Machine Learning: Solar Energy Output

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1. Abstract

1. Introduction

Solar generation is an up and coming alternative energy resource. On the campus of the University of Illinois at Urbana-Champaign researchers have created solar farms to try and reduce the University's carbon dioxide emissions. Solar farm 1.0 is the first UIUC solar farm; it has been operational since December of 2015. It is 20.8 acres of land and produces around 7,200 megawatt-hours of electricity annually. Surprisingly, this is only about 2% of the total megawatt-hours the university requires annually. In order to produce more the university recently published its plans to start work on "Solar Farm 2.0". Solar farm 2.0 will be around 54 acres and produce as much as 20 thousand megawatt-hours annually; approximately 6% of university demand annually. Solar generation is important to "balancing the grid" and the more one is able to predict this output the more efficient energy usage will be. Knowing when solar energy will "run out" is largely a part of being able to utilize the maximum amount of solar energy generation. The goal of this project is to use machine learning techniques learned in class and publicly available data in order to predict the daily energy output from the UIUC solar farms.

2. Literature Review

In order to better understand the current research on predicting solar generation, a literature review was conducted. ## 2.1 Machine learning methods for solar radiation forecasting: A Review - Cyril Voyant Et Al. The journal paper explores other journals that have conducted research on predicting solar generation. This mass review found that most people who are doing research on solar generation are using artificial neural networks in order to predict outputs. This method is effective, however, the authors found that regression tree methods are actually performing with better results. Using his information the model for this project will use both neural networks and regression trees to see how they perform against each other. ## 2.2 Predicting Solar Generation from Weather Forecasts Using Machine Learning - Sharma, N.; Sharma, P.; Irwin, D.; and Shenoy, P The next journal was a case study from a research group using national weather forecast data. The biggest issue they found was uncontrollable variability in weather patterns. This is expected in this type of research because the weather is a natural phenomenon that one can only predict toa certain extent. This group exclusively used support vector machines to resample the datasets. Support vector machines take in a large amount of data and then resample them into different smaller datasets in order to easily compare and analyze them. The most interesting aspect of this research was the use of datasets although they did not correlate well with test data. This is something that the group will keep in mind when making their own models.

Data Collection and Analysis

Model Development

Conclusion

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Model Type	RMSE	MAE	R-squared
Neural Network	1486	1557	0.93
Random Forest	824	634	0.97
Persistence Model	184	135	0.99

References