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archetypal: A Python package for collecting, simulating, converting and analyzing building archetypes

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Software

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Summary

The field of Urban Building Energy Modelling, which assesses the energy performance of buildings in cities relies on advanced physical models known as Building Energy Models (BEM) or simply, building archetypes. *archetypal* is a Python package that helps handle collections of such archetypes developed on the EnergyPlus model architecture. It offers three major capabilities:

1. Run, modify and analyze collections of EnergyPlus models in a persistent environment;
2. Convert EnergyPlus models to UMI Template Files;
3. Convert EnergyPlus models to TRNSYS TrnBuild Models.

EnergyPlus Simulation Environment

archetypal leverages the Python Eppy (Philip, Tran, Youngson, & Bull, 2004) and GeomEppy (Bull, 2016) packages to handle parsing and modifications of EnergyPlus files. Additional functionalities were developed such as a caching system and a file upgrade system as well as other class methods and properties that are specific to building archetype analysis. *archetypal* lets users query EnergyPlus results to return specific time series in a DataFrame format. For convenience, useful time series such as the space heating, space cooling and domestic hot water profiles are accessible by default. Users can also specify other output names and *archetypal* will append the IDF file and rerun the simulation.

Furthermore, *archetypal* features a caching method that handles simulation results. This is particularly useful for reproducible workflows such as the Jupyter Notebook programming environment. Reopening a closed notebook and running a cell containing the `run_eplus` command will use the cached simulation results instead of executing EnergyPlus again. This offers a drastic workflow speed gain, especially when larger IDF files can take several minutes to complete.

EnergyPlus to UMI Template File Conversion

archetypal aims at providing a way of creating UMI Template Files from EnergyPlus models. The algorithm approximates the non-geometric parameters of a multi-zone EnergyPlus model by dissecting and combining core zones and perimeter zones. The procedure is an attempt to streamline the creation of Urban Building Energy Models (UBEM) (Reinhart & Cerezo Davila, 2016) based on the "Shoeboxer" method (Dogan & Reinhart, 2017) by accelerating the creation of building archetype templates. This approach introduces a robust method to convert detailed multi-zone models to archetype templates, stripped of geometric properties.

Consequently, *archetypal offers researchers and designers a way of more quickly creating UBEM studies.

archetypal also aims at providing a scripting language for the modification UMI Template Files. It essentially is a Python interface to the data format of the UMI Template Editor.

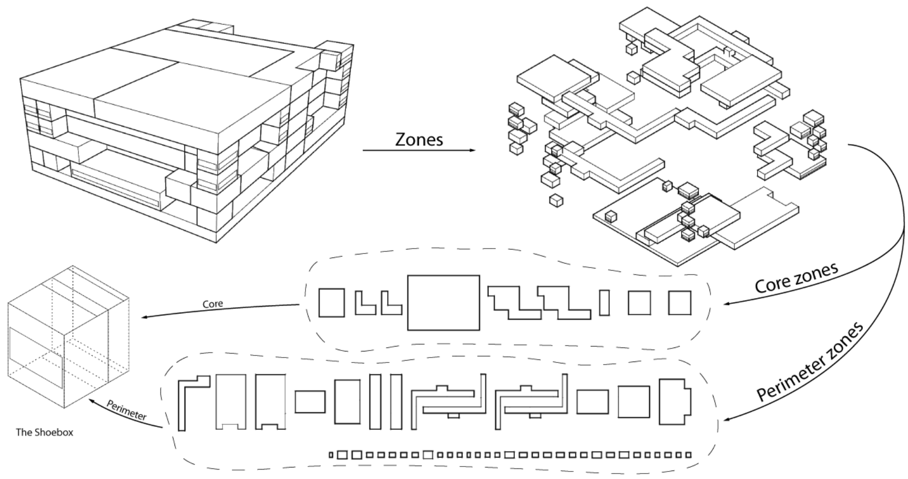

Figure 1: Archetypal converts a multizone EnergyPlus model to an UMI Template File by combining core and perimeter zones

EnergyPlus to TRNBuild Conversion

Intermodel comparison methods are important in the field of building energy modelling because they allow model methodologies and results to be reviewed (Judkoff & Neymark, 1995). Furthermore, some model engines include features that others don't already implement. Since it can be long and error-prone to create archetype buildings by hand, converting EnergyPlus models to TrnBuild models emerged as a way of speeding both the intermodel comparisons and the supplemental model creation. That is to say, a large repository of prototype building models exists in the literature with a large majority developed in the popular EnergyPlus environment (US DOE - Building Energy Codes Program, 2012; US DOE - Building Technology Office, 2018). `archetypal` answers a need from researchers and building energy model specialists to create TrnBuild Models from existing EnergyPlus models.

The latest stable release of the software can be installed via pip and full documentation can be found at https://archetypal.readthedocs.io.

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