Preface

Understanding and predicting reality is one of humanity's dreams, perhaps the first and most intricate dream. Nevertheless, reality is sometimes complex and it is therefore difficult to understand all of it without the use of models that simplify its understanding. Models are tools for conceptualizing reality. Therefore, they simplify system compression and analysis. Operations Research (OR) uses models to solve problems and owns a set of methodologies to construct these models.

Simulation is a part of OR in which a set of methodologies is used to understand and analyze a wide range of systems. A good definition for simulation can be "(…) the process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behavior of the system and/or evaluating various strategies for the operation of the system" (Shannon 1998).

In applying these methodologies, the relationships between different system elements are reproduced and a set of hypotheses can be used, some of them to simplify reality. Simplification hypotheses are not true, from the point of view of the system, but are used in the construction of the model to simplify the modeling process, and sometimes just to make this process possible, due to the inherent complexity of the system. These relationships and hypotheses describe the behavior of the system and an experimental environment that represents the target of the study is created. The various relationships and rules, which are usually mathematical or logical, make up the model, the tool that acquires data and provides answers about the system.

The main interest of this book is to offer the reader a broader view of some of the various alternatives that currently exist for formally representing a simulation model. Not all the alternatives are represented, and please forgive the omission of some other interesting, useful, and powerful alternatives that exist; but, obviously, we need to focus on just a few. The main objective of the alternatives presented here is to introduce the reader to the methodologies of formally representing a simulation model. This book is a first step in understanding the importance of formalizing a simulation model and a starting point for beginning to learn in this area.

The book is structured as follows: the first chapter, "Conceptual Modeling Using PETRI Nets" describes the use of Petri Nets for discrete simulation and provides some examples. As an introductory chapter, it also emphasizes the need to formally represent the simulation model before coding it in the chosen simulation environment.

The second chapter, "Modeling for System's Understanding" describes system dynamics modeling and the main diagrams needed for describing complex systems through this approach.

The third and fourth chapters, "The DEVS Formalism" and "Thermal Analysis of the MIPS Processor Formulated Within DEVS Conventions" describe DEVS formalism. While the third chapter discusses DEVS from a broader perspective, the fourth chapter presents a detailed example of a MIPS processor defined using DEVS.

The fifth and sixth chapters, "Specification and Description Language for Discrete Simulation" and "Modeling a Chilean Hospital Using Specification and Description Language", describe Specification and Description Language (SDL), which is a standard graphical alternative for fully representing a simulation model. The fifth chapter describes SDL from a broader perspective while the sixth chapter presents a detailed example using the language.

The seventh chapter, "Formal Consistency Verification of UML Requirement and Analysis Models" proposes an enriched format for documenting UML 2.0 use cases to verify the consistency of the functional requirements of the sequence diagrams included in the analysis model.

The eighth chapter, "Model-Based System Design Using SysML: The Role of the Evaluation Diagram" presents SysML and proposes some extensions to the language in order to effectively describe non-functional requirements.

The ninth chapter, "Domain Specific Simulation Modeling with SysML and Model-to-Model Transformation for Discrete Processes" presents an approach for developing a simulation model using SysML and how to convert such a general model into a simulation-tool-specific model.

The tenth chapter, "An Integrated Framework to Simulate SysML Models Using DEVS Simulators" presents a framework that joins SysML and DEVS, allowing the validation of SysML models using DEVS simulators.

The eleventh chapter, "Overview on Agent-Based Social Modelling and the use of Formal Languages" presents a review of the most relevant aspects of modeling in the social sciences and discusses the use of formal languages by social scientists.

And last but not least, the twelfth chapter, "Agent-Based Simulation Model Representation Using BPMN" presents the Business Process Model and notation diagrams for representing the agent-based simulation conceptual model for business applications.

I hope that this collection of chapters, which illustrate some of the existing alternatives for formally representing a simulation model, will help the reader understand the complexity of the discipline.

Finally, I wish to thank the hard work performed by the authors of the chapters, the Editorial Advisory Board, the reviewers and the editorial team, all of whom made this book possible.

Enjoy modeling!

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REFERENCES

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