

Forecast DNI of Solar Energy using a Deep Learning Model Temporal Fusion Transformer

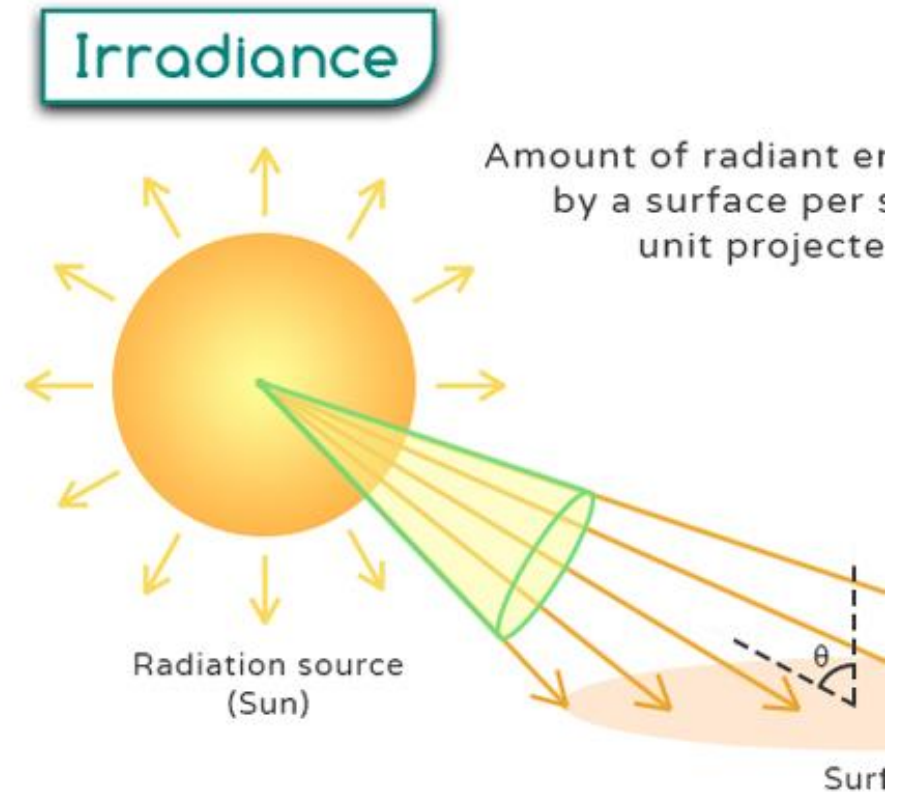
Erdos Institute Deep Learning Boot
Camp Summer 2024

Team: Md Mehedi Hasan



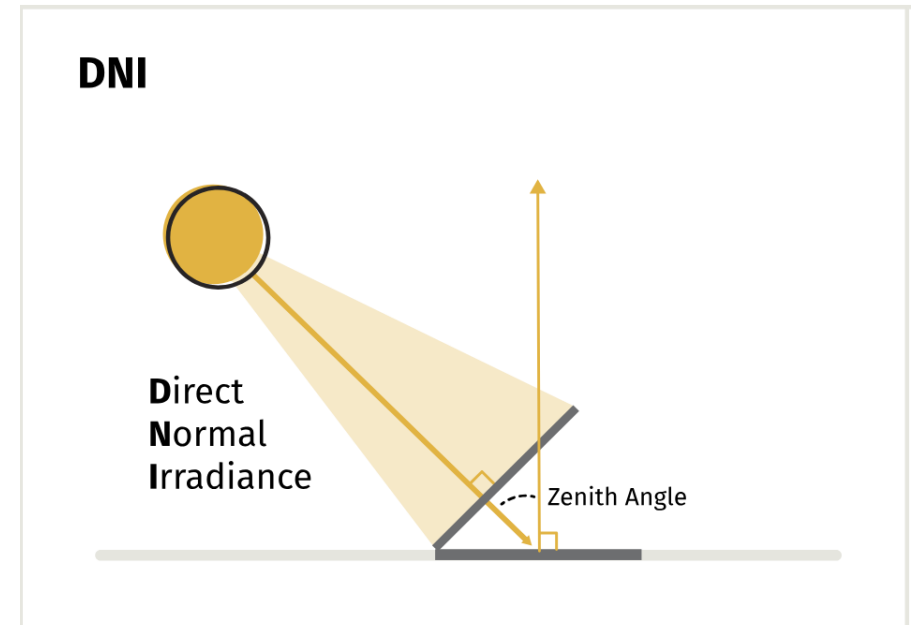
Overview

Solar energy, a renewable source of power, plays an important role in reducing greenhouse gases, mitigating climate change, and protecting ecosystems. Nowadays, the adoption of solar energy into the power grid has increased, and Direct Normal Irradiance (DNI) is particularly important in forecasting the performance of concentrating solar power (CSP) systems. Photovoltaic panels track the sun to receive more DNI, which accounts for a large portion of solar energy from PV.



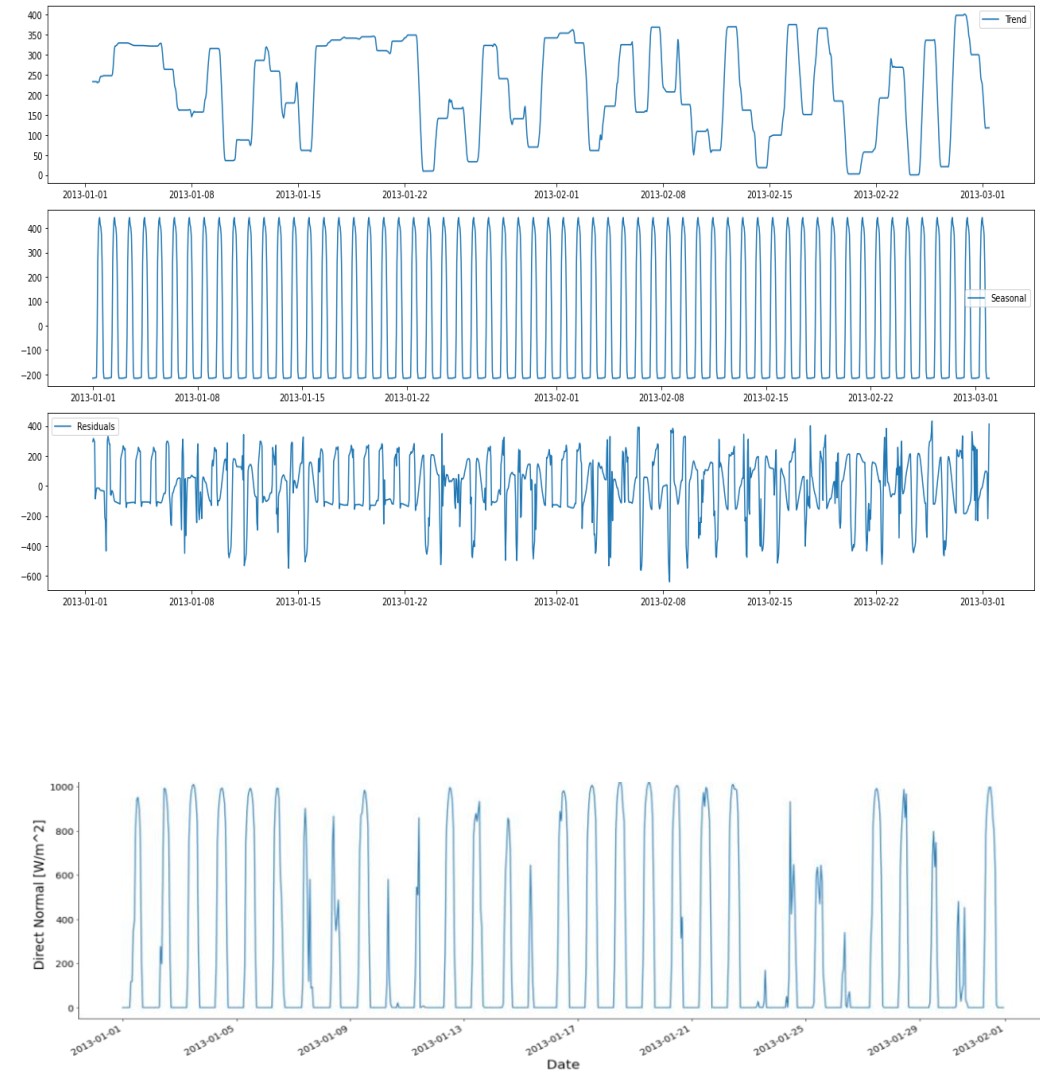
Goal

Use Temporal Fusion Transformer, an effective deep-learning model to forecast a day and a week ahead of Direct Normal Irradiance from solar power. This is crucial for the effective operation and maintenance of power systems, ensuring their ability to harness solar energy effectively.



Data Processing

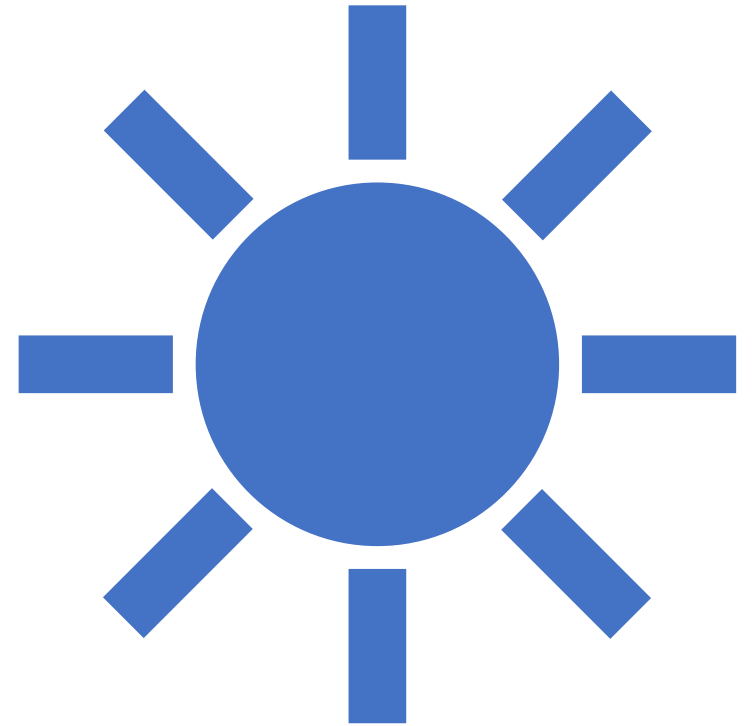
I collected the from the Lowery power station and conducted a thorough data cleaning process, fixing anomalies, filling in missing values, and converting it to an hourly dataset. Also, check the seasonality and trend of the data



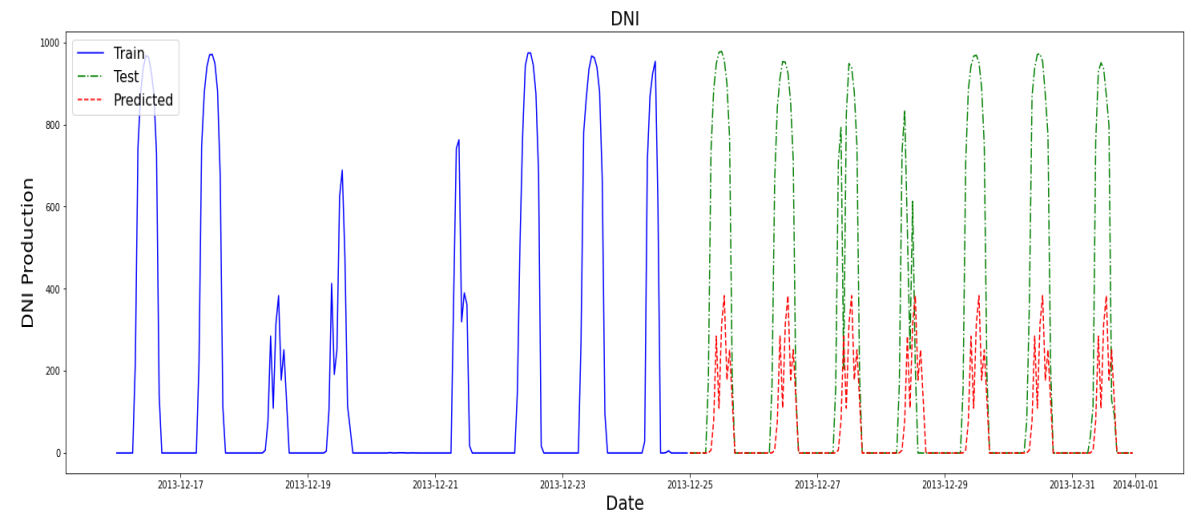
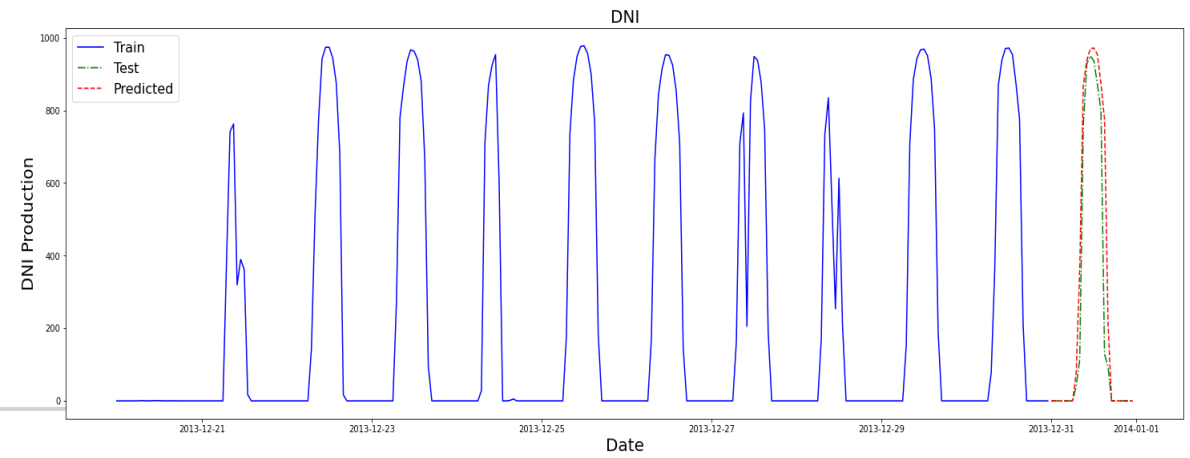


Models

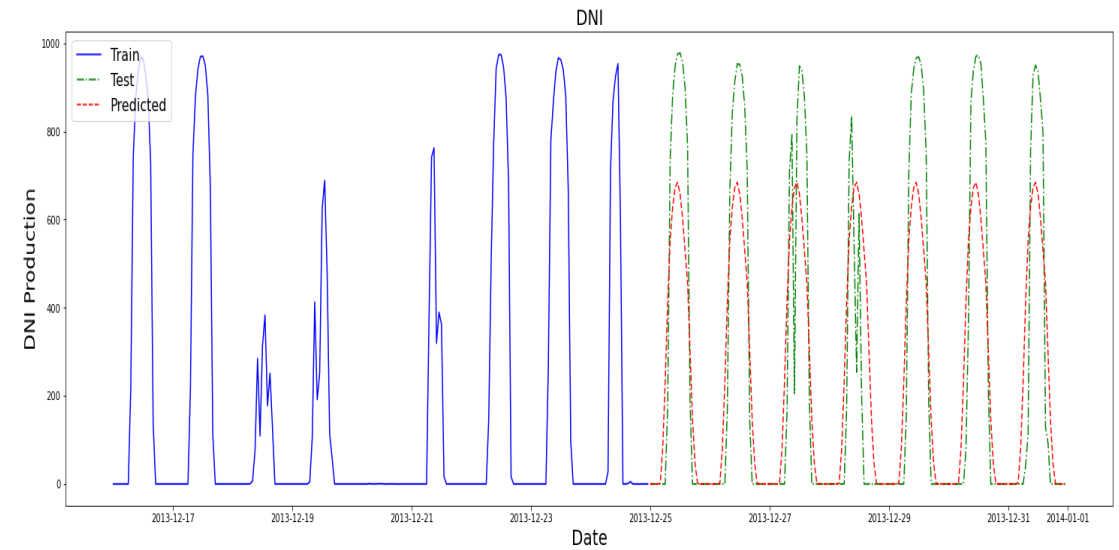
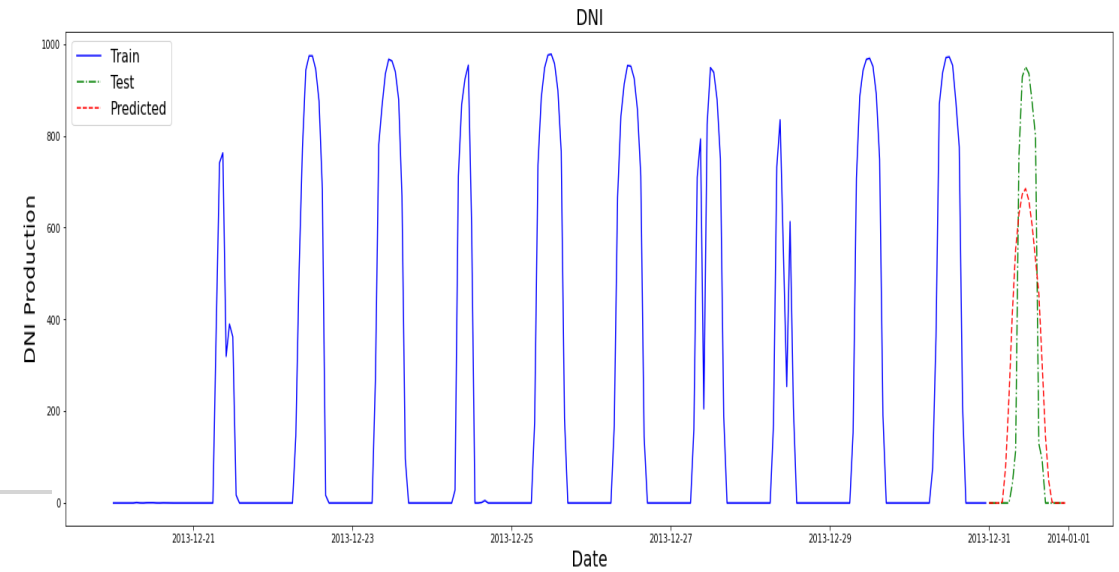
- Naïve Seasonal
- Seasonal Average
- Tripple Exponential Smoothing
- SARIMAX
- Temporal Fusion Transformer



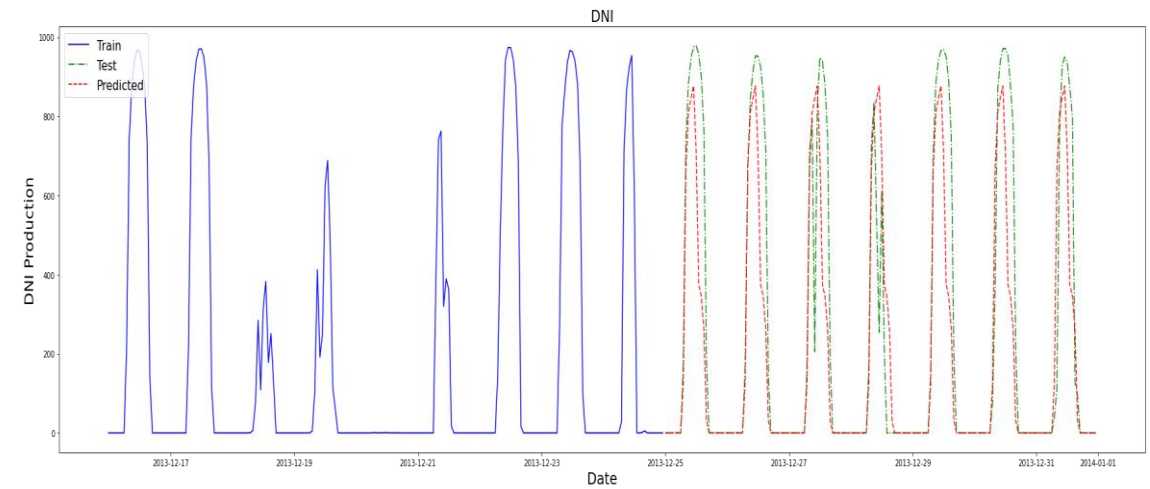
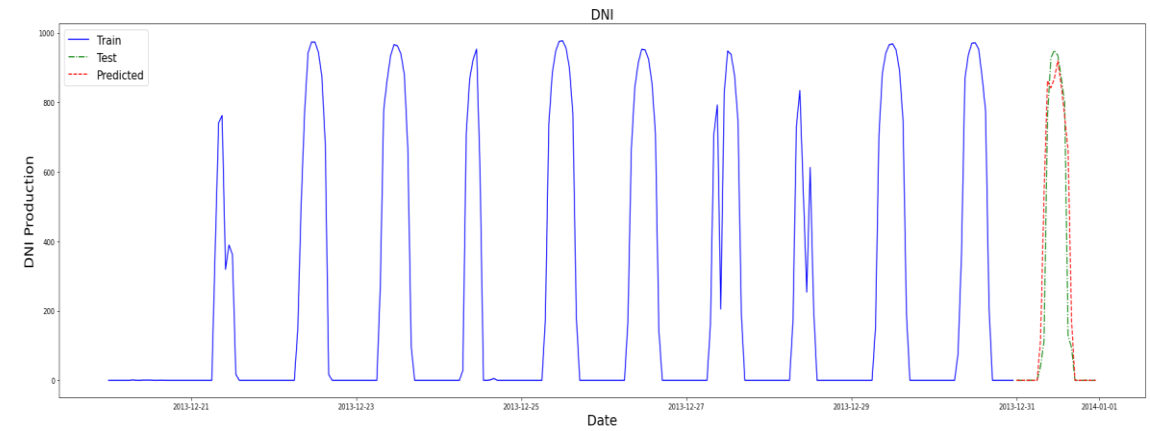
Seasonal Naïve



Average Seasonal Forecast

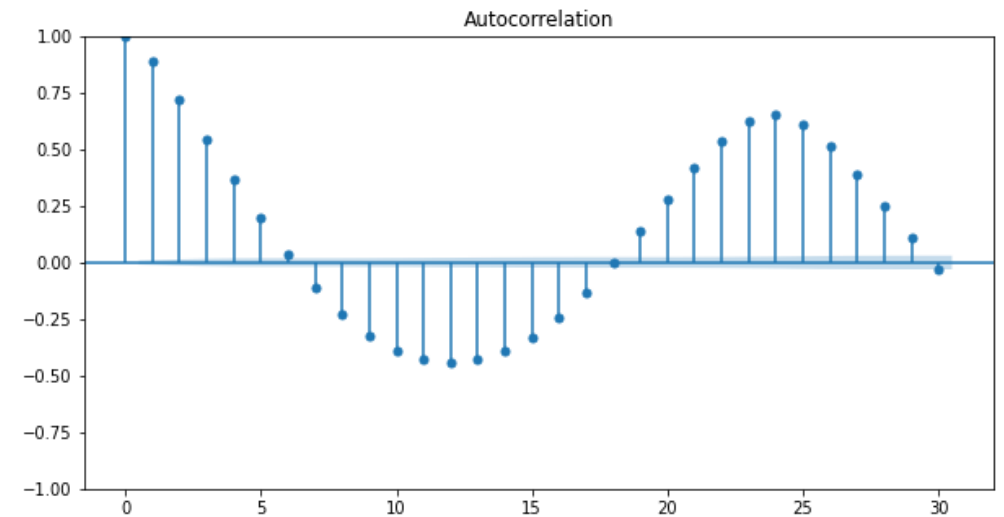
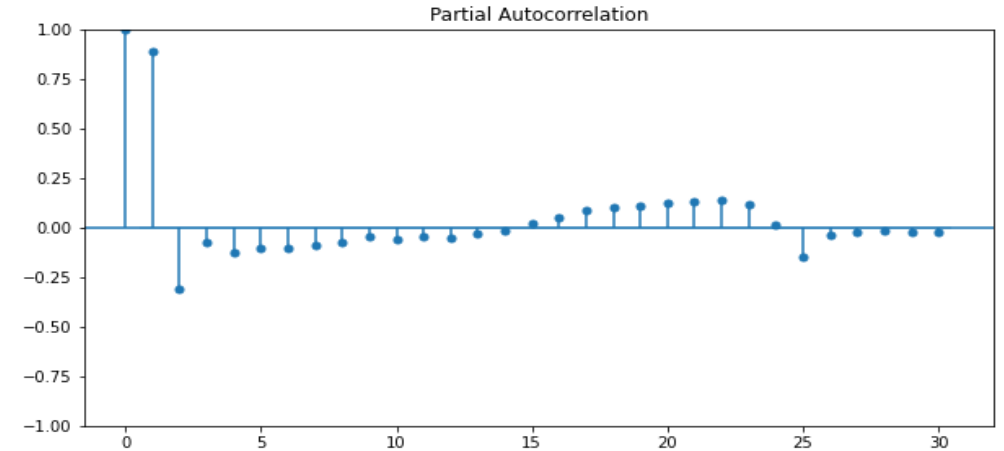


Triple Exponential Smoothing

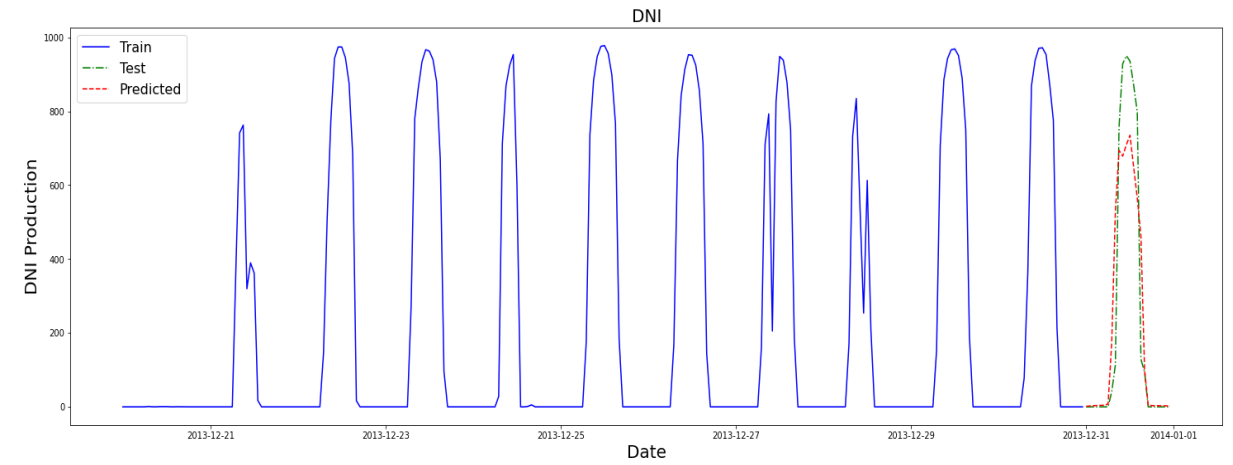
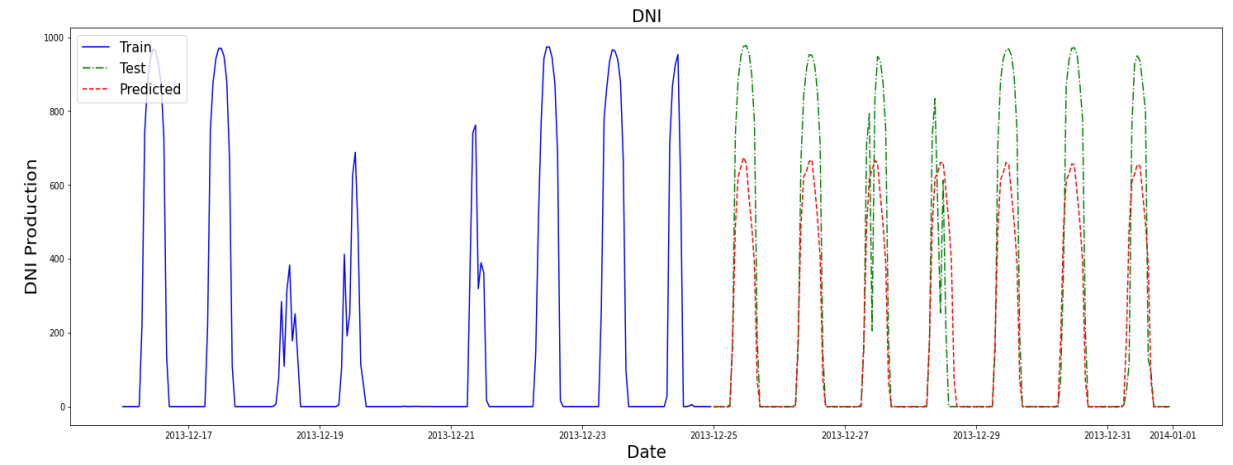


ACF and PACF

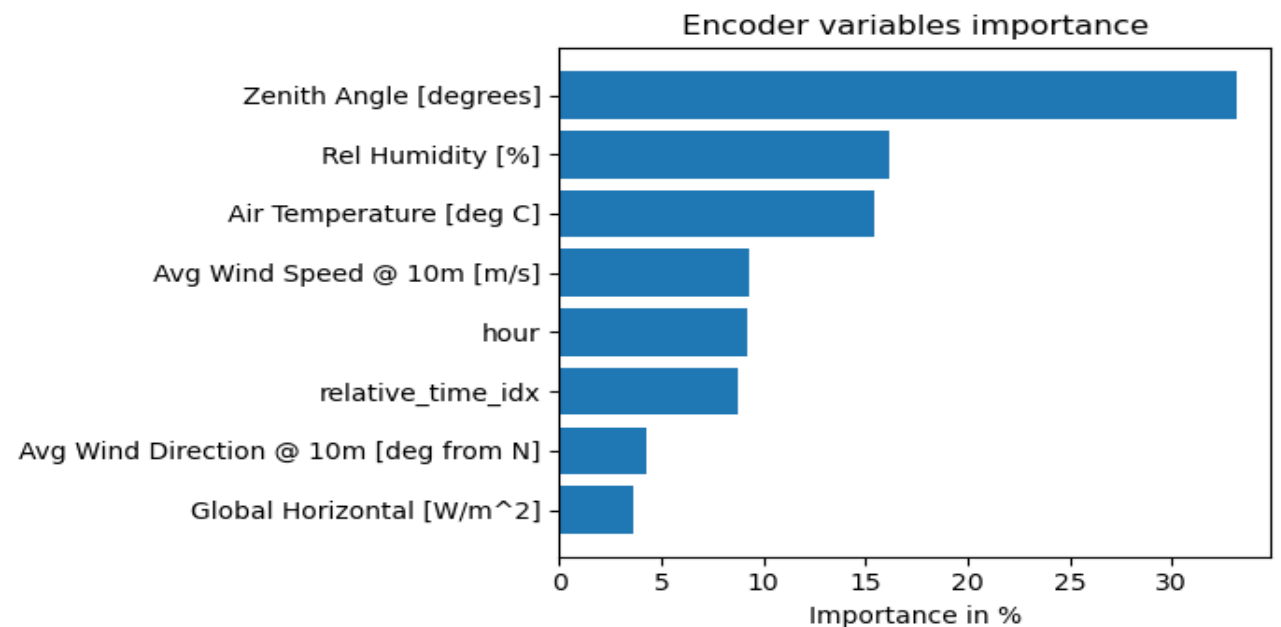
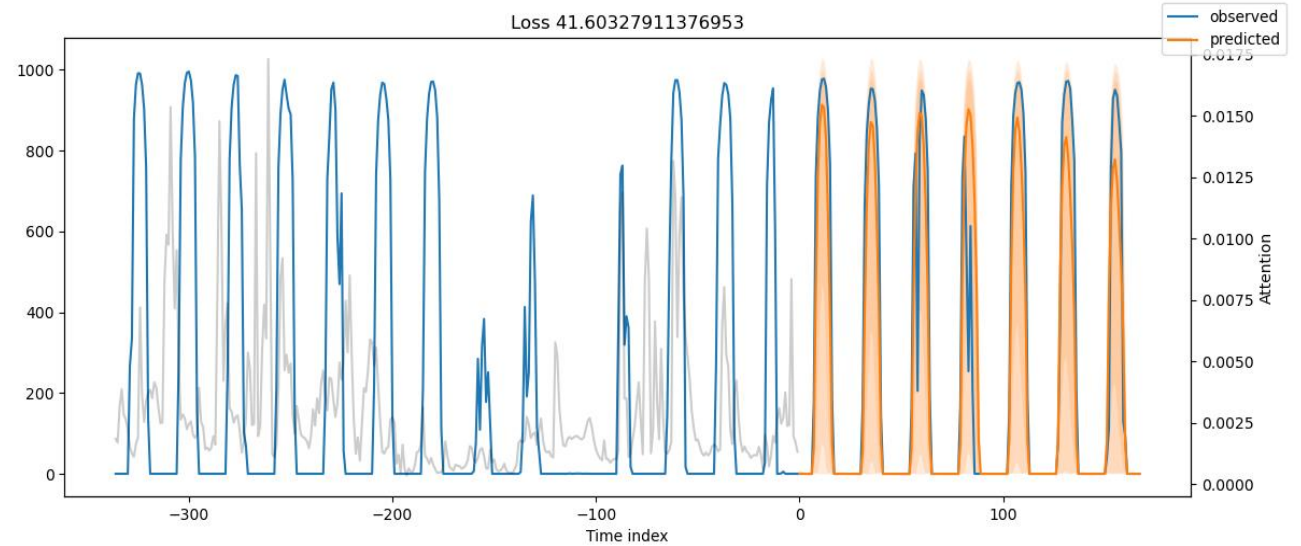
From autocorrelation and partial autocorrelation plots, identify the seasonal pattern of direct normal irradiance



SARIMAX



Temporal Fusion Transformer



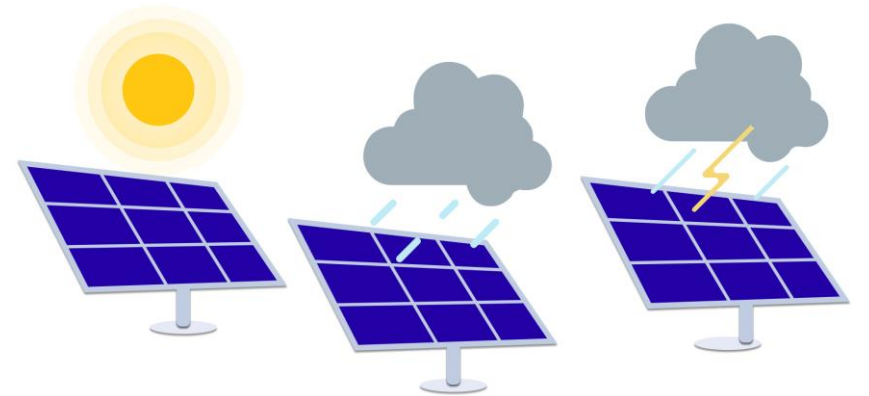


Model Comparison

Model	RMSE of a day ahead forecast	RMSE of a week ahead forecast
Naive	147.53	360.69
Seasonal Average	197.70	193.36
Tripple Exponential Smoothing	144.49	202.26
SARIMAX	154.13	181.81
TFT	180.57	159.75

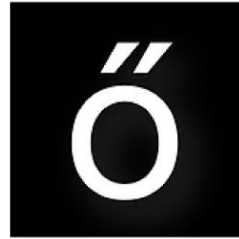
Future Work

- Incorporate weather and cloud cover data, which can be important features for forecasting direct normal irradiance.
- Develop a solar energy-based TFT Model that will give more attention to weather data.





Thank you!



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