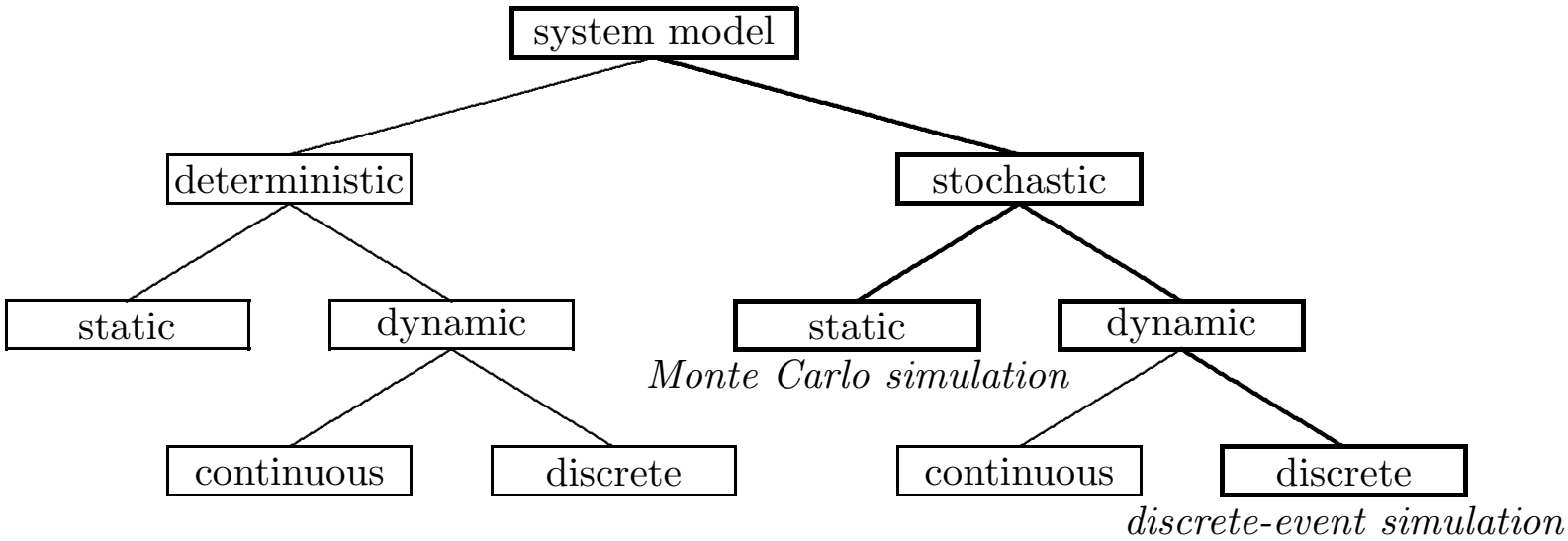
Introduction

- What is discrete-event simulation?
  - Modeling, simulation, and analyzing systems
  - Computation and mathematical techniques
- **Model**: conceptual framework describing a system
- **Simulate**: perform experiments using computer implementation of the model
- **Analyze**: draw conclusions from output

Characterizing a Model



Characterizing a Model

- Deterministic or Stochastic
  - Does the model contain stochastic components?
  - Randomness is easy to add to a DES
- Static or Dynamic
  - Is time a significant variable?
- Continuous or Discrete
  - How does the system state evolve?
  - Continuous: classical mechanics
  - Discrete: queuing, inventory, machine shop models

Definitions

- Discrete-Event Simulation Model
  - Stochastic
  - Dynamic
  - Discrete-Event
- Monte Carlo Simulation
  - Stochastic
  - Static

DES Model Development

Algorithm 1.1.1 – How to develop a model:

1. Goals and objectives
2. Build a *conceptual* model
3. Convert into a *specification* model
4. Convert into a *computational* model
5. Verify
6. Validate

Typically an iterative process

Three Model Levels

- Conceptual
  - Very high level
  - How comprehensive should the model be?
  - What are the state variables?
- Specification
  - On paper
  - May involve equations, pseudocode, etc.
  - How will the model receive input?
- Computational
  - A computer program
  - General-purpose PL or simulation language?

Three Model Levels

Conceptual Model My understanding of the physical (or pseudo physical) system to simulate.

Specification Model How I can represent the *Conceptual Model* using data, data structures, algorithms, and mathematical equations.

Computational Model How I can implement my *Specification Model* in a particular machine using a particular set of languages.

Verification vs. Validation

- Verification
  - Computational model should be consistent with specification model
  - Did we build the model right?
- Validation
  - Computational model should be consistent with the system being analyzed
  - Did we build the right model?
  - Can an expert distinguish simulation output from system output?
- Interactive graphics can prove valuable

Now that we have some basic vocabulary under our belt, let's talk about those simulation articles…