CS551/651: Advanced Modeling and Simulation Spring, 2006

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Class Time/Place: 7:00 – 8:15PM, Tuesday and Thursday

Course Webpage: http://www.cs.virginia.edu/~pfr/cs651/

Prerequisites: Knowledge of fundamentals of discrete event simulation, e.g. Sys362 (intro to M&S) or equivalent, **or** knowledge of basics in Law and Kelton, 3rd Ed, ch 1, 2, 4, 5, 6, 9, 12 (http://www.mhhe.com/engcs/industrial/lawkelton/). The Law and Kelton material could be acquired in the first ten days of the semester, on your own.

> "All science is simulation these days," --Stephen Lee, Deputy Division Leader, Computational Sciences, Los Alamos National Labs.
> --- Wired Magazine, Jan, 2006. http://www.wired.com/wired/archive/14.01/birdflu.html

Course Objectives: Modeling and Simulation (M&S) is ubiquitous. In most science disciplines, simulation has replaced many experiments in labs and in the field. Historians and social scientists use simulation to explore and validate theories. Manufacturers use simulation in design to replace construction of expensive prototypes. The military uses simulation extensively, to train soldiers and to design and evaluate equipment.

Unfortunately simulationists frequently use simulation naively, i.e. they lack understanding of critical M&S technology, relating e.g. to model semantics, composability, coercibility, multi-resolution modeling and federations. Invariably simulation users wish to construct larger simulations from smaller ones (composing) or study phenomena at varying levels of abstraction (multi-resolution modeling), but the knowledge to do so, and an awareness of known challenges and limitations, is lacking. CS551/651 is designed for students, scientists and non-scientists alike, who wish to acquire a technical appreciation for existing capabilities, challenges, and limitations in M&S technology.

Evaluation: Midterm (20%), final exam (25%), four projects during the semester (25%) and class participation (30%), including presentations.

Reading: Weekly. Assigned papers and material on the web.

Key topics:

Model semantics; abstraction and fidelity; paradigms and contexts
Interface and semantics standards; semantic consistency; ontologies; interoperability
Model repositories; model reuse; composability, model families
Multi-resolution modeling
COERCE; designing for coercibility
Parallel and distributed simulation
  DIS / HLA; federation management
  Time management
  Data distribution management
DDDAS
Verification, validation and accreditation VV&A
Agent based simulation
Human behavioral modeling
Genetic algorithms & Neural networks; response surfaces

Additional notes:

We will have some guest speakers. I have a number of contacts in industry and government who have faced many of the challenges that will be exposed and discussed in the class. Their practical experience is invaluable.

Projects (four) will be related and form a "project sequence". Project sequences will consist of work in a) semantics, b) interoperability, multi-resolution and/or federating, c) verification and validation and d) Coercion. Project sequences will be derived from one of a handful of possibilities, including: 1) building a working, adaptable federation, 2) infusing course-related technologies into the on-going simulation effort of a research program; 3) supporting a PhD student performing research in simulation technology, or 4) supporting a professional simulationist conducting work in simulation technology. I'm open to other project sequence suggestions.

If you have any questions, feel free to contact me at reynolds@virginia.edu or at 434 924-1039.

Pledge Policy:

Exams will be pledged. You're strongly encouraged to work together on projects and studying in general.