Regional Medium-Term Hourly Electricity Demand Forecasting Based on LSTM

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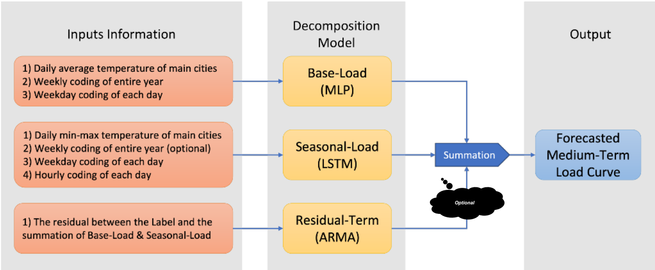
Contribution

- **New purpose**: serve for power system real-time applications (raised in recent years)
  - Provide available load profile reference
  - Customizable operating condition for load data
- **High Accuracy**: error less than 5% MAPE
- **High Resolution**: hourly output
- **Long Lead-Time**: predict longer than one year time series

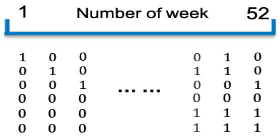
Overview



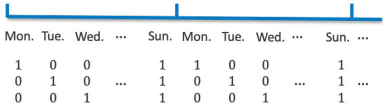
$$y(t) = B(t) + S(t) + R(t)$$

$B(t)$: ***base-load, medium/long-term load trend***
$S(t)$: ***seasonal-load, seasonal/periodic load variation***
$R(t)$: ***residual-term, treated as time-series***

Time Coding

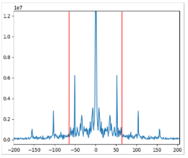


Weekly-Coding: 6 bits binary number to express 52 weeks of one year, convenient for users to determine the time.

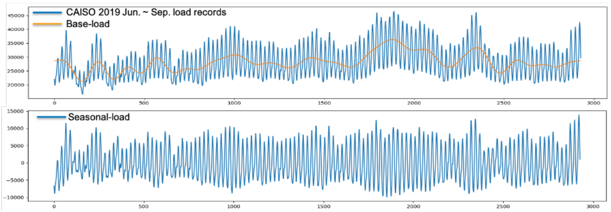


Weekday-Coding: 6 bits binary number to distinguish working days and weekends, label periodic feature.

Training Label Extraction

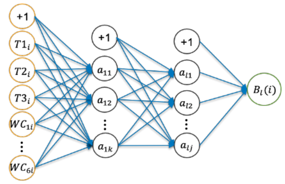


Fourier Smoothing

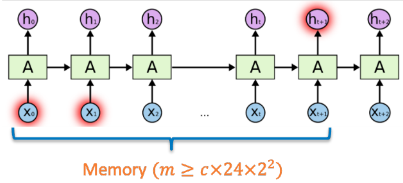


Base-Load and Seasonal-Load examples

Learning Methods

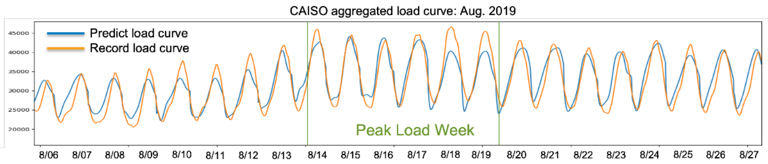


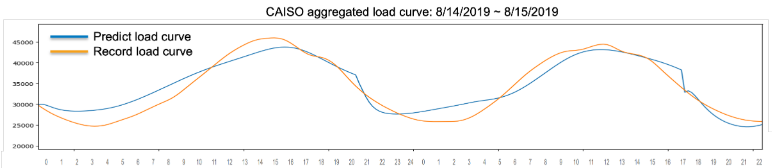
Multi-Layer Perceptron (MLP). Keeping the nonlinear relationship (time-coding) with least computational cost.



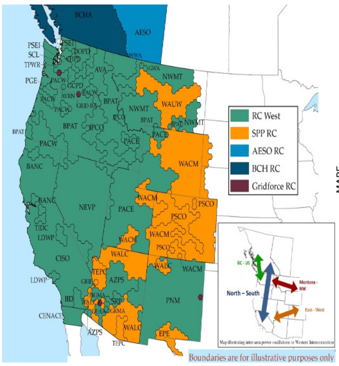
Long short-term memory (LSTM). If the load curve sampling rate is c samples per hour, then the length of memory of $S(t)$ should larger than c × 24 × 22 .

Case Studies:

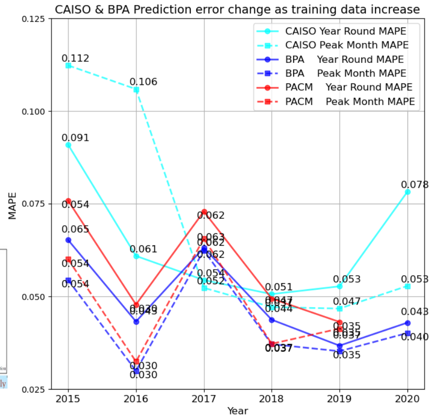




CAISO 2019 Peak Summer Load Forecasting



Western Interconnection RCs Footprints [Source: WECC].



CAISO, BPA, PACW load forecasting 2015 ~ 2020

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