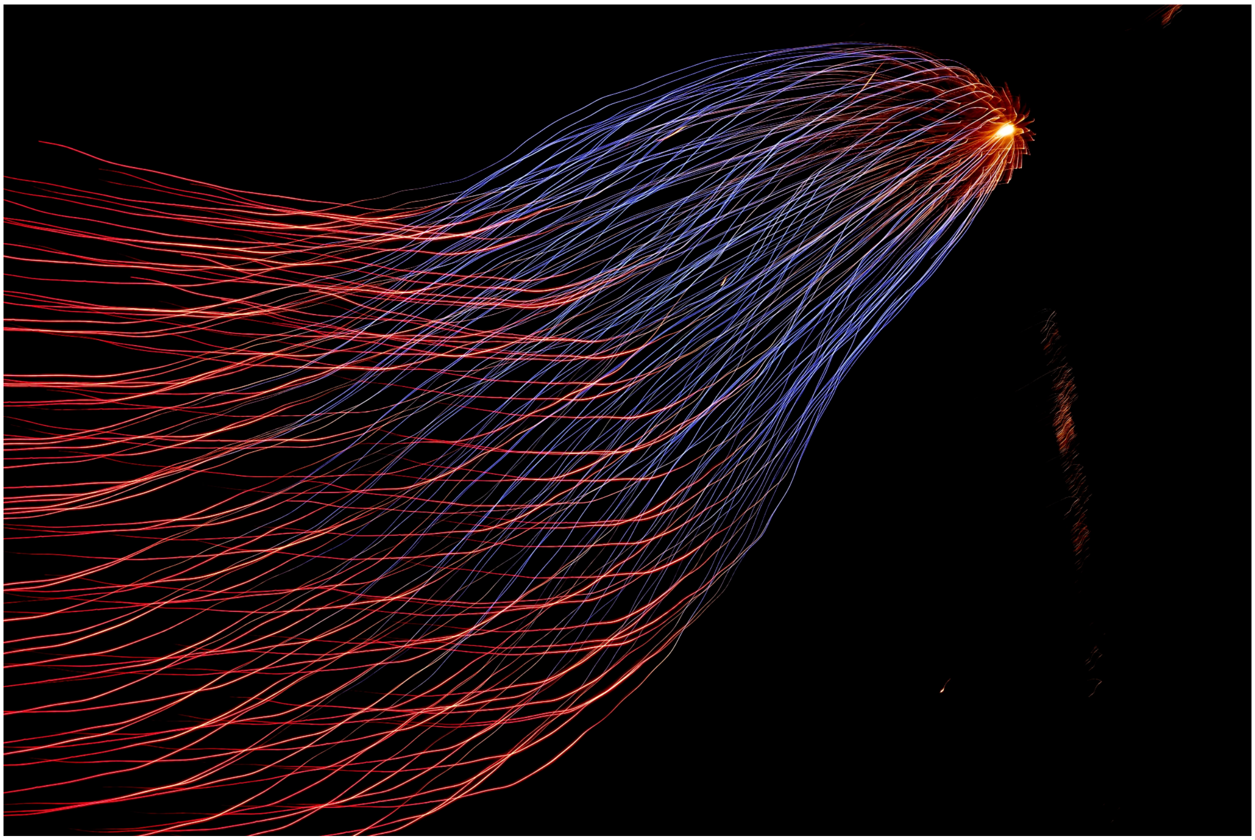
Building an ANN Regression Model

Predicting the Electrical Energy Output of a Combined Cycle Power Plant



Introduction

This report presents a case study on how to develop an Artificial Neural Network (ANN) regression model to predict the net hourly electrical energy output (EP) of a Combined Cycle Power Plant (CCPP). The goal is to utilize available hourly average ambient variables to create a data model that accurately forecasts the energy output. The project utilizes Tensorflow 2.0, a popular machine learning library, and Google Colab, a cloud-based notebook environment.

Purpose of the Project:

The main objective of this project is to build an ANN regression model that can effectively predict the net hourly electrical energy output of the CCPP.

By using ambient variables such as temperature, ambient pressure, relative humidity, and exhaust vacuum, the model aims to provide accurate predictions that can aid in optimizing the power plant's performance and energy generation.

Description of the Data:

The dataset used in this project contains 9568 data points collected over 6 years (2006-2011) when the Combined Cycle Power Plant was operating at full load.

The features of the dataset include hourly average ambient variables: Temperature (T), Ambient Pressure (AP), Relative Humidity (RH), and Exhaust Vacuum (V).

The target variable is the net hourly electrical energy output (EP) of the plant.

- Temperature (T) in the range of 1.81°C and 37.11°C,
- Ambient Pressure (AP) in the range 992.89-1033.30 millibar,
- Relative Humidity (RH) in the range 25.56% to 100.16%
- Exhaust Vacuum (V) in the range 25.36-81.56 cm Hg
- Net hourly electrical energy output (EP) 420.26-495.76 MW

A Sample from the Data:

Here is a small sample from the dataset that shows the values of the ambient variables and the corresponding net hourly electrical energy output:

	AT	V	AP	RH	PE
0	14.96	41.76	1024.07	73.17	463.26
1	25.18	62.96	1020.04	59.08	444.37
2	5.11	39.40	1012.16	92.14	488.56
3	20.86	57.32	1010.24	76.64	446.48
4	10.82	37.50	1009.23	96.62	473.90
5	26.27	59.44	1012.23	58.77	443.67
6	15.89	43.96	1014.02	75.24	467.35
7	9.48	44.71	1019.12	66.43	478.42
8	14.64	45.00	1021.78	41.25	475.98
9	11.74	43.56	1015.14	70.72	477.50

Building the ANN Model:

The process of building the ANN regression model involves several steps

Part 1: Data Preprocessing:

- ❖ Importing the dataset and necessary libraries.
- ❖ Splitting the dataset into the training set and test set for model evaluation.

Part 2: Building an ANN:

- ❖ Initializing the ANN model using Tensorflow 2.0.
- ❖ Adding the input layer and the first hidden layer to the model.
- ❖ Adding the output layer to the model.
- ❖ Compiling the ANN model with appropriate optimizer and loss function.

Part 3: Training the ANN:

- ❖ Training the ANN model on the training set to learn the patterns in the data.
- ❖ Predicting the results on the test set to evaluate the model's performance.

Summary and Citations:

In conclusion, this case study demonstrates how to build an ANN regression model to predict the net hourly electrical energy output of a Combined Cycle Power Plant.

By leveraging hourly average ambient variables, the model can offer valuable insights for optimizing the plant's energy generation.

The dataset used in this study is sourced from the UCI Machine Learning Repository and is licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) license.

Citation details are as follows:

- Tfekci, Pnar and Kaya, Heysem. (2014). Combined Cycle Power Plant. UCI Machine Learning Repository. https://doi.org/10.24432/C5002N.
- Photo by Hunter Harritt on Unsplash

With the completed ANN model, this study contributes to the ongoing efforts of enhancing energy efficiency and sustainable power generation in Combined Cycle Power Plants.