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Information Theory for Information Technologists

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University of Reading*

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Preface

Information Technology may be defined as the acquisition, storage, processing, communication and display of information. As a technology it is unique in that it refers to an abstract concept -- information; all previous technologies have been linked to specific physical concepts. Information Technology is thus independent of the physical technologies used to implement it, and its principles will therefore continue unchanged despite the considerable technological developments expected in the next few years.

Information Theory, the science of quantification, coding and communication of information, is the basis of Information Technology. It is a precise, quantitative theory developed largely during and after the Second World War. Some of its theorems were at first considered impractical but recent technological developments have changed this and strongly underlined the importance of fundamental theory as a basis for technology.

The aim of this book is to present the fundamentals of Information Theory in a manner suitable for persons working in or interested in the field of Information Technology. Quantity of information is first defined, and the concepts of entropy and redundancy introduced, with application to the English language. Information in noisy channels is then considered, and various interpretations of information transfer presented: this leads on to the requirement of coding information before transmission, either in noiseless or noisy channels, and to Shannon's fundamental theorem.

In order to consider more general signals than purely digital or discrete signals, a review of signal and noise theory is required, including probability distributions, electrical noise, the Fourier Theory of signals and sampling theory. This paves the way for a study of the information capacity of a general channel and the ideal communication theorem. Finally a review of communication systems is presented in the light of Information Theory, together with examples of the applications of Information Theory to recent developments such as speech processing and recognition, sound generation, music synthesis and character recognition.

The book is based largely on a second-year course of about 30 lectures given to Cybernetics honours degree students. The approach adopted is one of intuitive understanding rather than rigorous formal theory. It is suitable for both specialist courses in Information Technology and for the new one-year conversion courses; arts-based graduates on these courses are advised to omit chapters 8 and 9 on first reading. Many of the worked examples and exercises are based on Reading University examination questions set by the author, who is pleased

to acknowledge the University's permission to publish them. His only regret is that he has seriously depleted his stock of such questions for future years. Early retirement looms large indeed.

Reading, 1984

M.J. USHER

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