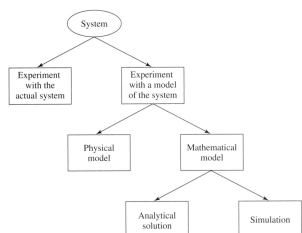


Overview of Modeling & Simulation

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Ways to Study a System



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Models

- Types
 - Informal vs. Formal Description
 - Static vs. Dynamic Behavior
 - Deterministic vs. Stochastic Behavior
 - Discrete vs. Continuous Variables

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Simulation

- Types (Homework #1)
 - Deterministic
 - State to state behavior determined
 - Continuous time base with continuous process
 - Differential equations, e.g. suspension system, predator-prey
 - Chaotic systems, e.g. logistic map for population
 - Stochastic
 - State to state behavior probabilistic
 - Continuous time base with discrete events
 - Discrete event simulation

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Simulation

- Models vs. computer implementation
- Process
- Advantages/Disadvantages (Homework #1)

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Discrete Event Simulation (DES)

- Definition
- Types of time-keeping
 - Fixed increment
 - Event-scheduling (vs. process models)
- Programming components of event-scheduling
 - Event-list (priority queue) (Homework #2, 4, 5)
 - Dynamic data structures (Homework #4, 5)
 - Event routines (Homework #2, 4, 5)
 - Random number generators (Homework #4)
 - Linear Congruential Generators (PMMLCG)
 - Probability Distributions: Uniform, Exponential, Normal
 - Testing Generators: Chi-Square (Homework #4)

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Queueing Systems

- Definitions and Types of Queueing Systems
 - Servers
 - Single server, FIFO queue (Homework #2, 4, 5)
 - Tandem servers (Homework #2, 4)
 - Parallel servers (Homework #5)
 - Queue protocols
 - FIFO (Homework #2, 4, 5)
 - Round-robin (Homework #5)
- Performance measures
 - Analytical solutions
 - Computed through simulation
- Markov models

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Experimenting with Simulations

- Collecting input data & analyzing distributions (Homework #3)
- Steady-state vs. transient vs. chaotic
- Warmup, sample size, replication (Homework #2, 4, 5)
- Varying parameters (Homework #5)
- Confidence interval for the mean of multiple replications (runs) (Homework #2, 4, 5)
- Comparing two conditions: confidence interval for the mean of the difference

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Simulation Languages and Packages

- Purpose
- Types
- Examples
 - Text based: GPSS & Simscript
 - GUI based: Extend 4
- Advantages & Disadvantages

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Case Studies of DES Simulations

- Simulation is ubiquitous
 - Many applications in business, science, etc.
 - Law text has many examples
 - Specialized hardware for numerical simulation
- Applications in computing
 - Operating systems, architecture, networking
 - Extend 4: Multi-processing, network crash analysis
 - Homeworks #2, 4 & 5
 - Specialized issues in collecting data

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Parallel Simulation

- Why?
- Types of synchronization algorithms
 - Optimistic
 - Conservative
- Advantages & Disadvantages

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