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Artem Kruglov · Giancarlo Succi



Developing Sustainable and Energy-Efficient Software Systems

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Developing Sustainable and Energy-Efficient Software Systems

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*Anna,
Hoc opus tibi dedico.
Amor est vitae essentia.
Giancarlo*

Preface

An important research priority for the study of sustainable systems is the development of modeling and decision-making approaches that support dynamic, adaptive management rather than static optimization. This requires methods for understanding the full implications of alternative choices and their relative attractiveness in terms of enhancing system resilience. Due to the complexity of coupled systems, researchers should explore the simultaneous use of multiple models that reflect different system interpretations or stakeholder perspectives. In these circumstances, it is essential to analyze, monitor, and forecast the values of the basic parameters of the system, which directly affect its efficiency and sustainability.

A number of technical advances will likely improve the usefulness of models, including rigorous methodologies for dealing with missing and uncertain information; improved methods for interpretation of multivariate data sets and for multiobjective decision-making involving trade-offs among conflicting goals; and novel modeling methods as alternatives to traditional mathematical models, for example, agent-based models with appropriate utility functions. More generally, there is a great need to identify and analyze the metrics as the main parameters of sustainability of the system and its effectiveness. Software metrics are quantitative measures of specific attributes of software development, including software process and product. There are several kinds of metrics, based on the analysis of source code, developed during the past few decades for different programming paradigms such as structured programming and object-oriented programming (OOP). An important step in establishing a measurement program is the selection of the measures to use. The selection of the metrics should fit the process used and should have a direct impact on the quality of the delivered software. Different metrics may be appropriate for different products or processes even within the same organization. Metrics validation is another important topic in the area of software measures because their acceptance depends on whether they are able to predict important qualities.

The objectives of this book are:

- To identify existing and easily collectible measures, if possible in the early phases of software development, for predicting and modeling both the traditional

attributes of software systems and attributes specifically related to their efficient use of resources, and to create new metrics for such purposes.

- To describe ways to collect these measures during the entire life cycle of a system, using minimally invasive monitoring of design-time processes, and consolidate them into conceptual frameworks to support model building by using a variety of approaches, including statistics, data mining, and computational intelligence.
- To present models and tools to support design-time evolution of systems based on design-time measures and to empirically validate them. The models will support designers by providing suggestions with the idea of realizing an experience factory based on the analysis of the available measures (e.g., by using a model that identifies a vulnerability in the source code and suggests the need for refactoring).

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Innopolis, Russia
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