Ernst Schultze

EINFÜHRUNG IN DIE MATHEMATISCHEN GRUNDLAGEN DER INFORMATIONS THEORIE

(Introduction to the Mathematical Bases of the Information Theory)

Lecture notes in Operations Research and Mathematical Economics 9, Edited by M. Beckmann, Springer-Verlag, Berlin-Heidelberg-New York, 1969.

Based on the course of introduction to the theory of information held by Dr. Ernst Schultze at the Berne University, the present work presents, in a concise and didactic form, the fundamentals of this science which is of high interest at present. The problems approached in this volume as a section pertaining to operational research and economic mathematics represents a generalization of the results obtained in the technique of conveying information, leaning on the mathematical formalizing of the various aspects already suggested by Hartley and C.I. Shannon, which have become classical in this respects.

The reader finds, in very a accessible form, introductory knowledge regarding the entropy of a finite field of probabilities, illustrated by sufficiently intuitive numerical examples. The basic theorems and their proofs are expounded in a concise form, and the exercises aim to make the reader deepen his study of the ideas expounded and fix them. Conceptual transitivity between uncertainty and entropy are analyzed in detail, as well as the fundamental properties of the entropy of the composed field of probability, of the conditioned fields and the sinentropy of two fields is defined and interpreted, as well as their informational content.

A special chapter is devoted to the characterization of discrete information sources and of the codifying which they imply. The notion of correlation refers to the connection between sources without memory and the corresponding (binary) codifying. The categories, mean length of the code-word (Kraft's inequality in the case of an irreducible code), optimum code (Huffman's procedure), chain codifying and correspondence between the content of information and a redundancy, are made to stand out adequately. Likewise, the sources of information with memory of various orders, entropy of stationary forces, as well as natural and "artificial" language are defined.

A noteworthy introduction is made by the author to the analysis of discrete channels with perturbations, having in view stationary channels without and with memory, on which transmitting capacities are defined. The fundamental theorem of the information theory which determines the conditions for removing, with a given accuracy, perturbations, is adequately presented. The heuristic proof used is based on Shannon's works, and the exact one on R.B. Ash's.

We consider as praiseworthy the author's endeavour to synthesize a vast bibliographic material adopting the results of fundamental works such as those of C.E. Shannon, L.G. Kraft, R.M. Fano and D.A. Huffman, as well as more recent achievements such as those of J. Wolfowitz, R.B. Ash and L.B. Hyvarinen.

For its qualities the work reviewed may be considered as a basic instrument in the hands of those who by their theoretical and practical concerns are involved in the elucidation of the implications deriving from this modern theory.

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