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Information in Layers †

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† Presented at the IS4SI 2017 Summit DIGITALISATION FOR A SUSTAINABLE SOCIETY, Gothenburg, Sweden, 12–16 June 2017.

Published: 8 June 2017

Abstract: This paper examines different uses of ideas of layers in philosophical and semiotic thinking and compares these ideas with the use of layers by engineers, especially for the design and analysis of communication systems. It looks at how some authors have drawn on layered thinking to discuss the information, and attempt to draw out some new insights into the nature of information.

Keywords: information; layers; communications

1. Introduction

Ideas of layers and levels are used in a wide range of disciplines. Science partitions nature vertically into different realms of discourse, with physics at the bottom and extending upwards through chemical and biological sciences to social sciences. In engineering, the use of hierarchies of levels is fundamental to tackling all complex technical problems to the extent that it is often taken for granted and invisible. The designer of equipment using mains electricity, for example, takes for granted the electricity generation and distribution, while those working in the infrastructure of the electricity distribution need not concern themselves with the details of domestic electrical goods. Civil engineers use materials with known characteristics but do not concern themselves with development and the manufacture of the material.

Levels in computing and communications technology are more explicit and formalised. Applications written in high-level languages run on top of the operating systems of computers. Of particular relevance here, however, is the layering used in computer- and tele-communications, such as the ISO's seven-layer model for Open Systems Interconnection ('the OSI seven-layer model') and the TCP/IP levels developed for data communication over the internet.

This paper explores the concepts used by and emerging from layered thinking—ideas such as abstraction, emergence, supervenience, reductionism, self-similarity—and examines how layered thinking articulates with a developing understanding of the nature information.

2. Layered Thinking

Some of the most foundational ideas around levels and layers came from systems theory and cybernetics and the work of the likes of Bertalanffy [1] and Ilya Prigogine.

In the background to his philosophy of information, Luciano Floridi identifies four categories of what he refers to as levelism in the philosophical literature [2] (p. 47).

1. epistemological, e.g., levels of observation or interpretation of a system;
2. ontological, e.g., levels (or rather layers) of organization, complexity, or causal interaction etc. of a system
3. methodological, e.g., levels of interdependence or reducibility among theories about a system; and

4. an amalgamation of (1)–(3)

Floridi argues that ontological levelism is untenable, but presents an approach to epistemological layers which he describes as the method of Levels of Abstraction (LoA [2] (Chapter 3)).

Although not explicitly described in the language of levels or layers, Gregory Bateson's discussion of the distinction and relationship between Creatura and Pleroma [3] and Alfred Korzybski insights expressed by the phrase 'the map is not the territory' [4] are informative in an exploration of levels and information.

Ideas of levels are important in the literature of semiotics, especially in the form of the three levels identified by Charles Morris [5]: syntactics (syntax), semantics, pragmatics. In crude terms, syntax is about the structure of messages; semantics about the meaning, and pragmatics about the effects. Also from the field of semiotics are the connotations of vertical metaphors, so 'up' is generally associated with positive, good, greater, things while down is associated with negative, bad and lesser things [6].

3. Layers and Levels in Theories of Information

In many narratives, information is located at one level in the DIKW (data-information-knowledge-wisdom) hierarchy. Warren Weaver [7], in the companion article to Shannon in The Mathematical Theory of Communication [8], identified three levels of the communication problems: The technical problem (the regime of Shannon's theory); the semantic problem; and the effectiveness problem. These three levels align in some way with the semiotic levels of syntax, semantics, pragmatics, but Colin Cherry [9] argues that Weaver's classification needs to be distinguished from that of semiotics because they are associated with different perspectives: the perspective of the external observer in contrast to that of the participant observer.

Cherry's work uses the semiotic categories, and, like Weaver, locates Shannon's theory firmly at the bottom: the syntactic level. Cherry argues that the word 'information' has different—though related—meaning at the different levels.

The method of Levels of Abstraction of Luciano Floridi [2] is part of the framework of his comprehensive philosophy of information.

Wolfgang Hofkirchner's work on 'emergent information' [10] brings together ideas from a wide range of disciplines including systems theory and semiotics to present a framework for a unified theory of information. Hofkirchner's framework makes use of the 'triple c' hierarchy: cognition; communication and cooperation. A unified theory of information requires the 'information' of a physicist to be the same thing as the information of, say, a librarian. This question—whether they are the same—has been presented as a so-called 'trilemma' of Capurro [10] (p. 148).

The author's own suggestion [11] is a formulation which leans heavily on the conventions of communications engineering, and envisages information as the interpretation of data in a lower layer for use in the layer above.

4. Conclusions

Thinking in terms of layers or levels brings with it a rich variety of ideas from a wide variety of disciplines, both philosophical and practical. An understanding of information is helped by a number of different aspects of layered thinking, and, indeed, addressing information without the concepts of layers is almost inconceivable.

Conflicts of Interest: The author declares no conflict of interest.

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