Machine Learning for Demand Forecasting in Smart Grid

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Machine Learning Approach
- An informatics approach for forecasting electricity demand
- Use direct and indirect indicators of power usage
- Use scalable Machine Learning for data intensive workloads
- Use Hadoop Map-Reduce on Clouds platforms for performance, scalability and reliability
- Experiment on the USC campus microgrid testbed

Scalable Forecasting
- AMI’s collect TB of data from millions of customers @ 15min
- Several forecasting models
- New data arrives constantly
- Models operate on large data sets

Demand Forecasting using Machine Learning†

Regression Tree Machine Learnt Models
- Use CV-RMSE to compare model accuracy – root mean square error between observed and predicted normalized to the mean of observed

Campus-level Daily Model

- Model Used: CV-RMSE
- Annual Mean: 11.32%
- Day of Week Mean: 14.93%
- Day of Year Mean: 12.62%
- Regression Tree: 7.45%

Campus-level 15-MinModel

- Model Used: CV-RMSE
- Annual 15-min Mean: 37.37%
- Time of Week Mean: 16.00%
- Time of Year Mean: 25.07%
- Regression Tree: 13.70%

Features used in models were evaluated for their impact on prediction

Ongoing Work
- Dynamic feature selection
- Moving windows of predictions
- Data feeds from information repository
- Effect of data granularity on prediction
- Multiple models for buildings/consumers
- From Medium term » Short term Models

Planetary Scalable Learning Algorithm

- Google’s Regression Tree Algorithm
- Combine MR+Weka

Performance Limitations of Centralized Machine Learning

For 15-min interval data, we need 32 days & 700GB memory to train the model

Solution
- Parallel processing on Cluster/Cloud using Hadoop Map-Reduce

Benefits
- Divide and conquer: Scalable as the training data size increases
- High Performance, Lower time for data intensive modeling
- Reliable operation for continuous execution

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† Improving Energy Use Forecast for Campus Micro-grids using Indirect Indicators, Saima Aman, Yogesh Simmhan and Viktor K. Prasanna, DDDM, 2011