AN INTRODUCTION TO INFORMATION THEORY

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PRE-REQUISITES : Basic knowledge of probability theory and digital communications

INTENDED AUDIENCE : 3rd/4th year UG students in EC stream, 1st year PG students in communications and signal processing specialization

INDUSTRIES APPLICABLE TO : Communication companies, defense laboratories

COURSE OUTLINE :

Information Theory answers two fundamental questions: what is the maximum data rate at which we can transmit over a communication link, and what is the fundamental limit of data compression. In this course we will explore answers to these two questions. We will study some practice source compression algorithms. We will also study how to compute channel capacity of simple channels.

ABOUT INSTRUCTOR :

Prof. Adrish Banerjee received his Bachelors degree from Indian Institute of Technology, Kharagpur and Masters and Ph.D. degree from University of Notre Dame, Indiana. He is currently an Associate Professor in the Department of Electrical Engineering at Indian Institute of Technology, Kanpur. He is a recipient of Microsoft Research India young faculty award, Institute of Engineers India young engineer award, and IETE Prof. K. Sreenivasan memorial award. His research interests are in the physical layer aspects of wireless communications, particularly green communications, error control coding, and cognitive radio.

COURSE PLAN :

Week 1: Introduction: Entropy, Relative Entropy, Mutual Information;
Information Inequalities;

Week 2: Block to variable length coding-I: Prefix-free code
Block to variable length coding-II: Bounds on optimal codelength;
Block to variable length coding-III: Huffman coding.

Week 3: Variable to block length coding
The asymptotic equipartition property
Block to block coding of DMS

Week 4: Universal Source Coding-I: Lempel-Ziv Algorithm-LZ77
Universal source coding-II: Lempel-Ziv Welch Algorithm (LZW)

Week 5: Coding for sources with memory
Channel capacity of discrete memoryless channels.

Week 6: Joint typical sequences
Noisy channel coding theorem;
Differential entropy;

Week 7: Gaussian Channel;
Parallel Gaussian Channel.

Week 8: Rate Distortion Theory;
Blahut-Arimoto Algorithm for computation of channel capacity and rate- distortion function.