



Chapter IV

Concept and Definition of Complexity

Russell K. Standish, UNSW, Australia

Abstract

The term complexity is used informally both as a quality and as a quantity. As a quality, complexity has something to do with our ability to understand a system or object—we understand simple systems, but not complex ones. On another level, complexity is used as a quantity when we talk about something being more complicated than another. In this chapter, we explore the formalisation of both meanings of complexity, which happened during the latter half of the twentieth century.

Introduction: Is Complexity a Quality or a Quantity?

The term *complexity* has two distinct usages, which may be categorised simply as either a quality or a quantity. We often speak of complex systems as being a particular class of systems that are difficult to study using traditional analytic techniques. We have in mind that biological organisms and ecosystems are *complex*, yet systems like a pendulum, or a lever are simple. Complexity as a *quality* is therefore what makes the systems complex.

However, we may also speak of complexity as a quantity—with statements like a human being being more complex than a nematode worm, for example. Under such usage, complex and simple systems form a continuum, characterised by the chosen complexity measure.

Edmonds (1999) performed a comprehensive survey of complexity measures as part of his PhD thesis, however it has not been updated to include measures proposed since that time. However, it remains the most comprehensive resource of complexity measures available to date.

The aim of this chapter is not to provide a catalogue of complexity measures, but rather to select key measures and show how they interrelate with each other within an overarching information theoretic framework.

Complexity as a Quantity

We have an intuitive notion of complexity as a quantity; we often speak of something being more or less complex than something else. However, capturing what we mean by complexity in a formal way has proved far more difficult, than other more familiar quantities we use, such as length, area, and mass.

In these more conventional cases, the quantities in question prove to be decomposable in a linear way (i.e., a 5 cm length can be broken into 5 equal parts 1 cm long) and they can also be directly compared—a mass can be compared with a standard mass by comparing the weights of the two objects on a balance.

18 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/concept-definition-complexity/24185

Related Content

Innovative Systems Structure for Real Corporate Governance

(2021). *International Journal of System Dynamics Applications* (pp. 0-0).

www.irma-international.org/article//272227

Services Derivation from Business Process: A PSO-based Multi-Objective Approach

Mohamed El Amine Chergui and Sidi Mohamed Benslimane (2016). *International Journal of Adaptive, Resilient and Autonomic Systems* (pp. 59-74).

www.irma-international.org/article/services-derivation-from-business-process/169724

A Multi-Actor Ontology-Based Assistance Model: A Contribution to the Adaptive Semantic Web

Gilbert Paquette and Olga Marino (2012). *Intelligent and Adaptive Learning Systems: Technology Enhanced Support for Learners and Teachers* (pp. 213-228).

www.irma-international.org/chapter/multi-actor-ontology-based-assistance/56082

A Machine Learning Based Meta-Scheduler for Multi-Core Processors

Jitendra Kumar Rai, Atul Negi, Rajeev Wankar and K. D. Nayak (2012). *Technological Innovations in Adaptive and Dependable Systems: Advancing Models and Concepts* (pp. 226-238).

www.irma-international.org/chapter/machine-learning-based-meta-scheduler/63584

Evolving Learning in the Stuff Swamp

Jon Dron, Chris Boyne and Richard Mitchell (2003). *Adaptive Evolutionary Information Systems* (pp. 211-228).

www.irma-international.org/chapter/evolving-learning-stuff-swamp/4221