Editorial

Benoît Mandelbrot and the self-similarity of information

Abstract

Purpose

Notes the death of Benoît Mandelbrot (1924-2010) and reflects on the significance of his work for the information science.

Methodology

Briefly reviews relevant aspects of Mandelbrot's work.

Findings

Mandelbrot made two major contributions of relevance to information science: his extensions to Zipf's Law, and his development of concepts of fractals and of self-simlarity.

Value

The idea of the self-similarity of information provides a powerful and deep understanding, which has not been fully appreciated or applied.

Keywords

Information science; Mathematics; Fractals; Distributions; Laws; Mandelbrot

Paper type

viewpoint

Benoît Mandelbrot (20 November 1924 – 14 October 2010)

News of the death of Benoît Mandelbrot should lead us to reflect on his creative work over wide areas of mathematics, his innovative use of computer graphics to convey his results, and his enthusiastic popularisation of his works, through books such as *The Fractal Geometry of Nature*.

Mandelbrot's work has had an influence on the information sciences in two main ways.

The first is his mathematical extension and refinement of the laws of Bradford, Zipf and Pareto to yield what is generally described as the Zipf-Mandelbrot Law, giving a generalised form for many commonly found bibliometric distributions. This is well set out in Fairthorne's 1969 article, and a commentary on it by Rousseau (2005).

Such laws, as Mandelbrot noted from the first, show the phenomenon of 'self-similarity', or invariance to scale. The same properties are exhibited at large or small scales, so that it impossible to tell, without additional information, whether one is examining the distribution on a large or small scale; see for example, Egghe (2005) for a detailed analysis.

This leads to the second major strand of Mandelbrot's work; the elucidation of the concept of fractal geometry the mathematics applicable to a phenomenon exhibiting the 'roughness' characteristic of the natural and social worlds, as opposed to the smoothness of the 'ideal' world of mathematics. Many fractals have the property of 'self-similarity'; if a small portion is enlarged, it seems very similar, perhaps even seemingly identical, to the original, so that there is similarity of properties at any scale.

Apart from the self-similarity of the infometric distributions, the idea of fractal self-similarity has entered the information sciences in various ways, being applied to topics as varied as the structure of the semantic web (Berners-Lee and Kagal 2008) and to the concept of relevance (Ottaviani 1994).

Whether it can be said as a general principle that "information is self-similar" – repeating its patterns at all levels – is an intriguing and open question. If there is some truth in this, then this might give a clue as to the nature of the inter-relation between the concept of information in different domains – the physical, biological, social and technological. This sounds like just the kind of question which interested Mandelbrot, and we must regret that he is no longer with us to help solve it.

David Bawden

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