CS5710 Machine Learning - Project

PROJECT PROPOSAL

Title
Solar Energy Prediction Using Machine Learning

Team:

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Project overview:

The world is largely dependent on fossil fuels, but these resources are finite. Leaving the era of fossil fuels behind is gaining enormous pace. Solar energy is the cheapest way to produce electricity without using fossil fuels considering the rising greenhouse effect. Solar panel electricity can be harvested directly from the sun even on overcast days without the need for a costly setup beyond the installation of solar panels. Even the pollution of the air and water is decreased by this procedure. Solar photovoltaic (PV) and concentrated solar power (CSP) are the two methods used to collect solar energy. In the first way, electrical devices are used to transform solar energy into electricity. The energy from sun rays is captured using mirrors in the later method.

Solar photovoltaic is gaining popularity for its modularity and low cost. By the end of 2020, there were 710 GW of solar PV installations worldwide.

Many nations are entering the markets to select the most affordable electric equipment. We need to be aware of the device power forecast to accomplish this. Machine learning regression models are used to carry out this task to produce improved results.

Related work:

Academic study has increasingly centered on examining the dynamics of solar energy prediction. In thissection we review the related works on solar generated energy and exported energy using machine learning.

Support Vector Machines Based on Multi-source Data Fusion:

This paper proposes the SVM-DF (Support Vector Machine) model and ANN(Artificial Neural Network) models to predict the solar power generated and solar power emission. SVM-DF is an extension of general SVM. To perform experiments weather parameters and power related data are used. To improve the performance another set of weather data NWP is used. In the experimental analysis SVM-DF outperformed the ANN regressor [1].

Solar Power Generation Prediction from Weather Forecasts using Machine Learning:

This paper proposes a strategy in building smart power grids. Optimization of the number of grids in the solar energy system is gaining popularity. To assist this information of weather data and geographical location is needed. Weather data is collected from NSRDB(National Solar Radiation Database). Multiple linear regression models like Ridge and Lasso are implemented to forecast solar energy [2].

Solar Energy Prediction using Meteorological Variables:

This study presents a time series solar energy forecasting model 7 days in advance. To predict solar energy two types of parameters are considered one is plant related parameters and temperatures parameters. In the first category inverter, cables are considered and in the second category statistical parameters of the ambient temperature are considered. Experimental results showed accurate results except on overcast days [3].

Proposal:

In this project we are proposing ensemble regression models to predict both generated energy and exported energy.

Main objectives of the project are:

- Selecting the 2 individual datasets for experimental analysis.
- Analyzing the data with Exploratory data analysis
- Building multiple regression models to predict the solar energy generation and exported energy using weather and plant parameters.
- Evaluating the models and conducting a comparative analysis of the models

Data:

Data in this project is collected from the source PV-Output.org. The original data is maintained by solar energy department Queensland, Australia. The dataset contains the 21 files which is the consolidation of different profiles who installed the Photovoltaic plants at their business or home. This is made available through GitHub *https://github.com/gomesramos/PV-Output-Datasets*.

The features in the dataset are: Generated energy, Peak Generation, exported energy, minimum temperature, maximum temperature and generate/exp ratio.

Contributions and impact:

Limitations of existing methods:

- Solar energy forecast features exhibit a complex relationship between the weather parameters and solar energy parameters which leads to bias in predictions.

Improvements:

- Multiple evaluation metrics are incorporated to assess the model performance Mean Absolute Error (MAE), Rooted Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE).
- The complexity of the parameters is reduced by choosing the ensemble models. Assembling techniques allow one to choose the individual models by reducing the bias in predictions.
- Aggregating the results of multiple data model performance.

Plan of execution:

- The project execution plan and milestones are displayed in fig.1. Python programming language is selected to implement the project. Pandas, Seaborn, matplotlib and scikit-learn libraries are used in project development.

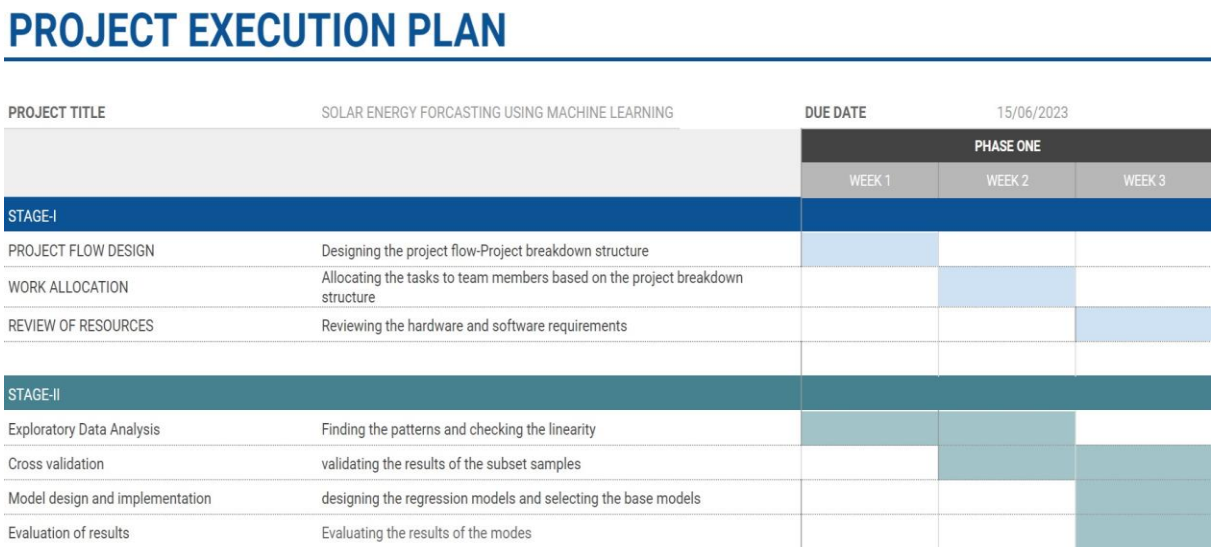

Fig.1.project management chart

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[1]. W. Buwei, C. Jianfeng, W. Bo and F. Shuanglei, "A Solar Power Prediction Using Support Vector Machines Based on Multi-source Data Fusion," 2018 International Conference on Power System Technology (POWERCON), Guangzhou, China, 2018, pp. 4573-4577, doi: 10.1109/POWERCON.2018.8601672.

[2]. R. Singhal, P. Singhal and S. Gupta, "Solar-Cast: Solar Power Generation Prediction fromWeather Forecasts using Machine Learning," 2022 IEEE 10th Power India International Conference (PIICON), New Delhi, India, 2022, pp. 1-6, Doi: 10.1109/PIICON56320.2022.10045237.

[3]. D. Solanki, U. Upadhyay, S. Patel, R. Chauhan and S. Desai, "Solar Energy Prediction using Meteorological Variables," 2018 International Conference on Recent Innovations in Electrical, Electronics & Communication Engineering (ICRIEECE), Bhubaneswar, India, 2018, pp. 16-19, Doi: 10.1109/ICRIEECE44171.2018.9009175.