Project 1.9

Learning Control for Building Systems

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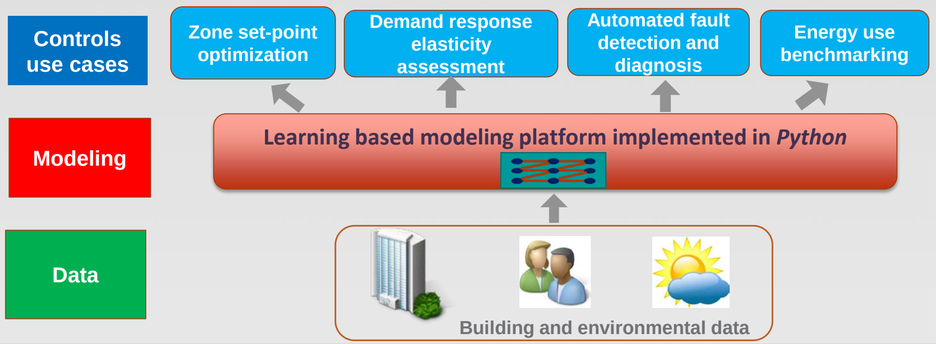
Objective

- Physics-based building energy modeling is resource- and time-intensive
- There is a need to augment existing building control and operation methods with **learning capabilities**
- **Vision:** Development of ***generalized***, ***learning-based*** **framework** for **control-oriented modeling** of buildings

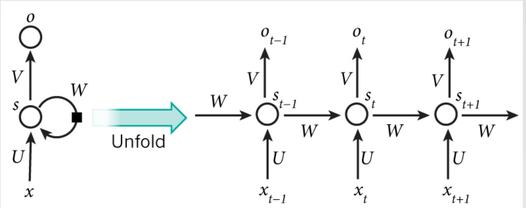


Methodology

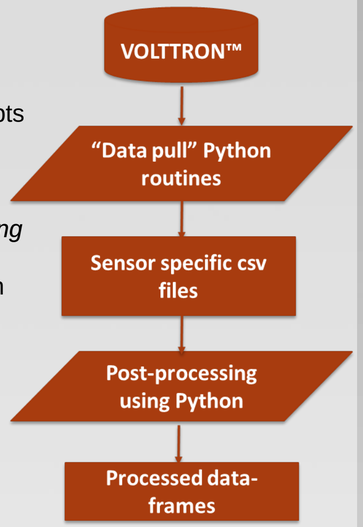
- **Data pre-processing**
  - Data streams downloaded using *Python* scripts
- **Data post-processing**
  - **Data categorization**
  - **Data cleaning** → Address gaps, anomalies
- **Data normalization** → *Standardization* and *scaling*

Learning based modeling

- Control-oriented modeling of energy consumption in buildings



General Scheme of RNN[1]



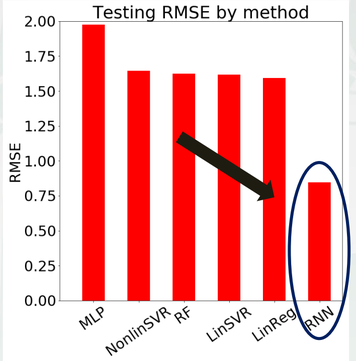
Data Pre-processing and Post-processing

Results

Comparison of learning techniques

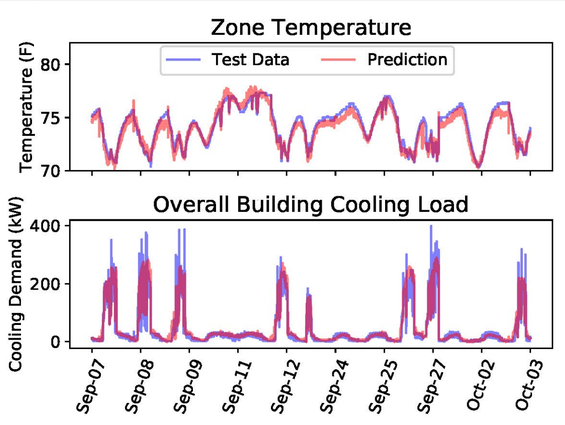
- Methodology applied to SEB building data
- Recursive Neural Networks (RNNs) outperform other learning approaches significantly **(50%-62%)**

Goal: Predict ***energy consumption*** from ***exogenous inputs*** and ***controls***



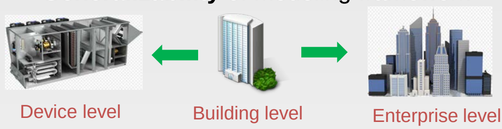
RNN deep dive

Zone temperature and thermal demand modeling

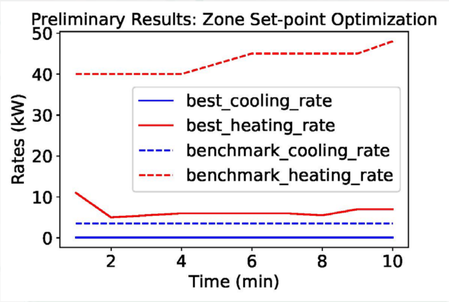


Future work

- **Generalizability** of modeling framework



- **Demonstration** of controls use cases
- **"Live"** integration using VOLTTRON™



Preliminary Results: Zone Set-point Optimization

[1]LeCun, Y., Bengio, Y. and Hinton, G., 2015. Deep learning. *Nature*, *521*(7553), pp.436-444.

CCSI Control of Complex Systems Initiative

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