CEE 5390 - Modeling and Simulation in CEE

Lecture 1: Law 1.2, 1.3 + Readings online

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Definitions

System: A collection of entities that act and interact together toward the acoomplishment of some logical end. The *state* of a system is a collection of variables necessary to describe a system at a point of time. (read Sanchez 2007)

These variables can be *continuous* or *discrete.* In continuous systems the state variables change continuously with respect to time (most physical systems), while in a discrete system variables change instantaneously at separated points in time.

A *Model* is an abstraction of a system! This is an overloaded term and it would be probably more accurate to refer to it as a *family of abstractions*. There are many different ways of classifying these abstractions. Read Fishwick (1998) for a good hearty discussion.

Discussion on models: Prescriptive Models, Descriptive models, Conceptual models, Constraint models, Flow models, Spatial models, Physical models etc.

A *Simulation* is a tightly coupled and iterative three component process composed of: (Fishwick 1998)

- model design
- model execution
- execution analysis

The chain links: Conceptual model ⇒ Executable model ⇒ Formalism, Program (Fishwick 1998)

Discussion on the incompletenes of models - they are *all* incomplete, some are *useful*.

Discussion on why we build simulations. What are interactive vs. non-interactive simulations? What is a general purpose simulation? What is an expert system?

Where does all this fit into a design philosophy defined over the life-cycle of a product, the processes involved and the organizations used?

Discrete Event Simulations (DES)

A DES is a simulation of a system represented by a discrete model. Simuation is a progression from 1 time point to the next along a time line that consists of a countable number of time points. Each time point signifying an event!

Modeling events and the nature of time (Discussion).

The advance of time in a model can be a *next-event time advance* or *fixed-increment time advance*. What happens when the simulation is interactive? (Discussion)

Components of a DES:

- System State (knowledge representation aspect of model)
- Simulation Clock (temporal aspect of model)
- Event lists (various data structures to aid information computing)
- The main executable (simulation)
- Bunch of routines/sub-routines (simulation)

Knowledge of statistics required in analyzing simulation data, and knowledge of "a programming language of choice" needed to simulate model.