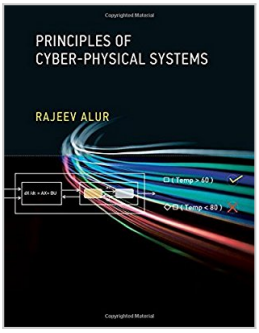

Principles of Cyber-Physical Systems (MIT Press)

By Rajeev Alur

Principles of Cyber-Physical Systems (MIT Press) By Rajeev Alur

A cyber-physical system consists of a collection of computing devices communicating with one another and interacting with the physical world via sensors and actuators in a feedback loop. Increasingly, such systems are everywhere, from smart buildings to medical devices to automobiles. This textbook offers a rigorous and comprehensive introduction to the principles of *design*, *specification*, *modeling*, and *analysis* of cyber-physical systems. The book draws on a diverse set of subdisciplines, including model-based design, concurrency theory, distributed algorithms, formal methods of specification and verification, control theory, real-time systems, and hybrid systems, explaining the core ideas from each that are relevant to system design and analysis.The book explains how formal models provide mathematical abstractions to manage the complexity of a system design. It covers both synchronous and asynchronous models for concurrent computation, continuous-time models for dynamical systems, and hybrid systems for integrating discrete and continuous evolution. The role of correctness requirements in the design of reliable systems is illustrated with a range of specification formalisms and the associated techniques for formal verification. The topics include safety and liveness requirements, temporal logic, model checking, deductive verification, stability analysis of linear systems, and real-time scheduling algorithms. Principles of modeling, specification, and analysis are illustrated by constructing solutions to representative design problems from distributed algorithms, network protocols, control design, and robotics.This book provides the rapidly expanding field of cyber-physical systems with a long-needed foundational text by an established authority. It is suitable for classroom use or as a reference for professionals.

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Editorial Review

Review

This is the first self-contained and comprehensive textbook presenting an elegant and rigorous unification of the theoretical underpinnings behind the practices in the emerging field of cyber-physical systems. It is remarkably well written and documented. It is a unique guide to understanding the multifaceted aspects of cyber-physical systems and their numerous applications.

(Joseph Sifakis, Professor, École polytechnique fédérale de Lausanne; Laureate of the 2007 Turing Award)

Cyber-physical systems are ubiquitous in modern technology. They occur in planes, automobiles, and other aspects of our daily life. It is critically important that they be correct, since people's lives may depend on them. This book is an excellent introduction to a complex and highly technical subject by the leading researcher in that field. I enthusiastically recommend it for either individual study or classroom use.

(Edmund M. Clarke, FORE Systems University Professor of Computer Science, Carnegie Mellon; Laureate of the 2007 Turing Award)

About the Author

Rajeev Alur is Zisman Family Professor of Computer and Information Science and Director of the Embedded Systems Masters program at the University of Pennsylvania.

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