A Weather Story (Part II)

By

Thomas Efstathiades
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Objective

As a continuation of the project in achievement 1, the objective of the project is to help predict the consequences of climate change, while using machine learning.

Objective

- Identifying weather patterns outside the regional norm in Europe
- Determining if unusual weather patterns are increasing
- Generating possibilities for future weather conditions over the next 25 to 50 years based on current trends
- Determining the safest places for people to live in Europe over the next 25 to 50 years

Thought Experiment I (1)

-> First apply principal component analysis (PCA), with a random reduction to 15 components, representing the weather stations/cities, for reducing the complexity of the data set and potentially preventing overfitting.

-> For the 2 resulting clusters (seasons) the concept of iteration is being applied: further splitting the data by weather stations, iterating upon each of them, improving the results and combining them;

-> Applying the random forest ML model

Thought Experiment I (2)

-> Generating feature importance for each of the weather stations

-> Applying random search optimization

-> Finally interpreting what observation type features are having the most influence on data division and hence weather conditions

-> Analyzing the seasonal change in unpleasant weather days and further making predictions for the following decades

-> Further splitting the data into regions by grouping weather stations and analyzing which regions are predominantly affected

Thought Experiment II (1)

-> Synthetic weather data augmentation using Generative Adversarial Networks (GANs), to better balance datasets for rather rare extreme weather events.

-> For this purpose, hurricane data streamed from the U.S. and typhoon data from Japan is added to the weather data set.

Thought Experiment II (2)

-> This helps where pleasant days are rather overrepresented in the data. By training on more diverse and balanced data, classification models can better detect and predict rare unpleasant weather days, such as extreme weather events.

-> By mixing European data with overseas extreme weather data, predictions for such extreme weather events in Europe become more accurate.

Thought Experiment III

-> Using Generative Adversarial Networks (GANs) to predict extreme weather events across Europe, while analyzing and predicting which regions are rather affected and therefore at a higher risk.

-> For this purpose, past radar and satellite data is being used alongside the weather data set, while hurricane and typhoon data is added to better balance out the data.

Summary Table

ML Model & Optimization	Potential	Data	Strengths	Limitations	Notes
Random forest & random search	moderate to high	weather data set	relative fast/low computational cost	prone to overfitting/jumping to noise	manually adjusting hyperparameters (random search optimization)
GANs (network comprised of CNN & any classification-type model)	high	weather, radar & satellite data	performs well on complex non-linear data	computational resources	getting it to converge is very difficult

Questions ?

Contact details

thomas.ef@outlook.com

LinkedIn

Thank you !