

14B1WCI831: Simulation Techniques

Course Credit: 3

Semester: VIII

Introduction

This course introduces simulation techniques including model design and development, comparison to analytical models, input data preparation, random number generation, output statistical analysis, and model validation. Using these techniques, students will: model real-world systems, implement the model as a computer program, and evaluate the performance of real-world systems by analyzing the output of the model under various conditions.

Course Objectives (Post-conditions)

Knowledge objectives:

This course introduces simulation techniques including model design and development, comparison to analytical models, input data preparation, random number generation, output statistical analysis, and model validation. Using these techniques, students will: model real-world systems, implement the model as a computer program, and evaluate the performance of real-world systems by analyzing the output of the model under various conditions.

Application objectives:

- Student can explain what computer simulation is and why it is needed.
- Student can identify application areas of computer simulation such as industry defense, finance, and education.
- I can explain the differences between the types of simulation such as Monte Carlo, VS. Discrete Event, and/or Real-time simulation.
- Student can explain how to develop and build a simulation model to be executed on a simulation tool.
- Student can develop what-if scenarios with variable number of input parameters and configurations.
- Student can identify and explain what are the important components of a Discrete Even Simulation Engine.
- Student will be familiar with at least one Commercial off the shelf simulation tool.
- Student can explain why Random Number Generators are used in a typical simulation study.
- Student can conduct analysis of the obtained result of the simulation study.

- Student can explain the importance of Verification and Validation in a simulation study

Expected Student Background (Preconditions)

Programming experience in C/C++, working knowledge of UNIX operating system, basic probability and statistics.

Topics Outline:

S NO	Topics	Hrs
1	Introduction: Simulation Language Tutorial, Overview of Basic Approaches: Monte Carlo Simulation, Queuing Network Simulation, Quasi-continuous Simulation, Discrete-event Simulation <---	8
2	Simulation Basics: Basic Concepts: System, Attribute, State, Event, Process, Activity, Time, Parallelism, Model, Basic Mechanisms: Time Advance, Scheduling, Alternative Models: Activity, Process, Others	10
3	Stages of Simulation Model Development: Problem, System Analysis, Data Collection, Fitting Distributions to Data: Parameter Estimation, Goodness-of-Fit, Iterative Prototyping, Statistical Instrumentation, Verification, Validation <--- Emphasized, Inference	10
4	Abstract Representation Techniques: Activity-cycle Diagrams, State-Transition Diagrams, Petri Nets	5
5	Random Number Distributions: Sources of Randomness, Random Number Generation, Random Variates: From Distribution Functions, From Empirical Data	5
6	Evaluation of Simulation Modeling: Ethical Issues in Simulation, Benefits of Simulation, Limitations of Simulation.	2
7	Introduction to simulators:- Introduction to some popular simulator :- ns2. Matlab or omnet++, simulation projects.	2
	total	42

References

1. Computer Simulation Techniques – The Definitive Introduction: Harry Perros, North Carolina State University.

2. Simulation Modeling & Analysis" by A. Law and D. Kelton, McGraw Hill Publishing.
3. Simulation Model Design and Execution: Building Digital Worlds" by P. Fishwick, Prentice-Hall.
4. Discrete-Event System Simulation" by J. Banks, J. Carson and B. Nelson, 2nd edition, Prentice Hall.

Evaluation Scheme:

S.No	Examination	Marks
1	T-1	15
2	T-2	25
3	T-3	35
4	*Internal Marks	25

*Internal Marks Breakdown:

Assignments	9 marks (3x3)
Quizzes	12 marks (3x4)
Regularity	4 Marks