Please submit your proposed individual research project outline and proposed individual our group physical project description by uploading to the appropriate Canvas site and/or emailing to me directly: kimog@uw.edu

Proposed Individual Research Project Outline, due April 8

For my research paper, I would like to use it as a means to document the research done in the lab project. I have been thinking deeper about what I see the need to accomplish in this course to advance my work towards my thesis and have revised my decision from Tuesday’s class.

As I had mentioned previously in the first course meeting, I am intending to use this course a complimentary study alongside Arch 597: Research Practicum. That is, as the technical half to the analytical other. In 597 I am proposing to write a review paper in the general space of algorithms and housing, while my intended thesis area is specifically machine learning (ML) and accessory dwelling unit (ADU) design.

My thesis concept consists of an ML algorithm utilizing shape grammars and/or expert systems to allow for more site-specific (read: high performance) design of ADUs. I intend to divide the project into three scales for introductory research into the topic: site, program/plan, and fabrication. While I was initially discussing delving into the fabrication portion, I do not aim to fully flesh out all three project scales- it would simply not allow me enough focus for effective research. Therefore, I believe it would be much more beneficial if I did pivot, and instead focus on more of the digital side of the research, to focus on the technical portions of ML algorithms.

I intend to use the open-source Google ML framework known as TensorFlow to explore the starting-point ideas of both shape grammars and expert systems. Shape grammars refers to the abstraction of design elements into a semantic ruleset of patterns that both an algorithm or human can interpret and reproduce. On the other hand, an expert system is an early method of artificial intelligence wherein a ruleset is represented in a *knowledge base*, while a logical *inference engine* runs through boolean if/else statements. I intend to look for a way to synthesize these two philosophies.

What I have discovered in some preliminary literature review in research practicum is the resemblance between shape grammars and expert systems as a methodology. Expert systems represent one of the most influential yet simple ways of driving rules-based machine learning algorithms, while shape grammars follow a similar logic, yet based in geometry. However, there is a definite lack of information on using shape grammars in place of expert systems as the driving logic of a rules-based machine learning algorithm. I would like to explore the substitution of/hybrid between shape grammars for/with expert systems logics in machine learning.

**Project Description:**

Alongside my research paper, I intend to delve into learning to utilize Google’s open-source TensorFlow machine learning (ML) framework in the domain of architectural design. To fully grasp how learning algorithms will impact my thesis path, I need to start from the ground up. I will be exploring various methods. In order to apply ML to architectural design, I will be simultaneously researching and testing ML in tandem with shape grammar and site analysis techniques. Site data can theoretically be parsed and decisions made quicker through the use of machine learning, while shape grammars in theory are the best means to shape floor plan layouts moving forward with the knowledge gained from an automated site analysis.

Tools intended to be utilized: Python, TensorFlow; possibly: Rhino, Grasshopper

**Schedule:**

Each week: research and read info on ML from TensorFlow wiki, blogs, forums, textbooks (o’reilly’s “hands-on machine learning”), additional articles

Week 3: get acquainted: setup TensorFlow, required libraries and utilities

Week 4: begin testing and comparing learning algorithms variants:

Week 5: supervised learning techniques and testing

Week 6: unsupervised learning techniques and testing

Week 7: optimization/genetic algorithms + ML

Week 8: investigate use of shape grammars w/ ML

Week 9: attempt to integrate shape grammar technique with ML; possibly with fabrication aspect

Week 10: wrap up, write-up; conclusions