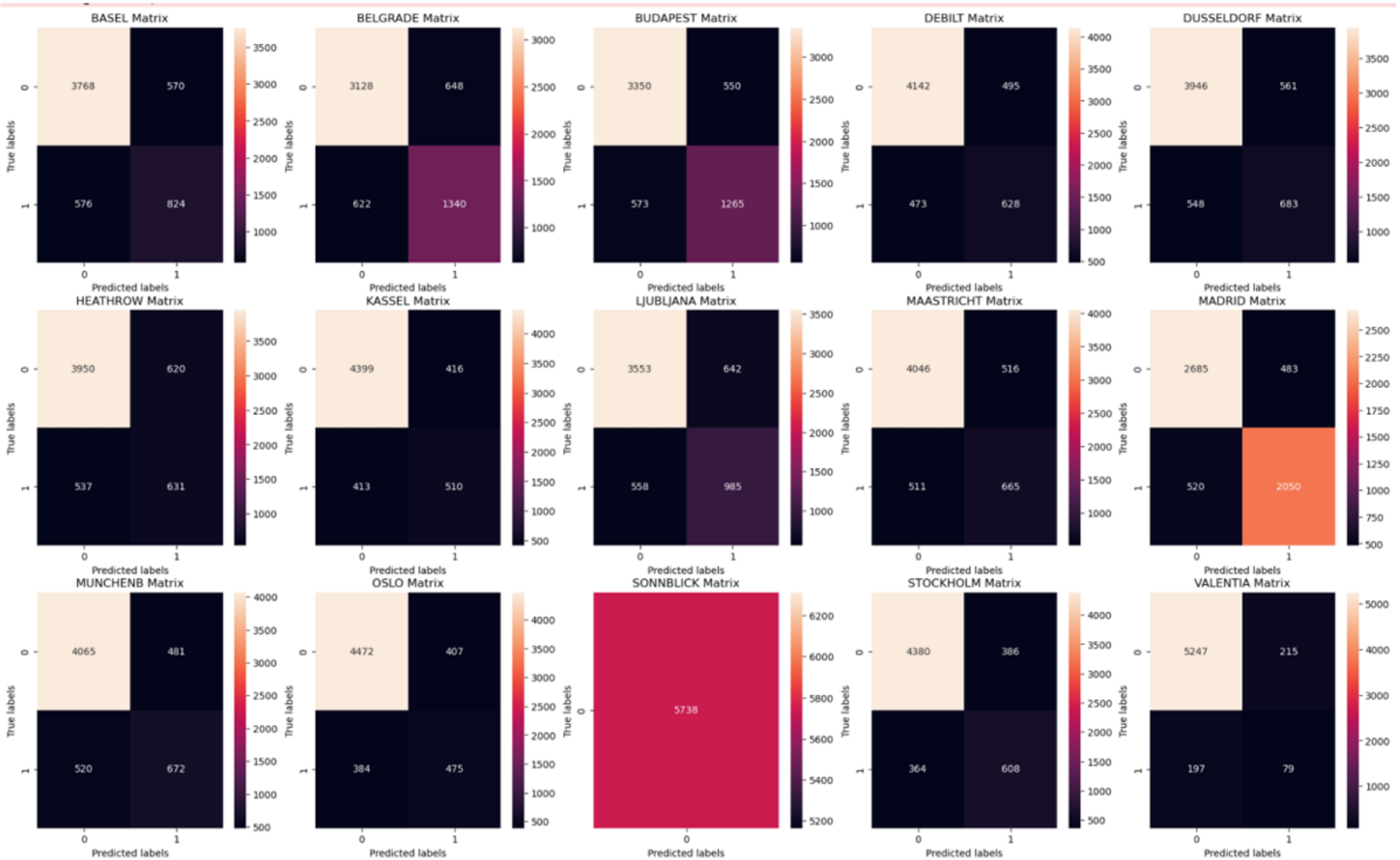


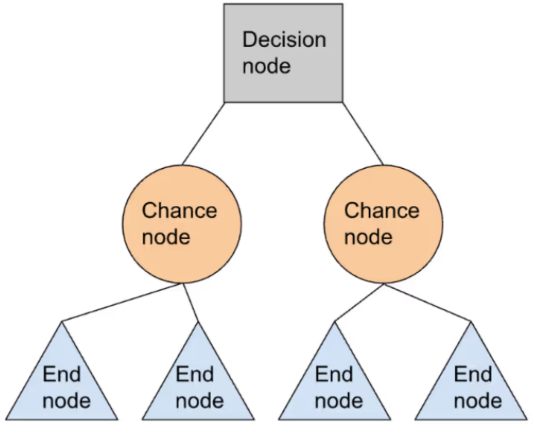


DT method

The DT classifier didn't performed well
Accuracy score is 40.54%

Model parameters: criterion='gini', min_samples_split=2





DT method

The DT classifier didn’t performed well
Accuracy score is 40.54%
Underfitting – training accuracy was similarly low
The tree is too complex

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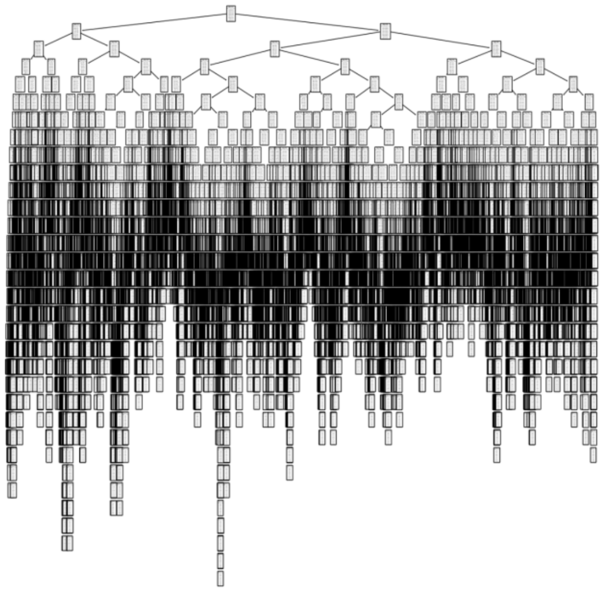
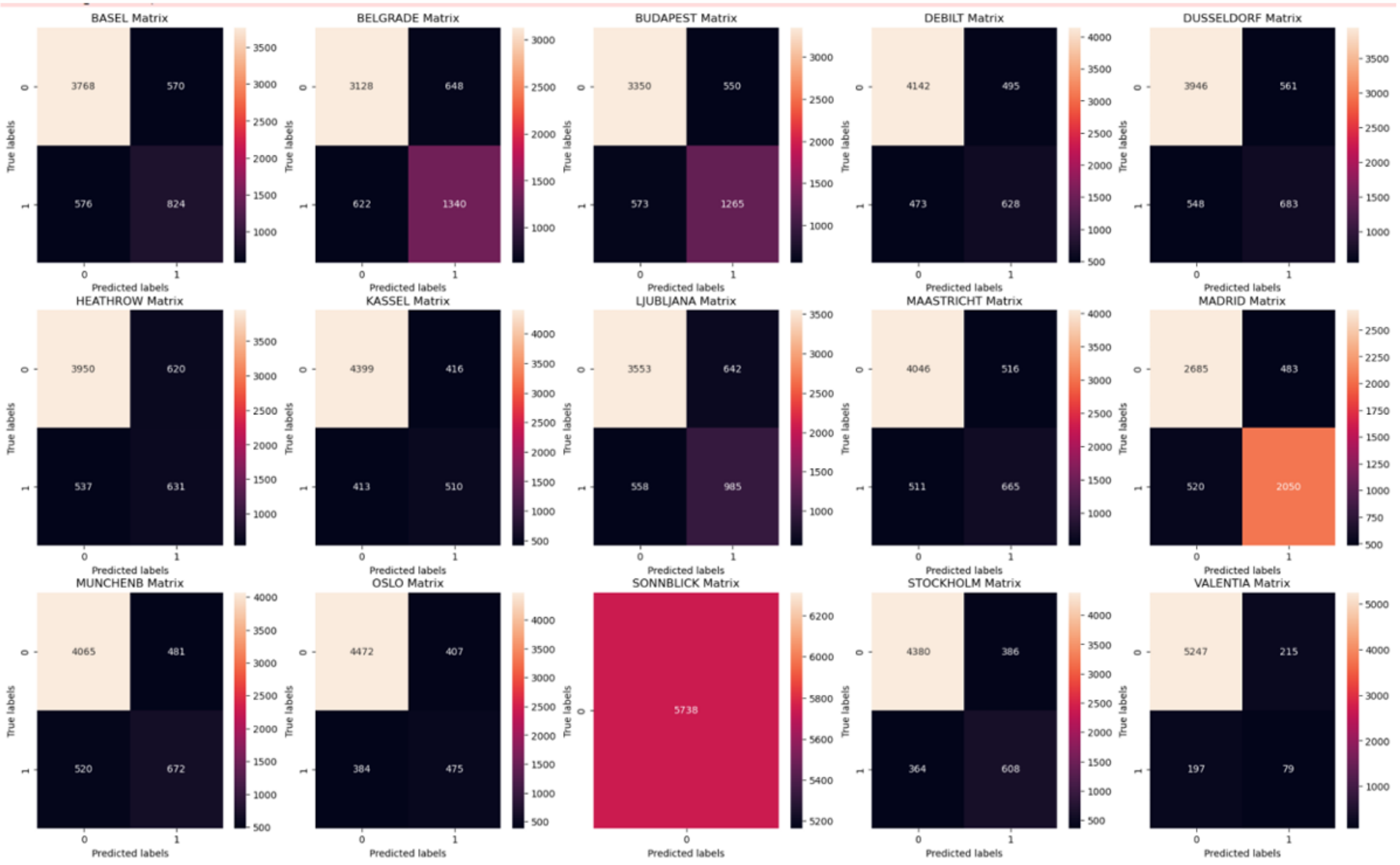
Model parameters: criterion='gini', min_samples_split=2
```





ANN method

The ANN classifier didn't performed well
Accuracy score is 45.43%
Underfitting – training accuracy was similarly low

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Model parameters: MLPClassifier(hidden_layer_sizes=(100, 50, 25),
max_iter=1000, tol=0.0001)
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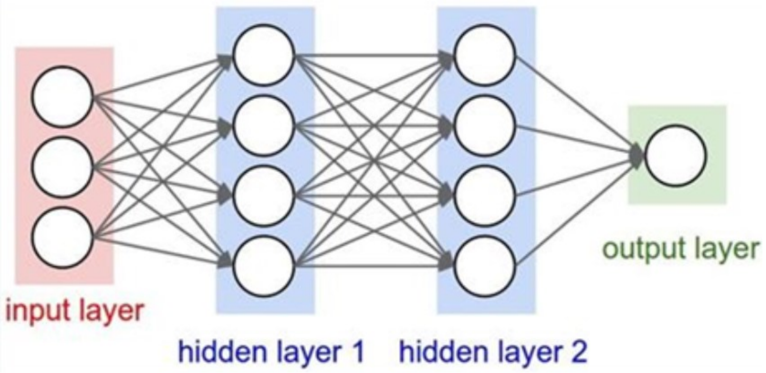

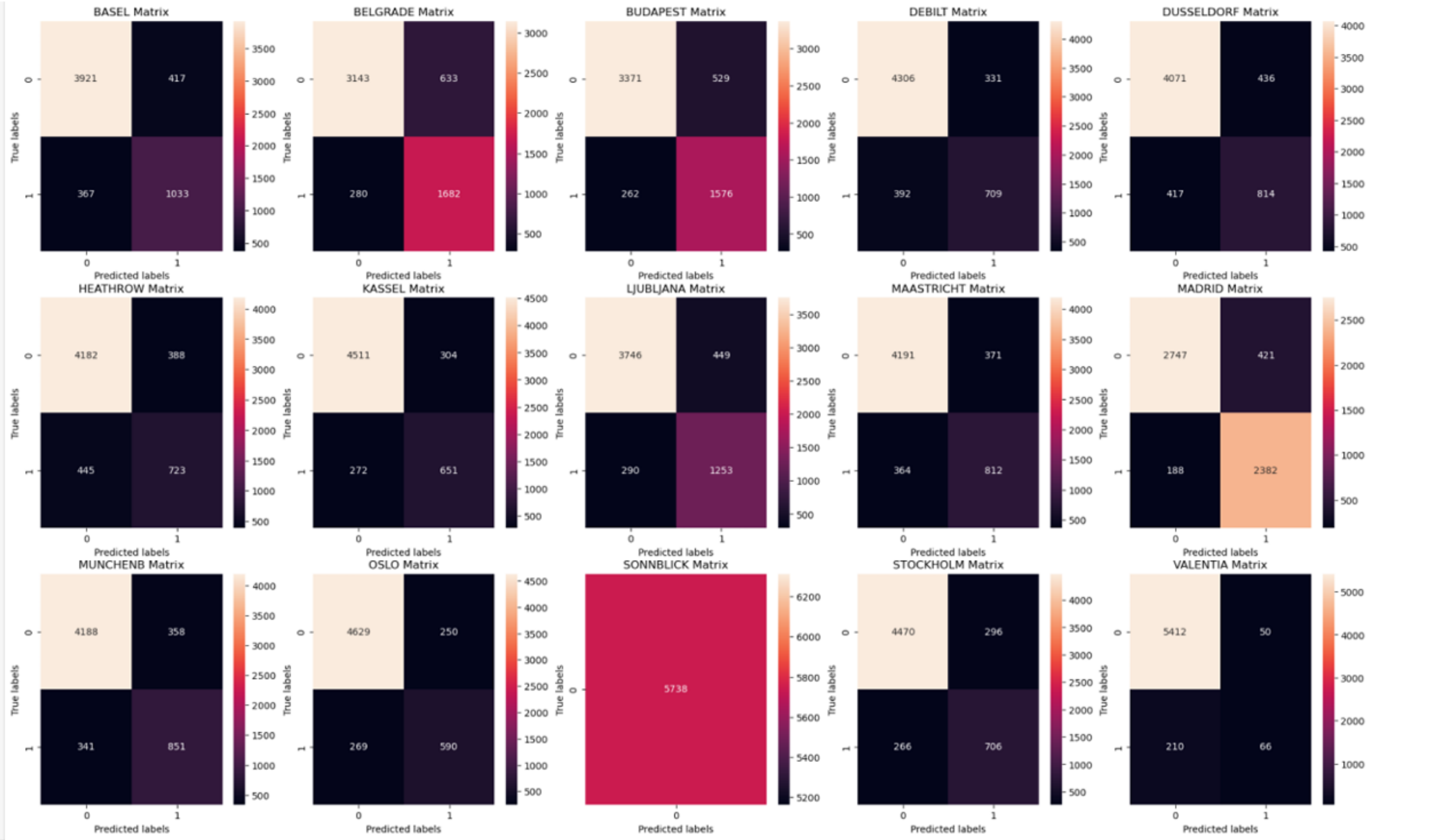

- ML algorithms can be used to predict weather conditions

- The best performing model was KNN

- The models that didn't perform are probably too simple and didn't learn nor generalize well the complex weather data

- More features can be used in the future analysis (e.g. wind speed or cloud cover)

- Modelling the weather data can be useful in predicting local and global trends in climate change

THANK YOU!

If you have any questions, please contact me!

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The repository with scripts and data for this project can be found here:
GitHub: https://github.com/kikimorka88/ML_project