



Sri
SAI RAM
ENGINEERING COLLEGE
INSTITUTE OF TECHNOLOGY
West Tambaram, Chennai - 44

Sairam
INSTITUTIONS



SAIRAM
DIGITAL RESOURCES

UNIT NO 4

SOURCE AND ERROR CONTROL CODING

Shannon–Fano coding
Huffman Coding

YEAR
II

SEM
III

EC8394

ANALOG AND DIGITAL COMMUNICATION

ELECTRONICS & COMMUNICATION ENGINEERING



Shannon-Fano Coding

Step 1: The message symbols are listed in descending order of their probabilities.

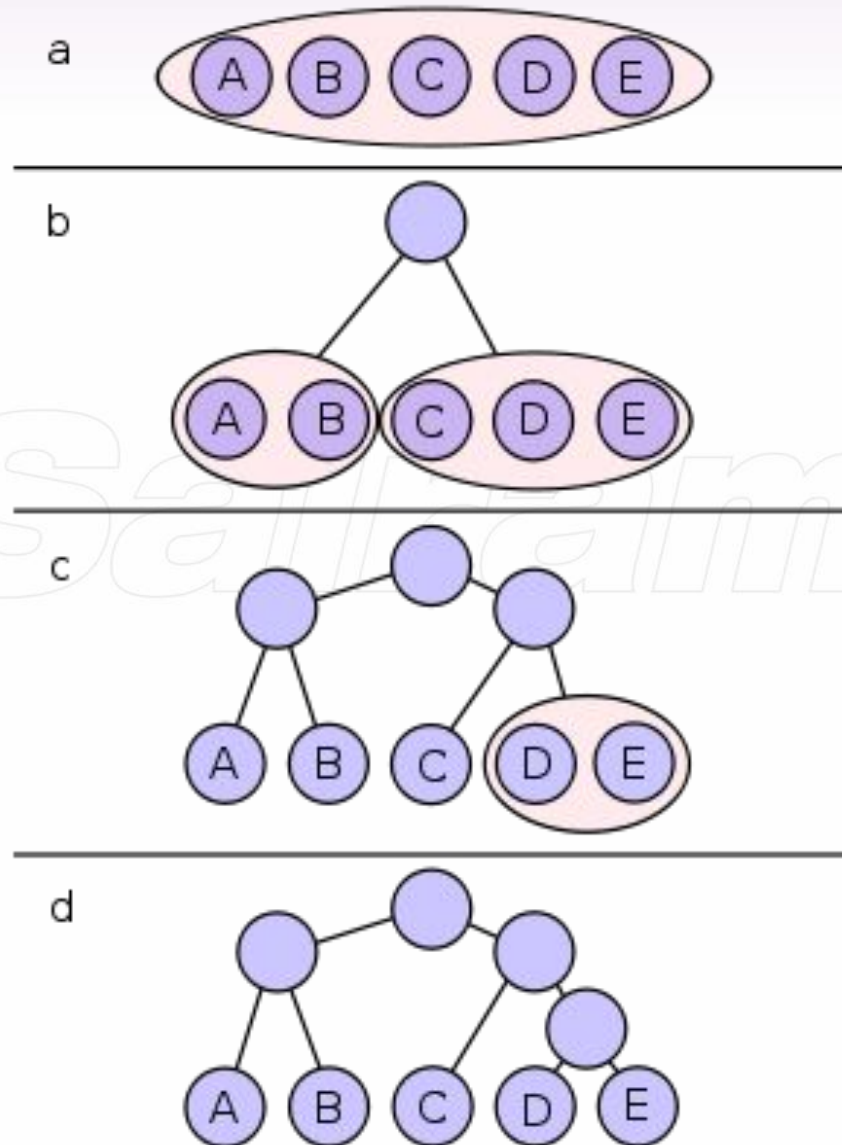
Step 2: The list is divided into two groups of as nearly equal probabilities as possible.

Step 3: First group assigned with symbol 0 as first bit – prefix code. Second group assigned with symbol 1 as first bit.

Step 4: Each of these groups is then further divided and assigned second bit in the same manner.

Step 5: The process is repeated until 1 symbol is left in each subgroup.

Method:



Example

Symbol	Probability	Stage I	Stage II	Stage III	Code
S_0	0.3	0	00		00
S_1	0.2	0	01		01
S_2	0.2	1	10		10
S_3	0.15	1	11	110	110
S_4	0.15	1	11	111	111

Example

a_i	$p(a_i)$	1	2	3	4	Code
a_1	0.36	0	00			00
a_2	0.18		01			01
a_3	0.18	1	10			10
a_4	0.12		11	110		110
a_5	0.09			111	1110	1110
a_6	0.07				1111	1111

Parameters to be calculated:

- Find Length of each code l_k
- Find entropy of the source $H(S)$
- Find average length of the code
- Find Coding efficiency
- Find Redundancy

Huffman Coding

Step 1: The message symbols are listed in descending order of their probabilities.

Step 2: The least two groups probabilities are added and *step 1* is repeated including the sum probability.

Step 3: *Step 2* and *Step 3* are repeated until two values are left.

Step 4: Prefix codes are now formed with 0 and 1

Step 5: The process is completed when each symbol takes an unique code.

Example – Source Reduction

Original source		Source reduction			
Symbol	Probability	1	2	3	4
a_2	0.4	0.4	0.4	0.4	0.6
a_6	0.3	0.3	0.3	0.3	
a_1	0.1	0.1	0.2	0.3	0.4
a_4	0.1	0.1			
a_3	0.06	0.1	0.1	0.1	0.1
a_5	0.04				

Code Assignment:

Original source			Source reduction			
Sym.	Prob.	Code	1	2	3	4
a_2	0.4	1	0.4 1	0.4 1	0.4 1	0.6 0
a_6	0.3	00	0.3 00	0.3 00	0.3 00	0.4 1
a_1	0.1	011	0.1 011	0.2 010	0.3 01	
a_4	0.1	0100	0.1 0100	0.1 011		
a_3	0.06	01010	0.1 0101			
a_5	0.04	01011				