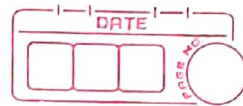


## Tutorial - 5



Name : Devansh Shah

Roll no : 1914078

Batch : B2

Q1) Comparison of Huffman and Arithmetic coding.

Arithmetic coding	Huffman coding
It is not a statistical method	It is a statistical method
It yield and optimum result.	It does not yield an optimum result
There is no one to one correspondence btw source symbol and code word	There is one to one correspondence between source symbol and code word
Does not produce prefix code	Produces prefix code
Decompression speed is slow	Decompression speed is fast

Symbol : BACA

$P(A) = 0.5$

$P(B) = 0.25$

$P(C) = 0.25$

low value = low value + Diff \* range from symbol

High value = high value + Diff \* range to symbol

Difference = High value - low value  
(Initially 1)

Input Symbol	Low value	High value	Difference
B	$= 0.0 + 1.0 \times 0.5$ $= 0.5$	$= 0.0 + 1.0 \times 0.75$ $= 0.75$	$= 0.75 - 0.5$ $= 0.25$
A	$= 0.5 + 0.25 \times 0$ $= 0.5$	$= 0.5 + 0.25 \times 0.5$ $= 0.625$	$= 0.625 - 0.5$ $= 0.125$
C	$= 0.5 + 0.125 \times 0.5$ $= 0.59375$	$= 0.5 + 0.125 \times 1$ $= 0.625$	$= 0.625 - 0.59375$ $= 0.03125$
A	$= 0.59375 + 0.03125 \times 0$ $= 0.59375$	$= 0.59375 + 0.03125 \times 0.5$ $= 0.609375$	$= 0.015625$

∴ Code is  $[0.59375, 0.609375)$

Decoding formula:  $\frac{\text{code} - \text{range from symbol}}{\text{Range to symbol} - \text{Range from symbol}}$

Code	Output symbol	Range from symbol	Range to symbol	Difference
$= 0.59375$	B	0.5	0.75	0.25
$= \frac{0.59375 - 0.5}{0.25} = 0.375$	A	0.0	0.5	0.5
$= \frac{0.375 - 0}{0.5} = 0.75$	C	0.75	1.0	0.25
$= \frac{0.75 - 0.75}{0.25} = 0$	A	0.0	0.5	0.5
$= 6 \leftarrow \text{loop halt}$				



Q2) what are the applications of arithmetic coding. Explain one application in detail.

Ans) Arithmetic coding is used in a variety of lossless and lossy compression applications. It is a part of many international standards. Some applications are:-

- Adaptive text compression
- Compressing black/white images
- Non adaptive coding
- Coding arbitrary distributed integers

→ Compressing black/white images using arithmetic coding has been investigated by Langdon and Rissanen who achieved excellent results using a model that conditioned the probability of pixels being black on a template of pixels surrounding it. To increase coding speed Langdon and Rissanen used an approximate method of arithmetic coding that avoided multiplication by representing probabilities as integer powers of  $1/2$ . Huffman coding cannot be directly used in this application as it never compresses a two symbol alphabet.