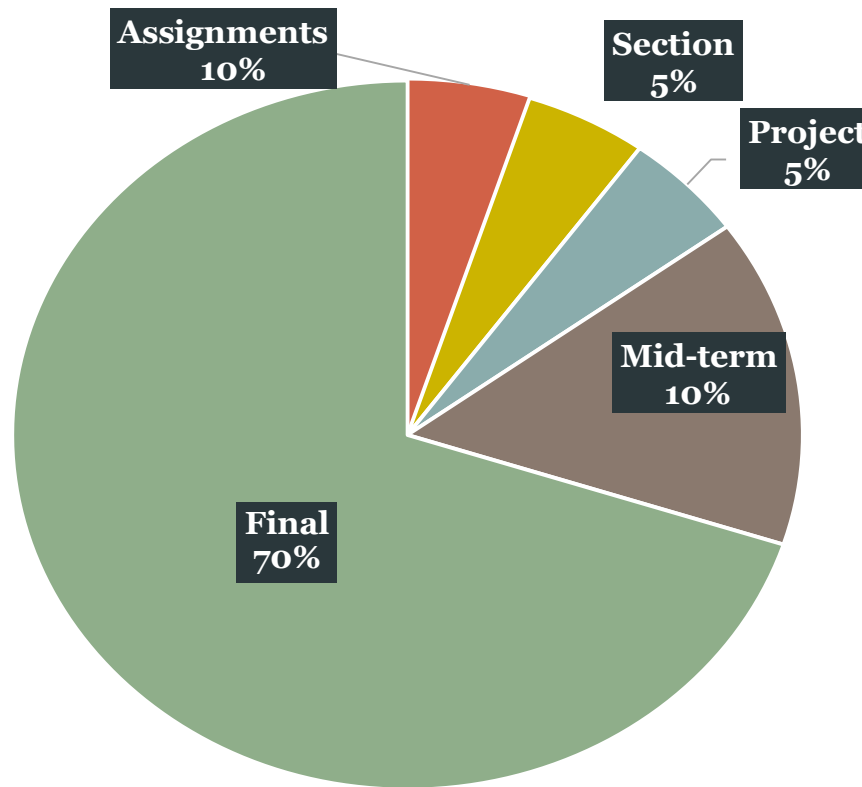# System Modeling and Simulation

Instructor

- Instructor: GAMAL FAROUK
- Email: gamalfaruk@yahoo.com
- Time : 9-11 on Tuesday
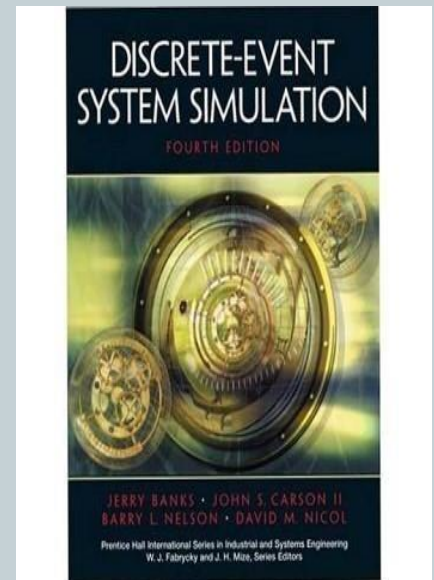
Assessment

Textbook

- Title : **Discrete-Event System Simulation (4th Edition)**

- Author : **Jerry Banks , John Carson, Barry L. Nelson, David Nicol**
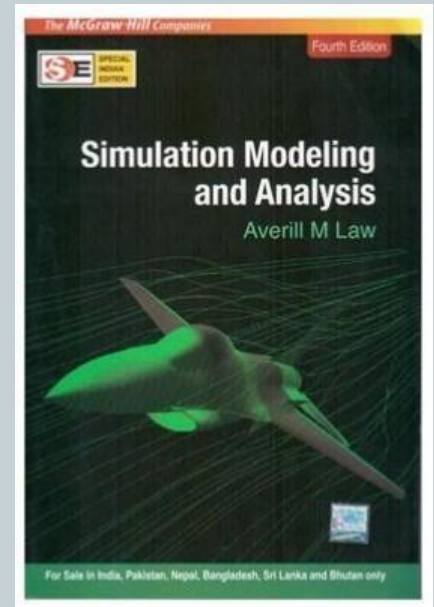
- Publisher: Prentice Hall; 4 edition (December 19, 2004)

Textbook
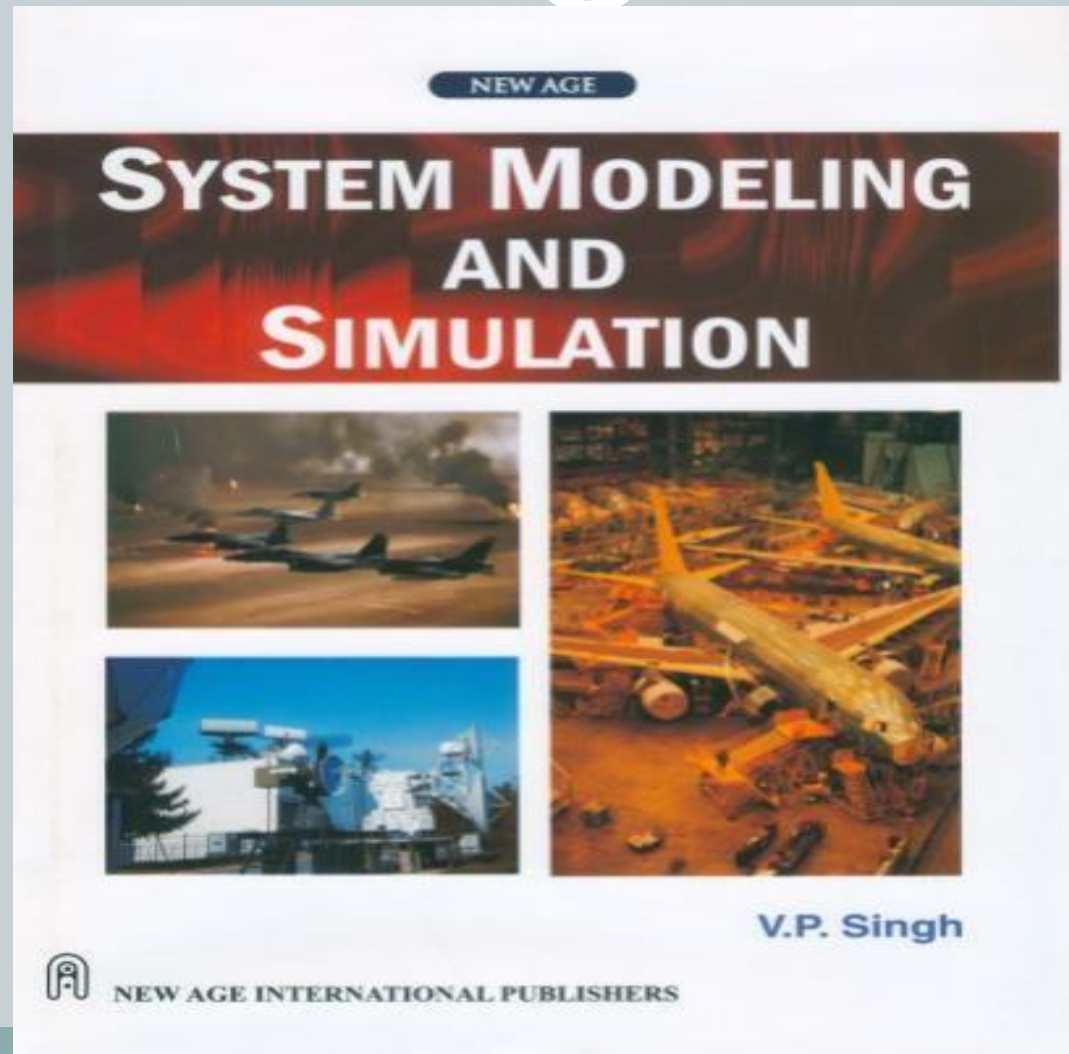
- Author: Averill M. Law
- Title: "Simulation Modeling and Analysis", Fourth Edition
- Publisher: McGraw-Hill Higher Education

Notes:

- The codes in this book are written in C++. However, simulations throughout the course will be done using Excel. Ideas from this book will be used

Textbook

PART ONE
Introduction to
Discrete-Event System
Simulation

Introduction

Outline

- Definitions
- Goals of Modeling and simulation
- When simulation is the appropriate tool
- When simulation is the not appropriate tool
- Advantage and disadvantage of simulation
- Areas of application
- The Process of Simulation
- Steps of Model Building

Definitions

What is Simulation?

- A *simulation* is the imitation تقليد of the operation of a real- world process or system over time. Whether done by hand or on a computer.

- simulation involves the generation of an artificial history of a system, and the observation of that artificial history to draw inferences concerning the operating characteristics of the real system.

- Simulation is the process of design model of a real system to understanding the behavior of the system and/or evaluating various strategies for the operation of the system.

Definitions Cont.

○ Whether perform simulation Manual or by computers that generate artificial history of the system to produce the operational properties of the real system.

○ In general: A Simulation of a system is the operation of a model, which is a representation of that system.

Definitions

- Basic of Modeling
- What is Model?

  - Is an abstract representation (real) system , object, that captures the essential characteristics or properties of the system or object . Model used to understand this system

  - Then we can say: Model consider a Construct conceptual of the framework that describes system.

  - Often requires making simplifying assumptions about how the system works

- Examples:

  - Model airplane, molecular model, performance for any model

Definitions

Remarks :

- Modeling is an essential tool in computer system
- Model is both "art" and "science"
- Art when minimize the parameter's model
- Science because using statics, mathematic, programing
- Model reality check: George Box , 1979 :

"All models are wrong, some models are useful"

- Models are wrong because not all parameter consider in model
- Models are useful when provide the performance of the system behavior.
- Models are especially valuable when are simple, elegant and fast

Definitions

☐ Modeling is a way of looking at the world

- Any system can have multiple models
- Models simplified thing
- Using the appropriate model allows us to make decisions, even حتى on the system when the situation is complex or resources are limited
- We are always using models

Goals of Modeling and simulation

☐ A model can be used to investigate a wide verity of " What if " questions about real world system.

☐ Potential changes to the system can be simulated and predicate their impact on the system.

☐ Find adequate مناسبة parameters before implementation.

☐ So simulation can be used as

○ Analysis tool for predicating the effect of changes.

○ Design tool to predicate the performance of new system.

☐ It is better to do simulation before implementation.

How a model can be developed?

A Mathematical Methods :

- Uses symbolic notations and equations to represent a system
- Probability theory, algebraic methods,….
- Their results are accurate.
- They have a few number of parameters
- It is impossible for complex systems.

A Numerical Computer-based simulation

- It is simple
- It is useful for complex system.

When simulation is the appropriate tool?

- Simulation enable the study of **internal interaction of a subsystem** with complex system. or of a subsystem within a complex system.

- Informational, organizational and **environment changes** can be simulated and the effect of these alterations on the model's behavior can be observed.

- A simulation model help us to gain knowledge about improvement of system.

- Finding important input parameters with changing simulation inputs.

- Simulations can be used with new design and policies before implementation.

When simulation is the appropriate tool?

- Simulating different capabilities for a machine can help determine the requirement.

- Simulation can be used to verify analytic solutions.

- Simulation models designed for training make learning possible without the cost disruption.

- Animation shows a system in simulated operation so that the plan can be visualized.

- The modern system (factory, wafer fabrication plant, service organization, etc.) is so complex that the interactions can be treated only through simulation.

END Lec 1