

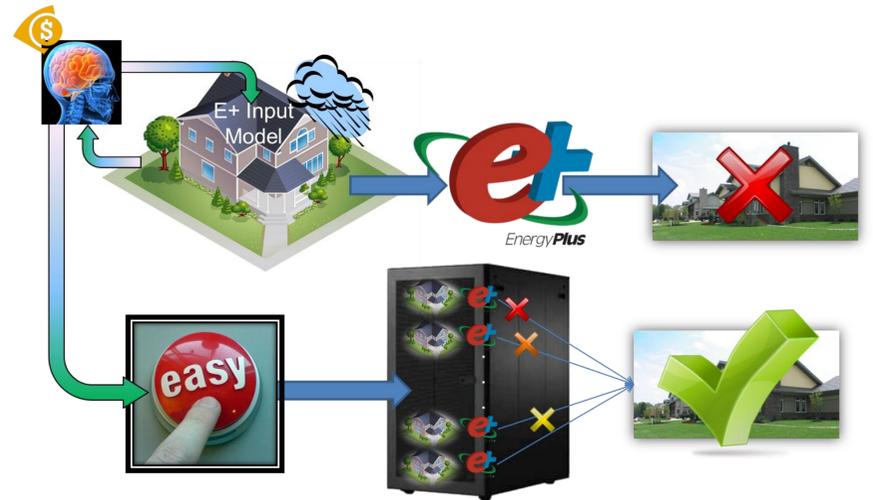
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### Introduction

The major **barriers** to DOE's Building Technology Program (BTP) goals and the adoption of building energy modeling software are the user **expertise**, **time**, and **associated costs** required to develop a software model that accurately reflects reality. Typically, a building modeler uses the software tool they have most experience with to create the geometry of a building, layer it with detailed material properties, add equipment with anticipated operational schedules and run the simulation.

An E+ building model can easily have **3,000+ inputs** for a normal residential building with very specific details that most energy modelers **do not have data for**.

The **goal** of the Autotune project is to save the time building modelers spend tweaking building input parameters to match ground-truth data by providing an "autotune" **easy button** for a standard desktop computer which intelligently adjusts model inputs.



Traditional model tuning vs. "Autotune"

### Approach

In order to achieve automatic tuning of buildings:

- Robotically emulated-occupancy 2800 ft<sup>2</sup> home with 269 channels of 15-minute sensor data
- Parametric E+ simulations, sensitivity analysis, and machine learning systems to characterize the effect of multi-variable perturbations on E+ simulations
- Intelligent adaptation of an existing E+ model to approximate sensor data for up to 96 E+ outputs



Heavily instrumented ZEB Alliance houses

### Machine Learning

- Created MLSuite, an XML-based framework for flexible integration of 8+ machine learning algorithms via available tools such as Matlab (and several toolboxes), open-source libsvm for support vector machines, evolutionary computation with inspyred (on github), and others
- Multiple methods supported to alter input order and cross-validation methodologies for robust classification

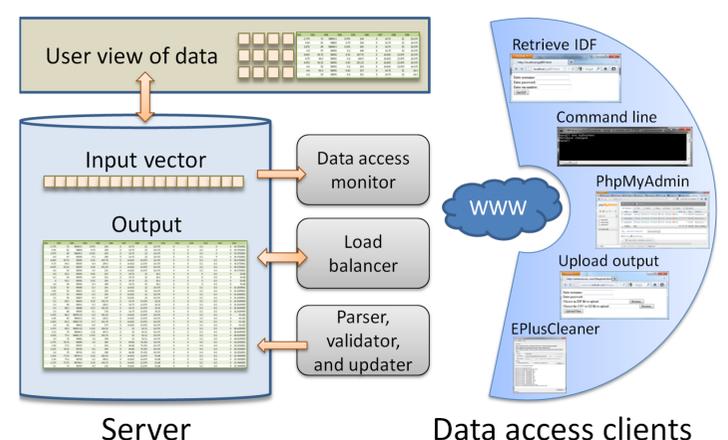


ORNL's Jaguar and UT's Nautilus supercomputers

### Supercomputing and Big-data

- ORNL's Jaguar/Titan (299,000 cores), Frost (2,048 cores) and NICS's Nautilus (1,024 cores) systems in use
- Markov order sampling for increasing combinatorial effects of 156 important and widely used E+ inputs
- 4 most popular US buildings: residential home, warehouse, stand-alone retail, and medium office
- Anticipated ~270 TB of raw data for ~8 million simulations constituting 26.9 trillion data points
- Advanced database engines and architectures for hosting queryable data for power-users

- **Parametric E+ data is available for public download now!**



Public access to simulation data through use of advanced database engine technologies



More information and data access at <http://autotune.roofcalc.com>

...making software accountable.