Combined Cycle Power Plant: Gradient-Descent

Abstract: -

This chapter deals with the theory behind power plants with particular reference to [cogeneration](https://www.sciencedirect.com/topics/engineering/cogeneration) and combined cycle power plants (CCPPs). The two key cycles are the Brayton (gas turbine) and [Rankine](https://www.sciencedirect.com/topics/engineering/rankine) (steam turbine) cycles, within each of which there are further subdivisions. A combination of the Brayton and Rankine cycles, often known as the combined cycle, has been found to obtain efficiencies as high as 60% and consequently is now used extensively worldwide as the main source of power. It is also more commonly being used in [combined heat and power](https://www.sciencedirect.com/topics/engineering/combined-heat-and-power) (CHP) plants that provide power and other sources of energy such as heat and air conditioning for major complexes or parts of cities. The chapter also deals with availability and reliability of major power plants and with power plant emissions and techniques to contain the emissions from these plants.

Introduction: -

A combined cycle power plant (CCPP) is composed of gas turbines (GT), steam turbines (ST) and heat recovery steam generators. In a CCPP, the electricity is generated by gas and steam turbines, which are combined in one cycle, and is transferred from one turbine to another. While the Vacuum is colected from and has effect on the Steam Turbine, he other three of the ambient variables effect the GT performance. In this Project we are Implementing the Gradient Descent and also using Inbuilt Gradient Descent Regressor on the Combined Cycle Power Plant Dataset to predict its output.

### Combined-cycle power plants: -

Combined-cycle power plants (Fig. 2.3) are compound gas turbine–steam [turbine](https://www.sciencedirect.com/topics/engineering/turbine) systems wherein the extreme hot exhaust from a gas turbine is employed to run a boiler, and the steam thus produced is fed into a [steam turbine](https://www.sciencedirect.com/topics/engineering/steam-turbines) to generate power.

Diagram

Description automatically generated

Dataset: -

The dataset contains 9568 data points collected from a Combined Cycle Power Plant over 6 years (2006-2011), when the power plant was set to work with full load. Features consist of hourly average ambient variables Temperature (T), Ambient Pressure (AP), Relative Humidity (RH) and Exhaust Vacuum (V) to predict the net hourly electrical energy output (EP) of the plant.

Attribute Information: -

Features consist of hourly average ambient variables

- Temperature (T) in the range 1.81°C and 37.11°C,

- Ambient Pressure (AP) in the range 992.89-1033.30 milibar,

- Relative Humidity (RH) in the range 25.56% to 100.16%

- Exhaust Vacuum (V) in teh range 25.36-81.56 cm Hg

- Net hourly electrical energy output (EP) 420.26-495.76 MW

The averages are taken from various sensors located around the plant that record the ambient variables every second. The variables are given without normalization.

Machine Learning Algos Involved: -

Gradient Boosting Regressor: -

This framework was further developed by Friedman and called Gradient Boosting Machines. Later called just gradient boosting or gradient tree boosting. The statistical framework cast boosting as a numerical optimization problem where the objective is to minimize the loss of the model by adding weak learners using a gradient descent like procedure.

Graphical user interface

Description automatically generated

Steps Involved: -

1. Importing the Libraries

2. Importing the data

3. Data Pre-processing

4. EDA

5. Study Correlation

6. Extensive Plotting

7. Feature Scaling

8. Build the model

Libraries used: -

1.Pandas

2.Numpy

3.Matplotlib

4.Scikit-learn

5.Seaborn