**Machine Learning Energy Use Intensity Optimization of Accessory Dwelling Units**

**Thesis Statement:**

There is a dire need for housing across the United States. In Seattle, the Office of Planning and Community Development has been testing the use of accessory dwelling units, or ADUs. Since 1994, Seattle has allowed for the construction of ADUs, as they increase housing supply and density, which in turn lowers housing prices. A tool named ADUniverse was created as a joint project between the Seattle Office of Planning and Community Development and the University of Washington Data Science for Social Good program, in which homeowners can simply enter their address and easily visualize physical feasibility, as well as potential construction issues based on zoning.  Potential ADU owners were asked in an official 2019 survey to name the most important features that would make them consider going through with the build. The two primary concerns were cost and sustainability. This research is intended to augment ADUniverse by using machine learning as a surrogate model in place of simulation. Use of the traditional EnergyPlus simulation package is limiting when conducting optimization due to time constraints. Optimizing energy use intensity (EUI) of typical detached ADUs includes design constraints of placement, size, and other features of apertures. The end goal of training the machine learning model to calculate EUI faster and with the same accuracy by using a dataset of traditional EnergyPlus results. This model can be incorporated into the ADUniverse web app to allow homeowners to determine sustainability and reduction in utility costs more accurately, as well as serve as a case study into the efficacy of ADUs on increasing housing availability.

**Theoretical/Conceptual Framework:**

Building simulation help improve building performance, yet results are difficult to scale. Machine learning tools and big data are becoming a part of the architect's toolkit at an ever-increasing pace. One such program, *cove.tool*, increases performance and sustainability while also lowering costs. The data-rich architectural tool can eliminate costly later design decisions, while finding the most efficient decisions regarding energy use at an early stage. Simulating each individual accessory dwelling unit requires exact knowledge beforehand of the design, whereas a machine learning model can output accurate energy use readings while adjusting design parameters on the fly. Typical simulation workflows, usually utilizing the United States Department of Energy's EnergyPlus suite, are too time consuming and exact input specific to be effective for end-user evaluation of data. Use of a machine learning model offers the benefit of front-loading the time and data investment into training the model, but thereafter each result is output at a much greater rate.