1.Summary of the Paper

- **Title**: Charging Strategies for Electric Vehicles Using a Machine Learning Load Forecasting Approach for Residential Buildings in Canada
- **Paper Name**: (Applied Sciences_2024_Charging Strategies for Electric Vehicles Using a Machine Learning Load Forecasting Approach for Residential Buildings in Canada)
- **Authors**: Ahmad Mohsenimanesh (Corresponding Author), Evgueniy Entchev
- **Journal**: Applied Sciences
- **Publisher**: None
- **Published Year**: 2024
- **Workflow/Process**: The study involves analyzing the aggregated charging power of EVs during peak residential demand periods, focusing on three proposed charging strategies to mitigate peak load issues.
- **Methodology**: A hybrid machine learning approach is utilized, combining similar day selection, complete ensemble empirical mode decomposition with adaptive noise (CEEMDAN), and deep neural networks to forecast load and optimize charging strategies.
- **Approaches**: The paper proposes three charging strategies: Overnight Charging, Workplace/Other Charging Sites, and a combination of both, aimed at reducing peak electricity demand and costs.
- **Source**: The study is based on data collected from 1000 EVs across nine provinces in Canada.
- **Dataset**: The dataset includes charging loads for thirty-five vehicle models, charging locations, and levels.
- **Dataset Availability**: The dataset is not explicitly stated as open-accessible.
- **Dataset Source Link**: Sorry, can't generate citation of the paper due to insufficient data.
- **Research Gaps**: The paper identifies the need for effective charging strategies to address the challenges posed by the rapid expansion of the EV market and its impact on energy infrastructure.
- **Research Key Findings**: The proposed strategies can significantly reduce the Peak-to-Average Ratio (PAR) and energy costs during peak periods, with reductions of approximately 54% and 56% in spring and winter, respectively.
- **Paper's Results/Output**: The Overnight Workplace/Other Charging Sites strategy showed PAR values approximately half those of the predicted load profile, indicating effective load management and cost reduction during peak times .

2. **Summary of the Paper**

- **Title**: Electric Vehicle Charging Demand Prediction Model Based on Spatiotemporal Attention Mechanism
- **Paper Name**: (MDPI_2025_Electric Vehicle Charging Demand Prediction Model Based on Spatiotemporal Attention Mechanism)
- **Authors**: Yang Chen, Zeyang Tang, Yibo Cui, Wei Rao, Yiwen Li
- **Journal:** Energies
- **Publisher:** MDPI
- **Published Year**: 2025
- **Workflow/Process**:
    - The study begins by analyzing correlations between urban regions to establish coupling relationships.
    - The FastDTW algorithm constructs an adjacency matrix to capture spatiotemporal correlations.
    - The ASTGCN model is then applied to predict power load accurately.
- **Methodology**:
    - Integration of dynamic time warping (DTW) with a spatial-temporal attention graph convolutional neural network (ASTGCN) to enhance prediction accuracy.
- **Approaches**:
    - Utilizes a spatiotemporal attention mechanism to focus on significant features across different urban areas.
    - Employs wavelet decomposition and attention mechanisms to extract deep data information.
- **Source**: Not specified
- **Dataset**: Not specified
- **Dataset Availability/Public/Open-accessible**: Not specified
- **Dataset Source Link**: Not specified
- **Research Gaps**:
    - Existing methods primarily focus on temporal dependencies, often overlooking spatial heterogeneity in urban functional zones.
- **Research Key Findings**:

- The proposed model effectively couples spatial, feature, and temporal dimensions, facilitating information exchange among regions.

- **Paper's Results/Output**:
  - The model demonstrates improved accuracy in predicting charging demand by capturing spatiotemporal characteristics of power load .

3. **Summary of the Paper**

- **Title**: Electric Vehicle Charging Load Demand Forecasting in Different Functional Areas of Cities with Weighted Measurement Fusion UKF Algorithm
- **Paper Name**: (Energies_2024_Electric Vehicle Charging Load Demand Forecasting in Different Functional Areas of Cities with Weighted Measurement Fusion UKF Algorithm)
- **Authors**: Minan Tang (Corresponding Author), Xi Guo, Jiandong Qiu, Jinping Li, Bo An
- **Journal**: Energies
- **Publisher**: None
- **Published Year**: 2024
- **Workflow/Process**:
  - The paper analyzes urban EV charging patterns, develops a load demand forecasting model, and validates the proposed strategy through simulation experiments.
- **Methodology**:
  - Utilizes data from OpenStreetMap and Amap for urban POI distribution analysis, applies travel chain theory, and employs the Improved Floyd algorithm for optimal routing.
- **Approaches**:
  - Introduces a weighted measurement fusion unscented Kalman filter (WMF-UKF) to enhance prediction accuracy by integrating multi-source data for detailed spatial-temporal load demand forecasting.
- **Source**:

    - The paper addresses delays, uncertainties, and nonlinearity in urban EV charging, impacting load demand forecasting accuracy.
- **Dataset**:
    - Data collected from OpenStreetMap and Amap.
- **Dataset Availability/Public/Open-Accessible**:
    - Not specified.
- **Dataset Source Link**:
    - Not provided.
- **Research Gaps**:
    - The paper identifies issues in forecasting accuracy due to uneven spatial and temporal distribution of EV charging demand.
- **Research Key Findings**:
    - The proposed WMF-UKF model significantly improves peak hour prediction accuracy, with enhancements of 53.53% for the first peak and 23.23% for the second peak.
- **Paper's Results/Output**:
    - The results validate the WMF-UKF model's effectiveness in forecasting EV load demand, supporting grid operations and management .

4. **Summary of the Paper**

- **Title**: Electric vehicle charging station demand prediction model deploying data slotting
- **Paper Name**: (Renewable and Sustainable Energy Reviews_2024_Electric vehicle charging station demand prediction model deploying data slotting)
- **Authors**: A V Sreekumar, R R Lekshmi
- **Journal**: Renewable and Sustainable Energy Reviews
- **Publisher**: None
- **Published Year**: 2024

Workflow/Process (in detail):

- The study identifies the complexities in predicting electric vehicle charging station (EVCS) demand due to various factors such as vehicle attributes and external conditions. It employs data-slotting during the pre-processing stage to enhance prediction accuracy by minimizing non-linearities in the dataset.

Methodology:

- The research utilizes machine learning techniques, specifically Random Forest, Categorical Boosting, Extreme Gradient Boosting, and Light Gradient Boosting models, to forecast EVCS demand based on different feature combinations.

Approaches (in detail):

- Four distinct datasets are created, combining average and total demands as predictors and responses. The study emphasizes the importance of data-slotting (1-h, 2-h, 3-h, and 4-h) to frame feature vectors, with the 4-h slot showing the least variance.

Source:

- The paper is sourced from the journal Renewable and Sustainable Energy Reviews.

Dataset:

- The dataset comprises historical EVCS demand data, which is complicated and exhibits non-linear characteristics.

Dataset Availability/Public/Open-Accessible:

- The dataset's availability is not specified as public or open-accessible.

Dataset Source Link:

- Sorry, can't generate citation of the paper due to insufficient data.

Research Gaps:

- The study identifies gaps in existing literature regarding the unpredictability of EV charging behavior, conventional data pre-processing techniques, and the lack of comparative analysis among various prediction models.

Research Key Findings:

- The Categorical Boosting Regression model is recommended for its superior performance, achieving the least mean absolute error, mean square error, and root mean square error.

Paper's Results/Output:

- The model demonstrates significant advantages for charging station operators by enhancing operational efficiency and aiding in resource and cost management through strategic planning. The energy demand patterns are highly variable, with notable peaks and troughs observed in the data .

5. **Summary of the Given Paper**

- **Title**: Enhanced Load Forecasting for Electric Vehicle Charging Stations Using a Hybrid Random Forest-Convolutional Neural Network Algorithm
- **Paper Name**: (Information_2022_Enhanced Load Forecasting for Electric Vehicle Charging Stations Using a Hybrid Random Forest-Convolutional Neural Network Algorithm)
- **Author**: Meng Zhang (Corresponding Author)
- **Journal**: Information
- **Publisher**: Not specified
- **Published Year**: 2022
- **Workflow/Process**: The research involved data preprocessing, feature selection, model training, and predictive evaluation. The study utilized charging data from 15 public electric vehicle charging stations during the second quarter of 2022 for validation.
- **Methodology**: The study proposed an RF-CNN algorithm combining random forest and convolutional neural network techniques to enhance prediction accuracy and efficiency in load forecasting.

- **Approaches**: The RF-CNN algorithm effectively extracts key features from load data and learns spatial and temporal characteristics through multi-layer convolution and pooling operations.
- **Source**: doi|10.31449/inf.v48i19.6649
- **Dataset**: Data from 15 public electric vehicle charging stations.
- **Dataset Availability/Public/Open-accessible**: Not specified.
- **Dataset Source Link**: Not provided.
- **Research Gaps**: Traditional models exhibit low prediction accuracy and limited data types, failing to address uncertain EV user behavior and computational efficiency.
- **Research Key Findings**: The RF-CNN algorithm achieved a prediction accuracy of 92.71%, outperforming BP and LSTM models, with a training loss of 11.34% and an average response speed of 42 milliseconds.
- **Paper's Results/Output**: The model demonstrated higher accuracy and robustness in load forecasting, indicating significant application value in load analysis and prediction for electric vehicle charging stations.

6. **Summary of the Paper**

- **Title**: Optimizing Electric Vehicle (EV) Charging with Integrated Renewable Energy Sources: A Cloud-Based Forecasting Approach for Eco-Sustainability
- **Paper Name**: (Mathematics_2024_Optimizing Electric Vehicle (EV) Charging with Integrated Renewable Energy Sources: A Cloud-Based Forecasting Approach for Eco-Sustainability)
- **Authors**: Mohammad Aldossary (Corresponding Author), Hatem A Alharbi, Nasir Ayub
- **Journal**: Mathematics
- **Publisher**: None
- **Published Year**: 2024
- **Workflow/Process**:

    - The study integrates renewable energy data into EV charging station load management.
    - It employs SARLDNet for forecasting, enhancing predictive accuracy and reducing errors.
- **Methodology**:
    - Utilizes machine learning, fuzzy logic, and optimization algorithms.
    - Data integrity is ensured through meticulous handling of missing data and feature engineering.
- **Approaches**:
    - Introduces SARLDNet architecture combining LSTM, regularization, and dense output layers.
    - Employs empirical mode decomposition (EMD) for signal decomposition to identify temporal patterns.
- **Source**:
    - The paper discusses advancements in energy consumption management and demand forecasting for EV charging stations.
- **Dataset**:
    - Detailed EV charging station utilization data collected over 3.5 years from various locations in California.
- **Dataset Availability**:
    - The dataset is not explicitly stated as open-accessible.
- **Dataset Source Link**:
    - Sorry, can't generate citation of the paper due to insufficient data.
- **Research Gaps**:
    - The study highlights the need for improved forecasting methods in the context of increasing EV adoption and renewable energy integration.
- **Research Key Findings**:
    - SARLDNet achieved a mean absolute percentage error (MAPE) of 7.2%, RMSE of 22.3 kWh, and R^2 Score of 0.87, indicating superior accuracy compared to traditional models.
- **Paper's Results/Output**:
    - Validation of SARLDNet's effectiveness for real-world applications in EV infrastructure planning and energy management .

7. **Summary of the Paper**

- **Title**: Predicting EV Charging Demand in Renewable-Energy-Powered Grids Using Explainable Machine Learning
- **Paper Name**: (Sustainability_2025_Predicting EV Charging Demand in Renewable-Energy-Powered Grids Using Explainable Machine Learning)
- **Authors**: Jack Barkenbus, Nicoletta Matera, Taicheng Zhang, Qiao Peng, Shihong Zeng (Corresponding Author)
- **Journal**: Sustainability
- **Publisher**: None
- **Published Year**: 2025
- **Workflow/Process**: The study employs a high-resolution dataset to predict hourly EV charging demand, utilizing various machine learning models and SHAP for feature importance analysis.
- **Methodology**: Five machine learning models (XGBoost, random forest, LightGBM, CatBoost, and linear regression) were evaluated for predictive accuracy.
- **Approaches**: The study integrates explainable machine learning techniques, particularly SHAP, to interpret model predictions and understand feature contributions to EV charging demand.
- **Source**: The research is based on data from California, covering the period from January 2021 to May 2024.
- **Dataset**: High-resolution dataset on EV charging demand and renewable energy usage.
- **Dataset Availability**: Open-accessible.
- **Dataset Source Link**: Not provided in the context.
- **Research Gaps**: The study highlights the need for scalable and interpretable solutions to align EV charging infrastructure with decarbonization goals.
- **Research Key Findings**: A strong positive relationship exists between renewable energy penetration and EV charging demand, with significant increases in demand corresponding to higher renewable usage.

- **Paper's Results/Output**: XGBoost achieved the highest predictive accuracy among the evaluated models, and SHAP analysis identified key drivers of charging behavior, including renewable energy usage and grid stability .

8. **Summary of the Paper**

- **Title**: Quantifying the Uncertainty of Electric Vehicle Charging with Probabilistic Load Forecasting
- **Paper Name**: (MDPI_2023_Quantifying the Uncertainty of Electric Vehicle Charging with Probabilistic Load Forecasting)
- **Authors**: Joeri Van Mierlo, Myoungho Sunwoo, Namwook Kim, Yvenn Amara-Ouali, Bachir Hamrouche, Guillaume Principato, Yannig Goude
- **Journal**: Electronics
- **Publisher**: MDPI
- **Published Year**: 2023
- **Workflow/Process**: The paper reviews literature, details methodologies for forecasting quantiles, and discusses results from real-world EV charging data. It includes sections on literature review, methodology, results, and conclusions .
- **Methodology**: The study employs probabilistic forecasting algorithms, utilizing Generalized Additive Models for location scale and shape (GAMLSS) and Quantile Generalized Additive Models (QGAM) to model load curves .
- **Approaches**:
  - **Direct Approaches**: Utilize GAMLSS or QGAM methods to learn from past load curves.
  - **Bottom-Up Approaches**: Predict individual charging session characteristics before reconstructing load curves.
  - **Adaptive Approaches**: Correct predictions in real-time using conformal predictions .
- **Source**: The research is based on real-world charging session data from Palo Alto .

- **Dataset**: The dataset includes EV charging session data, which is highly non-stationary and requires frequent model refitting .
- **Dataset Availability/Public/Open-Accessible**: The dataset and model implementations are available on GitHub in CSV format and R code .
- **Dataset Source Link**: GitHub Repository
- **Research Gaps**: The study indicates that while bottom-up approaches perform worse than direct approaches on most quantiles, this conclusion may require further nuance .
- **Research Key Findings**: The research highlights the importance of quantifying uncertainty in load forecasts, which aids stakeholders in anticipating surges in EV demand and optimizing grid management .
- **Paper's Results/Output**: The results demonstrate the effectiveness of the proposed methods across various metrics, including pinball loss, empirical coverage, and RPS, indicating the potential of probabilistic forecasting for EV load management .

9. **Summary of the Given Paper**

- **Title**: Research on electric vehicle load forecasting considering regional special event characteristics
- **Paper Name**: (Frontiers_2024_Research on electric vehicle load forecasting considering regional special event characteristics)
- **Authors**: Tuo Xie, Yu Zhang, Gang Zhang, Kaoshe Zhang, Hua Li, Xin He, Hailong Li, Yongxi Zhang
- **Journal:** Frontiers in Energy Research
- **Publisher:** Frontiers
- **Published Year**: 2024
- **Workflow/Process**:

- The process begins with data preprocessing, including the supplementation of missing data and correction of anomalies in the original EV charging load data.
  - A factor set is established, incorporating epidemic factors and other relevant variables.
  - The data is normalized, and a typical characteristic curve is created for personalized processing.
  - The maximum relevant minimum redundancy (mRMR) method is applied to select the optimal feature set, which is then input into the IPSO-LSTM model for prediction.
- **Methodology**:
  - The study employs a high-precision forecasting model based on mRMR and IPSO-LSTM to predict EV charging loads, particularly during epidemic events.
- **Approaches**:
  - The model integrates epidemic factors such as new confirmed cases and risk area counts, alongside environmental factors like temperature, to enhance load forecasting accuracy.
  - It focuses on improving sensitivity to epidemic changes and capturing significant load variations.
- **Source**: The research is based on data collected from a city in China.
- **Dataset**:
  - The dataset includes EV charging load data from November 2021 to April 2022, covering two local epidemics.
- **Dataset Availability/Public/Open-accessible**: The availability status is not specified.
- **Dataset Source Link**: Not provided.
- **Research Gaps**: The paper suggests a need for improved forecasting models that can adapt to sudden changes in load due to external events like epidemics.
- **Research Key Findings**:
  - The proposed model outperforms traditional forecasting models, achieving over 20% reduction in MAE, RMSE, and SMAPE across different forecasting periods.
- **Paper's Results/Output**:
  - The model demonstrates good stability and representativeness, effectively predicting EV charging loads during both epidemic and non-epidemic periods, with results validated through various forecast periods (2 h, 4 h, 6 h) .

10. **Summary of the Paper**

- **Title**: Spatial-temporal load forecasting of electric vehicle charging stations based on graph neural network
- **Paper-name**: (Journal of Intelligent & Fuzzy Systems_2023_Spatial-temporal load forecasting of electric vehicle charging stations based on graph neural network)
- **Authors**: Yanyu Zhang, Chunyang Liu, Xinpeng Rao, Xibeng Zhang (Corresponding Author), Yi Zhou
- **Journal**: Journal of Intelligent & Fuzzy Systems
- **Publisher**: IOS Press
- **Published-year**: 2023
- **Workflow/Process**: The paper proposes a framework called Adaptive Spatial-temporal Graph Neural Network with Transformer (ASTNet-T) to forecast EV charging loads by capturing spatial-temporal correlations among charging stations. It includes a Transformer network to model global dependencies and conducts extensive experiments on real-world datasets to validate the approach.
- **Methodology**: The methodology involves constructing a graph structure to represent the spatial relationships of charging stations and utilizing a Transformer to predict future charging loads based on historical data.
- **Approaches**: The approach integrates Graph Neural Networks (GNN) to learn spatial dependencies and a Transformer to handle temporal dependencies, enhancing prediction accuracy by considering both aspects simultaneously.
- **Source**: The research is based on the interrelated charging loads of EV stations in a given area.
- **Dataset**: The paper utilizes two real-world charging load datasets for experimentation.
- **Dataset-availability/Public/Open-accessible**: The availability of the datasets is not specified in the provided context.
- **Dataset-source-link**: Not provided in the context.
- **Research-gaps**: The paper addresses the limitations of traditional time series methods that fail to capture the spatial-temporal correlations in EV charging loads.

- **Research Key Findings**: The proposed ASTNet-T framework effectively captures both spatial and temporal correlations, leading to improved accuracy in forecasting EV charging loads.
- **Paper's Results/Output**: The experiments demonstrate the effectiveness and robustness of the ASTNet-T model compared to existing methods, indicating significant improvements in prediction performance .

11. Summary of the Paper

Title: TOWARDS USING MACHINE LEARNING TO GENERATIVELY

- **Paper Name:** A preprint_2024_Towards Using Machine Learning to Generatively Simulate EV Charging in Urban Areas
- **Authors:** Marek Miltner, Jakub Zíka, Daniel Vašata, Artem Bryksa, Magda Friedjungová, Ondřej Štogl, Ram Rajagopal
- **Journal:** Preprint
- **Publisher:** Not specified
- **Published Year:** 2024

Workflow/Process (in detail):

- Development of a neural network model for predicting EV charging profiles.
- Incorporation of geographic and demographic data with charging session logs.
- Analysis of seasonal and behavioral trends to categorize charging demand based on local area types.

Methodology:

- Use of a neural network to simulate EV charging profiles.
- Collaboration with PREdistribuce for extensive data collection in Prague.
- Utilization of latent charging profiles to identify varying charging behaviors.

Approaches (in detail):

- The model identifies four distinct charging behaviors influenced by local area characteristics.
- Load curve analysis categorizes demand into four groups, providing insights into demand variability.
- Continual refinement of the model to incorporate updated data and understand behavior impact due to external factors such as COVID-19.

Source: Not explicitly mentioned in the provided context.

Dataset:

- Charging session logs from public EV chargers in Prague.
- Geographic and demographic information relevant to the areas analyzed.

Dataset Availability/Public/Open-accessible: Not indicated, likely requires access through the collaborating entity or publication.

Dataset Source Link: Not provided.

Research Gaps:

- Need for additional recent data.
- Enhancement of the interpretability of charging load profiles.
- Investigating broader geographical applications to validate findings.

Research Key Findings:

- Identified significant variance in charging behavior between different local administrative unit types.
- Seasonal trends show lower demand on weekends and summer months with higher variability on weekdays.

Paper's Results/Output:

- Development of a predictive model to aid Distribution System Operators (DSOs) in optimizing EV charging infrastructure.