Review of *Information: A Very Short Introduction*

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The term 'information' is bandied about in modern times. In fact the notion of information is arguably amongst the most important of our 'information age'. Just what exactly is information though? Clearly the term is a polysemantic one, applied to a range of phenomena across a range of disciplines. There certainly has been particular interest in information from within philosophy, via investigations into its nature, applications of informational concepts to philosophical problems and questions concerning the ethics of information. Furthermore, conceptions of information within other disciplines such as biology and physics can and have been of philosophical interest. In this contribution to the Very Short Introduction series, philosopher of information Luciano Floridi provides a succinct yet fairly comprehensive outline of information.

Chapter 1 begins with a discussion of the emergence of the information age and information society. Information here has a familiar, colloquial sense and the discussion is straightforward, touching upon themes that readers will generally be familiar with: the information revolution, the lifecycle of information, the current saturation and continuing growth of digital information within our societies and the relevance and importance of Information and Communication Technologies (ICT). Floridi then moves onto the 'fourth revolution', a thesis he has developed concerning how technology and the information age have changed our relationship to one another and to the world. Science, as Floridi simply puts it, has two ways of changing our understanding, *extrovert* (about the world) and *introvert* (about ourselves). Three preceding revolutions have had an impact, in both ways; the Copernican, Darwinian and the Freudian revolutions. Likewise, it is argued that computer science and ICTs have also exercised such revolutionary influence (Floridi suggests associating this revolution with Alan Turing). Regarding the extrovert, one general idea given, along with some particular examples, is the shift from a materialistic metaphysics to an informational one. Regarding the introvert, Floridi argues that the fourth revolution is eliciting the intrinsically informational nature of human agents; rather than being standalone entities, we are interconnected informational organisms (*inforgs*), sharing with other biological agents and engineered artefacts a global environment ultimately consisting of information (*infosphere*). This incipient idea of a fourth revolution is an interesting one. No doubt there remains further discussion and debate to be had on the matter and it is an idea which can be better assessed given an elapse of time and retrospective vantage point.

For now, at the least it is fair to say that computer science and ICTs have had a revolutionary and transformative impact.

In Chapter 2 Floridi introduces the language of information. As he puts it, information is a conceptual labyrinth. To aid navigation through this labyrinth, a general map of the information spectrum is introduced here and used throughout the book to situate the various types of information looked at. Here the reader will also get an introduction to Floridi's practice of using everyday scenarios and themes to explicate informational concepts. It is in this chapter that he introduces the general definition of information, according to which X is an instance of information, understood as semantic content if and only if (1) X consists of n data, for $n \geq 1$ (2) the data are *well-formed* (3) the well-formed data are *meaningful*. The prime point of this definition is that information is made of data. The nature of data is itself an interesting topic and Floridi spends some time discussing general definitions and interpretations of data. 'Well-formed' here means that the data are composed according to the rules (syntax) governing the chosen system in question and 'meaningful' means that the well-formed data comply with the meanings (semantics) of the chosen system. All this seems straightforward enough, though it does raise some questions. Is it possible to have data that is meaningful but not well-formed? If not, then the condition of meaningfulness renders the condition of well-formation redundant and this definition is basically saying that information = data + meaning. On the other hand, a stipulation of well-formation would rule out counting the not well-formed string 'the car red won the race' (String1) as information in the English language, even though it is potentially meaningful. In such a case, String1 could perhaps be considered a piece of data that can be mapped to the information 'the red car won the race'. At any rate, I think that the point to be extracted from this is that ultimately such information can be identified with propositions.

Amongst further discussion in this chapter is an outline of analogue and digital data as well as an explication of binary data. A particularly interesting section provides a classification of different types of data/information; primary data, secondary data, metadata, operational data and derivative data. Further to this primary definition of information as semantic content, Floridi briefly introduces another important type of information, or another way in which we commonly use the term 'information'. This so-called *environmental information* concerns how one thing can carry information about another thing in a system when there is a certain correlation between the two, such as smoke carrying the environmental information that there is fire. In closing Chapter 2, Floridi goes back to information understood as semantic content, of which there are two main types: *instructional* and *factual*. Here he briefly looks at the former, as the more fundamental latter is discussed in greater depth in Chapter 4.

After the first two chapters, Floridi starts concentrating on particular, usually discipline specific types of information. Along the way, he locates these various types of information on his general information map.

Chapter 3 is dedicated to mathematical information, which Floridi locates within the structured data region of the information map. This region is located at the top of the information hierarchy and mathematical information forms a basis and provides constraints for the more high-level types of information. This chapter essentially boils down to a swift outline of Claude Shannon's mathematical theory of communication (MTC). Also known as information theory, MTC is a branch of applied mathematics and electrical engineering that deals with the quantification and transmission of information (or data, the two terms are synonymous in this context). As is duly explained, Shannon's theory however is a purely syntactic treatment of information and is not concerned with semantic aspects.

Chapter 4 deals specifically with semantic information, which as Floridi puts it is the 'queen' of all concepts discussed in the book. Since this is the one area that Floridi himself has most worked on and contributed to, much of the material in this chapter is the result of his own research. The focus is on *factual* semantic information, information that is about some state of affairs or some fact. Recall the earlier definition of information as semantic content; that is, well-formed, meaningful data. Floridi's definition of factual semantic information is well-formed, meaningful and *veridical* data. According to this definition, factual semantic information encapsulates truth; truth and falsity do not supervene on factual semantic information. Consequently, false information or misinformation are not kinds of genuine information; as Floridi puts it, ''one speaks of false information not as one speaks of a false statement, which is a sentence that happens to be false, but in the same way as one qualifies someone as a false friend, i.e. not a friend at all''. This veridicality thesis has been a point of contention in the literature and I personally am inclined to endorse it. Whilst it might seem that the debate is just a trivial terminological one, there is more to it. Firstly, the qualification of truth gives semantic information a certain rigour and significance, which it would otherwise not have. Secondly, there are practical benefits for working with a truth-based definition of semantic information. Some of these benefits are touched upon, including its support of a link between information and knowledge.

Whatever semantic information is, it is certainly something that is amenable to quantification; we may naturally say that one statement is more or less informative than another. What are some of the approaches to quantifying semantic information? Here

Floridi introduces the Inverse Relationship Principle (IRP), which can be traced back to MTC. According to this principle, the amount of information associated with p (where p may refer to amongst other thing a proposition, statement or situation) is inversely proportional to the probability associated with p. This principle forms the basis of the probabilistic approach to semantic information, introduced and probably to this day still most associated with Yehoshua Bar-Hillel and Rudolf Carnap's seminal work in the area. Generally this approach provides acceptable results. For example, someone telling you that a die landed on 6 is more informative than them telling you that it landed on 5 or 6, since the former is less probable than the latter. However, quantitative accounts of semantic information based on IRP are susceptible to two issues. One of them is known as 'the scandal of deduction', a term which I believe was coined by Jaakko Hintikka. Basically, whilst there seems to be a sense in which the deduction of a logical truth can carry or yield information, such accounts of semantic information do not count logical truths as informative, since they have a maximum probability of 1. There have been many attempts to address this issue and Floridi uses this section as an opportunity to very briefly outline one of his own suggestions. The other issue, termed the 'Bar-Hillel-Carnap Paradox' by Floridi, concerns the fact that under such quantitative accounts of information, since contradictions have a minimum probability of 0, the measure of informativeness assigned to them is maximum. Whilst I am not sure that contradictions should be assigned a degree of informativeness of 0 as per Floridi's suggestion, at the very least surely it is problematic to say that nothing can be more informative than a contradiction. Enter another advantage of Floridi's truth-based definition of information, or as he has termed it, the Theory of Strongly Semantic Information. The embedding of truth as a requirement of semantic information paves the way for a quantitative approach to semantic information that measures the amount of information associated with a statement in terms of its truthlikeness.

The next three chapters each cover a conception of information specific to a certain discipline (physics, biology and economics). One might note here a hierarchy of information that parallels a linear hierarchy of scientific disciplines.

The chapter on physical information begins with a discussion of the relationship between thermodynamics and information theory. Maxwell's demon thought experiment is employed to show how information as a physical phenomenon is subject to the laws of thermodynamics; or is it? The interesting area of quantum information and computation is touched upon before the chapter closes with a look at some informational metaphysics, invoking another demon, that of Laplace, along the way. Is the ultimate nature of physical reality informational? Is the physical universe a gigantic digital computer?

To keep the discussion of biological information simple, Floridi focuses on two aspects in particular: genetic and neural information. Starting with the former, he outlines fundamental biological concepts such as genes, chromosomes and DNA before relating them to information. Biological information is instructional information, information for something (in this case, the creation and maintenance of life), not about something. Floridi concludes the chapter on biological information by showing how the nervous system can be conceived of as an informational system.

Economic information is classed as a form of semantic information. From an economic viewpoint information is a commodity with value and information quality is paramount. This chapter mainly focuses on explaining information as a key term in game-theory, which is a cornerstone of economic theory. It deals with such key notions as complete information, asymmetric information and perfect information before closing with a look at Bayesian information.

The final chapter concerns the ethics of information. Like Chapter 4, this is another area to which Floridi himself has made significant contributions. To begin with, the ethics of information is discussed within a framework acronymically titled the RPT model, which basically deals with the connections between moral agents and information. Moral agents can use information as a *resource*, generate information as a *product* and in doing so affect their informational environment (information as a *target*). One particularly beneficial aspect of this model is that it abstracts away from specific technologies in favour of the more fundamental phenomenon of information. However, the inadequacies of this *microethical* approach to information ethics are pointed out and a more expansive and ambitious macroethical approach to information ethics is outlined. Here information ethics is touted as a new environmental ethics, the new environment being the infosphere. Moral agents are classified as informational entities, who are also embedded within the infosphere. The scope of ethics is expanded, replacing the *biocentrism* of standard environmental ethics (with a scope ranging from humans, to any form of life, to any component of the natural environment) with an *ontocentrism,* where any informational entity, anything that exists as an informational being is considered, in virtue of it having an intrinsic worthiness and being attributed a minimal set of rights appropriate to its nature. Accompanying this shift, a particular conception of *entropy* is seen as being more fundamental than the traditional, negatively valued notion of *suffering*. Entropy here refers to any kind of destruction, corruption, pollution or depletion of informational objects, or as Floridi puts it, any impoverishment of reality. This information ethics is a novel, interesting and perhaps somewhat wild line of thought, one which really requires elaboration beyond a review. Its implications remain to be fully assessed and its realisation as an applied ethics unspecified and uncertain. At this stage, one pertinent task is investigation into how it accommodates or conflicts with standard or traditional ethical theories.

The book ends on a pensive note, with an epilogue concerning the prospects of a successful marriage between *physis* (nature, reality) and *techne* (practical science and its application), two things often perceived to be at odds with each other. This is not exactly a new issue, but one that is becoming increasingly pertinent. For his part, Floridi is optimistic and his points quite commonsensical and agreeable. Information technology is here to stay. At the same time, we must be mindful of and avoid or minimise any of its detrimental affects to nature. In fact, information technologies can actually aid in the maintenance of nature. What is called for therefore is a holistic environmentalism, one that generally privileges neither but accepts both.

In conclusion, this book is an enjoyable read and valuable contribution to both the Very Short Introduction series and the literature on information. Although a grand unified theory of information is elusive, perhaps even inherently impossible given such uncontained usage of the term, Floridi does a good job of providing a clear, integrated and broad outline of this potentially unwieldy concept. One thing to note is that whilst most introductory books concern a topic with historical depth or draw from a range of well-established material, since formal theoretical work concerning the concept of information is relatively recent and Floridi himself is at the forefront of developments within many of the areas, this introductory book is in a unique position with regards to the novelty and particularity of its content. Also, whilst there are likely to be at least a few different introductory books for many if not most of the topics to be found in a topic list such as that of the Very Short Introduction series, to my knowledge this is currently the only introductory book on the general topic of information.