System Simulation
Project Guidance
Fall 2018

For your project, you are to specify, program, and verify a simulation of an system of interest to you. You are also to use the simulation to answer at least two "what if" questions about the system you are simulating. You will be provided with a checklist of features and capabilities that your simulation must include and you will be required to write a report that *clearly* explains the following:

1) How you provided each required feature. This discussion should include a clear indication of where in your code the feature is, why you chose to code the feature in the way you did, and how you module tested the feature separately from the full simulation.

2) Why you chose your what-if questions and what simulated experiments you could run to get answers to those questions. You should include in any such discussion what data you'll collect and what statistical measures you'll use to determine if your data was indeed sufficient to answer the questions you chose

3) Graduate students MUST write the report in the form of an IEEE conference or journal paper and must make use of suitable formatting templates. Undergraduate students may adopt an IEEE format or use a more informal format.

4) Your simulation must have at least ONE of each of the following features. You need not limit yourself to ONE of each, however. You should use as many features as necessary to build a simulation you can use to answer you what-if questions.

   a) There must be one or more uses of a time update method. These include event based, fixed interval, or some hybrid as you might see fit.

   b) There must be at least one example of each of the following model types
      Deterministic Mechanistic
      Deterministic Empirical
      Stochastic Mechanistic
      Stochastic Empirical

   c) In addition to the above four models, there must be at least one pseudo-random number generator that uses an empirically derived PDF and at either rejection sampling or inverse transform sampling. Such a pseudo-random number generator would fall in the category of a Stochastic Empirical Model. This pRNG does NOT count against the item (b) requirement. A second separate pRNG of this nature, however, would.

d) Your simulation must output a plain text file that can be imported into a separate analysis tool or program to support analysis of outcomes (Excel, sciPy, etc.). In each row of this file, the first column should contain a time stamp of the current "simulated world time". The rest of the columns should contain the values for key simulation state values that would be needed to conduct analyses. You should provide a key that explains what each column means. In effect, this is a "history" file that could be used to show the unfolding of your simulated reality over time.

e) You must use some statistical analysis tool and appropriate inferential statistics to provide statistically relevant (significant) answers to your two "what if" questions. This presumes you will generate enough data with your simulation to make statistically significant statements AND that you will use appropriate tests (T-tests, ANOVA, etc.)