

Performance Analysis of Shannon-Fano Coding and Tunstall Coding

Ezhilarasu.P, Murali.C, Krishnaraj.N, Sowmya.R, Manoj Prabhakar.J, Karpagam.R

Abstract— In this paper, we compare Shannon-Fano coding and Tunstall coding for two types of input. First, input with 200 characters (16 unique characters) used for comparison. Then, random input with mixed characters and mixed probability of unique characters used for comparison. The three condition namely compression ratio, space savings, and average bits calculated and then compared for both the compression.

Keywords— Shannon-Fano coding, Tunstall coding, Compression, Encoding, Decoding.

I. INTRODUCTION

The advancement in the field of Information Technology is phenomenal. This lead to the improvement in the performance along with the drastic reduction in the cost as well as the size. In olden days the battle between size and the cost always cost wins. Ex. If there are two CRT TV with one occupies large area with less cost and another occupies less amount of area with higher cost; Then people will consider least cost TV. But today the mindset of the people is different. They prefer compactness instead of price. Ex. preferring Laptop over Desktop computers although Laptop cost higher than the Desktop computers.

Data compression is a technique which focuses of compactness by reducing the redundancy. It is defined as the reorganization of data in such a way that, the volume of the resultant data is less than that of the volume of the source data. The decompression technique used to get the original data. After decompression if some data lost, then the compression called as lossy compression. If none of the data lost, then the compression called as lossless compression. The Shannon-Fano coding comes under lossless compression. Each compression technique deals with two important aspects. Those are space complexity and time complexity.

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Because of data compression, data transfer from source to destination takes less amount of time. For instance, if the data size is 768MB and the transfer rate between origin and destination is 256 kbps. The transfer time calculated by the given equation 1.□

$$\text{Transfer Time} = \text{Input data} / \text{Bandwidth(Data Rate)} \quad (1)$$

(1 MB = 1024 KB and 1 KB = 8 kb)

$$\begin{aligned} \text{Input data} &= 768 \text{ MB} \\ &= 768 * 1024 \text{ KB} \\ &= 768 * 1024 * 8 \text{ kb} \end{aligned}$$

$$\text{Transfer rate} = 256 \text{ kbps}$$

$$\begin{aligned} \text{So Transfer Time} &= (768 * 1024 * 8) / 256 \\ &= 3 * 1024 * 8 \\ &= 24576 \text{ seconds} \end{aligned}$$

If the given data compressed into 384MB, then the time taken for transfer will be 12288 seconds.

If the destination allowed amount of storage is 1TB(1024 GB), then the target machine can store the following number of files by using the equation 2.

$$\text{Number of files can be stored} = \text{Total amount of storage} / \text{Size of the file} \quad (2)$$

$$\begin{aligned} (1 \text{ GB} = 1024 \text{ MB}) \\ &= 1024 \text{ GB} / 768 \text{ MB} \\ &= 1024 * 1024 \text{ MB} / 768 \text{ MB} \\ &= 1365.33 \end{aligned}$$

Therefore, the destination system can store 1365 files for uncompressed data.

$$\begin{aligned} \text{For compressed file, it can store} \\ &= 1024 * 1024 \text{ MB} / 384 \text{ MB} \\ &= 2730.66 \\ &= 2730 \text{ files.} \end{aligned}$$

The space and time complexity based on compression ratio. It calculated by using the following equation 3.

$$\text{Compression ratio} = \text{Uncompressed actual data} / \text{Compressed Data} \quad (3)$$

$$\begin{aligned} &= 768 \text{ MB} / 384 \text{ MB} \\ &= 2:1 \end{aligned}$$

The compressed data takes little storage with faster transfer rate than the actual data.

The files are of many types. It may be a text file, image file, video or audio file. The compression ratio differs for each file types.

The data compression also has some limitations. If the data to be compressed are video data, we need special hardware. For compression and decompression, it takes some amount of time. During compression and decompression, the some data may be lost. The limitations aggregated as

1. Data quality
2. Time for processing
3. Cost for processing

In compression, we have the following types

1. Lossy compression (Compressed data size is less than source data)
2. Lossless compression (Compressed data size is equal to source data).

In this paper, we discuss Shannon-Fano lossless data compression algorithm and Tunstall coding.

II. RELATED WORK

Shannon-Fano coding technique was developed independently by Shannon and Fano in 1944. Shannon introduced the concept [1] and later the encoding of the message was implemented by Fano [2]. Mark Nelson and Jean-loup Gailly [1995] described the basics of data compression algorithms. It includes lossless and lossy algorithms [3]. David Salomon [2000] described many different compression algorithms altogether with their uses, limitations, and common usages. He gave an overview on lossless and lossy compression [4]. Khalid Sayood [2000] gave an introduction into the various area of coding algorithms, both lossless and lossy, with theoretical and mathematical background information [5]. Many books [6, 7, 8, 9] published about the data compression techniques. The tunstall coding examines the number of sources from variable to fixed length code which can be obtained in a random manner [10]. In tunstall coding the faster incremental algorithm can make the tunstall coding tree for the source [11]. The implementation of tunstall code improves non-Bernoulli sources by constructing a code in an effective way [12]. Tunstall code encodes the variable number of source symbols into fixed length codeword [13]. Without any loss in compression the error performance can be examined and then it is improved [14]. In adaptive code, the tunstall code can able to encode the wrong code in which it may update the current code when the time changes [15]. The algebraic characterization [16] can get the average redundancy rates by using asymptotic results. The parameterized pattern matching can find the matches between a pattern and the text by examine the tunstall code [17]. By rising the compression ratio the variable to fixed length code is little hard than fixed to variable length code [18, 19].

III. SHANNON-FANO ENCODING

In the field of data compression, Shannon-Fano coding, named after Claude Shannon and Robert Fano, is a technique for constructing a prefix code based on a set of symbols and their probabilities (estimated or measured) [20].

Algorithm

1. Get the data (input).
2. Read the input data character by character.
3. Identify unique characters along with its occurrences.
4. Calculate the probability of every unique character.

5. Write the characters with the most probability to the left of the code table. Then characters with the least probability to be placed at the right of the code table.

6. Find the result of frequency count difference between, the right part and the left part. If the result very close to zero, Split the list into two parts.

7. The left part assigned the value 0 and the right part assigned the value 1.

8. Apply step six and seven recursively to each of the two halves until we get leaf nodes equal to number of unique characters.

A. Basic Example

If in a message(M), whose length is 100 we have eight unique characters (m1, m2, m3, m4, m5, m6, m7, m8) with occurrences are 25,20,20,10,10,5,5,5. The probability (P) of each unique character given as (p1, p2, p3, p4, p5, p6, p7, p8) given in the equation 4.

Probability of a character (P) = Occurrence of the character / Total length of the message (4)

The probability of the unique characters (m1, m2, m3, m4, m5, m6, m7, m8) calculated as (p1, p2, p3, p4, p5, p6, p7, p8) using the equation 4 and is given in the coding table as given in the table 1

CHARACTER	m1	m2	m3	m4	m5	m6	m7	m8
OCCURRENCE	25	20	20	10	10	5	5	5
PROBABILITY	0.25	0.2	0.2	0.1	0.1	0.05	0.05	0.05

Table. 1 . Coding table for the message(M) with unique characters(m1,m2,m3,m4,m5,m6,m7,m8).

The probability of each unique character is always between zero and one. Here the highest probability is 0.25 and the least is 0.05. Initially the list is having eight unique characters m1, m2, m3, m4, m5, m6, m7, m8. The sum of the probability is one. The grouping done from left to right.

1. $m1 = 0.25$, the sum of the remaining unique characters (m2-m8) probability = 0.75. So, the difference = $0.5(0.75-0.25)$.

2. $m1+m2=0.45$ the sum of the remaining unique characters (m3-m8) probability = 0.55. So, the difference = $0.1(0.55-0.45)$.

$m1+m2+m3=0.65$ the sum of the remaining unique characters (m4-m8) probability = 0.35. So, the difference = $-0.3(0.35-0.65)$.

The sum of the probability crosses the half of the total probability. In step one, the difference is 0.5, in step two it is 0.1 and in step three it is -0.3. The least absolute value and its corresponding group taken. The group (m1-m8) broken into two groups (m1-m2) with assigned value zero and (m3-m8) with the assigned value one. The group (m1-m2) has only two unique characters with equal probability. The left side character m1 assigned the value 0 and the right side character m2 assigned the value 1

The group (m3-m8) is having six unique characters with the total probability is 0.45.

1. $m3=0.2$, the sum of the remaining unique characters (m4-m8) probability = 0.25. So the difference = $0.15(0.35-0.2)$.

2. $m_3+m_4=0.3$, the sum of the remaining unique characters (m_5-m_8) probability = 0.2. So the difference = $-0.05(0.25-0.3)$.

The sum of the probability reaches the half of the total probability. In step one, the difference is 0.15 and in step two it is -0.05. The least value considered. The group (m_3-m_8) divided into two groups (m_3-m_4) with assigned value zero and (m_5-m_8) with the assigned value one. The group (m_3-m_4) has only two unique characters with equal probability. The left side character m_3 assigned the value 0 and the right side character m_4 assigned the value 1.

The group (m_5-m_8) is having four unique characters with the total probability is 0.25.

1. $m_5=0.1$, the sum of the remaining unique characters (m_6-m_8) probability = 0.15. So the difference = $0.05(0.15-0.1)$.

2. $m_5+m_6=0.15$, the sum of the remaining unique characters (m_7-m_8) probability = 0.1. So the difference = $-0.05(0.1-0.15)$.

The sum of the probability reaches the half of the total probability. In step one, the difference is 0.05 and in step two it is -0.05. Both are equal. Hence the first least value considered. The group (m_5-m_8) broken into two groups (m_5-m_6) with assigned value zero and (m_7-m_8) with the assigned value one. The group (m_5-m_6) and (m_7-m_8) has only two unique characters with equal probability. The left side character m_5 , m_7 assigned the value 0 and the right side character m_6 , m_8 assigned the value 1. The result shown in Figure 1 and in Table 2.

Fig. 1. Shannon-Fano Tree

Message	m1	m2	m3	m4	m5	m6	m7	m8
Probability	0.25	0.2	0.2	0.1	0.1	0.05	0.05	0.05
Encoding vector	00	01	100	101	1100	1101	1110	1111

Table . 2. Shannon-Fano Encoding

$$\begin{aligned} \text{The total number of bits needed} &= 25 * 2 + 20 * 2 + 20 * 3 + \\ &10 * 3 + 10 * 4 + 5 * 4 + 5 * 4 + 5 * 4 \\ &= 50 + 40 + 60 + 30 + 40 + 20 + 20 + 20 \\ &= 280 \text{ bits} \end{aligned}$$

$$\begin{aligned} \text{The size of the input as uncompressed} &= 100 * 8 \\ &= 800 \text{ bits} \end{aligned}$$

$$\begin{aligned} \text{The size of the compressed data using binary coding} &= 100 * 3 = 300 \text{ bits.} \end{aligned}$$

B. Advanced Example

INPUT

Input: “Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience.”

The input placed between “ and ”.

Total length of given input = 90

Total unique characters = 29

S.NO	SYMBOL	OCCURRENCE	PROBABILITY
1.	SPACE	12	0.133333
2.	a	12	0.133333
3.	e	9	0.1
4.	i	7	0.077778

5.	r	6	0.066667
6.	l	5	0.055556
7.	n	4	0.044444
8.	s	3	0.033333
9.	m	3	0.033333
10.	h	3	0.033333
11.	c	3	0.033333
12.	v	2	0.022222
13.	p	2	0.022222
14.	o	2	0.022222
15.	d	2	0.022222
16.	.	2	0.022222
17.	z	1	0.011111
18.	y	1	0.011111
19.	x	1	0.011111
20.	U	1	0.011111
21.	u	1	0.011111
22.	t	1	0.011111
23.	P	1	0.011111
24.	g	1	0.011111
25.	f	1	0.011111
26.	E	1	0.011111
27.	D	1	0.011111
28.	3	1	0.011111
29.	0	1	0.011111

Table. 3. Shannon-Fano character occurrence for the given input

The initial probability = one. Half of the probability = 0.5.

The sum of first four characters in terms of probability = 0.44444

The sum of first five characters in terms of probability = 0.511111

Hence, the first five characters grouped as group 1 with assigned value 0, and last twenty-four characters grouped as group 2 with the assigned value 1. The process shown in the following table

S.NO	GROUP	ASSIGNED CODE	GROUP I	ASSIGNED CODE	GROUP II	ASSIGNED CODE
1.	1-29	-	1-5	0	6-29	1
2.	1-5	0	1-2	00	3-5	10
3.	1-2	00	1	000	2	100
4.	3-5	10	3	010	4-5	110
5.	4-5	110	4	0110	5	1110
6.	6-29	1	6-11	01	12-29	11
7.	6-11	01	6-7	001	8-11	101
8.	6-7	001	6	0001	7	1001
9.	8-11	101	8-9	0101	10-11	1101
10.	8-9	0101	8	00101	9	10101
11.	10-11	1101	10	01101	11	11101
12.	12-29	11	12-17	011	18-29	111
13.	12-17	011	12-14	0011	15-17	1011
14.	12-14	0011	12	00011	13-14	10011
15.	13-14	10011	13	010011	14	110011
16.	15-17	1011	15	01011	16-17	11011
17.	16-17	11011	16	011011	17	111011
18.	18-29	111	18-23	0111	24-29	1111
19.	18-23	0111	18-20	00111	21-23	10111
20.	18-20	00111	18	000111	19-20	100111
21.	19-20	100111	19	0100111	20	1100111
22.	21-23	10111	21	010111	22-23	110111
23.	22-23	110111	22	0110111	23	1110111
24.	24-29	1111	24-26	01111	27-29	11111
25.	24-26	01111	24	001111	25-26	101111
26.	25-26	101111	25	0101111	26	1101111
27.	27-29	11111	27	0111111	28-29	111111
28.	28-29	111111	28	0111111	29	1111111

Table 4. Formation of groups (11-29) from (1-29)
 The probability and encoding vector of each unique character represented in the table 5

S.NO	UNIQUE CHARACTER	PROBABILITY	ENCODING VECTOR
1.	SPACE	0.133333	000
2.	a	0.133333	100
3.	e	0.1	010
4.	i	0.077778	0110
5.	r	0.066667	1110
6.	l	0.055556	0001
7.	n	0.044444	1001
8.	s	0.033333	00101
9.	m	0.033333	10101
10.	h	0.033333	01101
11.	c	0.033333	11101
12.	v	0.022222	00011
13.	p	0.022222	010011
14.	o	0.022222	110011
15.	d	0.022222	01011
16.	.	0.022222	011011
17.	z	0.011111	111011
18.	y	0.011111	000111
19.	x	0.011111	0100111
20.	U	0.011111	1100111
21.	u	0.011111	010111
22.	t	0.011111	0110111
23.	P	0.011111	1110111
24.	g	0.011111	001111
25.	f	0.011111	0101111
26.	E	0.011111	1101111
27.	D	0.011111	0111111
28.	3	0.011111	0111111
29.	0	0.011111	1111111

Table 5. Encoding vector for each unique characters for the given input

The size of the compressed data derived from the table 5. It is given in the table 6.

S.NO	UNIQUE CHARACTER	OCCURRENCE	ENCODING VECTOR	TOTAL LENGTH
1.	SPACE	12	000	36
2.	a	12	100	36
3.	e	9	010	27
4.	i	7	0110	28
5.	r	6	1110	24
6.	l	5	0001	20
7.	n	4	1001	16
8.	s	3	00101	15
9.	m	3	10101	15
10.	h	3	01101	15
11.	c	3	11101	15
12.	v	2	00011	10
13.	p	2	010011	12
14.	o	2	110011	12
15.	d	2	01011	10
16.	.	2	011011	12
17.	z	1	111011	6
18.	y	1	000111	6
19.	x	1	0100111	7
20.	U	1	1100111	7
21.	u	1	010111	6
22.	t	1	0110111	7
23.	P	1	1110111	7
24.	g	1	001111	6
25.	f	1	0101111	7
26.	E	1	1101111	7
27.	D	1	0111111	6
28.	3	1	0111111	6
29.	0	1	1111111	7

Table 6. Size of the compressed data for the given input

The given input after encoding will be

0111111100110111101111110110110101100001100111
 01000010101011100011001111010110001011010000110110
 00011101111000001100100101100000110001010000110110
 0000110110100100111100010101110011110010000011011
 101101100100100001111111111100000011101010011100
 01010001100110101111000010011100111010000010001010
 00010001001110110001011010101010110111010000100100
 11101001101011100110010100111101010011011

The total number of bits needed is 389 bits.

The size of the input as uncompressed = 90 * 8
 = 720 bits
 The size of the compressed data using binary coding
 = 90*6=540 bits.

IV. SHANNON-FANO DECODING

The Shannon-Fano decoding implemented by replacing the encoding vector from the starting of the input. i.e., 1111111 replaced by D and so on. The decoding process stops after step number 114(no of characters). □

Input after Encoding:

011111111001101111011111110110110101100001100111
 01000010101011100011001111010110001011010000110110
 00011101111000001100100101100000110001010000110110
 00001101101001001111000101011100111110010000011011
 1011011001001000011111111111100000011101010011100
 01010001100110101111000010011100111010000010001010
 00010001001110110001011010101010110111010000100100
 11101001101011100110010100111101010011011

Input after Decoding

Step1

D11100110111101111111011011011011000011001110100
 00101010111000110011110101100010110100001101100001
 11011110000011001001011000001100010100001101100000
 1101101001001111000101011100111100100000110111011
 0110010010000111111111111000000111010100111000101
 00011001101011110000100111001110100000100010100001
 00010011101100010110101010101101110100001001001110
 1001101011100110010100111101010011011

Step2

Dr01101111011111110110110110110000110011101000010
 10101110001100111101011000101101000011011000011101
 11100000110010010110000011000101000011011000001101
 1010010011110001010111001111001000001101110110110
 0100100001111111111110000001110101001110001010001
 10011010111100001001110011101000001000101000010001
 00111011000101101010101011011101000010010011101001
 101011100110010100111101010011011

Step3

Dr.110111111101101101011000011001110100001010101
 11000110011110101100010110100001101100001110111100
 00011001001011000001100010100001101100000110110100
 10011110001010111001111100100000110111011011001001
 00001111111111111000000111010100111000101000110011
 01011110000100111001110100000100010100001000100111
 01100010110101010101101110100001001001110100110101
 1100110010100111101010011011

Step4

Dr.E11101101101011000011001110100001010101110001
 10011110101100010110100001101100001110111100000110
 01001011000001100010100001101100000110110100100111
 10001010111001111100100000110111011011001001000011
 11111111111000000111010100111000101000110011010111
 10000100111001110100000100010100001000100111011000
 10110101010101101110100001001001110100110101110011
 0010100111101010011011

Step5
Dr.Ez0110101100001100111010000101010111000110011
1101011000101101000011011000011101111000011001001
01100000110001010000110110000011011010010011110001
01011100111110010000011011101101100100100001111111
11111100000011101010011100010100011001101011110000
10011100111010000010001010000100010011101100010110
1010101011011010000100100111010011010111001100101
00111101010011011

Step6
Dr.Ezh011000011001110100001010101110001100111101
0110001011010000110110000111011110000110010010110
00001100010100001101100000110110100100111100010101
1100111110010000011011101101100100100001111111111
11000000111010100111000101000110011010111100001001
11001110100000100010100001000100111011000101101010
10101101110100001001001110100110101110011001010011
1101010011011

Step7
Dr.Ezhi000110011101000010101011100011001111010110
00101101000011011000011101111000001100100101100000
11000101000011011000001101101001001111000101011100
1111100100000110111011011001001000011111111111100
00001110101001110001010001100110101111000010011100
11101000001000101000010001001110110001011010101010
11011101000010010011101001101011100110010100111101
010011011

Step8
Dr.Ezhil0011101000010101011100011001111010110001
01101000011011000011101111000001100100101100000110
00101000011011000001101101001001111000101011100111
1100100000110111011011001001000011111111111100000
01110101001110001010001100110101111000010011100111
01000001000101000010001001110110001011010101010110
11101000010010011101001101011100110010100111101010
011011

Step9
Dr.Ezhila110100001010101110001100111101011000101
10100001101100001110111100000110010010110000011000
10100001101100000110110100100111100010101110011111
0010000011011101101100100100001111111111110000001
11010100111000101000110011010111100001001110011101
00000100010100001000100111011000101101010101011011
10100001001001110100110101110011001010011110101001
1011

Step10
Dr.Ezhilar100001010101110001100111101011000101101
00001101100001110111100000110010010110000011000101
00001101100000110110100100111100010101110011111001
0000011011101101100100100001111111111110000001110
10100111000101000110011010111100001001110011101000
00100010100001000100111011000101101010101011011101
00001001001110100110101110011001010011110101001101
1

Step11

Dr.Ezhilara001010101110001100111101011000101101000
01101100001110111100000110010010110000011000101000
01101100000110110100100111100010101110011111001000
0011011101101100100100001111111111110000001110101
00111000101000110011010111100001001110011101000001
00010100001000100111011000101101010101011011101000
010010011101001101011100110010100111101010011011

Step12
Dr.Ezhilaras01011100011001111010110001011010000110
11000011101111000001100100101100000110001010000110
11000001101101001001111000101011100111110010000011
0111011011001001000011111111111100000011101010011
10001010001100110101111000010011100111010000010001
01000010001001110110001011010101010110111010000100
10011101001101011100110010100111101010011011

Step13
Dr.Ezhilarasu0001100111101011000101101000011011000
01110111100000110010010110000011000101000011011000
00110110100100111100010101110011111001000001101110
1101100100100001111111111110000001110101001110001
01000110011010111100001001110011101000001000101000
01000100111011000101101010101011011101000010010011
101001101011100110010100111101010011011

Step14
Dr.Ezhilarasu
11001111010110001011010000110110000111011110000011
00100101100000110001010000110110000011011010010011
11000101011100111110010000011011101101100100100001
11111111111100000011101010011100010100011001101011
11000010011100111010000010001010000100010011101100
01011010101010110111010000100100111010011010111001
10010100111101010011011

Step15
Dr.Ezhilarasu
U101011000101101000011011000011101111000001100100
10110000011000101000011011000001101101001001111000
10101110011111001000001101110110110010010000111111
11111110000001110101001110001010001100110101111000
01001110011101000001000101000010001001110110001011
01010101010101101101000010010011101001101011100110010
100111101010011011

Step16
Dr.Ezhilarasu
Um10001011010000110110000111011110000011001001011
00000110001010000110110000011011010010011110001010
11100111110010000011011101101100100100001111111111
11100000011101010011100010100011001101011110000100
11100111010000010001010000100010011101100010110101
01010110111010000100100111010011010111001100101001
11101010011011

Step17
Dr.Ezhilarasu
Uma0101101000011011000011101111000001100100101100
00011000101000011011000001101101001001111000101011
1001111100100000110111011011001001000011111111111
10000001110101001110001010001100110101111000010011

1001110100001000101000010001001110110001011010101
01011011101000010010011101001101011100110010100111
101010011011

Step18

Dr.Ezhilarasu

Umad010000110110000111011110000011001001011000001
10001010000110110000011011010010011110001010111001
111100100000110111011011001001000011111111111000
00011101010011100010100011001101011110000100111001
110100000100010100001000100111011000101101010101
10111010000100100111010011010111001100101001111010
10011011

Step19

Dr.Ezhilarasu

Umade00011011000011101111000001100100101100000110
00101000011011000001101101001001111000101011100111
110010000011011101101100100100001111111111100000
01110101001110001010001100110101111000010011100111
010000010001010000100010011101100010110101010110
11101000010010011101001101011100110010100111101010
011011

Step20

Dr.Ezhilarasu

Umadev0110000111011110000011001001011000001100010
10000110110000011011010010011110001010111001111100
100000110111011011001001000011111111111000000111
01010011100010100011001101011110000100111001110100
0001000101000010001001110110001011010101010110110
10000100100111010011010111001100101001111010100110
11

Step21

Dr.Ezhilarasu

Umadevi0001110111100000110010010110000011000101000
01101100000110110100100111100010101110011111001000
001101110110110010010000111111111110000001110101
00111000101000110011010111100001001110011101000001
00010100001000100111011000101101010101011011101000
010010011101001101011100110010100111101010011011

Step22

Dr.Ezhilarasu

Umadevi

11101111000001100100101100000110001010000110110000
01101101001001111000101011100111110010000011011101
1011001001000011111111111100000011101010011100010
10001100110101111000010011100111010000010001010000
10001001110110001011010101010110111010000100100111
01001101011100110010100111101010011011

Step23

Dr.Ezhilarasu

Umadevi

P1000001100100101100000110001010000110110000011011
01001001111000101011100111110010000011011101101100
1001000011111111111100000011101010011100010100011
00110101111000010011100111010000010001010000100010
01110110001011010101010110111010000100100111010011
01011100110010100111101010011011

Step24

Dr.Ezhilarasu

Umadevi

Pa000110010010110000011000101000011011000001101101
00100111100010101110011111001000001101110110110010
01000011111111111110000001110101001110001010001100
11010111100001001110011101000001000101000010001001
11011000101101010101011011101000010010011101001101
011100110010100111101010011011

Step25

Dr.Ezhilarasu

Umadevi

Pal10010010110000011000101000011011000001101101001
00111100010101110011111001000001101110110110010010
00011111111111110000001110101001110001010001100110
10111100001001110011101000001000101000010001001110
11000101101010101011011101000010010011101001101011
100110010100111101010011011

Step26

Dr.Ezhilarasu

Umadevi

Pala1001011000001100010100001101100000110110100100
11110001010111001111100100000110111011011001001000
01111111111111000000111010100111000101000110011010
11110000100111001110100000100010100001000100111011
00010110101010101101110100001001001110100110101110
0110010100111101010011011

Step27

Dr.Ezhilarasu

Umadevi

Palan011000001100010100001101100000110110100100111
10001010111001111100100000110111011011001001000011
11111111111000000111010100111000101000110011010111
10000100111001110100000100010100001000100111011000
10110101010101101110100001001001110100110101110011
0010100111101010011011

Step28

Dr.Ezhilarasu

Umadevi

Palani000011000101000011011000001101101001001111000
10101110011111001000001101110110110010010000111111
11111110000001110101001110001010001100110101111000
01001110011101000001000101000010001001110110001011
01010101011011101000010010011101001101011100110010
100111101010011011

Step29

Dr.Ezhilarasu

Umadevi

Palani

01100010100001101100000110110100100111100010101110
0111110010000011011101101100100100001111111111110
00000111010100111000101000110011010111100001001110
01110100000100010100001000100111011000101101010101
01101110100001001001110100110101110011001010011110
1010011011

Step30

Dr.Ezhilarasu

Umadevi

Palani

i0010100001101100000110110100100111100010101110011
1110010000011011101101100100100001111111111110000
00111010100111000101000110011010111100001001110011
10100000100010100001000100111011000101101010101011
01110100001001001110100110101110011001010011110101
0011011

Step31
Dr.Ezhilarasu Umadevi Palani
is0000110110000011011010010011110001010111001111100
1000001101110110110010010000111111111111000000111
01010011100010100011001101011110000100111001110100
00010001010000100010011101100010110101010101101110
10000100100111010011010111001100101001111010100110
11

Step32
Dr.Ezhilarasu Umadevi Palani is
01101100000110110100100111100010101110011111001000
0011011101101100100100001111111111110000001110101
00111000101000110011010111100001001110011101000001
00010100001000100111011000101101010101011011101000
010010011101001101011100110010100111101010011011

Step33
Dr.Ezhilarasu Umadevi Palani is
h100000110110100100111100010101110011110010000011
0111011011001001000011111111111100000011101010011
10001010001100110101111000010011100111010000010001
01000010001001110110001011010101010110111010000100
10011101001101011100110010100111101010011011

Step34
Dr.Ezhilarasu Umadevi Palani is
ha000110110100100111100010101110011111001000001101
1101101100100100001111111111110000001110101001110
00101000110011010111100001001110011101000001000101
00001000100111011000101101010101011011101000010010
011101001101011100110010100111101010011011

Step35
Dr.Ezhilarasu Umadevi Palani is
hav01101001001111000101011100111110010000011011101
1011001001000011111111111100000011101010011100010
10001100110101111000010011100111010000010001010000
10001001110110001011010101010110111010000100100111
01001101011100110010100111101010011011

Step36
Dr.Ezhilarasu Umadevi Palani is
havi100100111100010101110011110010000011011101101
1001001000011111111111100000011101010011100010100
01100110101111000010011100111010000010001010000100
01001110110001011010101010110111010000100100111010
01101011100110010100111101010011011

Step37
Dr.Ezhilarasu Umadevi Palani is
havin001111000101011100111110010000011011101101100
1001000011111111111100000011101010011100010100011
00110101111000010011100111010000010001010000100010
01110110001011010101010110111010000100100111010011
01011100110010100111101010011011

Step38
Dr.Ezhilarasu Umadevi Palani is
having00010101110011111001000001101110110110010010
00011111111111110000001110101001110001010001100110
10111100001001110011101000001000101000010001001110

110001011010101011011101000010010011101001101011
100110010100111101010011011

Step39
Dr.Ezhilarasu Umadevi Palani is having
10101110011111001000001101110110110010010000111111
11111110000001110101001110001010001100110101111000
01001110011101000001000101000010001001110110001011
01010101011011101000010010011101001101011100110010
100111101010011011

Step40
Dr.Ezhilarasu Umadevi Palani is having
m1100111110010000011011101101100100100001111111111
11110000001110101001110001010001100110101111000010
01110011101000001000101000010001001110110001011010
10101011011101000010010011101001101011100110010100
111101010011011

Step41
Dr.Ezhilarasu Umadevi Palani is having
mo11100100000110111011011001001000011111111111110
00000111010100111000101000110011010111100001001110
01110100000100010100001000100111011000101101010101
01101110100001001001110100110101110011001010011110
1010011011

Step42
Dr.Ezhilarasu Umadevi Palani is having
mor0100000110111011011001001000011111111111100000
01110101001110001010001100110101111000010011100111
01000001000101000010001001110110001011010101010110
11101000010010011101001101011100110010100111101010
011011

Step43
Dr.Ezhilarasu Umadevi Palani is having
more000011011101101100100100001111111111110000001
11010100111000101000110011010111100001001110011101
00000100010100001000100111011000101101010101011011
10100001001001110100110101110011001010011110101001
1011

Step44
Dr.Ezhilarasu Umadevi Palani is having more
0110111011011001001000011111111111100000011101010
01110001010001100110101111000010011100111010000010
00101000010001001110110001011010101010110111010000
10010011101001101011100110010100111101010011011

Step45
Dr.Ezhilarasu Umadevi Palani is having more
t011011001001000011111111111100000011101010011100
01010001100110101111000010011100111010000010001010
00010001001110110001011010101010110111010000100100
11101001101011100110010100111101010011011

Step46
Dr.Ezhilarasu Umadevi Palani is having more
th10010010000111111111111000000111010100111000101
00011001101011110000100111001110100000100010100001
00010011101100010110101010101101110100001001001110
1001101011100110010100111101010011011

Step47
Dr.Ezhilarasu Umadevi Palani is having more than 100100001111111111110000001110101001110001010011001101011110000100111001110100001000101000010010011101100001001001110101010110111010000100100111010110101100110010100111101010011011

Step48
Dr.Ezhilarasu Umadevi Palani is having more than 000011111111111110000001110101001110001010001100110101110000100111001110100001000101000010001011011000101101010101101110100001001001110100110101100110010100111101010011011

Step49
Dr.Ezhilarasu Umadevi Palani is having more than 0111111111111000000111010100111000101000110011010111100001001110011101000010001010000100010011101100010110101010110111010000100100111010011010111010010100111101010011011

Step50
Dr.Ezhilarasu Umadevi Palani is having more than 31111111000000111010100111000101000110011010111100010011101000001000101000010001001110110001011010101011011101000010010011101001101011100110010100111101010011011

Step51
Dr.Ezhilarasu Umadevi Palani is having more than 30000000111010100111000101000110011010111100001001110011101000001000101000010001001110110001011010101010110100001001001110100110101110011001010011101010011011

Step52
Dr.Ezhilarasu Umadevi Palani is having more than 300011101010011100010100011001101011110000100111001110100000100010100001000100111011000101101010101011011101000010010011101001101011100110010100111101010011011

Step53
Dr.Ezhilarasu Umadevi Palani is having more than 300101001110001010001100110101111000010011100111010000100010100001000100111011000101101010101011011101000010010011101001101011100110010100111101010011011

Step54
Dr.Ezhilarasu Umadevi Palani is having more than 30001000101000010001001110101111000010011100111010000100010100001000100111011000101101010101011011101000010010011101001101011100110010100111101010011011

Step55
Dr.Ezhilarasu Umadevi Palani is having more than 300011000101000110011010111100001001110011101000010001010000100010011101100010110101010101101110100010010011101001101011100110010100111101010011011

Step56
Dr.Ezhilarasu Umadevi Palani is having more than 30001010000100010011101011110000100111001110100000100

010100001000100111011000101101010101011011101000010010011101001101011100110010100111101010011011

Step57
Dr.Ezhilarasu Umadevi Palani is having more than 3000010011010111100001001110011101000001000101000010001000100111011000101101010101011011101000010010011101010011011

Step58
Dr.Ezhilarasu Umadevi Palani is having more than 30100110101111000010011100111010000010001010000100010011101100010110101010101101110100001001001110101100110010100111101010011011

Step59
Dr.Ezhilarasu Umadevi Palani is having more than 30001011110000100111001110100000100010100001000100111011000101101010101011011101000010010011101001101011100110010100111101010011011

Step60
Dr.Ezhilarasu Umadevi Palani is having more than 300001001110011101000001000101000010001001110110010101010101011101000010010011101001101011100110010100111101010011011

Step61
Dr.Ezhilarasu Umadevi Palani is having more than 300100111001110100000100010100001000100111011000101101010101011101000010010011101001101011100110010101110011001101011100110010100111011

Step62
Dr.Ezhilarasu Umadevi Palani is having more than 3001001110100000100010100001000100111011000101101010101010101110100001001001110100110101110011001010011101010011011

Step63
Dr.Ezhilarasu Umadevi Palani is having more than 30010100111010000010001010000100010011101100010110101010101010111010000100100111010011010111001100101001111010011011

Step64
Dr.Ezhilarasu Umadevi Palani is having more than 300100000100010100001000100111011000101101010101010101101101000010010011101001101011100110010100111101010011011

Step65
Dr.Ezhilarasu Umadevi Palani is having more than 300001000101000010001001110110001011010101010101101101000010010011101001101011100110010100111101010011011

Step66
Dr.Ezhilarasu Umadevi Palani is having more than 30000101000010001001110110001011010101010101101110100010100010011101100010110101010101101110

10000100100111010011010111001100101001111010100110
11
Step67
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel010000100010011101100010110101010101101110100
0010010011101001101011100110010100111101010011011
Step68
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
paralle00010001001110110001011010101010110111010000
10010011101001101011100110010100111101010011011
Step69
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel00010011101100010110101010101101110100001001
0011101001101011100110010100111101010011011
Step70
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
10011101100010110101010101101110100001001001110100
1101011100110010100111101010011011
Step71
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
a1110110001011010101010110111010000100100111010011
01011100110010100111101010011011
Step72
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
ac100010110101010101101110100001001001110100110101
1100110010100111101010011011
Step73
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
aca01011010101010110111010000100100111010011010111
00110010100111101010011011
Step74
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
acad0101010101101110100001001001110100110101110011
0010100111101010011011
Step75
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
acade101010110111010000100100111010011010111001100
10100111101010011011
Step76
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academ01101110100001001001110100110101110011001010
0111101010011011
Step77
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel

academi1110100001001001110100110101110011001010011
1101010011011
Step78
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic000010010011101001101011100110010100111101
010011011
Step79
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
010010011101001101011100110010100111101010011011
Step80
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
e010011101001101011100110010100111101010011011
Step81
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
ex01001101011100110010100111101010011011
Step82
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
exp01011100110010100111101010011011
Step83
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
expe11100110010100111101010011011
Step84
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
exper0110010100111101010011011
Step85
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
experie010100111101010011011
Step86
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
experie100111101010011011
Step87
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
experien11101010011011
Step88
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
experie010011011
Step89
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
experience
011011
Step90
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
experience.
Step7-90
Dr.Ezhilarasu Umadevi Palani is having more than 30 years
of
parallel
academic
experience.

V. TUNSTALL ENCODING

Tunstall coding based on the probability of each character assigns the fixed length code for each symbol. The symbol may be the combination of more than one characters.

Tunstall Coding with length 6

S.NO	SYMBOL	Encoding Vector
1.	a	000000
2.	e	000001
3.	i	000010
4.	r	000011
5.	l	000100
6.	n	000101
7.	s	000110
8.	m	000111
9.	h	001000
10.	c	001001
11.	v	001010
12.	p	001011
13.	o	001100
14.	d	001101
15.	.	001110
16.	z	001111
17.	y	010000
18.	x	010001
19.	U	010010
20.	u	010011
21.	t	010100
22.	P	010101
23.	g	010110
24.	f	010111
25.	E	011000
26.	D	011001
27.	3	011010
28.	0	011011
29.	SPACE SPACE	011100
30.	SPACE a	011101
31.	SPACE e	011110
32.	SPACE i	011111
33.	SPACE r	100000
34.	SPACE l	100001
35.	SPACE n	100010
36.	SPACE s	100011
37.	SPACE m	100100
38.	SPACE h	100101
39.	SPACE c	100110

40.	SPACE v	100111
41.	SPACE p	101000
42.	SPACE o	101001
43.	SPACE d	101010
44.	SPACE.	101011
45.	SPACE z	101100
46.	SPACE y	101101
47.	SPACE x	101110
48.	SPACE U	101111
49.	SPACE u	110000
50.	SPACE t	110001
51.	SPACE P	110010
52.	SPACE g	110011
53.	SPACE f	110100
54.	SPACE E	110101
55.	SPACE D	110110
56.	SPACE 3	110111
57.	SPACE 0	111000

Input after encoding:

```
01100100001100111001100000111100100000010000100
000000000011000000001100100111011110001110000000
1101000001001010000010110010000000000100000000001
01000010011111000110100101000000001010000010000101
01011010010000110000001100000111000100100000000000
01011101110110111011010000010000000000110001101010
010101111010000000000001100000000100000100000001
00010001110100100100000000110100000100011100001000
10010111100100010010110000010000110000100000010001
01001001000001001110
```

Total Number of bits (Length 6) = 468

String Length = 90

Number of combined double bits = 12

Total bit = 12*6=72

Remaining single bit = 90-2*12=66

Total bit = 66*6=396

Total number of ASCII bit for 90 characters = 720

Tunstall Coding with length 7

S.NO	SYMBOL	Encoding Vector
1.	i	0000000
2.	r	0000001
3.	l	0000010
4.	n	0000011
5.	s	0000100
6.	m	0000101
7.	h	0000110
8.	c	0000111
9.	v	0001000
10.	p	0001001

11.	o	0001010
12.	d	0001011
13.	.	0001100
14.	z	0001101
15.	y	0001110
16.	x	0001111
17.	U	0010000
18.	u	0010001
19.	t	0010010
20.	P	0010011
21.	g	0010100
22.	f	0010101
23.	E	0010110
24.	D	0010111
25.	3	0011000
26.	0	0011001
27.	SPACE SPACE	0011010
28.	SPACE a	0011011
29.	SPACE e	0011100
30.	SPACE i	0011101
31.	SPACE r	0011110
32.	SPACE l	0011111
33.	SPACE n	0100000
34.	SPACE s	0100001
35.	SPACE m	0100010
36.	SPACE h	0100011
37.	SPACE c	0100100
38.	SPACE v	0100101
39.	SPACE p	0100110
40.	SPACE o	0100111
41.	SPACE d	0101000
42.	SPACE.	0101001
43.	SPACE z	0101010
44.	SPACE y	0101011
45.	SPACE x	0101100
46.	SPACE U	0101101
47.	SPACE u	0101110
48.	SPACE t	0101111
49.	SPACE P	0110000
50.	SPACE g	0110001
51.	SPACE f	0110010
52.	SPACE E	0110011
53.	SPACE D	0110100
54.	SPACE 3	0110101
55.	SPACE 0	0110110
56.	aSPACE	0110111

57.	aa	0111000
58.	ae	0111001
59.	ai	0111010
60.	ar	0111011
61.	al	0111100
62.	an	0111101
63.	as	0111110
64.	am	0111111
65.	ah	1000000
66.	ac	1000001
67.	av	1000010
68.	ap	1000011
69.	ao	1000100
70.	ad	1000101
71.	a.	1000110
72.	az	1000111
73.	ay	1001000
74.	ax	1001001
75.	aU	1001010
76.	au	1001011
77.	at	1001100
78.	aP	1001101
79.	ag	1001110
80.	af	1001111
81.	aE	1010000
82.	aD	1010001
83.	a3	1010010
84.	a0	1010011
85.	eSPACE	1010100
86.	ea	1010101
87.	ee	1010110
88.	ei	1010111
89.	er	1011000
90.	el	1011001
91.	en	1011010
92.	es	1011011
93.	em	1011100
94.	eh	1011101
95.	ec	1011110
96.	ev	1011111
97.	ep	1100000
98.	eo	1100001
99.	ed	1100010
100.	e.	1100011
101.	ez	1100100
102.	ey	1100101
103.	ex	1100110

104.	eU	1100111
105.	eu	1101000
106.	et	1101001
107.	eP	1101010
108.	eg	1101011
109.	ef	1101100
110.	eE	1101101
111.	eD	1101110
112.	e3	1101111
113.	e0	1110000

001011100000010001100001011000011010000110000000
 00000010011101101111100010001010110100001011000101
 10111110000000011000001111000111101000000000111010
 0001000100011100001000000000000110010100010001000
 01010000000110101000010010000011001111010110101001
 1001010101110101010000010000100010011100101010100
 1100111011011110000000101011001001101100001110001
 0110111000000000000111001110000011110001001101100
 00000000101101000001111100011

Total Number of bits (Length 7) = 427
 String Length = 90
 Number of combined double bits = 29
 Total bit = 29*7=203
 Remaining single bit = 90-2*29=32
 Total bit = 32*7=224
 Total number of ASCII bit for 90 characters = 720

VI. TUNSTALL DECODING

Tunstall decoding for the length 6

Given Input:

Output after encoding:

Step 1:

D0000110011100110000011110010000000100001000000
 000000110000000011001001110111100011100000001101
 000001001010000010110010000000001000000000010100
 00100111110001101001010000000010100000100001010101
 1010010000110000001100000111000100100000000000101
 1101110110111011010000010000000001100011010100101
 01111010000000000001100000000100000100000010001
 00011101001001000000001101000001000111000010001001
 01111001000100101100000100001100001000000100010100
 1001000001001110

Step 2:

Dr0011100110000011110010000000100001000000000000
 11000000000110010011101111000111000000001101000001
 00101000001011001000000000010000000000010100001001
 11110001101001010000000010100000100001010101101001
 00001100000011000001110001001000000000000101110111
 01101110110100000100000000001100011010100101011110
 100000000000011000000000100000100000010001000111
 01001001000000001101000001000111000010001001011110
 01000100101100000100001100001000000100010100100100
 0001001110

Step 3:

Dr.011000001111001000000010000100000000000011000
 00000011001001110111100011100000000110100000100101
 00000101100100000000001000000000001010000100111110
 00110100101000000001010000010000101010110100100001
 10000001100000111000100100000000000010111011101101
 11011010000010000000000110001101010010101111010000
 00000000011000000000100000100000001000100011101001
 00100000000110100000100011100001000100101111001000
 10010110000010000110000100000010001010010010000010
 01110

Step 4:

Dr.E00111100100000001000010000000000001100000000
 01100100111011110001110000000011010000010010100000
 1011001000000000010000000000101000010011111000110
 10010100000000101000001000010101011010010000110000
 00110000011100010010000000000001011101110110111011
 0100000100000000001100011010100101011110100000000
 00001100000000010000010000000100010001110100100100
 00000011010000010001110000100010010111100100010010
 11000001000011000010000001000101001001000001001110

Step 5:

Dr.Ez0010000000100001000000000000110000000001100
 10011101111000111000000001101000001001010000010110
 01000000000010000000000010100001001111100011010010
 10000000010100000100001010101101001000011000000110
 00001110001001000000000000101110111011011101101000
 00100000000000110001101010010101111010000000000001
 10000000001000001000000010001000111010010010000000
 01101000001000111000010001001011110010001001011000
 001000011000010000001000101001001000001001110

Step 6:

Dr.Ezh000010000100000000000011000000000110010011
 10111100011100000000110100000100101000001011001000
 00000001000000000001010000100111110001101001010000
 00001010000010000101010110100100001100000011000001
 11000100100000000000010111011101101110110100000100
 0000000011000110101001010111101000000000000110000
 00000100000100000001000100011101001001000000001101
 00000100011100001000100101111001000100101100000100
 00110000100000010001010010010000001001110

Step 7:

Dr.Ezhi000100000000000011000000000110010011101111
 00011100000000110100000100101000001011001000000000
 01000000000001010000100111110001101001010000000010
 10000010000101010110100100001100000011000001110001
 0010000000000001011101110110111011010000010000000
 001100011010100101011110100000000000011000000001
 00000100000001000100011101001001000000001101000001
 00011100001000100101111001000100101100000100001100
 00100000010001010010010000001001110

Step 8:

Dr.Ezhi000000000001100000000011001001110111100011
 10000000011010000010010100000101100100000000001000
 00000000101000010011111000110100101000000001010000
 01000010101011010010000110000001100000111000100100

0000000001011101110110110110100001000000000110
001101010010101110100000000000110000000010000
10000001000100011101001001000000011010000100011
100001000100101110010001001011000010000110000100
00001000101001001000001001110

Step 9:

Dr.Ezhilara000011000000001100100111011110001110000
00001101000010010100001011001000000000100000000
000101000010011111000110100101000000010100001000
010101011010010000110000011000011100010010000000
0000010111011101101110110100000100000000011000110
1010010101110100000000000011000000001000010000
0001000100011101001001000000001101000010001110000
1000100101110010001001011000001000011000010000001
000101001001000001001110

Step 10:

Dr.Ezhilara000000000110010011101111000111000000001
101000001001010000010110010000000001000000000010
1000010011111000110100101000000001010000100001010
1011010010000110000001100000111000100100000000000
10111011101101110110100000100000000001100011010100
1010111101000000000000011000000000100000100000010
00100011101001001000000001101000001000111000010001
00101111001000100101100000100001100001000000100010
1001001000001001110

Step 11:

Dr.Ezhilara000110010011101111000111000000001101000
0010010100000101100100000000001000000000010100001
00111110001101001010000000010100000100001010101101
0010000110000001100000111000100100000000000101110
11101101110110100000100000000001100011010100101011
110100000000000001100000000100000100000010001000
11101001001000000001101000001000111000010001001011
11001000100101100000100001100001000000100010100100
1000001001110

Step 12:

Dr.Ezhilaras01001110111100011100000000110100000100
1010000010110010000000000100000000001010000100111
1100011010010100000000101000001000010101010100100
001100000011000001110001001000000000001011011101
1011101101000001000000000011000110101001010111010
00000000000011000000000100000100000001000100011101
0010010000000011010000010001110000100010010111001
00010010110000010000110000100000010001010010010000
01001110

Step 13:

Dr.Ezhilarasu1011110001110000000011010000010010100
0001011001000000000010000000000101000010011111000
1101001010000000010100000100001010101010010000110
0000011000001110001001000000000000101110110110111
0110100000100000000001100011010100101011101000000
00000001100000000010000010000000100010001110100100
10000000011010000010001110000100010010111100100010
01011000001000011000010000001000101001001000001001
110

Step 14:

Dr.Ezhilarasu

U000111000000001101000001001010000010110010000000
00010000000000010100001001111100011010010100000000
10100000100001010101101001000011000000110000011100
01001000000000000101110111011011101101000001000000
0000110001101010010101111010000000000001100000000
01000001000000010001000111010010010000000011010000
01000111000010001001011110010001001011000001000011
000010000001000101001001000001001110

Step 15:

Dr.Ezhilarasu

Um00000000110100000100101000001011001000000000010
00000000001010000100111110001101001010000000010100
0001000010101010100100001100000011000001110001001
00000000000010111011101101110110100000100000000001
1000110101001010111101000000000000110000000001000
00100000001000100011101001001000000001101000001000
11100001000100101111001000100101100000100001100001
00000010001010010010000001001110

Step 16:

Dr.Ezhilarasu

Uma0011010000010010100000101100100000000001000000
00000101000010011111000110100101000000001010000010
0001010101010010000110000001100000111000100100000
00000001011101110110111011010000010000000000110001
10101001010111101000000000000011000000000100000100
00000100010001110100100100000000110100000100011100
00100010010111100100010010110000010000110000100000
01000101001001000001001110

Step 17:

Dr.Ezhilarasu

Umad00000100101000001011001000000000010000000000
10100001001111100011010010100000000101000001000010
1010110100100001100000011000001110001001000000000
00101110111011011101101000001000000000011000110101
0010101111010000000000000110000000001000001000000
10001000111010010010000000011010000010001110000100
01001011110010001001011000001000011000010000001000
101001001000001001110

Step 18:

Dr.Ezhilarasu

Umade0010100000101100100000000001000000000010100
00100111110001101001010000000010100000100001010101
1010010000110000001100000111000100100000000000101
11011101101110110100000100000000001100011010100101
01111010000000000000110000000001000001000000010001
00011101001001000000001101000001000111000010001001
01111001000100101100000100001100001000000100010100
1001000001001110

Step 19:

Dr.Ezhilarasu

Umadev0000101100100000000001000000000001010000100
1111100011010010100000000101000001000010101010100
1000011000000110000011100010010000000000010111011
10110111011010000010000000000110001101010010101111
0100000000000001100000000100000100000001000100011

101001001000000011010000100011100001000100101111
0010001001011000001000011000010000010001010010010
00001001110

Step 20:

Dr.Ezhilarasu

Umadevi110010000000000100000000001010000100111110
00110100101000000001010000010000101010110100100001
1000000110000011100010010000000000010111011101101
11011010000010000000000110001101010010101111010000
00000000011000000000100000100000001000100011101001
00100000000110100000100011100001000100101111001000
10010110000010000110000100000100010100100100000010
01110

Step 21:

Dr.Ezhilarasu

Umadevi

P0000000001000000000001010000100111110001101001010
00000001010000010000101010110100100001100000011000
00111000100100000000000010111011101101110110100000
1000000000011000110101001010111101000000000000110
00000000100000100000001000100011101001001000000001
10100000100011100001000100101111001000100101100000
1000011000010000001000101001001000001001110

Step 22:

Dr.Ezhilarasu

Umadevi

Pa0001000000000000101000010011111000110100101000000
00101000001000010101011010010000110000001100000111
000100100000000000001011101110110111011010000010000
0000001100011010100101011110100000000000011000000
00010000010000000100010001110100100100000000110100
00010001110000100010010111100100010010110000010000
110000100000010001010010010000001001110

Step 23:

Dr.Ezhilarasu

Umadevi

Pal00000000010100001001111100011010010100000000101
00000100001010101101001000011000000110000011100010
01000000000000101110111011011101101000001000000000
011000110101001010111101000000000000110000000010
00001000000010001000111010010010000000011010000010
00111000010001001011110010001001011000001000011000
010000001000101001001000001001110

Step 24:

Dr.Ezhilarasu

Umadevi

Pala0001010000100111110001101001010000000010100000
1000010101010100100001100000011000001110001001000
0000000001011101110110111011010000010000000001100
0110101001010111101000000000000110000000001000001
00000001000100011101001001000000001101000001000111
00001000100101111001000100101100000100001100001000
00010001010010010000001001110

Step 25:

Dr.Ezhilarasu

Umadevi

Palan000010011111000110100101000000001010000010000
1010101101001000011000000110000011100010010000000
00001011101110110111011010000010000000000110001101
01001010111101000000000000011000000000100000100000
00100010001110100100100000000110100000100011100001

00010010111100100010010110000010000110000100000010
00101001001000001001110

Step 26:

Dr.Ezhilarasu

Umadevi

Palani011111000110100101000000001010000010000101010
11010010000110000001100000111000100100000000000010
11101110110111011010000010000000000110001101010010
101111010000000000001100000000100000100000001000
10001110100100100000000110100000100011100001000100
10111100100010010110000010000110000100000010001010
01001000001001110

Step 27:

Dr.Ezhilarasu

Umadevi

Palani

i0001101001010000000010100000100001010101101001000
01100000011000001110001001000000000000101110111011
01110110100000100000000001100011010100101011110100
00000000000110000000001000001000000010001000111010
01001000000001101000001000111000010001001011110010
00100101100000100001100001000000100010100100100000
1001110

Step 28:

Dr.Ezhilarasu

Umadevi

Palani

is1001010000000010100000100001010101101001000011000
00011000001110001001000000000000101110111011011101
10100000100000000001100011010100101011110100000000
00000110000000001000001000000010001000111010010010
00000001101000001000111000010001001011110010001001
01100000100001100001000000100010100100100000100111
0

Step 29:

Dr.Ezhilarasu

Umadevi

Palani

is

h0000000010100000100001010101101001000011000000110
00001110001001000000000000101110111011011101101000
00100000000001100011010100101011110100000000000001
10000000001000001000000010001000111010010010000000
01101000001000111000010001001011110010001001011000
0010000110000100000010001010010010000001001110

Step30:

Dr.Ezhilarasu

Umadevi

Palani

is

ha001010000010000101010110100100001100000011000001
11000100100000000000010111011101101110110100000100
0000000011000110101001010111101000000000000110000
00000100000100000001000100011101001001000000001101
00000100011100001000100101111001000100101100000100
00110000100000010001010010010000001001110

Step31:

Dr.Ezhilarasu

Umadevi

Palani

is

hav00001000010101011010010000110000001100000111000
1001000000000000101110111011011101101000001000000
000110001101010010101111010000000000001100000000
1000001000000010001000111010010010000000011010000
10001110000100010010111100100010010110000010000110
000100000010001010010010000001001110

Step32:

Dr.Ezhilarasu

Umadevi

Palani

is

havi0001010101101001000011000000110000011100010010

0000000000101110111011011011010000100000000011
00011010100101011101000000000000110000000010000
01000000010001000111010010010000000011010000010001
1100001000100101110010001001011000001000011000010
000001000101001001000001001110

Step33:

Dr.Ezhilarasu Umadevi Palani is
havin01011010010000110000011000001110001001000000
0000001011101110110111011010000010000000001100011
010100101011110100000000000011000000001000001000
00001000100011101001001000000001101000001000111000
01000100101111001000100101100000100001100001000000
1000101001001000001001110

Step34:

Dr.Ezhilarasu Umadevi Palani is
having10010000110000001100000111000100100000000000
01011101110110111011010000010000000000110001101010
0101011110100000000000011000000000100000100000001
00010001110100100100000000110100000100011100001000
10010111100100010010110000010000110000100000010001
01001001000001001110

Step35:

Dr.Ezhilarasu Umadevi Palani is having
m001100000011000001110001001000000000000101110111
01101110110100000100000000001100011010100101011110
1000000000000110000000001000001000000010001000111
01001001000000001101000001000111000010001001011110
01000100101100000100001100001000000100010100100100
0001001110

Step36:

Dr.Ezhilarasu Umadevi Palani is having
mo00001100000111000100100000000000010111011101101
11011010000010000000000110001101010010101111010000
00000000011000000000100000100000001000100011101001
00100000000110100000100011100001000100101111001000
10010110000010000110000100000010001010010010000010
01110

Step37:

Dr.Ezhilarasu Umadevi Palani is having
mor00000111000100100000000000010111011101101110110
1000001000000000011000110101001010111101000000000
00011000000000100000100000001000100011101001001000
00000110100000100011100001000100101111001000100101
1000001000011000010000001000101001001000001001110

Step38:

Dr.Ezhilarasu Umadevi Palani is having
more1100010010000000000001011101110110111011010000
0100000000001100011010100101011110100000000000011
0000000001000001000000010001000111010010010000000
11010000010001110000100010010111100100010010110000
01000011000010000001000101001001000001001110

Step39:

Dr.Ezhilarasu Umadevi Palani is having more
t0010000000000001011101110110111011010000010000000
000110001101010010101111010000000000001100000000
10000010000000100010001110100100100000000110100000

100011100001000100101111001000100101100000100001110
00010000001000101001001000001001110

Step40:

Dr.Ezhilarasu Umadevi Palani is having more
th000000000101110111011011101101000001000000000011
0001101010010101111010000000000001100000000010000
01000000010001000111010010010000000011010000010001
11000010001001011110010001001011000001000011000010
000001000101001001000001001110

Step41:

Dr.Ezhilarasu Umadevi Palani is having more
tha00010111011101101110110100000100000000001100011
0101001010111101000000000000110000000001000001000
00001000100011101001001000000001101000001000111000
01000100101111001000100101100000100001100001000000
1000101001001000001001110

Step42:

Dr.Ezhilarasu Umadevi Palani is having more
than1101110110111011010000010000000000110001101010
0101011110100000000000011000000000100000100000001
00010001110100100100000000110100000100011100001000
10010111100100010010110000010000110000100000010001
01001001000001001110

Step43:

Dr.Ezhilarasu Umadevi Palani is having more than
30110111011010000010000000000110001101010010101111
01000000000000011000000000100000100000001000100011
10100100100000000110100000100011100001000100101111
00100010010110000010000110000100000010001010010010
00001001110

Step44:

Dr.Ezhilarasu Umadevi Palani is having more than
30101101000001000000000011000110101001010111101000
00000000001100000000010000010000000100010001110100
100100000000011010000010001110000100010010111100100
01001011000001000011000010000001000101001001000001
001110

Step45:

Dr.Ezhilarasu Umadevi Palani is having more than 30
y000001000000000011000110101001010111101000000000
00011000000000100000100000001000100011101001001000
00000110100000100011100001000100101111001000100101
1000001000011000010000001000101001001000001001110

Step46:

Dr.Ezhilarasu Umadevi Palani is having more than 30
ye00000000001100011010100101011110100000000000011
0000000001000001000000010001000111010010010000000
11010000010001110000100010010111100100010010110000
01000011000010000001000101001001000001001110

Step47:

Dr.Ezhilarasu Umadevi Palani is having more than 30
yea0000110001101010010101111010000000000001100000
00001000001000000010001000111010010010000000011010
00001000111000010001001011110010001001011000001000
011000010000001000101001001000001001110

Step48:

Dr.Ezhilarasu Umadevi Palani is having more than 30 year0001101010010101111010000000000001100000000100000100000000100010001110100100100000001101000010001110000100010111100100010010110000010000110001000000001001001001000001001110

Step49:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years101001010111101000000000000110000000010000010000000100010001110100100100000001101000010001110000100010111100100010010110000010000110000100000001001001001000001001110

Step50:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years o10111101000000000000110000000010000010000000100100011101001001000000011010000100011100001000100101110010001001011000001000011000010000010001001001000001001110

Step51:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of101000000000000110000000010000010000001000100010010011101001001000000011010000010001110000100010010111001000100101100000100001100001000001000101001001000001001110

Step52:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of p00000000001100000000100000100000010001000111010010000000011010000010001110000100010010111001000100101100000100001100001000001000101001001000001001110

Step53:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of pa000011000000001000001000000100010001110100100100000001101000001000111000010001001011100100010010110000010000110000100000100010100100100000100110

Step54:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of par00000000100000100000001000100011101001001000000001101000001000111000010001001011100100010010110000100001100001000001000101001001000001001110

Step55:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of para000100000100000010001000111010010010000000011010000010001110000100010010111001000100101100000100001100001000001000101001001000001001110

Step56:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of paral000100000010001000111010010010000000011010000010001110000100010010111001000100101100000100001100001000001000101001001000001001110

Step57:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parall00000100010001110100100100000000110100000100011100001000100101110010001001011000001000011000010000001000101001001000001001110

Step58:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of paralle00010001110100100100000000110100000100011100001000100101110010001001011000001000011000010000001000101001001000001001110

Step59:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel01110100100100000000110100000100011100001000100101110010001001011000001000011000010000001000101001001000001001110

Step60:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel a001001000000001101000001000111000010001001011110010001001011000001000011000010000001000101001001000001001110

Step61:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel ac000000001101000001000111000010001001011110010001001011000001000011000010000001000101001001000001001110

Step62:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel aca001101000001000111000010001001011110010001001011000001000011000010000001000101001001000001001110

Step63:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel acad000001000111000010001001011110010001001011000001000001000001000001000001000101001001000001001110

Step64:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel acade000111000010001001011110010001001011000001000001000001000001000001000001000101001001000001001110

Step65:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academ000010001001011110010001001011000001000001000001000001000001000001000101001001000001001110

Step66:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academi001001011110010001001011000001000001000001000001000001000001000101001001000001001110

Step67:

0111010000100010001110000100000000000011001010001
00010000101000000011010100001001000001100111101011
0101001100101010111010101000001000010001001110010
1010100110011101101111000000101011001001101100001
1110001011011100000000000011100111000001111000100
110110000000000101101000001111100011

Step 8:

Dr.Ezhil01110110111110001000101011010000101100010
11011111000000001100000111100011110100000000011101
00001000100011100001000000000000011001010001000100
00101000000011010100001001000001100111101011010100
11001010101110101010000001000010001001110010101010
01100111011011110000000101011001001101100001111000
10110111000000000000011100111000001111000100110110
000000000101101000001111100011

Step 9:

Dr.Ezhilar011111000100010101101000010110001011011
11100000000110000011110001111010000000001110100001
000100011100001000000000000001100101000100010000101
00000001101010000100100000110011110101101010011001
01010111010101000000100001000100111001010101001100
11101101111000000010101100100110110000111100010110
111000000000000001110011100000111100010011011000000
0000101101000001111100011

Step 10:

Dr.Ezhilaras00100010101101000010110001011011111000
00000110000011110001111010000000001110100001000100
011100001000000000000001100101000100010000101000000
01101010000100100000110011110101101010011001010101
11010101000000100001000100111001010101001100111011
01111000000010101100100110110000111100010110111000
0000000000111001110000011110001001101100000000010
1101000001111100011

Step 11:

Dr.Ezhilarasu0101101000010110001011011111000000001
10000011110001111010000000001110100001000100011100
00100000000000001100101000100010000101000000011010
10000100100000110011110101101010011001010101110101
0100000010000100010011100101010100110011101101110
00000010101100100110110000111100010110111000000000
00001110011100000111100010011011000000000010110100
0001111100011

Step 12:

Dr.Ezhilarasu

U000010110001011011111000000001100000111100011110
10000000001110100001000100011100001000000000000011
00101000100010000101000000011010100001001000001100
11110101101010011001010101110101010000001000010001
00111001010101001100111011011110000000101011001001
10110000111100010110111000000000000011100111000001
111000100110110000000000101101000001111100011

Step 13:

Dr.Ezhilarasu

Um1000101101111100000000110000011110001111010000
00001110100001000100011100001000000000000011001010
0010001000010100000001101010000100100000110011101

01101010011001010101110101010000001000010001001110
01010101001100111011011110000000101011001001101100
0011110001011011100000000000011100111000001111000
100110110000000000101101000001111100011

Step 14:

Dr.Ezhilarasu

Umad101111100000000110000011110001111010000000001
11010000100010001110000100000000000001100101000100
01000010100000001101010000100100000110011110101101
01001100101010111010101000000100001000100111001010
10100110011101101111000000010101100100110110000111
10001011011100000000000001110011100000111100010011
0110000000000101101000001111100011

Step 15:

Dr.Ezhilarasu

Umadev0000000011000001111000111101000000000111010
000100010001110000100000000000000110010100010001000
01010000000110101000010010000011001111010110101001
10010101011101010100000010000100010011100101010100
11001110110111100000001010110010011011000011110001
011011100000000000000111001110000011110001001101100
00000000101101000001111100011

Step 16:

Dr.Ezhilarasu

Umadevi0110000011110001111010000000001110100001000
1000111000010000000000000001100101000100010000101000
00001101010000100100000110011110101101010011001010
10111010101000000100001000100111001010101001100111
01101111000000010101100100110110000111100010110111
000000000000000111001110000011110001001101100000000
0101101000001111100011

Step 17:

Dr.Ezhilarasu

Umadevi

P0111100011110100000000011101000010001000111000010
00000000000011001010001000100001010000000110101000
01001000001100111101011010100110010101011101010100
00001000010001001110010101010011001110110111100000
0010101100100110110000111100010110111000000000000
11100111000001111000100110110000000000101101000001
111100011

Step 18:

Dr.Ezhilarasu

Umadevi

Pal01111010000000001110100001000100011100001000000
00000001100101000100010000101000000011010100001001
00000110011110101101010011001010101110101010000001
00001000100111001010101001100111011011110000000101
0110010011011000011110001011011100000000000011100
11100000111100010011011000000000010110100000111110
0011

Step 19:

Dr.Ezhilarasu

Umadevi

Palan000000000111010000100010001110000100000000000
00110010100010001000010100000001101010000100100000
11001111010110101001100101010111010101000000100001
00010011100101010100110011101101111000000010101100

1001101100001111000101101110000000000001110011100
000111100010011011000000000101101000001111100011

Step 20:

Dr.Ezhilarasu Umadevi
Palani00111010000100010001110000100000000000011001
01000100010000101000000011010100001001000001100111
10101101010011001010101110101010000001000010001001
110010101001100111011011110000000101011001001101
1000011110001011011100000000000011100111000001111
000100110110000000000101101000001111100011

Step 21:

Dr.Ezhilarasu Umadevi Palani
i0000100010001110000100000000000001100101000100010
00010100000001101010000100100000110011110101101010
01100101010111010101000000100001000100111001010101
00110011101101111000000010101100100110110000111100
01011011100000000000001110011100000111100010011011
0000000000101101000001111100011

Step 22:

Dr.Ezhilarasu Umadevi Palani
is01000111000010000000000000011001010001000100001010
00000011010100001001000001100111101011010100110010
10101110101010000001000010001001110010101010011001
11011011110000000101011001001101100001111000101101
11000000000000011100111000001111000100110110000000
000101101000001111100011

Step 23:

Dr.Ezhilarasu Umadevi Palani is
h10000100000000000000110010100010001000010100000001
10101000010010000011001111010110101001100101010111
01010100000010000100010011100101010100110011101101
11100000001010110010011011000011110001011011100000
00000000111001110000011110001001101100000000001011
01000001111100011

Step 24:

Dr.Ezhilarasu Umadevi Palani is
hav00000000000011001010001000100001010000000110101
00001001000001100111101011010100110010101011101010
10000001000010001001110010101010011001110110111100
00000101011001001101100001111000101101110000000000
00011100111000001111000100110110000000000101101000
001111100011

Step 25:

Dr.Ezhilarasu Umadevi Palani is
havi0000011001010001000100001010000000110101000010
01000001100111101011010100110010101011101010100000
01000010001001110010101010011001110110111100000001
0101100100110110000111100010110111000000000000111
00111000001111000100110110000000000101101000001111
100011

Step 26:

Dr.Ezhilarasu Umadevi Palani is
havin001010001000100001010000000110101000010010000
01100111101011010100110010101011101010100000010000
10001001110010101010011001110110111100000001010110

0100110110000111100010110111000000000000111001110
00001111000100110110000000000101101000001111100011

Step 27:

Dr.Ezhilarasu Umadevi Palani is
having01000100001010000000110101000010010000011001
11101011010100110010101011101010100000010000100010
01110010101010011001110110111100000001010110010011
0110000111100010110111000000000000111001110000011
11000100110110000000000101101000001111100011

Step 28:

Dr.Ezhilarasu Umadevi Palani is having
m000101000000011010100001001000001100111101011010
10011001010101110101010000001000010001001110010101
01001100111011011110000000101011001001101100001111
00010110111000000000000011100111000001111000100110
110000000000101101000001111100011

Step 29:

Dr.Ezhilarasu Umadevi Palani is having
mo00000011010100001001000001100111101011010100110
01010101110101010000001000010001001110010101010011
00111011011110000000101011001001101100001111000101
00010110111000000000000011100111000001111000100110
110000000000101101000001111100011

Step 30:

Dr.Ezhilarasu Umadevi Palani is having
mor10101000010010000011001111010110101001100101010
11101010100000010000100010011100101010100110011101
10111100000001010110010011011000011110001011011100
00000000000111001110000011110001001101100000000001
01101000001111100011

Step 31:

Dr.Ezhilarasu Umadevi Palani is having more
00100100000110011110101101010011001010101110101010
00000100001000100111001010101001100111011011110000
00010101100100110110000111100010110111000000000000
01110011100000111100010011011000000000010110100000
1111100011

Step 32:

Dr.Ezhilarasu Umadevi Palani is having more
t0000110011110101101010011001010101110101010000001
00001000100111001010101001100111011011110000000101
01100100110110000111100010110111000000000000011100
11100000111100010011011000000000010110100000111110
0011

Step 33:

Dr.Ezhilarasu Umadevi Palani is having more
th011110101101010011001010101110101010000001000010
00100111001010101001100111011011110000000101011001
00110110000111100010110111000000000000011100111000
001111000100110110000000000101101000001111100011

Step 34:

Dr.Ezhilarasu Umadevi Palani is having more
than0110101001100101010111010101000000100001000100
11100101010100110011101101111000000010101100100110
11000011110001011011100000000000001110011100000111
1000100110110000000000101101000001111100011

Step 35:
Dr.Ezhilarasu Umadevi Palani is having more than 3001100101010111010101000000100001000100111001010101001100110110111100000010101100100110110000111100010110110000000000011100111000001110001001101100000000101101000001111100011

Step 36:
Dr.Ezhilarasu Umadevi Palani is having more than 300101011101010100000010000100010011100101010100110011011011100000010101100100110110000111100010110110000000000011100111000001110001001101100000000010110100001111100011

Step 37:
Dr.Ezhilarasu Umadevi Palani is having more than 30 y1010101000000100001000100111001010101001100111011011100000001010110010011011000011110001011011100000000001110011100000111000100110110000000000101101000001111100011

Step 38:
Dr.Ezhilarasu Umadevi Palani is having more than 30 yea0000001000010001001110010101010011001110110111000000101011001001101100001111000101101110000000000011100111000001110001001101100000000010110100001111100011

Step 39:
Dr.Ezhilarasu Umadevi Palani is having more than 30 year000010001001110010101010011001110110111100000001010110010011011000011110001011011100000000000111001110000011100010011011000000000010110100000111100011

Step 40:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years01001110010101010011001110110111100000001010110010011011000011110001011011100000000000111001110000011110001001101100000000010110100000111100011

Step 41:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years o00101010100110011101101111000000101011001001101100001111000101101110000000000011100111000001111001001101100000000010110100000111100011

Step 42:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of01001100111011011110000001010110010011011000011100010110111000000000000111001110000011110001001101100000000010110100000111100011

Step 43:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of p0111011011110000001010110010011011000011110001011011100000000000011100111000001110001001101100000000010110100000111100011

Step 44:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of par01111000000010101100100110110000111100010110111

00000000000011100111000001111000100110110000000000101101000001111100011

Step 45:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of paral000001010110010011011000011110001011011100000000000010110100000111100000111100010011011000000000101101000001111100011

Step 46:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parall101100100110110000111100010110111000000000000000001011100000111100010011011000000000101101000001111100011

Step 47:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel00110110000111100010110111000000000000001110011100000111100000111100010011011000000000101101000001111100011

Step 48:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel a000011110001011011100000000000001110011100000111100010011011000000000101101000001111100011

Step 49:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel ac100010110111000000000000011100111000001111000100110110000000000101101000001111100011

Step 50:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel acad10111000000000000111001110000011110001001101100000000010110100000111100011

Step 51:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academ00000000001110011100000111100010011011000000000010110100000111100011

Step 52:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academi0000111001110000011110001001101100000000010110100000111100011

Step 53:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic00111000001111000100110110000000001011010000111100011

Step 54:
Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic e00011110001001101100000000010110100000111100011

Step 55:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience

Step 56:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience

Step 57:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience

Step 58:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience

Step 59:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience

Step 60:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience

Step 61:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience.

Step 4-61:

Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience.

VII. RESULT AND DISCUSSION

The compression ratio, space savings and average bits calculated for the Shannon Fano & Tunstall coding for the input “Dr.Ezhilarasu Umadevi Palani is having more than 30 years of parallel academic experience.”

S.No	Compression	Compression ratio	Space savings	Average bits
1	Shannon Fano	800/389=2.05:1	1-(389/800)=51.38%	389/90=4.32
2	Tunstall (Length 6)	800/468=1.71:1	1-(468/800)=58.5%	468/90=5.2
3	Tunstall (Length 7)	800/427=1.87:1	1-(427/800)=53.38%	427/90=4.74

VIII. CONCLUSION

The obtained results show that the input with the similar probability gives better compression ratio, space savings, and average bits than the input with the different probability. The Shannon-Fano code gives better compression ratio, space savings, and average bits as compared with the uncompressed data.

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