

Webinar on

# Intelligent Power Systems : Exploring the Application of Machine Learning

Organized by  
IEEE IIUC PES Student Branch Chapter



Speaker

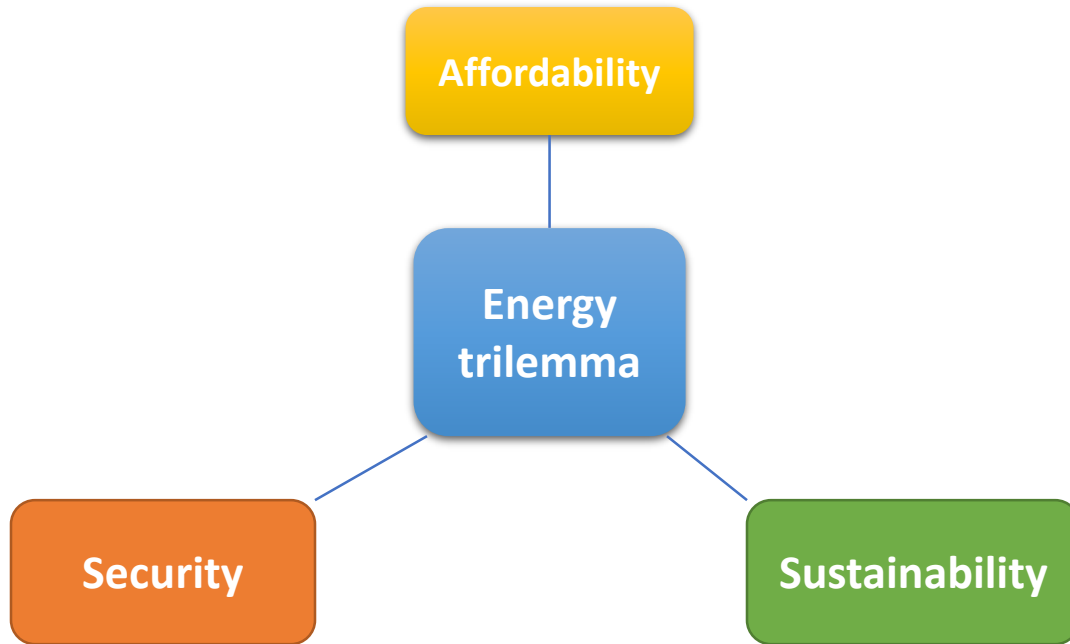
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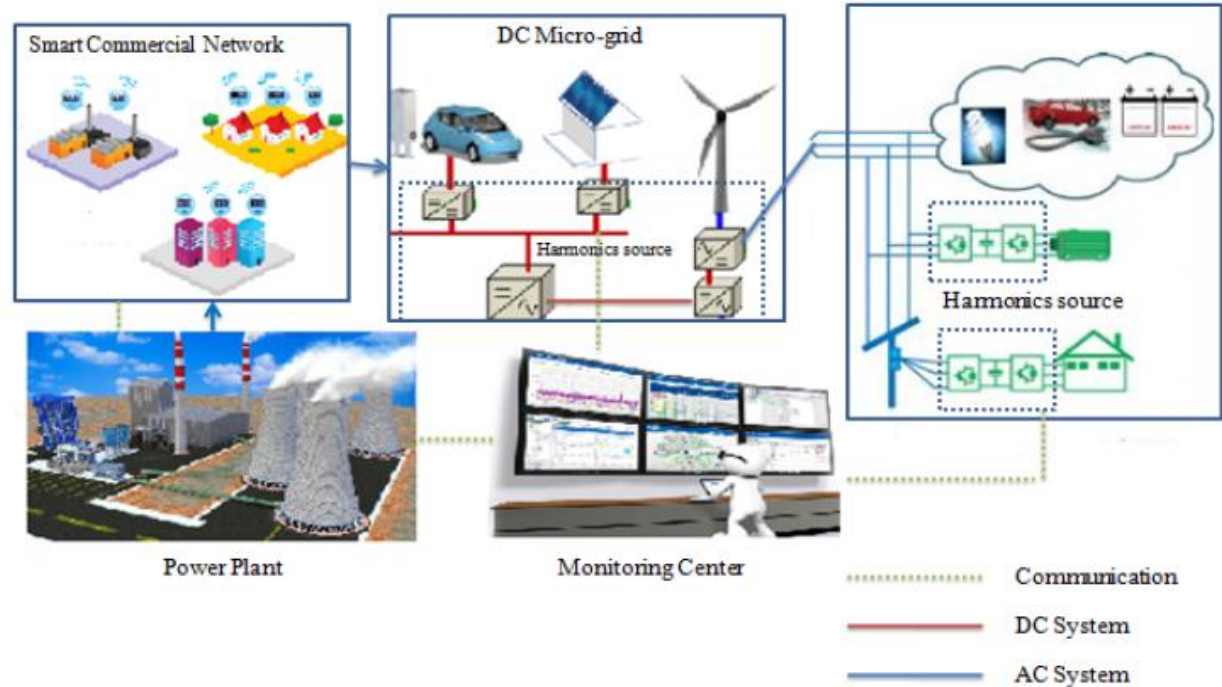
# Future Electrical Energy Networks



# Future Electrical Energy Networks

## Modern Power System

Modern power systems include various technological innovations such as distributed renewable energy sources, energy storage devices, electric vehicle charging stations and advanced communication

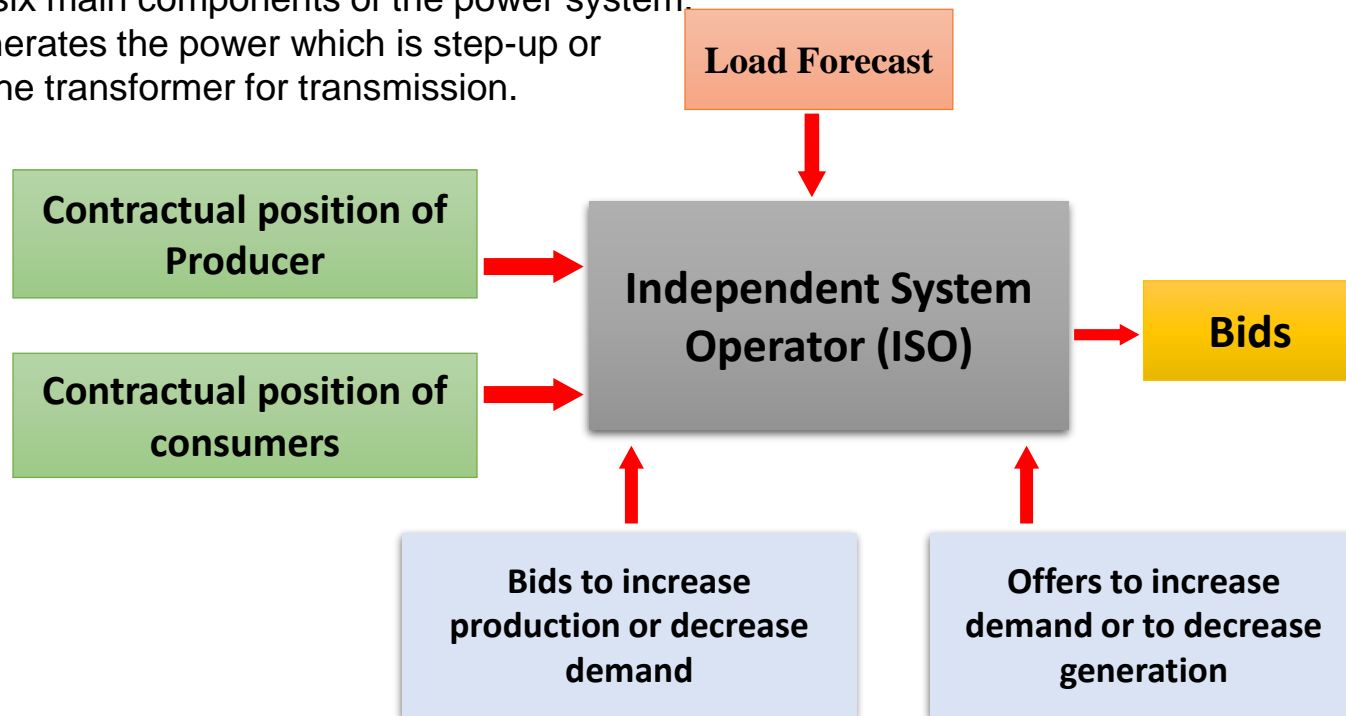


# Future Electrical Energy Networks

## Structure of Modern Power System Operation

The power plant, transformer, transmission line, substations, distribution line, and distribution transformer are the six main components of the power system.

The power plant generates the power which is step-up or step-down through the transformer for transmission.

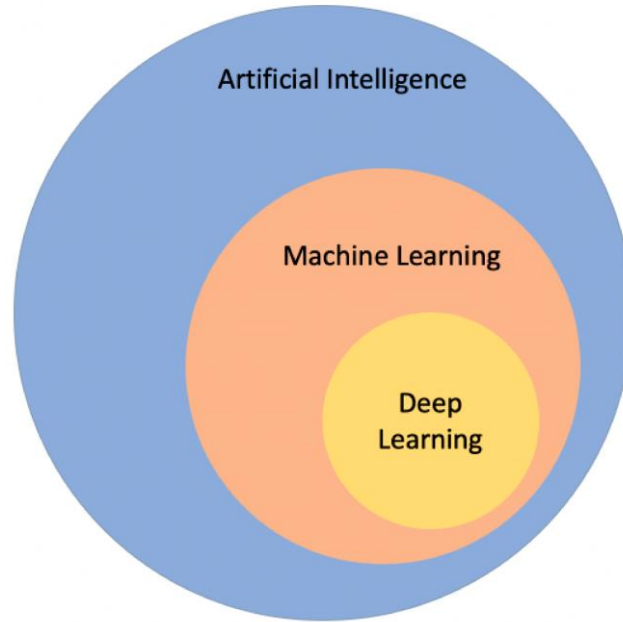


# MACHINE LEARNING



# AI, ML, DL

Artificial Intelligence (AI) deals with the broad topic related to the perception and extraction of knowledge from data. **AI can be divided into two main subsets: machine learning and deep learning.** Machine learning is the main subset of artificial intelligence, while deep learning can be represented as a subset of machine learning.



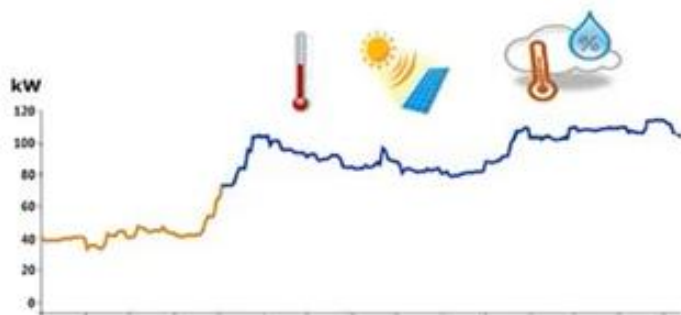


# Machine Learning

- Machine learning is the subset of AI that deals with the extraction of knowledge from the experience by analyzing and manipulating data gathered from real-world use cases.
- The primary purpose of machine learning is to develop reliable active learning models equipped with computerized patterns learning from raw data and perform fast-response predictions applied in decision-making processes

- AI enables technical systems to perceive their environment, deal with what they perceive, solve problems and act to achieve a specific goal. The computer receives data - already prepared or gathered through its own sensors such as a camera - processes it and responds.

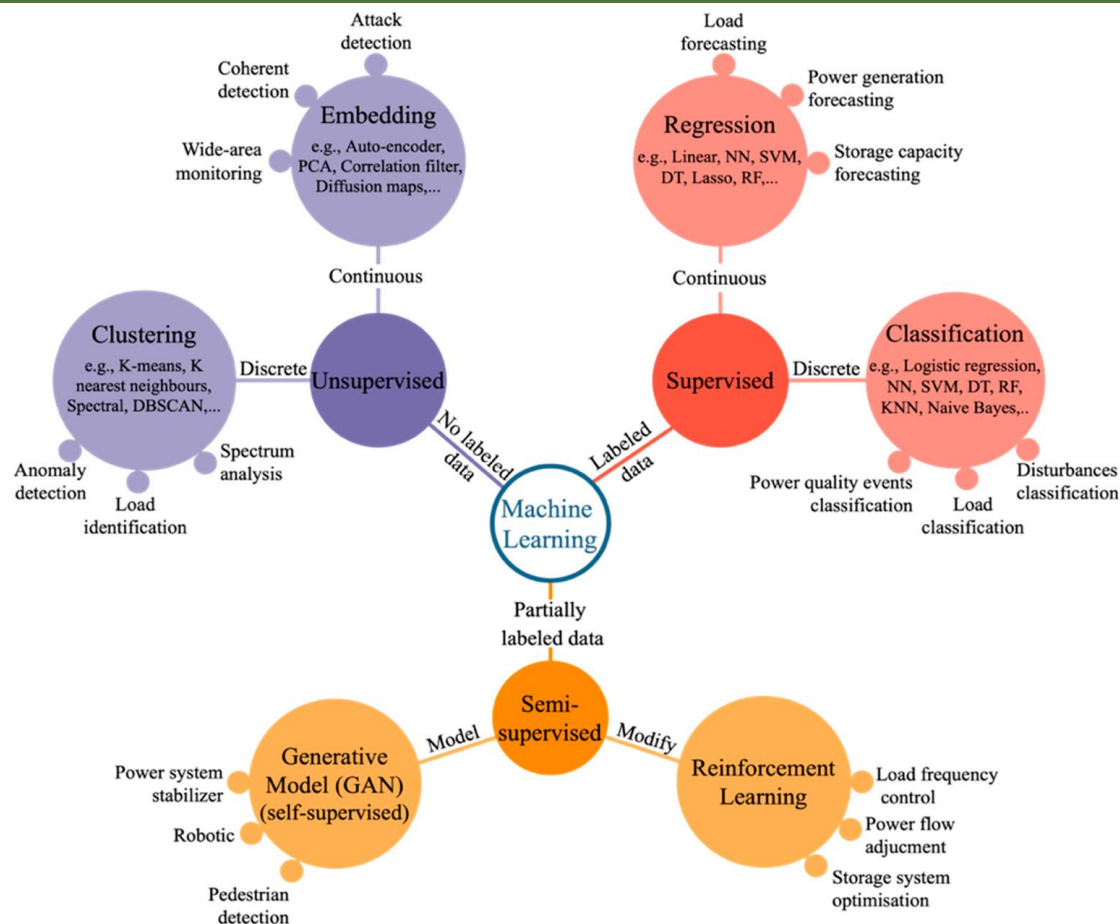
## MACHINE LEARNING IN POWER SYSTEMS



### Predictive Analytics:

- Load forecasting
- Generation forecasting
- Load disaggregation
- Condition-based monitoring

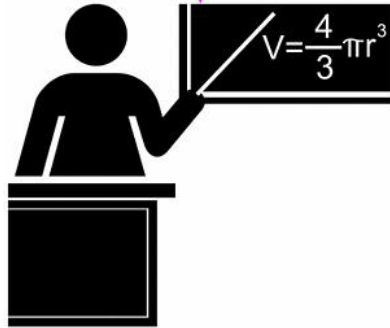
# Machine learning paradigms, algorithms, and applications in power systems.



# Supervised, Unsupervised, Reinforcement Learning

## Machine Learning

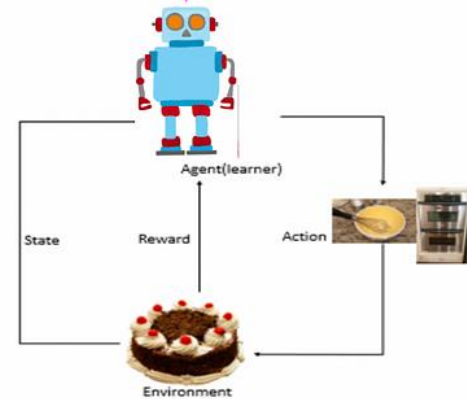
There are three main groups of algorithms in ML



Supervised Learning

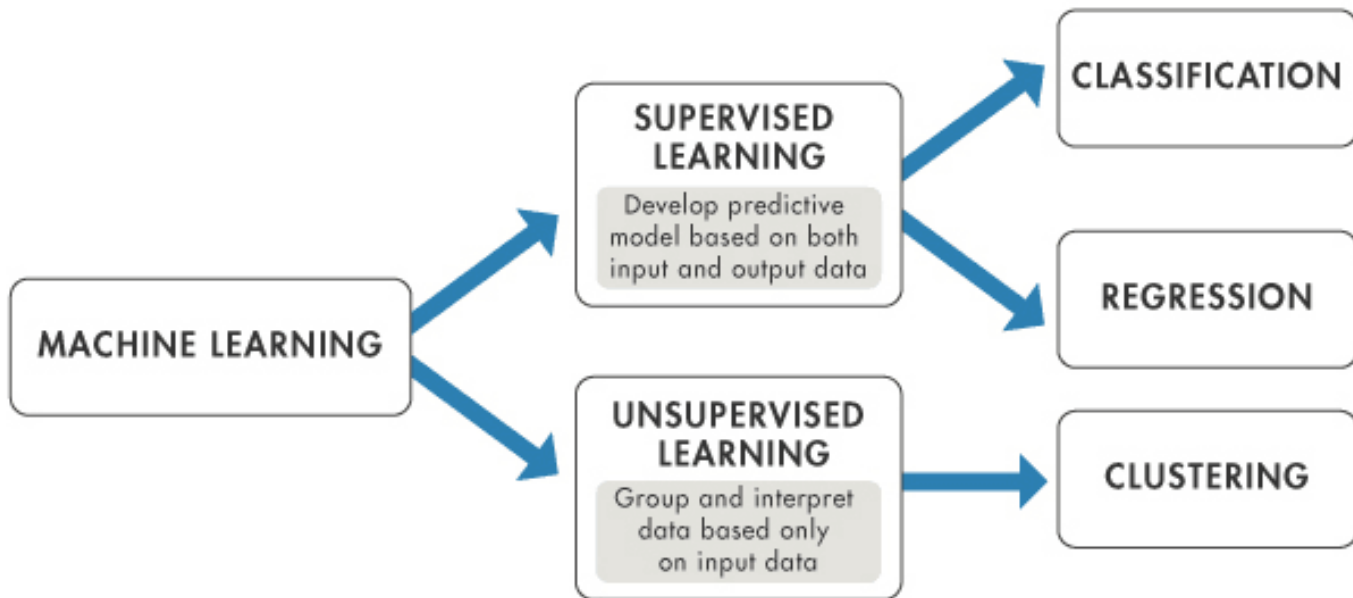


Unsupervised Learning



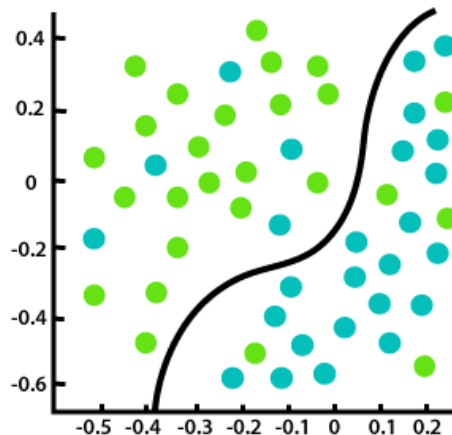
Reinforcement Learning

# Supervised, Unsupervised, Reinforcement Learning

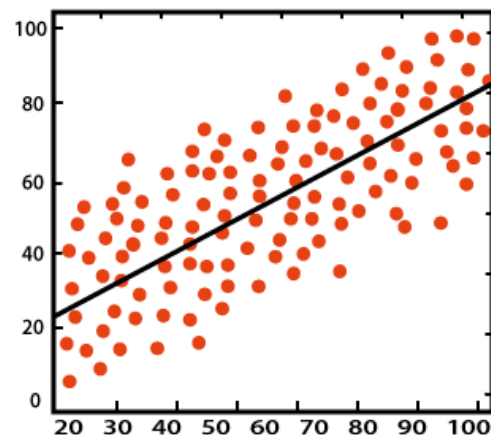


# Supervised, Unsupervised, Reinforcement Learning

The main difference between Regression and Classification algorithms that Regression algorithms are used to predict the continuous values such as price, salary, age, etc. and Classification algorithms are used to predict/Classify the discrete values such as Male or Female, True or False, Spam or Not Spam, etc.



Classification

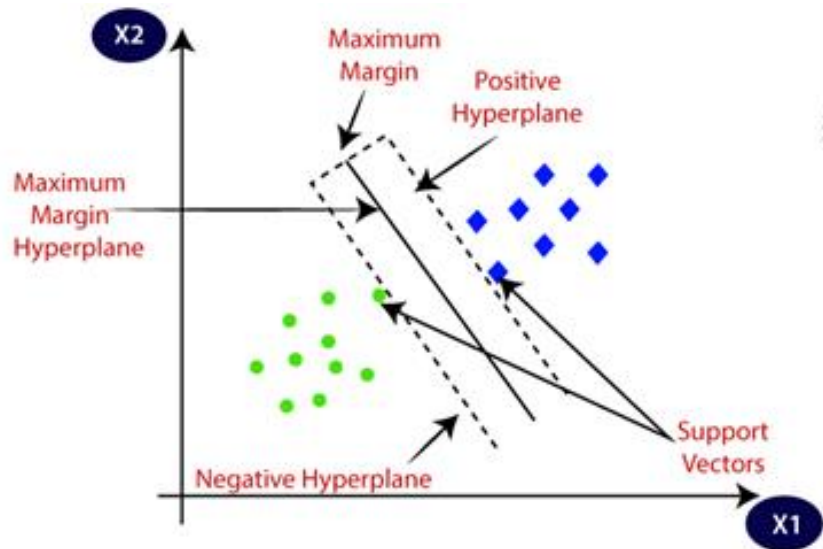


Regression

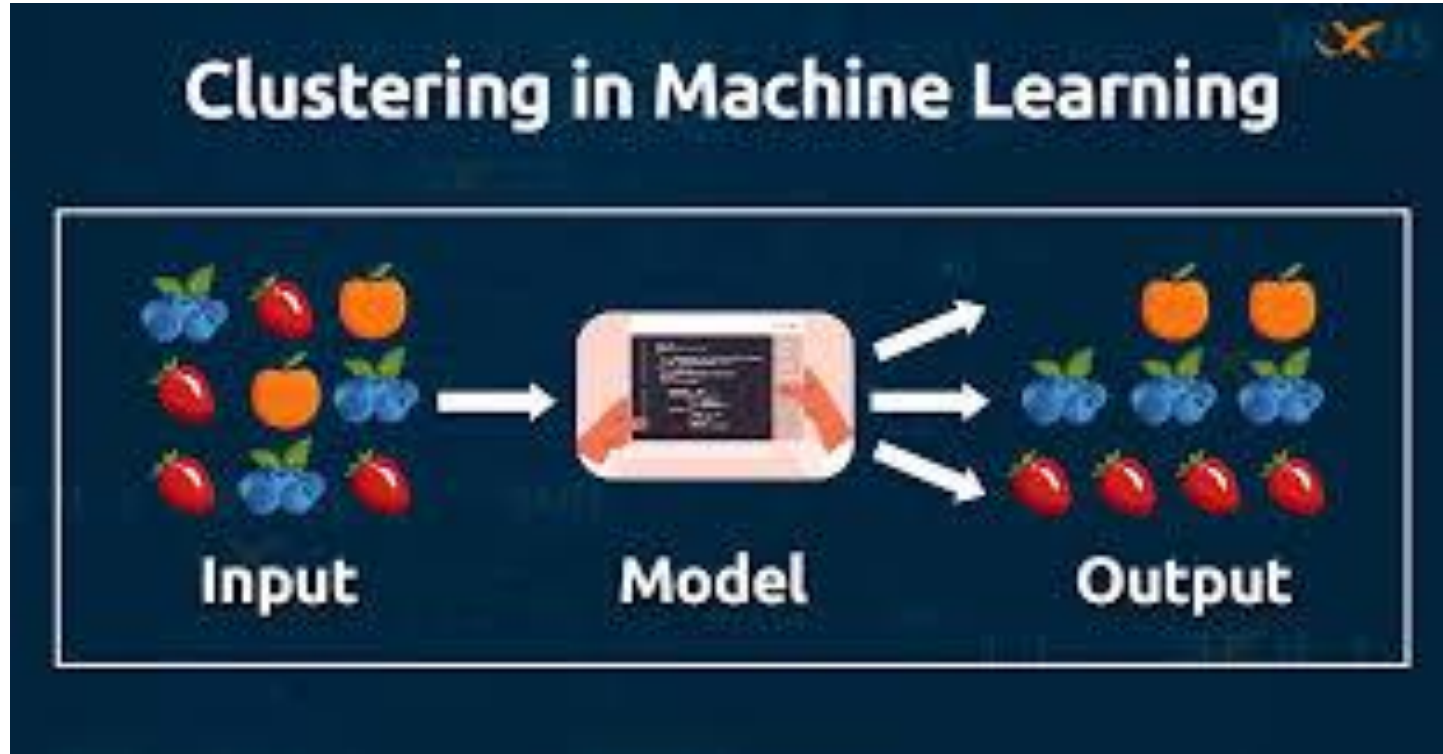
# Support Vector Machine (SVM)

**Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems.**

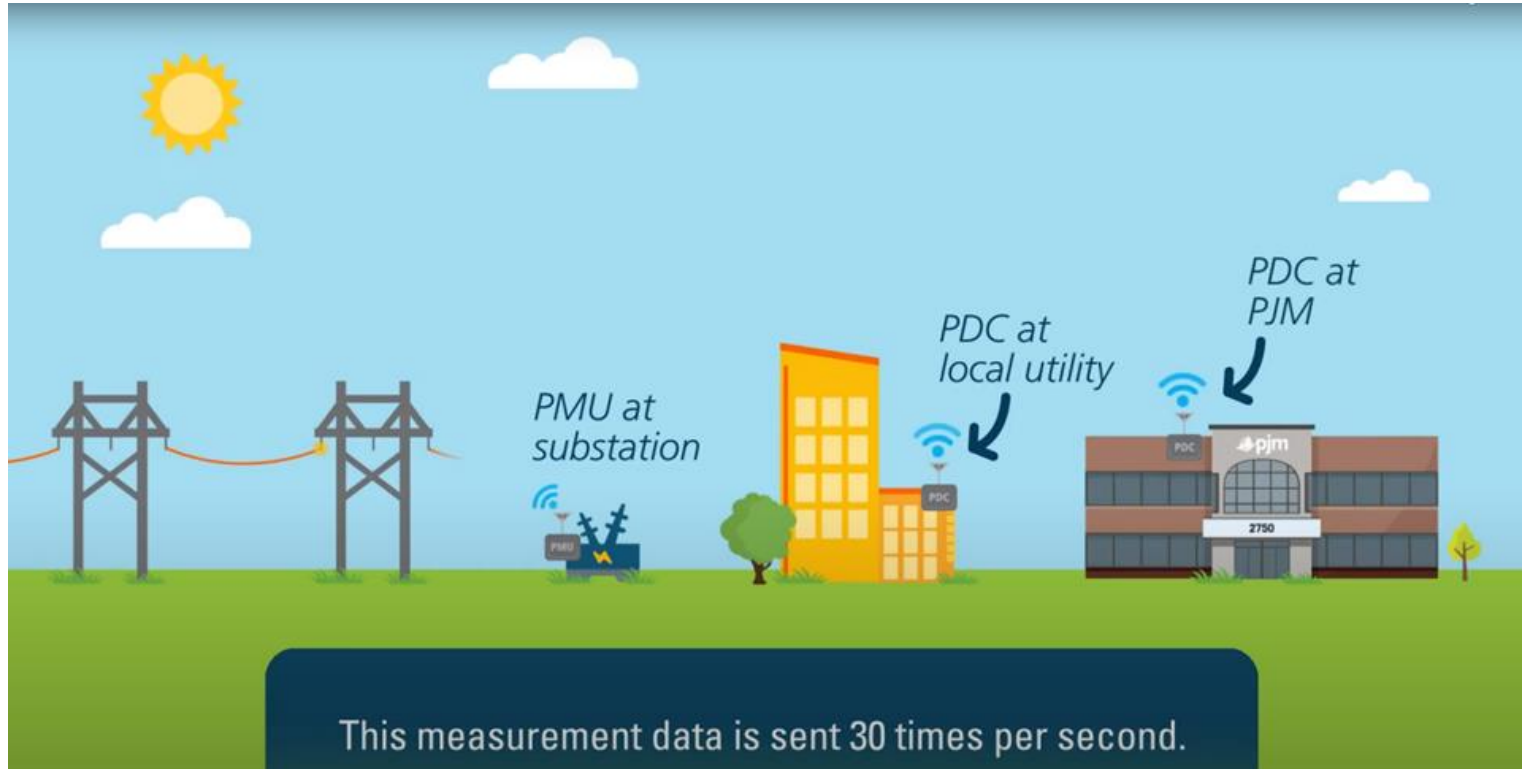
**SVM is a powerful supervised algorithm that works best on smaller datasets but on complex ones**



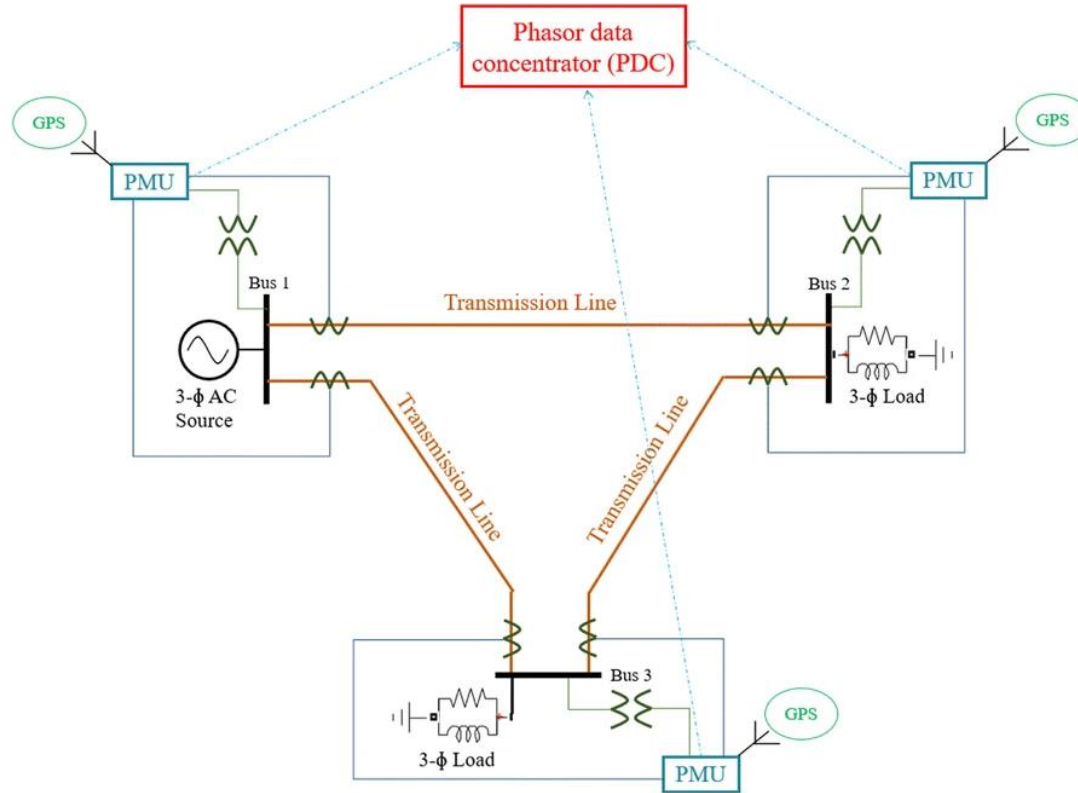




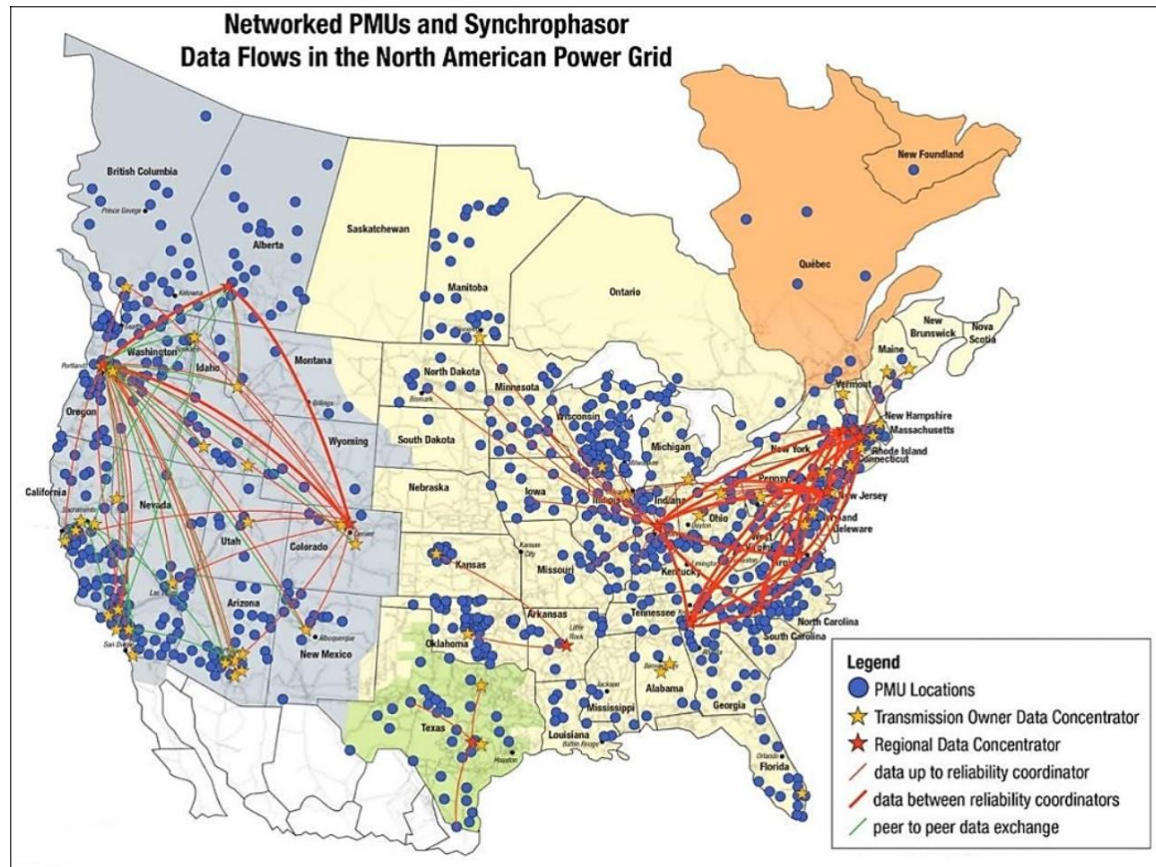
# Synchrophasor / PMUs – Phasor Measurement Unit system



# Single line diagram of three-bus model



# North America Synchrophasor Network



**The main state of art of machine learning-based applications in power systems are in power flow, power quality, photovoltaic system, intelligent transportation, and load forecasting.**

## **Power Flow Applications**

Compared to traditional algorithms, machine learning technologies make power flow problems easier to be handled. For example, algorithms like CNN, KNN, SVM, reinforcement learning, and decision tree affected power flow optimization problems in terms of accuracy, computational speed, and response time.

## Power Quality Applications

The power quality, one of the most critical topics in electrical systems, has also been affected by machine learning, which can be used to improve speed and accuracy in disturbances detection, or distortions classification, and estimations for future cycles. In addition, ML can also be used on a wide set of PQ parameters related to load functioning such as active power, reactive power, complex power, fundamental frequency, and power factor.

## Photovoltaic System Applications

Machine learning algorithms have been widely used for different purposes in Photovoltaic (PV), **from forecasting the long-, medium-, and short-term energy generation, to fault detection and classification.**

## Load Forecasting Applications

Accurate load forecasting, both short- and long-term, is an essential task for the daily (economic) dispatching of electricity, both to prevent **wasting energy production and integrating renewable energy resources. Energy companies monitor, control, and schedule load demands and power generation** to enhance energy management systems.

# Want to see how blackout happen?



# What is an Electrical blackout/?

**An electrical blackout occurs when there's a complete mains power supply failure. It is caused by an imbalance between power generation and consumption**

১. শূন্য থেকে পাইথন মেশিন লার্নিং
২. হাতে কলমে মেশিন লার্নিং
৩. হাতে কলমে পাইথন ডিপ লার্নিং
৪. হাতে কলমে বাংলা ন্যাচারাল ল্যাঙ্গুয়েজ প্রসেসিং

