ClimateWins
Using machine learning to predict climate change consequences

Interim Report, Joan Gandy, 01/05/2024

Question #1
Can pleasant weather be forecasted?

- Tested using three machine learning models
- Used European Climate Assessment Data Set
  - Temperature, wind speed, snow, global radiation from 18 European weather stations from 1960-2022
- Hypotheses
  - #1. The model that best predicts pleasant weather will predict consequences of climate change most accurately.
  - #2. Mean temperatures will have risen at all weather stations from 1960-2022.
  - #3. K Nearest Neighbor model will predict pleasant weather more accurately than other models.

Data Bias and Accuracy

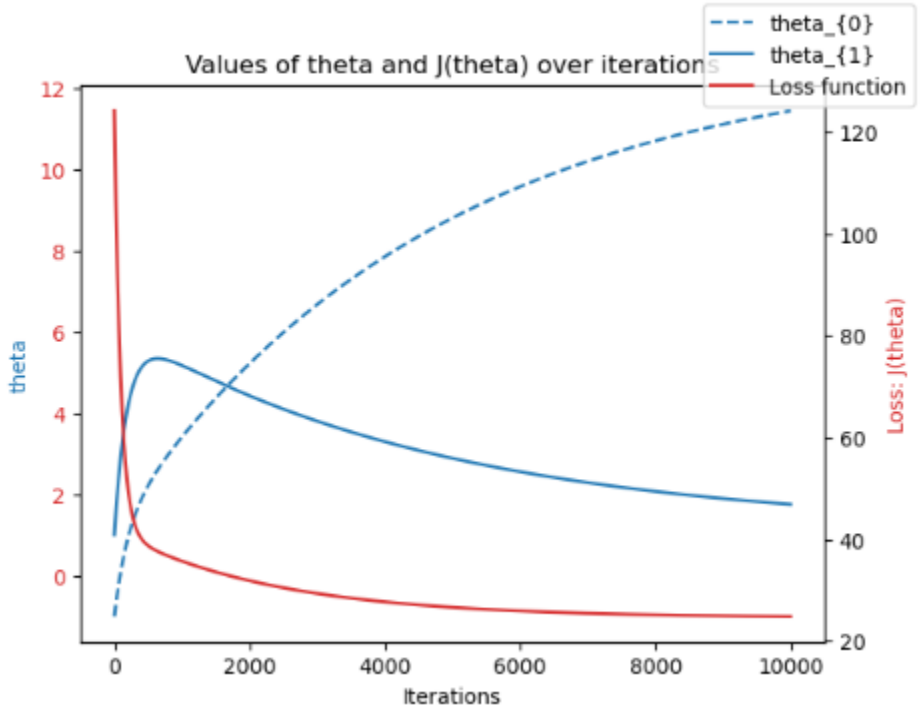
- Accuracy
  - Improvements in technology mean older data may be less accurate than more recent data.
- Location Bias
  - Data is geographically limited to 18 European weather stations. Results not applicable to global weather patterns.
- Analysis Bias
  - Pleasant weather is defined by ClimateWins as weather where people are comfortable participating in typical outdoor activities. However, this is a subjective definition.

Data Optimization

Gradient Descent Methods

- Find the optimal weights and biases that minimize the loss function.
- Tested on three stations' average temperature for years 1960, 1990, and 2000
- Iterations between 100 and 10,000
- Step sizes between .001 and .1
- Theta0 and Theta1 between -1 and 1

Results



Loss function drops quickly to zero using 10,000 iterations, thetas -1 and 1 and a 0.001 step size for Madrid average temperature in 2000. Similar results from other cities and years

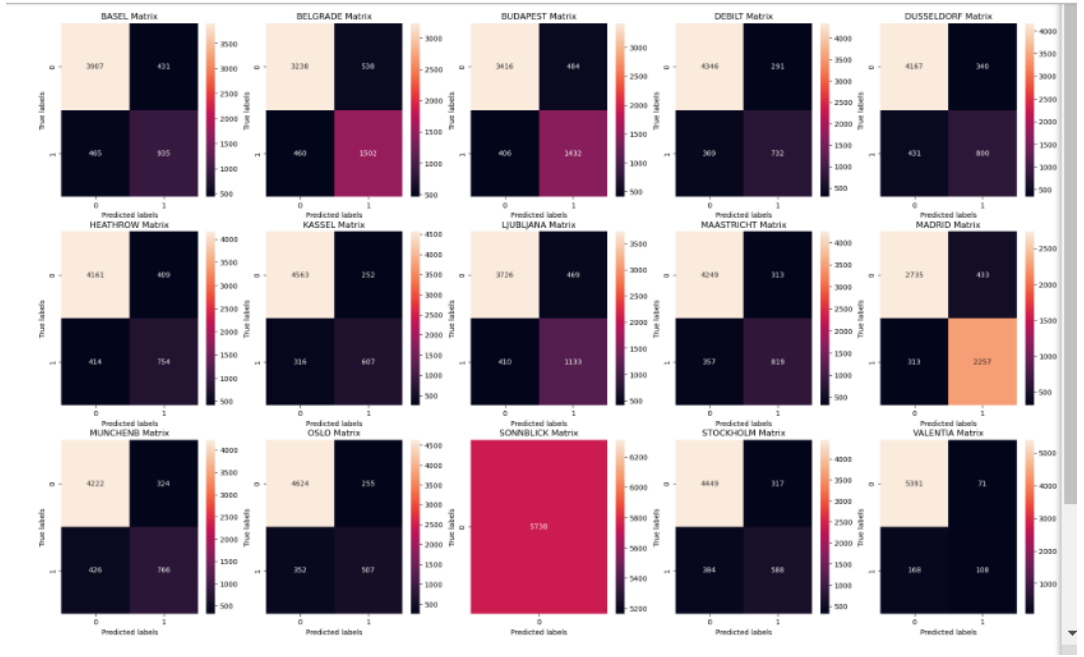
K Nearest Neighbor

Methods and Results

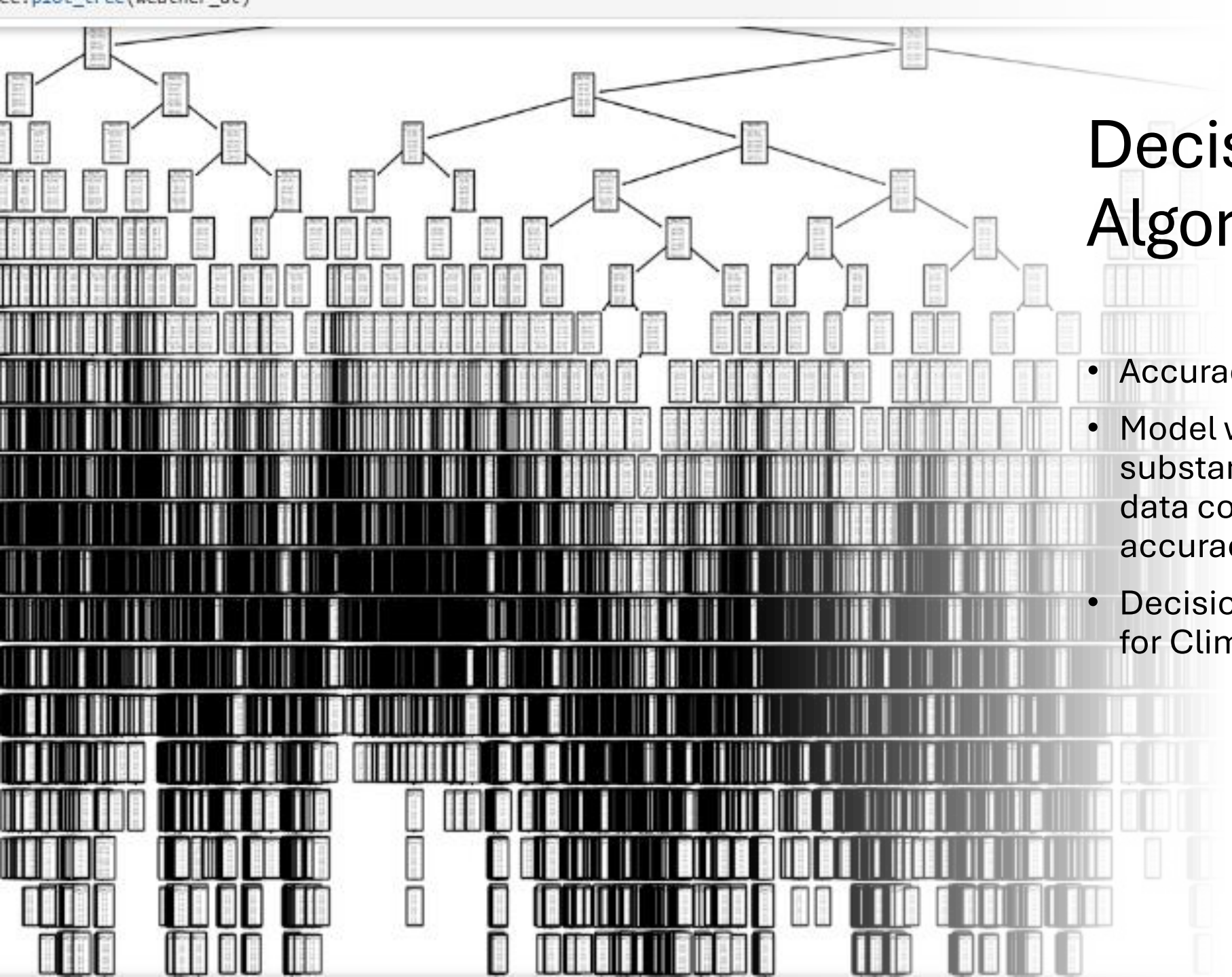
- Tested with neighbors between 1 and 4
- Average accuracy rate = 88%

General conclusions

- Accuracy varied from a low of 83% at Belgrade to 100% at Sonnblick weather station
- The 100 percent accuracy of the Sunnblick data suggests the model is overfitting. The model may be influenced too much by noise resulting in its over performance on the training data and under performance on new data. The model may not be able to generalize to other datasets.
- It will be important to diversify and broaden the training data if this model is to be used to make future weather predictions.
- Overall, the 88 percent accuracy means the model has a strong foundation but needs improvement.



City	Accurate 0	Accurate 1	False -	False +	Accuracy Rate
Basel Matrix	3907	935	431	465	84%
Belgrade	3238	1502	538	460	83%
Budapest	3416	1432	484	406	84%
Debilt	4346	732	291	369	88%
Dusselfdorf	4167	800	340	431	87%
Heathrow	4161	754	409	414	86%
Kassel	4563	607	252	316	90%
Ljublijana	3726	1133	469	410	85%
Maastricht	4249	819	313	357	88%
Madrid	2735	2257	433	313	87%
Muchenb	4222	766	324	426	87%
Oslo	4624	507	255	352	89%
Sonnblick	5738	0	0	0	100%
Stockholm	4449	588	317	384	88%
Valentia	5391	108	71	168	96%



Decision Tree Algorithm

- Accuracy rate of only 47%
- Model would need to be substantially pruned or more data collected to improve accuracy
- Decision Tree model not ideal for ClimateWins

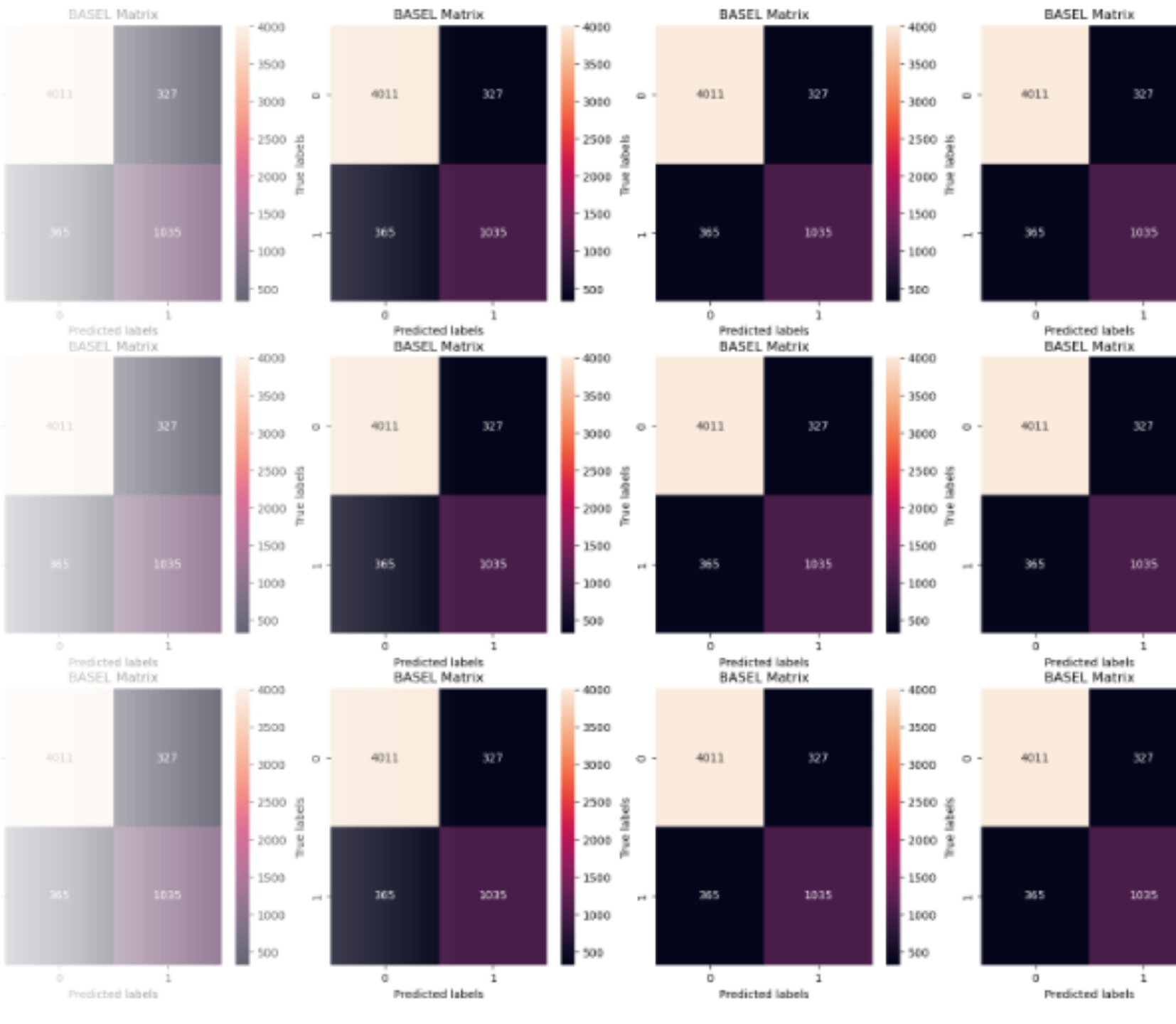
Artificial Neural Networks

Test parameters

- Hidden layers between 2 and 3
- Nodes (10, 5), (10, 5, 5), (10, 10, 10), and (15,15,15)
- Max iterations between 500 and 1000

Results

- Test accuracy between 47% and 48%
- Model did perform well enough under any scenario to be used to predict future weather events



Moving Forward

Question #2

Can changes in weather due to climate change be predicated using machine learning?

- The K Nearest Neighbor model should be used to assess if machine learning can be used to predict future weather events based on past weather data.
    - K Nearest Neighbor had highest accuracy results of three models tested
- Additional data on weather events from more geographical locations is needed to correct overfitting of model.
- Hypotheses to test
    - #1. Adding additional data will improve accuracy of KNN model and correct for overfitting.
    - #2. KNN model will be able to predict likelihood of extreme weather events based on historical data.

Questions?

Joan Gandy

Cell: XXX-XXX-XXXX

Email: XXXXX@gmail.com